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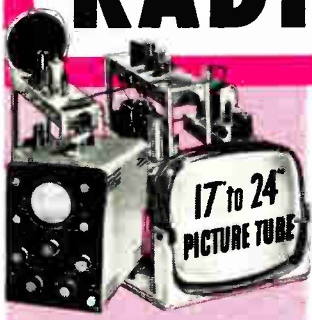

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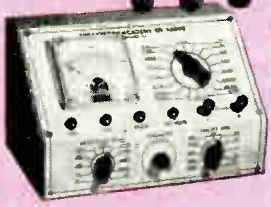

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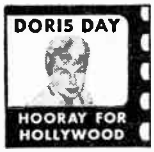

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★ Mail coupon below to receive your 6 records

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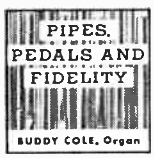
3. Didn't It Rain, God Is Real, etc.

21. Four dashing, fiery rhapsodies



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CIRCLE 6 NUMBERS:

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2	22
3	24
5	25
6	27
7	29
8	30
9	31
10	33
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12	40
15	49
16	50
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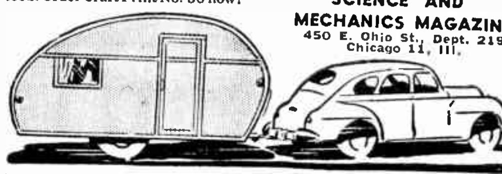


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Citizens Band Transceiver

A project for the individual, the civilian defense group, or the radio club—and one that can be used on the Amateur band as well as the Citizens band

By C. F. ROCKEY

Low in cost for what it delivers, this transceiver is specifically designed for use on the Citizens Band, but does double duty in the 10-meter amateur band.

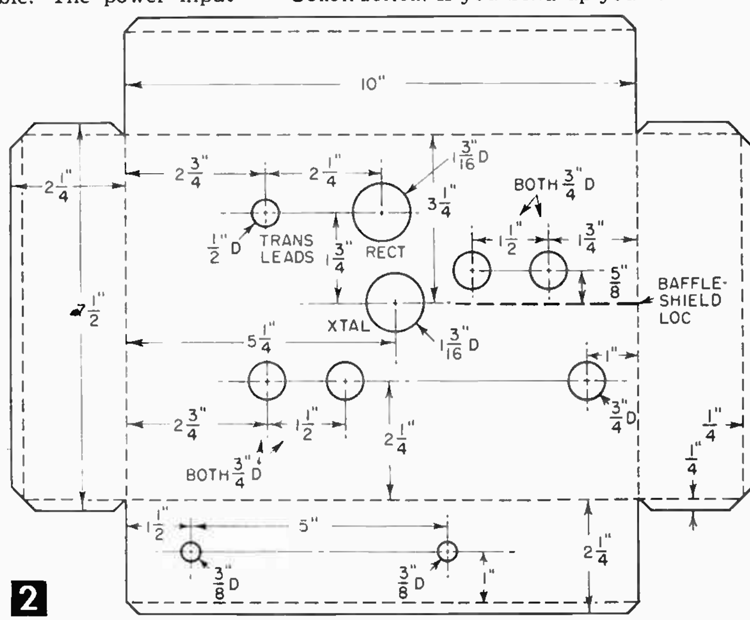
ALTHOUGH specifically designed for the Class D Citizens Band radio service (see box copy on page 25), this simple transceiver is also suitable for low-power telephony in the 28 megacycle band. Inexpensive, readily available tubes and parts are used throughout, and the total cost to build will be about $40. The writer believes that it is hardly possible to build an effective, truly legal radiotelephone unit for much less money.

The transmitter employs a stable, straightforward circuit that can be made to operate well with a minimum of trouble. The power input normally runs slightly less than the 5-watt maximum allowed to Class D Citizen's Band stations. The receiver employs the super-regenerative principle, providing maximum gain and sensitivity per tube. It also will be found easy to "get going." An RF stage reduces radiation and increases stability.

The frequency range of both transmitter and receiver is approximately 25 to 30 megacycles, which includes both the 27 megacycle Citizens Radio and the "10-meter" amateur bands. One cannot accurately predict the communication range, but about 4 or 5 miles (between two similar units) with the maximum legal antenna (see box copy) may be expected in the Citizens Band. Although a 117-*v* commercial *ac* power source is required for this unit, it may be readily modified to operate from an automobile storage battery if a different power supply system is installed.

Before beginning construction of this project, make sure that you have a grid-dip meter available (see p. 130 of this handbook). Proper adjustment will be very difficult without one of these, but almost every experimentally minded amateur owns one, and may lend it to you.

Construction. If you bend up your own chassis



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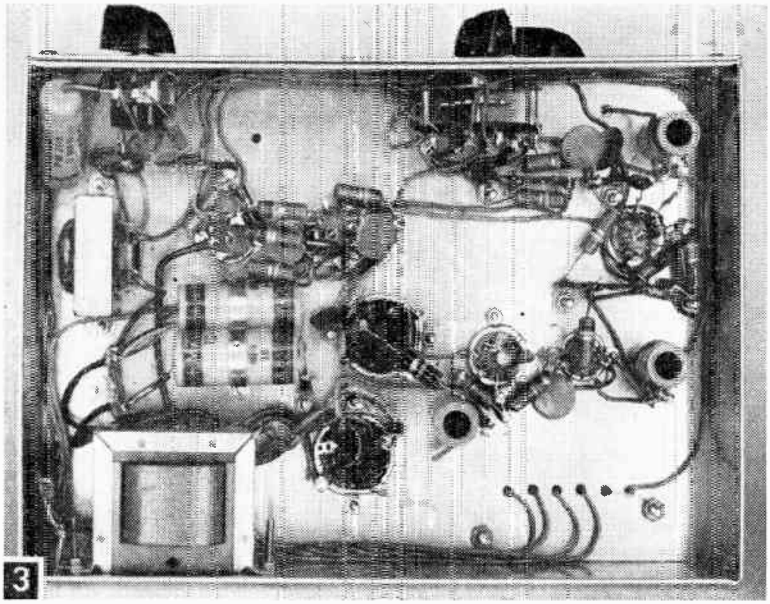

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Under-chassis view of transceiver.

When installing the electrolytic capacitors, be sure to observe the polarity of their connections. Otherwise, if reversed, they will generate internal gas and may explode, taking rectifier tube and possibly the power transformer to destruction with them. Recheck your wiring for correctness, being careful also to look for and remove any inadvertent solder shorts to chassis or between tube socket lugs. Each soldered joint (rosin-core solder only) should be clean, smooth and shiny. Make all ground connections to soldering lugs, since soldering to aluminum is generally unsatisfactory.

from sheet aluminum, complete this metalwork first. A developed view is shown in Fig. 2. If you do not have metalworking equipment (shear and small bending brake) you can use a commercially available 2 x 7 x 10-in. aluminum chassis and a 1/16 x 7 x 10- in. aluminum sheet for the panel.

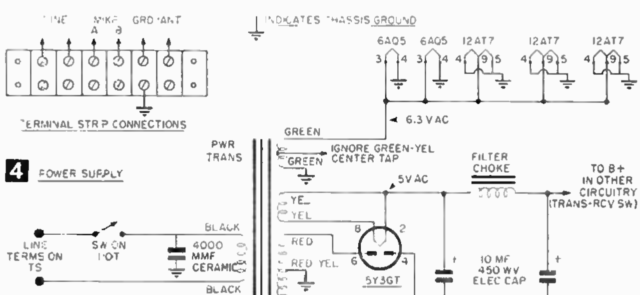
With panel and chassis at hand, begin by drilling and punching the major holes in the chassis. Mount all sockets and terminal strips before fastening the power transformer in place, using 6-32 *rh* machine screws for fastening everything except the miniature tube sockets, which require 4-36 screws. If you anticipate portable operation, put lock washers under each screw head for additional security.

The insulated tie-point strips may now be fastened under the chassis also, using the under-chassis photo, Fig. 3, as a guide. Mount the Send-Receive switch and the potentiometer and switch temporarily onto chassis, but temporarily omit the filter choke and do not install panel as yet.

Wire the power supply first, making sure to connect the power switch (on the potentiometer) in series with the transformer primary (see Fig. 4). And don't forget the 4000 mmfd line bypass capacitor to ground (ground indicates chassis in every case). Complete all power transformer and rectifier tube socket wiring before installing the filter choke, which mounts on back of chassis under power transformer. The green-yellow wire on the power transformer is the 6.3-*v* winding center tap. Cut this wire short and tape the end, so that it will not cause trouble with other circuits. Mount and connect filter choke after power transformer has been wired.

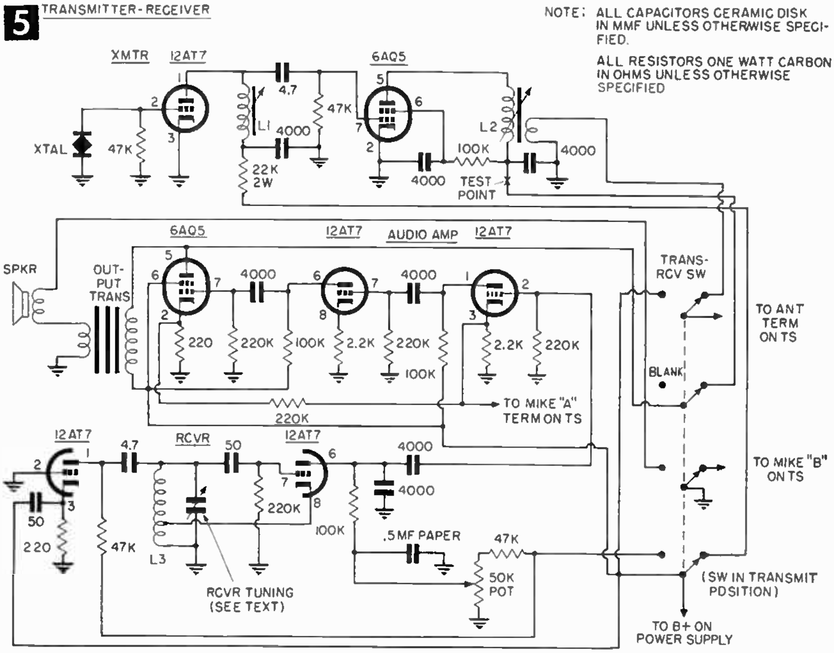
When the power supply has been wired and carefully checked, connect the line cord to the terminal strip, and insert the 5Y3 rectifier tube in its socket. When the line switch is on, the rectifier tube filament should glow, and a dc voltmeter should indicate about 275 *v* when connected from B+ to ground. (This voltage will drop to 250 *v* when a load is applied.) Since the power supply is straight-forward, a no-voltage condition indicates incorrect wiring, a bad tube, or a defective part. Remember that good electrolytic capacitors store a charge, so short 'em (with power off!) before continuing work; otherwise, you might get bit by a "dead" circuit.

Wire all of the 6.3-*v* heater circuits next, as per Fig. 4. Don't forget the ground-return for heater current at each socket. When heater wiring is completed, plug in other tubes, plug in set and turn it on. All tube heaters should light and warm-up directly. Again, watch out for shorts between those pesky little miniature socket lugs. If all's well, pull out line plug and tubes, and continue work.



4 POWER SUPPLY

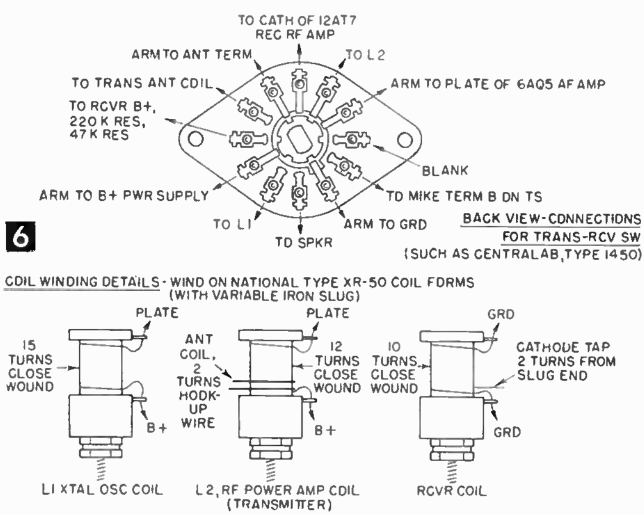
5



Install the speaker output transformer and wire the audio amplifier section, beginning with the 6AQ5 (see Fig. 5). Bring a pair of leads for the loudspeaker topside through a ⅛-in. deburred hole, twisting the leads to keep them together. Be especially careful when wiring the Send-Receive switch to Receive position. When tubes warm, cautiously touch screwdriver to control grid, pin No. seven. A buzzy click from loudspeaker means all's okay. If not, recheck wiring, particularly looking for solder shorts. A bad tube could also cause trouble.

When 6AQ5 is working, unhook and continue with 12AT7 audio amplifier. Plan your wiring as you progress (using Fig. 3 as a rough guide) so that you can hang the carbon resistors and ceramic capacitors in the wiring in the shortest and most direct manner. Where a bare lead might wiggle around and short to something, cover it with a piece of spaghetti tubing. You can check the 12AT7 amplifier as you did the 6AQ5: when wired, plug in 12AT7, 6AQ5 and 5Y3; turn on power and switch S-R switch to Receive position. A cautious touch of screwdriver to each grid should produce that clicky buzz, louder at the 12AT7 grids, of course.

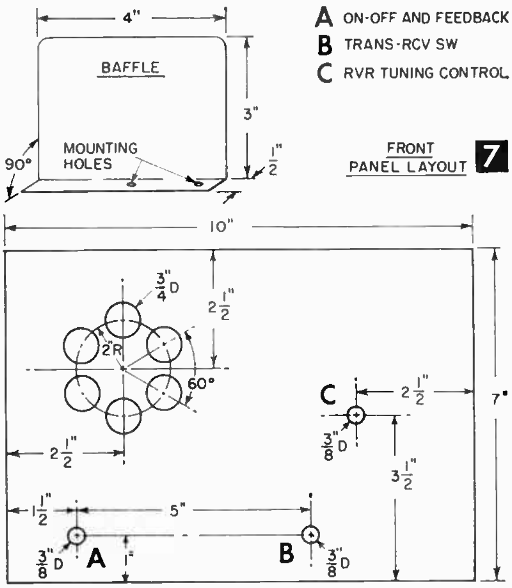
6



Begin the receiver section by winding the coil carefully (see Fig. 6). If you can't get double cotton-covered wire, use single cotton-covered—but if you use enamelled or Formvar insulated wire, use one less turn (on *each* of the three coils) to compensate for increased capacitance. Be careful to place the tap properly, since proper feedback relationships depend upon it. Keep the high-frequency leads short and direct in this circuit. Note that the grid of the RF amplifier is grounded; the signal enters the cathode of this tube. Observe also that the cathode of the detector is connected to the tap on the coil; it must *not* be grounded otherwise. The feedback-control potentiometer controls the plate voltage upon the super-regenerative detector; the voltage upon the plate should increase as the shaft is rotated to the right, looking from the front.

It will improve the appearance of the wiring if the plate supply, heater supply, and other non-critical leads are run along the corners of the chassis. Grid, plate, and other important connections, however, should be made as short and direct as possible. Use tie-lugs to support small parts.

Now, drill and install the panel (upon which the receiver tuning capacitor is mounted, see Fig. 7). When drilled, install the panel along with the tuning capacitor and the loud speaker, drilling a hole in the chassis to pass the tuning capacitor stator leads. Then, make and install aluminum baffle shield (Fig. 7). This shield serves to reduce interaction



FRONT PANEL LAYOUT 7

between receiver and transmitter. Fasten it to the chassis with two 6-32 machine screws whose nuts (underneath chassis) may also hold a four-lug tie point strip.

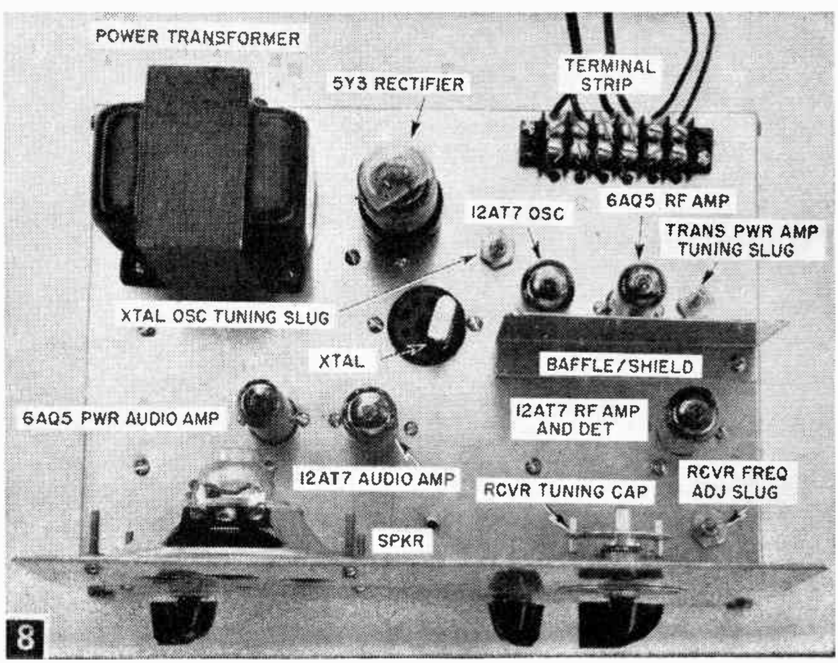
The receiver tuning capacitor should be modified by carefully removing one of its rotary plates. Grasp the rearmost plate firmly with a pair of long nose pliers and pull out the plate. This operation reduces the maximum capacitance and insures the correct tuning range. Be sure to put the calibrated dial plate under the fastening nut of this capacitor on the front of the panel.

Now you can insert tubes in all completed sections, plug in, and put Send-Receive switch in Receive position. As the feedback control is advanced toward the right, a smooth hiss should issue from the loudspeaker, indicating that super-regenerative action is occurring properly. If no hiss is forthcoming, check the wiring again. Be sure the coil has been wound and connected *exactly* as directed. Measure the voltage from the plate of the 12AT7 detector section to ground. As the feedback control is turned, this voltage should vary from zero to over 50 *v*, indicating correct *dc* plate conditions. With correct voltage available, coil wound as specified, and a good tube, this receiver cannot fail.

When proper super-regenerative action has been assured, adjust the tuning range of the receiver, using a grid dip meter. Screw the iron slug carefully into or out of the coil until the grid dip meter indicates a tuning range from about 25 to about 30 megacycles. A slightly wider tuning range does no harm. A reasonably good antenna connected to the antenna terminal should now provide a number of amateur signals in the 10-meter band, particularly during the daytime. Adjust the feedback control to provide the best response from each signal. The Citizens Radio Band should fall near the middle of the tuning range, the amateur 10-meter band further toward the low capacity end of the dial.

With the receiver operating properly, begin wiring the transmitter section (Fig. 5). Commence with the crystal oscillator (see Table A for crystal). Only half of the 12AT7 tube is used, the elements of the second triode remaining unconnected. This apparent waste of a good triode section may seem unthrifty until one remembers that the 12AT7 tube costs no more, and is often more available than a single-triode equivalent type.

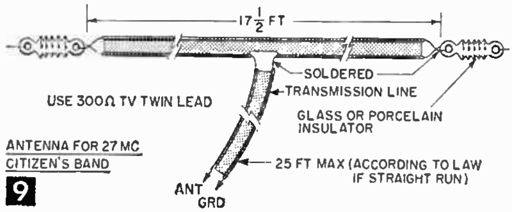
The standard quartz crystal holder will plug into any two *alternate* (not adjacent) holes in the standard octal socket, so pick any alternate pair of pins and use these for the crystal. The remainder of the pins may be used as tie-points, if desired.



8 Top-chassis view of transceiver.

The crystal oscillator circuit is simple and direct, and is recommended by most crystal manufacturers for use with their overtone crystals. Just follow the schematic diagram Fig. 5, keep the leads short and direct, and you will have no trouble. To test for oscillation, insert the rectifier and the crystal oscillator tubes, throw switch to Send position, and apply power. Make sure crystal is plugged securely into the correct holes. Tune your grid-dip meter to the crystal frequency and adjust the slug in the oscillator coil to obtain maximum RF output. No oscillation indicates wiring difficulties, poor tube, or defective crystal.

Wiring the transmitter RF power amplifier completes the project. This amplifier is simple and, if built as specified, may be expected to work well. Note especially however that the



ANTENNA FOR 27 MC CITIZEN'S BAND

9

transmitter RF amplifier obtains its B+ supply through the Send-Receive Switch from the plate of the 6AQ5 *audio* power amplifier, rather than directly through the switch from the power supply. This is because, in Send condition, the power audio amplifier acts as a *modulator*, causing the RF amplifier's supply voltage to vary in accordance with the voice variations. This is how the

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What the Class D License Is—and Is Not

ON September 11, 1958, the Federal Communications Commission vastly expanded the scope of the Citizens Radio Service. Of particular interest to the radio-TV experimenter is the inauguration of the Class D Citizens radiotelephone service in the 27-megacycle band. The opening of this class of service provides the opportunity of private radiotelephony to every U. S. citizen over 18 years of age. He may use this radiotelephone privilege for any legitimate, not-for-hire communication purpose.

Of course, *a license is required*, as it is for any radio transmission of any sort within the jurisdiction of the United States Government. But since it involves merely an operating privilege, no technical examination is required; neither is one required to master the radiotelegraph code. On the other hand, an individual so licensed is restricted as to the type of equipment he may operate and the frequencies he may use.

The new Class D Citizens Radio Service may be employed by any duly licensed individual or organization for personal communication, or for intra-organizational communication such as: communication between a man's home and his car (a boon to physicians, for instance); communication between various buildings or vehicles on a ranch or farm; communication between delivery trucks or service technicians on the job and their home office; exchange of information between college students and their professors upon legitimate, personal, educational matters; consultation between construction foremen and the architect or engineer of a large construction job; coordination of the activities of a school athletic contest, and other situations.

The sort of thing that the Commission frowns upon, or directly *forbids*, however, would be: the broadcasting of any type of music or entertainment; long-winded gab sessions, or clowning-around which might interfere with sincere users; foreign contacts, or contacts with stations of any radio service, *including amateurs*, except in a demonstrated emergency; deliberate interference with another station, or monopolizing of a frequency for non-constructive purposes; tinkering with the equipment by persons not authorized to make circuit changes or adjustments.

It is thus very clear that the Citizens Radio Service is not intended to be an amendment to or substitute for amateur radio. Furthermore, it is not an electronic playground for those too lazy to acquire an amateur license. In fact, the Citizens Radio license does not permit the use of any of the amateur bands, nor conversely, does the amateur license permit operation upon the Citizens Service band. One must have a Citizens Radio license to operate upon the Citizens Band, no other kind of license will do!

Several classes of Citizens Radio licenses are available, and are described in Part Nineteen of the Regulations of the Federal Communications Commission. These, for instance, provide legitimately for the privilege of controlling model planes, boats, etc., by radio. Another class provides for the use of the 465 megacycle UHF citizens band. But the class of most direct interest to the experimenter is *the Class D Citizens Radiotelephone Service*. It is the class D license which permits those communication privileges already described.

To obtain a Class D Citizens Radio Service you must: 1) Be a citizen of the United States; 2) be at least 18 years of age; 3) have a legitimate purpose for such communication; 4) obtain, read, and be prepared to take an oath to the effect that you have read, Part Nineteen of the Regulations of the Federal Communications Commission (available for 10¢ from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.); 5) fill out, notarize, and send to the Federal Communications Commission, Washington, D. C. *FCC Form Number 505* (available from the FCC Field Engineer's Office nearest you. These offices are located in each of the country's major cities).

The equipment for use under provisions of the class D license must meet the following requirements:

1) The dc plate power input to the stage feeding power to the antenna must not exceed 5 watts.

2) The transmitter must be crystal-controlled, and the frequency of operation must be held to within .005% of the assigned frequency. (Purchase of an approved crystal from a reputable manufacturer, and use of it in an approved circuit, will insure compliance with this regulation. Tell the manufacturer the circuit in which the crystal is to be used and specify a frequency tolerance of .005%.)

3) Statement of how compliance with these above regulations will be maintained must be filed along with your license application.

4) The antenna system to be used with a permanent (home) installation shall not be higher than 20 ft. above the building or other structure upon which it is erected.

5) The distance between the center of the antenna and the transmitter control point shall not exceed 25 ft.

Although the provisions of this class of license are indeed liberal, the prospective user should have no delusions as to the limitations involved. You are not going to set the world afire with 5 watts and a 20-ft. antenna. Under normal conditions, consistent communication over distances of three or four miles is about all one has a right to expect, though occasional thousand-mile contacts may be made.

Lastly, although building your own equipment is permissible, it must be tuned and adjusted finally by a licensed *commercial* operator, holding at least a second-class radiotelephone operator's license.

But if you're looking for low-cost radio communication over a restricted range with relatively inexpensive gear, the Class D Citizens radio service is definitely for you.

intelligence is impressed upon the radiated signal. Also observe that both the plate and screen supply are thus modulated.

To test the completed amplifier, insert tubes and apply power. With the switch in Send position, recheck the crystal oscillator for oscillation with the grid-dip meter. You may find it necessary to readjust the slug in the oscillator coil; this is normal. With the crystal oscillator operating, connect a No. 46 pilot lamp bulb across the antenna terminals. Now adjust the RF amplifier tuning slug until the bulb burns at its brightest. When the transmitter is operating correctly, the bulb should light brightly. Carefully adjust both transmitter coil slugs for best output, then unscrew the *oscillator* coil slug about three turns (outward) to provide best reliability of oscillation.

Using the grid-dip meter, carefully explore the output of the transmitter at the amplifier coil for spurious signals at frequencies other than that of the crystal. If you have built the unit as described, you should find absolutely none. This will keep you out of trouble with the FCC.

Finally, connect the microphone to its terminals upon the terminal strip. In transmit position, speaking into the mike should cause the bulb to flicker appreciably. If so, modulation is satisfactory, and you can consider your transceiver ready for use.

You may use any single-button *carbon* microphone but do not try to use a crystal or dynamic mike; the latter types will not work. One of the older telephone transmitters will work well, this may be obtained from Army Surplus or, from the Telephone Engineering Company, Simpson, Pa. Use the transmitter only, you do not need or want the receiver. Of course, with this type of mike the voice quality will be rather thin, but this is preferable for communications work, since it cuts through interference much better than the round, full response of the broadcast station. (You're not allowed to transmit music or entertainment anyway.)

Table A—Frequencies Available For Class D Citizens Band Operation: (All In Kilocycles)

26965	27035	27125
26975	27055	27135
26985	27065	27145
27005	27075	27155
27015	27085	27165
27025	27105	27175
	27115	27185
		27205
		27215
		27225

You may choose a crystal from any of these frequencies.

Crystals manufactured to the required .005% tolerance may be obtained from: Texas Crystal Co., 8538 W. Grand Ave., River Grove Ill., or American Crystal Co., 821 E. 5th St., Kansas City 6, Mo.

Although you now have your station completed, do not go on the air until you have received your Citizens Radio permit. To do so exposes you to a two year penitentiary sentence and/or a $10,000 fine. Remember, also, that an amateur license of any grade does *not* permit you to use the Citizens radio frequencies, per se.

However, if you hold a *general*, or higher, class of amateur license, you may operate this unit within the 10-meter amateur 'phone band, if you have an overtone crystal for operation therein. Usual amateur regulations will then apply.

If you wish, you may install this transceiver in either a metal or wooden cabinet. The only precaution is to provide ample ventilation for the tubes and parts and, if a metal cabinet is chosen, to avoid short-circuiting under-chassis components.

MATERIALS LIST—CITIZENS BAND TRANSCEIVER

No. Req.	Size and Description
1	aluminum chassis (as per text) 2 x 7 x 10"
1	piece of aluminum, 3½ x 4" (baffle shield)
1	aluminum panel (see text) or 7 x 10"
1	power transformer (Chicago-Standard type PC 8403; secondaries: 250-0-250 v at 70 ma., 5 v at 2 amps; 6.3 volts at 2½ amps.)
1	filter choke (Chicago-Standard type C-1708; 13 Henrys at 65 ma.)
1	output transformer (Chicago-Standard type A-3877; 5 watts; single-plate to 4-ohm voice coil)
1	4 inch P.M. loudspeaker (Jensen type 4 J 6)
1	Jones barrier terminal strip, 6-terminal, 2⅞" long
1	15 mmfd variable capacitor (Bud type MC-1870)
2	8-prong tube sockets (Amphenol)
3	9-prong miniature tube sockets (Amphenol)
2	7-prong miniature tube sockets (Amphenol)
3	National type XR-50 coil forms with iron slug
1	50 K linear taper potentiometer with switch (IRC)
1	4-pole DT phenolic insulated wafer switch (Centralab type 1450)
2	10 mfd. 450 w. v. tubular electrolytic capacitors (Mallory type TC-72)
1	0.5 mfd tubular paper capacitor 200 w. v. (Cornell-Dubilier)
3	bar knobs, set-screw type
1	dial plate calibrated 0 to 100 in 180° (Crowe type 55H)
1	power line cord with plug
1	quartz crystal for appropriate Citizens band frequency (see Table A)
1	single-button carbon microphone
3	4-lug insulated tie points
2	2-lug insulated tie points
5	220K ohm, 1-watt carbon resistors
10	4000 mmfd, disc type ceramic capacitors
2	50 mmfd. disc type ceramic capacitors
2	4.7 mmfd. disc type ceramic capacitors
1	5Y3 GT tube
3	12 AT 7 tubes
2	6 AQ 7 tubes
	plastic insulated hookup wire
	No. 22 double-cotton-covered magnet wire (¼ lb. roll)
	rosin core solder
	6–32 and 4–26 *rh* steel machine screws with nuts
	soldering lugs, spaghetti tubing, antenna materials
	For testing and adjustment the following is required:
1	2-watt neon bulb
1	pilot lamp bulb, type 46
1	0-100 milliampere DC milliammeter
1	grid dip meter with coils
1	radio service man's volt meter

One form of antenna suitable for Class D Citizens Band operation is shown in Fig. 9. If you contemplate operation with portable or mobile units, suspend the antenna vertically; if with other fixed stations, either vertical or horizontal antennas may be used. One thing to remember, though—all units working together must use similar-oriented antennas for best results. That is, all must use either vertical or horizontal arrangement. For operation within the amateur 10-meter band, make the antenna one ft. shorter overall.

When a dipole or similar antenna is used, connect one side of the feedline to the antenna, the other to the ground terminal. If a coaxial feedline is used, connect the inner conductor to the antenna terminal, the sheath to the ground.

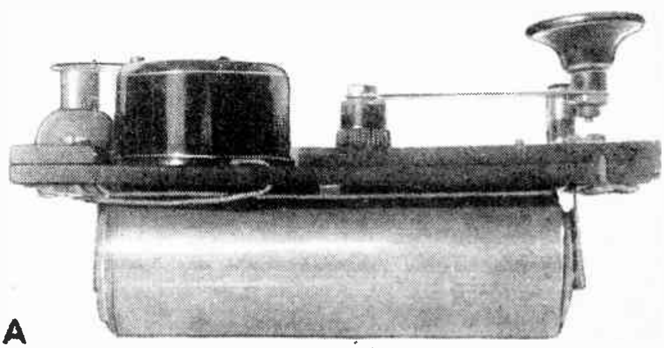
After arrival of your license, peak the final power amplifier tuning with the antenna connected.

With the transmitter on, hold a neon lamp bulb with its glass against the 6AQ5 RF power amplifier tube and adjust the amplifier slug for brightest glow of the neon lamp.

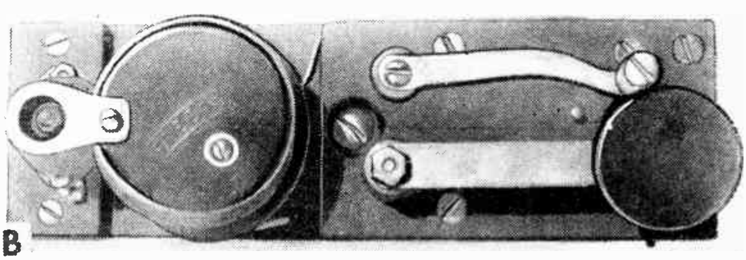
The law states that final tuning adjustment of a Citizens Band transmitter must be made by a person holding a second class radio-telephone (commercial) operator's license, or higher. (The operator of your local broadcast station or of your town's police radio system, when off-duty, may be willing to help you with this. When testing or adjusting the transmitter with the No. 46 dummy load lamp, no such license is required since useful radiation will not occur.) Once this adjustment is made, however, your Citizens Radio permit is all you need for further operation.

One last thought: The U. S. government is showing unusual generosity in allowing the use of the Citizens Band frequencies as liberally as it is. As of this writing, no other government permits such liberties. Ours is thus a rare privilege; let us remember this and never conduct ourselves on the air in such a way as to make our government regret its generosity.

Coat-Pocket Code Practice Unit



1A

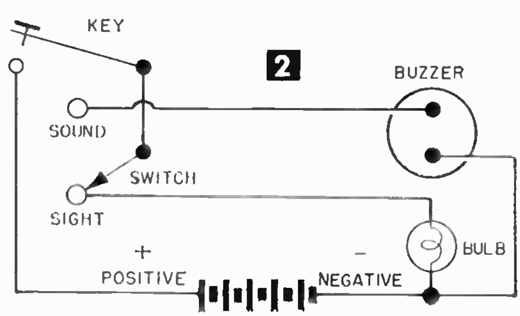


B

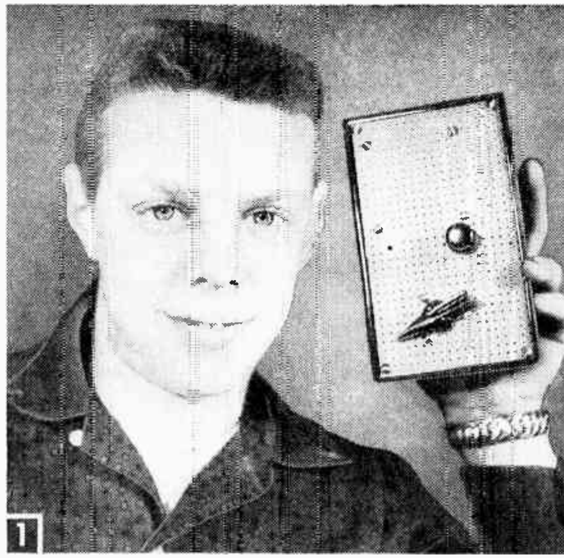
Side (1A) and top (1B) views of coat-pocket code unit.

HERE'S a code practice unit—sight or sound—small enough to carry around in your coat pocket, and all you need to buy to build it is a buzzer (Johnson Speed-X Model 114-400, $1.85), two size D flashlight cells (15¢ each), and a two-cell bulb, focusing type (10¢). The rest of the materials can be taken from your scrap box.

Mounting board for the unit is a 3/16 x 1 7/8 x 6 1/8-in. piece of Masonite, doubled on either side of the buzzer (see Fig. 1). A brass tube holder for the batteries is made from 1 1/2-in. O.D. plumbing drain stock, battery contacts are spring brass, key and switch (see Fig. 2) are taken from an old telegraph key, socket for bulb can be salvaged from a discarded flashlight.—Victor A. Ulrich.



Here's the transistor portable you've been waiting for. It operates on ordinary pen-lite cells, drives a loudspeaker with plenty of volume, has phone jack output for private listening, automatic volume control for smooth volume, and plenty of sensitivity. No outside antenna is required—and it can also be used as a tuner for a larger amplifier.



1

Small, but powerful, that's the transistorized superhet for which step-by-step building instructions are given in this article.

Three-Transistor Superhet Portable

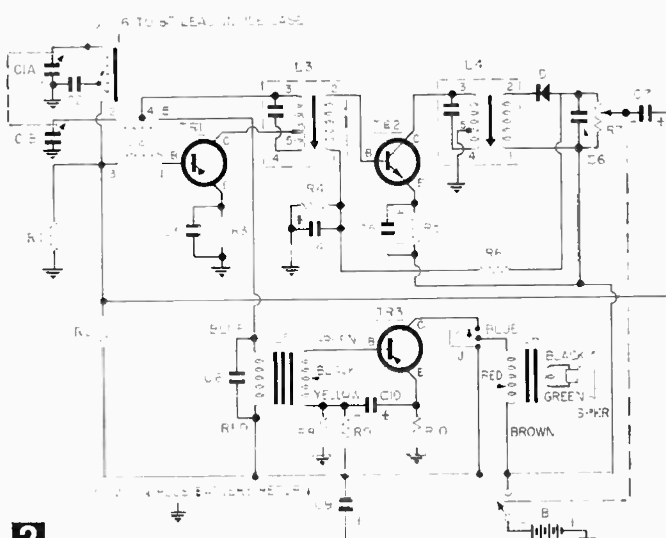
By FORREST H. FRANTZ, SR.

THE circuit diagram of this three-transistor superhet is shown in Fig. 2. The transistor TR1, RCA 2N412, does triple duty. The RF signal (550 to 1500 *kc*) which it receives from the antenna loop L1 and antenna tuning capacitor C1A is amplified and mixed with the oscillator signal. The oscillator signal, also generated by TR1, is always 455 *kc* above the received RF signal.

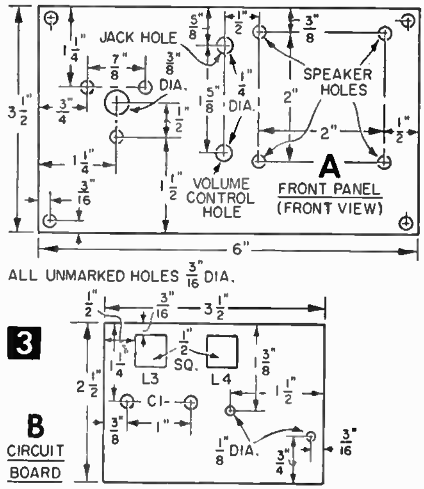
The oscillator tuning capacitor C1B is ganged to the antenna tuning capacitor so that oscillator and antenna tuning track. The signal through L3 is amplified by the IF amplifier transistor TR2. This transistor is a high-gain, high-frequency GE 2N168A. Diode D detects the signal after it passes through L4. Capacitor C6 filters out the RF signal components so that the signal across volume control R7 is audio frequency (AF). The signal is then passed through R6 and the audio is filtered out so that a *dc* bias proportional to the strength of the received signal is provided to control the gain of the IF amplifier TR2. The stronger the signal, the lower the gain of TR2. Thus, fading is minimized for reasonably strong signals. This is the automatic volume control (AVC).

The slider on volume control R7 picks off the audio signal for audio amplification. Transistor TR1 performs its third job as the first audio amplifier. It's possible to use the same transistor for the mixing oscillator and audio amplifier functions, since the frequencies are widely separated. The amplified audio output of TR1 appears across transformer L5 and is transferred to the audio output stage TR3 which amplifies the audio signal for speaker or headphone output.

This receiver has several outstanding features that make exceptional performance possible with only three transistors. The advantage of making TR1 do several jobs, for instance, is apparent. Further, the antenna loop L1 is the Miller 2003 high-Q loop which has a Q of 500 and this



2 SCHEMATIC



unusually high Q builds up the signal and allows the tuning capacitor to select the desired station with considerable discrimination against interfering signals before the transistors even begin to go to work.

The audio output stage TR3 is transformer coupled to TR1—and two transformer-coupled audio stages have almost as much gain as three! Actually, a considerable amount of the available audio gain of TR1 is not exploited since the emitter bias resistor R3 of TR1 is not bypassed by a large capacitor. A large capacitor would increase the gain but would degrade the fidelity and create a tendency for the receiver to go into regeneration.

Preparing Parts for Assembly. First, cut out and prepare the front panel and the circuit board (Fig. 3). Cut the tuning capacitor (C1) shaft to a length of ½ in., the volume control (R7) shaft to a length of ¼ in. Remove the antenna loop from its mounting by cutting off the ends of the fiber retainer with tin snips; fasten the output transformer (L6) on the loudspeaker (see Fig. 5) by bending the transformer mounting lugs to fit around the magnet frame. A few drops of Pliobond or a similar cement placed under the transformer prior to mounting will steady it against the magnet frame.

Next, solder the connection lugs of the battery holder for series connection as shown in Fig. 4. Use rosin core solder only! Mark the battery end polarities to avoid making mistakes in connections or inserting batteries. Rotate the battery lugs with a pair of pliers and simply solder them together to make connections, and then fill with solder the surfaces of the eyelets which will contact the batteries.

Figure 5 shows the parts and wiring on the back of the front panel. Mount the loudspeaker (SPKR), volume control (R7) and the phone jack (J), and complete wiring as shown. Be cautious in soldering; too much heat can damage the volume control. The same precaution applies to the other components, especially transistors, in subsequent soldering.

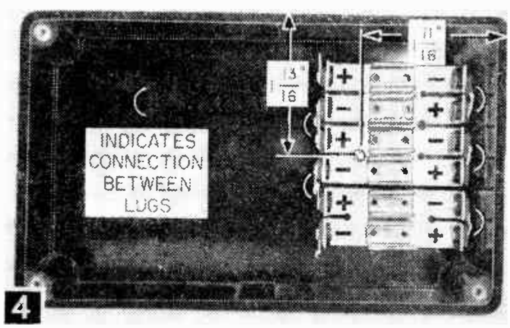
The Wiring Board. Top and bottom views of the assembled wiring board are shown in Fig. 6. Fasten L3 and L4 by inserting them in the holes and bending the mounting lugs against the back of the board.

Next, you will mount C1, L1 and L2. (Be careful not to let the screws which hold C1 pass through far enough to touch the plates of the capacitor; use washers or spacers if necessary.) Fasten L1 and L2 with Duco cement, give the cement time to set, then fasten L5 and T1 to the board.

The next step is to solder B of TR1 to terminal 1 on L2, C to terminal 5 of L3, pass E through the circuit board, and fasten TR1 against the case of L3 with a rubber band.

The remaining components are fastened to the circuit board as the wiring progresses. Be sure to connect the frame of C1 and the cases of L3 and L4 to the common plus battery return (designated by the "ground" symbol in Fig. 2). When circuit board wiring is completed, connect a lead 6 in. long to the common return for later connection to the plus terminal of the 9-*v* battery. The other lead from the circuit board is a 6 to 8 in. length of wire connected to C1A. The other end of this lead hangs free inside of the case after final assembly. This lead is essentially a short antenna which gives the set additional pick-up.

Final Assembly. There are five lead ends extending from the front panel (Fig. 5). The lead from the switch will connect to the minus terminal of the battery. The other four leads connect to the circuit board. The circuit board is joined to



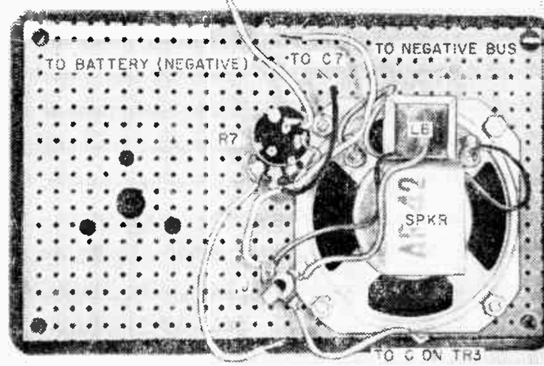
Battery-holder mounting in case, and connections.

the front panel by the tuning capacitor's (C1) three mounting screws. Place fiber washers or cardboard spacers 1/16-in. thick between C1 and the front panel when you join panel and circuit board.

Check for clearance between the circuit board components and the panel components. Particular items to watch are interference of TR2 with J, C9 with S on R7 and L6 with SPKR. Place the assembly in the cabinet to check fit and make any necessary adjustments in parts placement.

The leads from the front panel connect as follows: 1) The lead from the junction of R7, S and J connects to the circuit board minus line. 2) The lead from J connects to C of T3. 3) The lead from the "hi" terminal of R7 connects to the junction of D, C6, and R6. 4) The center terminal lead of R7 connects to the minus terminal of C7.

With these connections completed, adjust the slug of L2 flush with or just slightly below the coil form viewed from the back of the assembly. There are two trimmers on C1 which were intentionally eliminated from Fig. 2 to avoid confusion. These trimmers in parallel with C1A and C1B are provided to align the antenna and oscillator circuits respectively for proper high-frequency tracking. Open the antenna trimmer till the trimmer tension is nearly released (minimum trimmer capacity). Turn the oscillator trimmer full closed (maximum trimmer capacity), and then back the screw off ½ turn. Place the knobs on C1 and R7. (You can provide a calibrated dial made of paper and covered with plastic for C1 later if you wish). With S off, connect the leads from the assembly to the battery to complete wiring and assembly. These leads should be about 6 in. long to allow easy removal of the assembly from the case. To prevent the screws which hold the battery holders in place from scratching furniture, fasten rubber grommets to the back of the case with Pliobond cement.

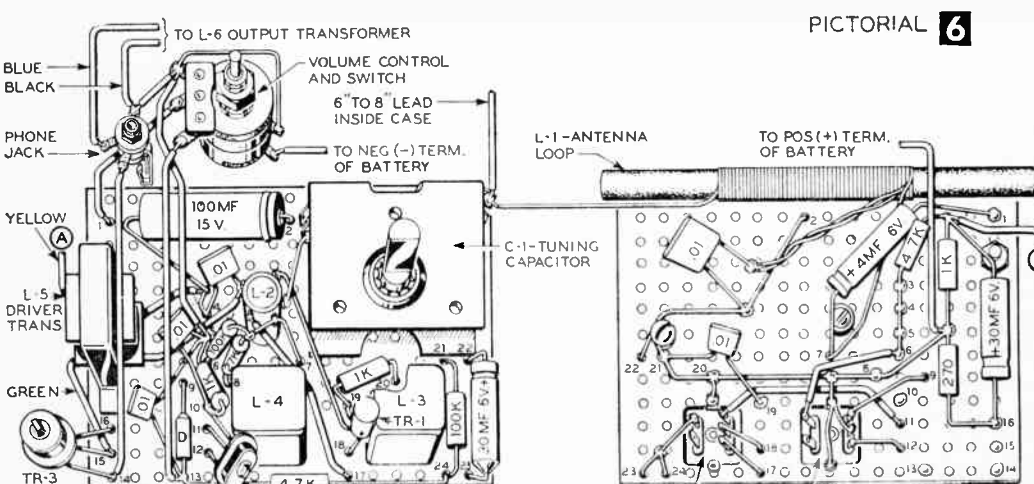


5 Back of front-panel view, showing connections.

Tune-Up. If you have a milliammeter, connect it across the terminals of switch S. The meter should read between 6 and 15 *ma* if all is well. Don't worry if the set motorboats when you make this measurement. If the current exceeds 15 *ma*, look for a short or an incorrect connection. If the current is less than 6 *ma*, the trouble is probably low battery voltage or an incorrect connection.

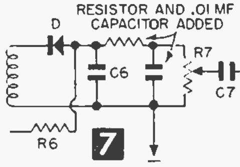
Assuming all is well at this point—or that you don't have a meter to make this measurement—turn the set on and turn the volume control about ⅞ths up (clockwise). Maximum volume does not occur at the full clockwise position of the volume control. This is a normal characteristic of the reflex circuit. (The term reflex is applied to a receiver which uses one transistor or tube to amplify both RF or IF and AF signals). With the volume control turned approximately ⅞ths full clockwise, rotate the tuning dial slowly. If you're in a metropolitan area or within about 10 or 15 miles of a large station, you'll probably pick up a signal even though the set is not accurately aligned. But if you don't pick a station up, there's no cause for alarm because the IF transformers (L3 and L4) may be way out of adjustment. If you pick up a station you can feel reasonably sure the wiring is correct. If you can't pick up a station, the presence of noise of any kind from the speaker indicates that at least part of the audio is working properly. In either case; you're ready to try alignment.

PICTORIAL 6



TOP VIEW OF PERFORATED BAKELITE MOUNTING BOARD

BOTTOM VIEW OF PERFORATED BAKELITE MOUNTING BOARD



The steps in the alignment procedure are: 1) Adjust the IF transformers. 2) Adjust the tuning capacitor trimmers at the high frequency end of the broadcast band. 3) Adjust the oscillator coil slug at the low frequency end of the band. 4) Repeat step 2. A signal source is required to carry out the alignment procedure. This source may be an RF signal generator or it may be an ordinary broadcast receiver if you don't have, or can't borrow a signal generator. The use of a broadcast superhet for aligning other superhets is discussed on pages 66, 67 and 68 of the *Radio-TV Experimenter*, No. 559, Volume 7, available from SCIENCE AND MECHANICS, 450 East Ohio Street, Chicago 11, Illinois.

To adjust the IF transformers, connect the high side of the signal source through a .01 *mfd* capacitor to the stator of C1A (the antenna terminal), and the low side to set ground. With the signal source tuned to 455 *kc*., adjust the slugs of L3 and L4 for maximum output. Keep the signal from the source so weak that you can barely hear it (to minimize AVC action). Adjust the volume control to the point where the signal is loudest. The slugs of L3 and L4 are accessible through the holes in their bottoms. Use a small screwdriver, preferably one with very little metal in it such as a radio-TV serviceman's alignment tool.

After IF alignment is completed, disconnect the signal source.

You should easily be able to complete the remainder of the alignment procedure with broadcast station signals. Tune in a weak station between 1300 and 1450 *kc*. Increase the antenna trimmer capacity. If this increases the speaker output, adjust this trimmer for maximum speaker output. If the volume decreases, repeat the procedure.

Next, tune the receiver to a station between 550 and 650 *kc*. Detune C1 slightly to one side and adjust the slug of L2 for maximum output. If this output is greater than the previous output, repeat the process till the most sensitive point is found.

If the output is less than the previous output, detune C1 in the other direction and adjust L2 till the point of maximum output is found.

Finally, repeat the alignment procedure at the high-frequency end of the band. This is necessary since the adjustment of L2 has some influence on the high frequency end of the band, too. Capacitor C1 may be tracked across the broadcast band by bending the outer plates of C1A, but the process is tedious and not always worth the effort.

You may experience oscillation at high volume control settings, but this oscillation will occur beyond the actual maximum volume point and is therefore harmless. But if you wish to eliminate it, add a resistor and .01 *mfd* capacitor in the volume control circuit as shown in Fig. 7. The resistance value should be determined experimentally. It will be between 500 ohms and 1K in most cases.

MATERIALS LIST—THREE-TRANSISTOR PORTABLE SUPERHET

Desig.	Description
R10	270 ohms
R3, R5, R8	1K
R6, R9	4.7K
R1	27K
R2, R4 (all resistors, ½ watt, ±20%)	100K
R7-S	5K miniature volume control with switch (Lafayette VC-27)
C2, C3, C5, C6, C8	.01 mfd subminiature square capacitor (Lafayette C-612)
C7	4 mfd, 6v ultraminiature electrolytic capacitor (Lafayette CF-101)
C4, C10	30 mfd, 6v ultraminiature electrolytic capacitor (Lafayette CF-104)
C9	100 mfd, 15v ultraminiature electrolytic capacitor (Lafayette CF-126)
C1	2-gang tuning capacitor, A-123 mmfd, B-78 mmfd (Lafayette MS-261)
L1	miniature antenna loop (Miller 2003)
L2	transistor oscillator coil (Lafayette MS-265)
L3	1st IF transformer, 455 kc (Lafayette MS-268)
L4	output IF transformer, 455 kc (Lafayette MS-269)
L5	transistor driver transformer 10K:500 ohms (Lafayette TR-96)
L6	transistor output transformer 500:3.2 ohms (Lafayette TR-95)
TR1	transistor (RCA 2N412)
TR2	transistor (GE 2N168A)
TR3	transistor (GE 2N241A)
D	diode (Raytheon 1N66)
B	9v battery—6 penlite cells in series (RCA VS074)
J	miniature phone jack (Lafayette MS-282)
SPKR	2½" PM speaker, 3.2 ohm (Lafayette SK-65)
1	2-cell battery holder (Lafayette MS-138)
1	4-cell battery holder (Lafayette MS-170)
1	miniature perforated board for front panel (Lafayette MS-305)
1	miniature perforated board for chassis (Lafayette MS-304)
1	miniature knob (Lafayette MS-185)
1	pointer knob (Lafayette KN-40)
1	2 x 3¾ x 6¼" Bakelite case (Lafayette MS-216)
	For earphone listening, use a 2K earphone (Lafayette MS-268)

Parts available from Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, New York.

This three-transistor portable may be used as an amplifier tuner by connecting a 10K resistor from C of TR3 to the negative voltage line. This resistor provides *dc* return for the collector of TR1 when a plug is inserted in the jack. If the amplifier to be used with the tuner does not have a capacitor in series with the input, provide one of about 0.1 *mfd* capacity. The connection of the 10K resistance will have negligible effect on the loudspeaker or headphone performance of the set. The Lafayette MS-281 plug fits the jack and should be used in making the amplifier connection cable.

The receiver may be equipped with a calibrated dial to simplify station finding. The calibrations may be painted on the panel face or many be placed on paper with India ink. A sheet of celluloid or clear plastic placed over the dial scale will protect it.

Both the scale and its plastic protector can be held in place by the three screws which fasten the variable capacitor.

The tone and volume of the set can be improved by placing a thin sheet of cardboard between the back of the panel and the components.

1

Stereo-Hi-Fi cabinet ensemble is modern (and modular) in design, antique in finish; units are flexible in arrangement, can be used separately also. Sliding doors bypass each other.

build yourself a . . . Stereo Music Center

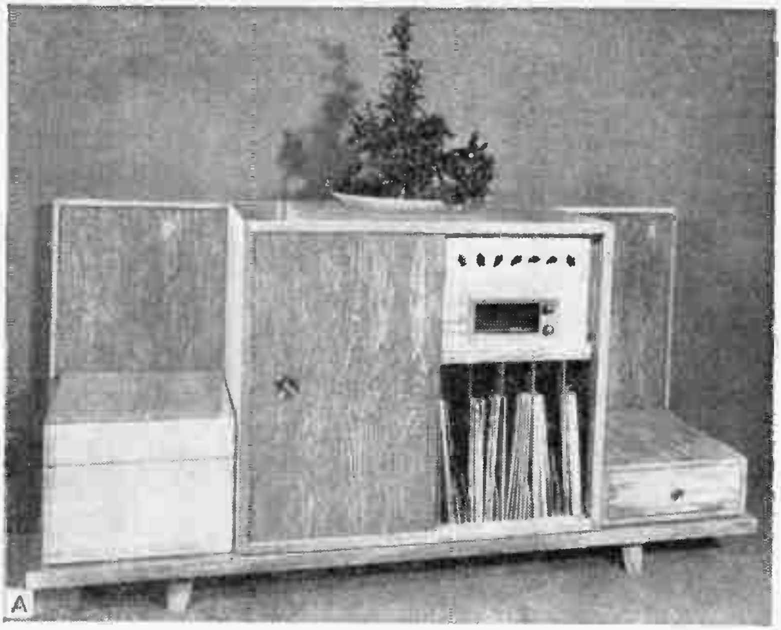
By R. J. DeCRISTOFORO

IF stereo (or hi-fi) hasn't gotten to you yet, it will, and here is a music center unit that will not only house your present components of any make, but also any future additions to your equipment (Fig. 1). This music center houses stereo tape deck or turntable, two-channel (stereo) preamplifier and two-channel or separate amplifiers and also has room for an AM-FM tuner placed in the stereo (two-channel) preamp compartment. In addition to arrangement adaptability, the music center provides building flexibility (Fig. 2B). You must have the main cabinet which houses stereo components plus records and the changer unit, but you can add the other units later. However, we'll begin construction with the bench so you'll have an understanding for the other units.

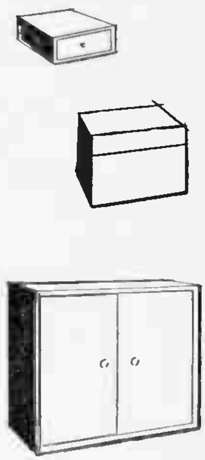
Building the bench. Square the slab top, part 1 in Fig. 2 and the Materials List, to size. Next cut the frames, parts 2 and 3, slightly longer than called for. Rabbet these pieces, then miter one piece at a time and fit to the slab top. Use plenty of glue to attach the frame pieces and drive nails up through the flange into the underside of the top. Wipe off excess glue before it dries. Now, shape the legs, parts 4, then slot the top of each to receive parts 5. Glue and nail these in place and then add the cross pieces, part 6. Locate the assembly on the underside of the top and glue and nail it in place as in Figs. 2 and 3 with 2-in. finishing nails.

Drawer and Compartment. The drawer (Figs. 2 and 4) holds extra needles, pick-ups and record cleaning equipment. Make the compartment first, using the rabbet joint construction shown in Fig. 2. Glue and nail parts 7 and 8, then cut part 9 to a tight fit. Apply glue to its edges, press in place and fasten with 2-in. finishing nails in all edges.

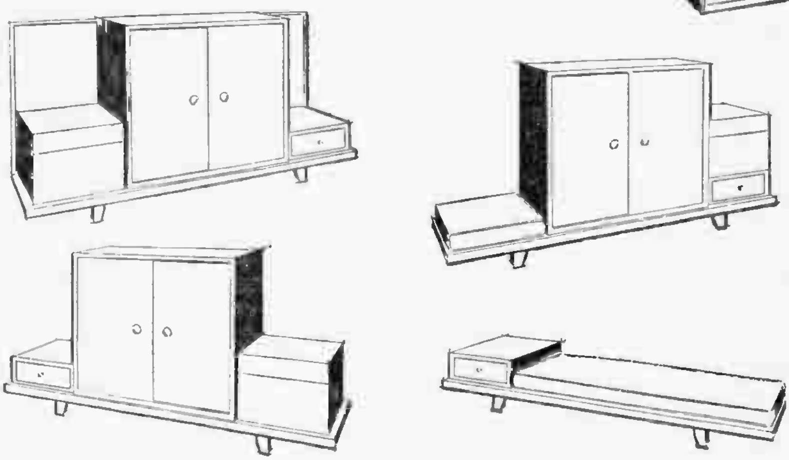
Make the drawer front and sides first. Then rabbet each end of the front to receive the sides. Cut the grooves in the sides and the front for the drawer bottom. Attach the sides to the front



Lower half of main cabinet has plenty of record storage space.



2B



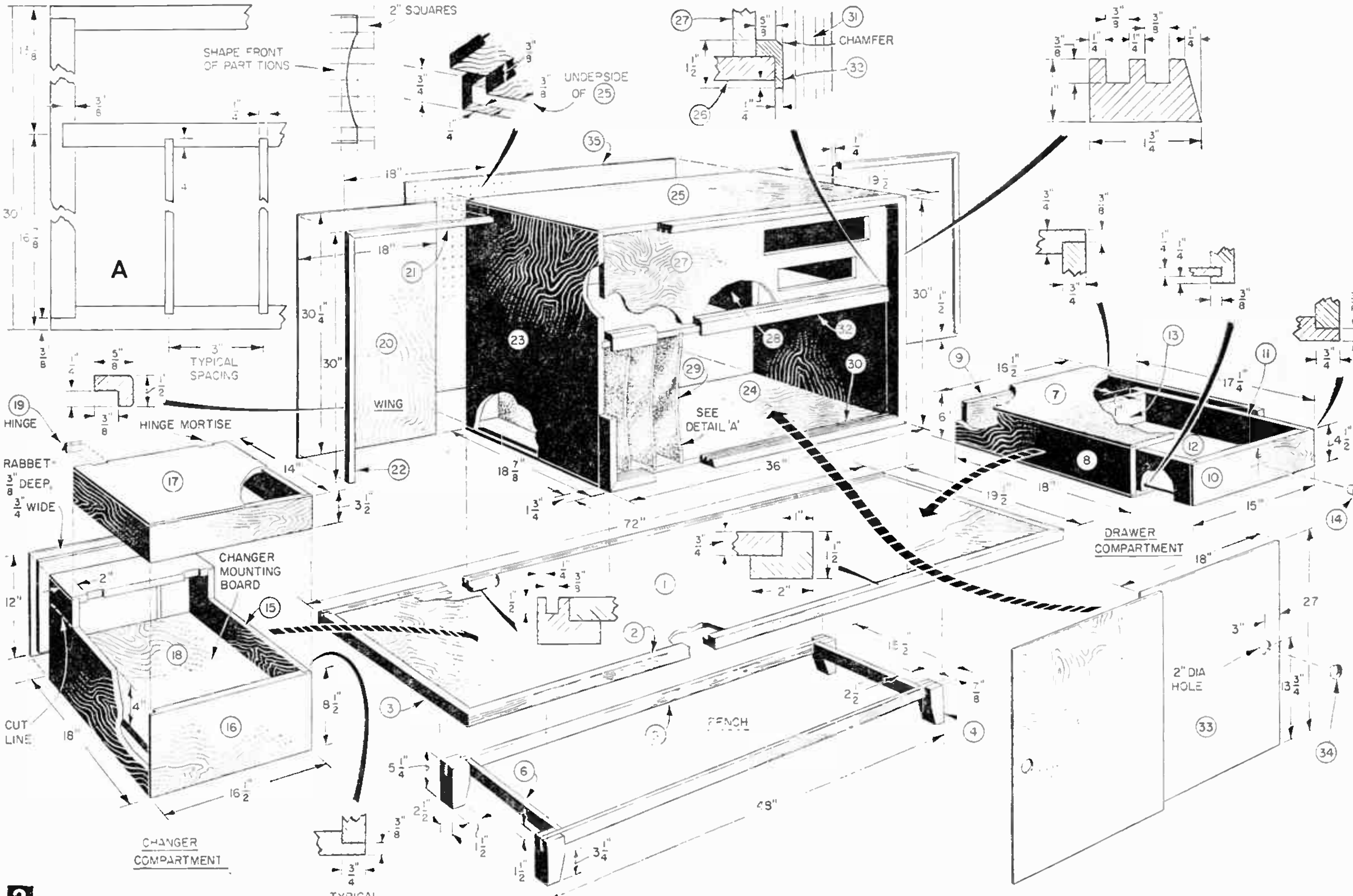
using glue and driving the nails through the side pieces. Slip the bottom into place, then make and add the back. Secure this by driving nails into it through the drawer sides and up through the drawer bottom.

Be sure the drawer slides easily in its compartment. If it's a tight fit, dress the top with sandpaper.

The cabinet for the changer is made like a bottomless box even though the construction details (Fig. 2) show the parts as they appear after they have been cut apart. Best bet is to cut the sides (parts 15) first, then the front and back (parts 16). The front piece is rabbeted along its two outer edges, the back piece is rabbeted the same way but also along the top edges. Glue and nail these parts in place, then add the top, but be sure to space nails so they will clear the cut line (3½-in. down from the top). When the glue has dried, slice off the top section on the table saw, then cut off the back end of this so you end up with the three parts shown in Figs. 2 and 5.

Next step is to mortise for and attach the hinges. The cut-out in the changer mounting board will have to be tailored to your unit. If you are installing new equipment (Fig. 6), you'll have a template to work with. If you are going to take the changer from an existing cabinet, remove the mounting board, too, and use this as a template to make the new one.

Use plenty of glue when assembling the top to the base and keep it tightly under clamps until the glue is thoroughly dry. To compensate for the saw cut, you'll have to move the top in from the back, but since this is the back of the cabinet, it won't be seen. After the clamps are removed,


2" SQUARES
SHAPE FRONT OF PARTITIONS
UNDERSIDE OF (25)
CHAMFER
A
TYPICAL SPACING
HINGE MORTISE
HINGE
RABBET 3/8" DEEP, 3/4" WIDE
WING
SEE DETAIL 'A'
CHANGER MOUNTING BOARD
DRAWER COMPARTMENT
2" DIA HOLE
CUT LINE
BENCH
CHANGER COMPARTMENT
TYPICAL

2

MATERIALS LIST—HI-FI MUSIC CENTER

Part No.	No. Req'd	Description
BENCH		
1	1	¾ x 17½ x 70" D.F. plywood
2	2	1½ x 2 x 72" clear pine
3	2	1½ x 2 x 19½ clear pine
4	4	2½ x 2½ x 5¼" clear pine
5	2	¾ x 1½ x 48" D.F. plywood
6	2	¾ x 1½ x 12¼" D.F. plywood
DRAWER & COMPARTMENT		
7	2	¾ x 16½ x 18" D.F. plywood
8	2	¾ x 5¼ x 18" D.F. plywood
9	1	¾ x 4½ x 15" D.F. plywood
10	1	¾ x 4½ x 15" D.F. plywood
11	2	¾ x 4½ x 16⅞" D.F. plywood
12	1	¼ x 14¼ x 16⅞" D.F. plywood
13	1	¾ x 4 x 13½" D.F. plywood
14	1	1" diameter brass drawer pull
CHANGER COMPARTMENT		
15	2	¾ x 11⅝ x 17¼" D.F. plywood
16	2	¾ x 11⅝ x 16½" D.F. plywood
17	1	¾ x 16½ x 18" D.F. plywood
18	1	¾ x 15 x 16½" D.F. plywood
19	1 pair	2" butt brass hinges
WINGS		
20	2	⅜ x 18 x 30¼" etched plywood
21	2 (1L-1R)	½ x ⅝ x 18" pine
22	2 (1L-1R)	½ x ⅝ x 30" pine
COMPONENTS & RECORD STORAGE CABINET		
23	2	¾ x 17⅛ x 29¼" D.F. plywood
24	1	¾ x 17⅛ x 36" D.F. plywood
25	1	¾ x 17¾ x 36" D.F. plywood
26	1	¾ x 17⅛ x 35¼" D.F. plywood
27	1	¾ x 12 x 34½" D.F. plywood
28	1	¾ x 12 x 15¾" D.F. plywood
29	10	¼ x 16¼ x 17⅛" Masonite
30	2	1 x 1¾ x 36" pine
31	2	1 x 1¾ x 30" pine
32	1	⅞ x 1½ x 34½" pine
33	2	⅜ x 18 x 27½" etched plywood
34	2	2" diameter flush door pulls (brass)
35	1	¼ x 30⅛ x 35¼" perforated Masonite
		finishing nails, glue

check to see that the top closes correctly. It may be a little tight on the hinge side, and if so, will require sanding.

The wings are merely pieces of etched plywood dimensioned as shown in Fig. 2 and trimmed along two edges with the molding strips shown. Both top (part 21) and bottom (part 22) trim pieces are shorter than the corresponding dimension on part 20 so that the wing can fit in the slot cut in the top of the bench and a small amount of the other free edge can be behind the main cabinet.

Component Cabinet. The main cabinet (Fig. 7) is fairly simple to build but you must use care when laying out for the edge joints and when cutting the dadoes for the shelf and the record storage area partitions.

Cut the sides first and run the dadoes that will receive part 26. Next, cut the bottom (part 24). Before going further, cut the dadoes for the record partitions and be sure you place them on the top surface of the bottom and the underside of the center shelf. With this done, you can assemble the two sides, the bottom and the center shelf.

Next, cut out part 27. Here, the cutout for the components (tuner, pre-amp) will have to be cut out to fit your own equipment. Work carefully —be sure you're right *before* doing any cutting. Put this part in place, spacing it ⅝ in. from the front edge of the parts so far assembled. Check this with a square before nailing to be sure the part is perfectly vertical. Now make and add the center divider (part 28) and the top (part 25). Part 32 is a decorative detail but also serves to hide the plywood edge on part 26.

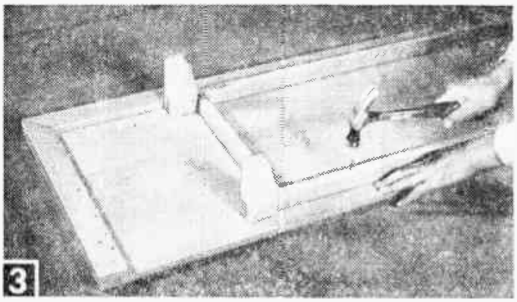
Next step is to make the front frame of the cabinet. Size these as shown in Materials List and bevel the front edge of each strip. The grooves for the sliding doors are the same in each piece except the top. Here, although spacing is the same, the grooves should be ¼ in. greater in depth to provide room so the sliding doors can be put into place (Fig. 8) or removed.

When attaching the frame pieces to the cabinet front, drill holes for 2½-in. finishing nails. Make the holes smaller than the nail shank diameter but not so deep that you can't drive the nails in solidly.

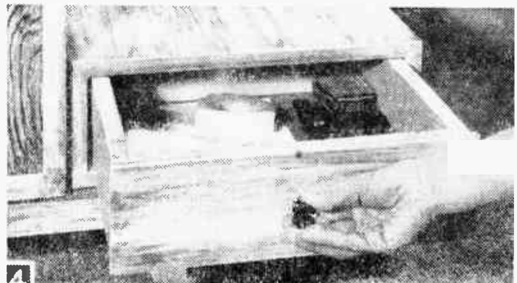
Put plenty of glue on mating edges before you begin nailing.

Cut the partition pieces to size, then make the layout for the slight curve in the front edge on one piece. Tape, or otherwise hold all the pieces together and make the cut.

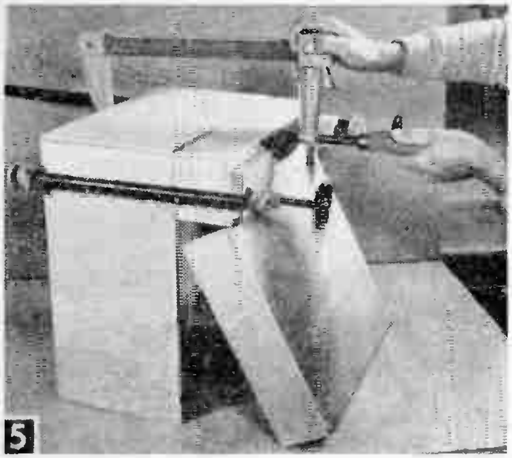
You will note, incidentally, that the 3-in. spacing between partitions will leave a narrower



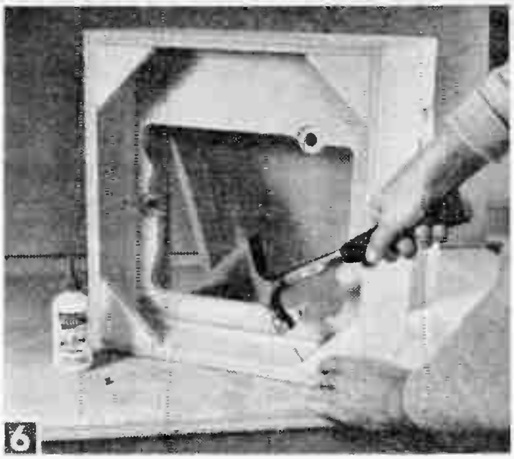
3 Leg assembly is attached to underside of bench with glue and nails. Structure is simple but strong.



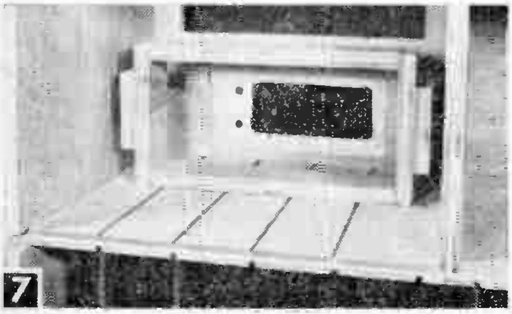
4 Drawer is good place to keep accessories—needles, record cleaning cloth, etc.



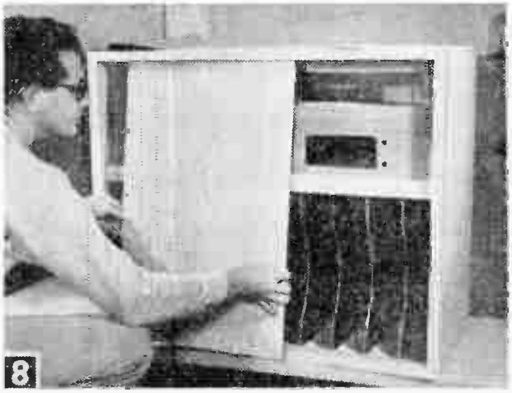
Top is sliced off changer compartment box, then glued back on again.



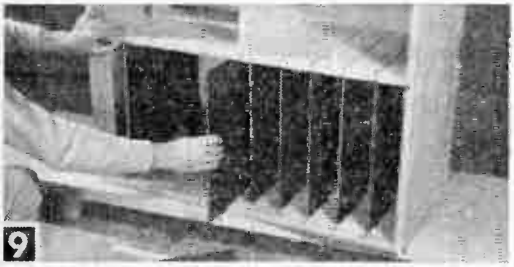
Glue blocks (not shown in Fig. 2) can be added to increase rigidity. Note cut-out for record changer.



Skeleton structures are sufficient to support components, in this case, tuner and pre-amp.



Deeper groove in top front-frame member allows sliding doors to be inserted.



Masonite panels make good record storage dividers. Note narrower compartment in center.

space in the center of the cabinet, but the sliding-door overlap compensates for this. (You can use this narrower section for records you're sorry you bought.) When the partitions are shaped and edges have been sanded, slip them into place in the dadoes previously cut (Fig. 9).

The back of the cabinet is a piece of perforated Masonite. Somewhere in the back, near the bottom edge, drill a 1-in. hole for speaker and record changer wiring pass-through.

Finishing. The antique finish we used is applied as follows: First, set all nail heads below the surface of the wood and fill with wood putty. Brush a full coat of clear resin sealer on all surfaces (inside and out) and let dry. On all outside surfaces brush a full coat of flat-finish, white undercoat.

After the undercoat dries, make an antique glaze by mixing equal parts of turpentine and glazing liquid and tinting it to the tone desired. Colors-in-oil can be used or you can do a good job with walnut or maple stain. Best bet is to experiment with slight amounts of scrap wood until you get the effect that pleases you most.

Wipe the glaze on with a rough cloth, being sure that it piles up in corners. Technique of application with the glaze has much to do with final appearance. Practice to establish the best wiping stroke.

Note that some leeway is possible by letting the glaze dry a while and then wiping again with a cloth dipped in turpentine. This way you can lighten the finish overall or achieve a high-lighted effect with areas of light and dark.

Let the glaze dry thoroughly, then finish up with two coats of satin-finish varnish. The last varnish coat can be rubbed with steel wool and lustered with paste wax rubbed to a high, gleaming polish.

The Mini-Player

Employing a transistorized wireless broadcaster and flash-battery-powered turntable, this self-contained record player plays all microgroove records from 33 to 16 rpm through any radio set

The Mini-player operates equally well in conjunction with a battery portable set as shown here, or with transistor, auto or line powered sets. Trim, three-speed motor is completely self-contained.

By THOMAS A. BLANCHARD

HOW would you like a record player that would work anywhere there was a radio—*without* any electrical plug-in's? Here is probably the smallest non-toy, three-speed, wireless record player that could be designed.

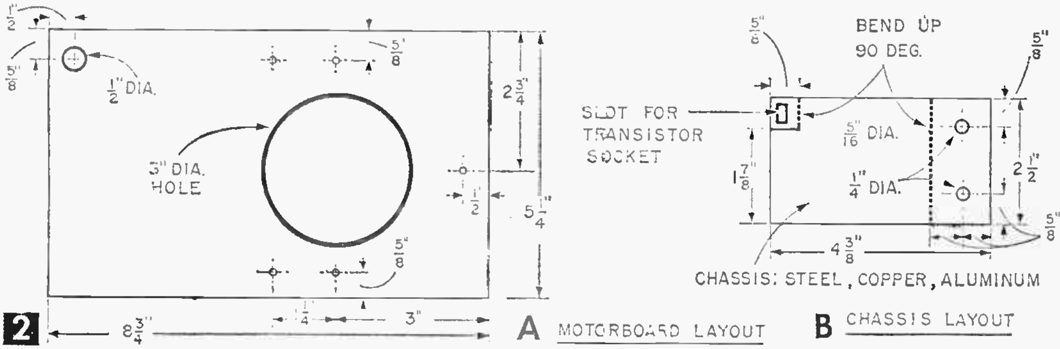
Since components are standard, the most important item is to get a 25's cigar box 1½ x 5½ x 9 in.

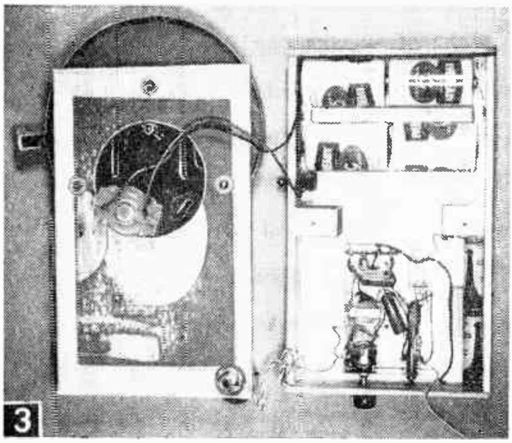
Remove the box lid and then, with a medium grit sandpaper, remove loose paper from both lid and box. Drill holes in the motor board as shown in Fig. 2A. The trim final finish is obtained by covering the box with self-stick plastic fabric sold in most variety stores under the trade name "Con-Tact."

The phonograph turntable is just 6 in. in dia. Power is provided by a tiny 6-*v* PM motor operated with four flashlight cells wired in series. A spring tension clip fashioned from a strip of metal secures the cells in the cabinet. A single pole toggle switch turns the motor on and off.

Note that the two rows of flashlight cells (see Fig. 3) are separated by a strip of wood cemented to the bottom of the box. This strip measures ⅜ x ⅝ x 4¼ in. The bronze turntable spindle bearing extends below the motorboard, and this spacer strip allows bearing clearance which would otherwise be blocked if the batteries were in two close rows.

Two brass upholstery tacks to which motor leads are soldered provide the 6 *v* plus and minus power takeoff. These are mounted inside the box opposite the spring brass battery retainer clip. Insert batteries so first cell has the small *plus* button in contact with one tack head with the fourth cell's zinc case contacting the remaining tack head. When power is turned on, turntable should rotate away from the crystal pickup arm. If not, simply reverse the sequence of the flashlight cells and motor will





Underside of Mini-player motorboard and arrangement of penlite and standard size cells.

MATERIALS LIST—MINI-PLAYER

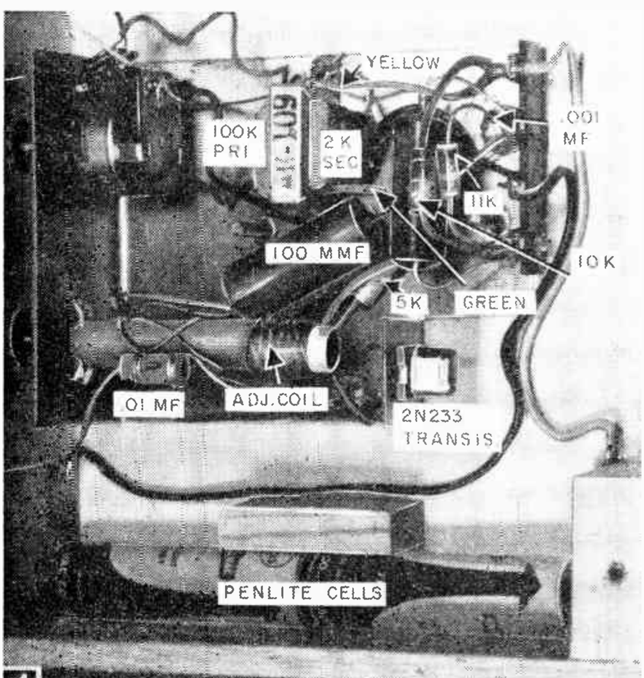
No. Req.	Size and Description
1	ferrite slug-tuned radio antenna "Loop" coil
1	Argonne miniature transformer #AR 145 (100K Primary; 2K secondary)
1	Sylvania type 2N233 N-P-N radio frequency transistor
1	molded plastic transistor socket and retainer ring
2	100 or 150 mmf. ceramic tubular or disc capacitors
1	.01 mfd. disc ceramic capacitor
1	.001 mfd. disc ceramic capacitor
1	10K (10,000) ohm ½ or ¼-watt resistor
1	11K ohm ½ or ¼-watt resistor
1	5K ohm ½ or ¼-watt resistor
1	2½ x 4⅜ pc. of thin steel, copper or aluminum for chassis
1	cigar box—minimum dimensions: 1½ x 5½ x 9"
¼ yd	"Con-Tact" plastic fabric
1	crystal phonograph pickup with 1 mil needle
1	miniature, battery-operated phono motor with 6" turntable (Alliance, General Industries, German/British import)
2	1½v. penlite cells
4	1½v. size D flashlight cells

turn in the correct clockwise direction. For future reference, the inside of box can be marked with an outline of batteries in correct polarity position.

The pickup can be any popular standard-size crystal unit with a turnover cartridge if you expect to use old records. Otherwise a pickup with a single 1 mil needle will be sufficient. The turntable features a built in adaptor for playing 45 *rpm* records and drops down for playing 33 *rpm* and 16 *rpm* discs—any size up to 12 in.

To secure the motorboard to the cabinet, cement two blocks of wood ¾ x 1 x 1⅜ in. in the center of box. Fashion a spring clip to form a contact for one of the penlite cells used to power the transistorized phono oscillator and secure it with a small wood screw before the block in foreground (see Fig. 4) is cemented in place. A flat strip of metal is cemented to the corner of the box to form contact to the second penlite cell.

Some experimenters might at this point get the urge to obtain the 3 *v* needed to operate the oscillator by tapping the larger batteries at the spring retainer clip. Boys, it won't work! The PM motor is a brush type unit, not induction, and the hash noise will be broadcast along with the recorded music. Separate power supplies eliminate any chance of electrical interference.



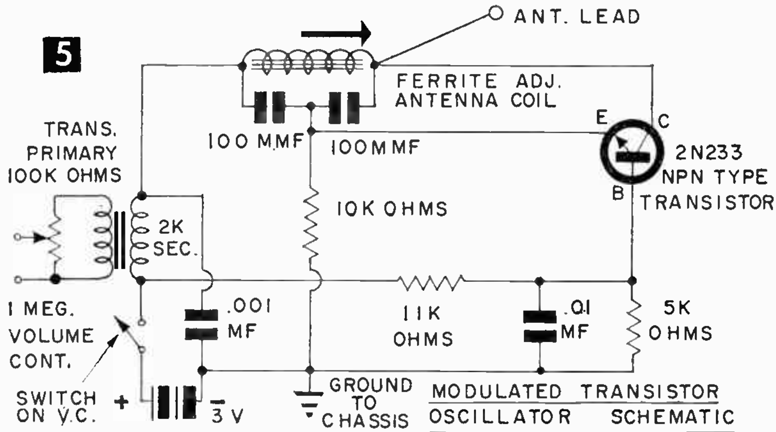
Closeup view of chassis. Small block of wood holds penlite cells in position. Four-lug tie-strip simplifies mounting small components. Chassis is secured in box with a pair of 3-48 *fh* machine screws.

Transistor Oscillator. The most interesting part of the project is the tiny transistor-operated oscillator by virtue of which it is only necessary to place the record player near any radio, tune the set to 1600 *kc* or any nearby point where a regular station doesn't tune in, and you are able to listen to the recorded music through the set's speaker loud and clear with no physical connections of any kind.

The oscillator is a transistorized version of the Colpitts circuit. The tank coil is nothing more than the popular ferrite type radio antenna coil. The ferrite slug is turned in or out to tune the oscillator to any frequency from 1620 *kc* to about 1000 *kc* so that a "clear channel" can be found on the radio dial.

The chassis is fashioned from a small piece of aluminum, copper or tin-plate as shown in Fig. 2B. Note that one corner is slotted, then bent up to provide a convenient mounting arrangement for the transistor socket. Note, also, in Fig. 4 that the original design included a 4-lug tie strip for convenience in making circuit connections.

So long as the wiring of components agrees with Fig. 5, you can vary the design to suit your whims. A piece of flexible insulated hookup wire attached to the coil lug is all the antenna necessary. A longer wire will, of course, increase the range of the oscillator.



While the circuit is almost foolproof, it must be pointed out that just any transistor will not work as an oscillator. The transistor must be of the RF N-P-N type such as the popular-priced Sylvania 2N233; *AF P-N-P* type will not work.

Since a switch was required to turn off or on penlite power to the oscillator, we employed a miniature 1 megohm potentiometer with switch and included a separate volume control. You can, for all practical purposes, leave out the volume control so long as you provide an on-off switch. The phonograph pickup leads may be connected directly to the 100K primary of the miniature Argonne #AR 145 input transformer and volume controlled from the radio set.

If hum appears when the pickup is handled so long as you hold it, ground the pickup arm's swivel to the chassis. Of course, the hum isn't present while records are playing, so this grounding can be optional.

This truly novel record player can even be used with car radios, simply by wrapping the oscillator lead loosely around the car's whip antenna.

D. Victor

Starting the countdown—ten seconds, nine, eight, seven . . .

Small, versatile and powerful—that's this miniaturized power supply.

1

Miniature Variable Voltage Power Supply

By BRICE L. WARD

THOUGH miniature in cost, labor and physical size, this power supply is big in all other respects. It will supply a full 25 *v* adjustable from zero, and up to 35 *ma* of current depending on the load. It will save hair-pulling and gnashing of teeth by supplying the voltage you need for your transistor circuits with the twist of a knob and it can handle any five- or six-transistor circuit with ease.

It has no fuse or switch because it needs none. If the leads are accidentally shorted, the current will jump to its maximum of 40 or 50 *ma*, the voltage will drop to a low value and it could be left this way all day with no harm.

Printed Circuit. Begin construction by laying out the printed circuit (Fig. 2) on a piece of single side laminate board (see Materials List) using 1/16-in. tape resist or, if preferred, a ballpoint resist tube. You can use tape resist circles at the numbered points, if you wish. These should be pressed down firmly and care should be taken to eliminate air pockets where the circles and lines join, otherwise undercutting will result during the etching process. One excellent way to eliminate this air space is with thinned liquid resist (resist can be thinned with lighter fluid). Using a small brush, carefully touch up the air spaces, allowing the liquid resist to flow under the tape.

Remove the small cutouts from the center of the tape resist circles. The etched centers will serve as drill guides later. The large circles can be painted in with liquid resist, put on with a ballpoint tube or laid out with tape resist and trimmed or left square.

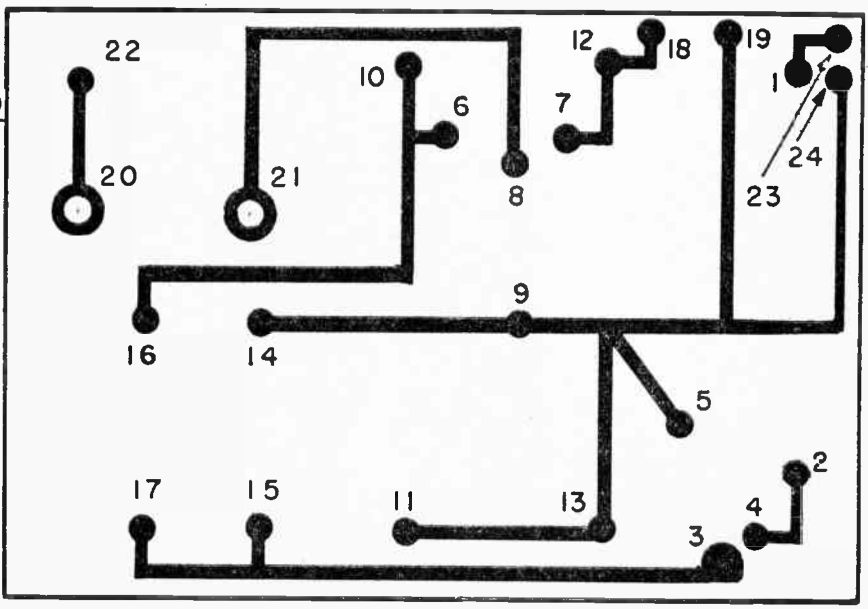
After etching the board, remove the resist and clean the board thoroughly with scouring powder. Tape resist can be pulled off. Liquid or ballpoint resist is removed with lighter fluid.

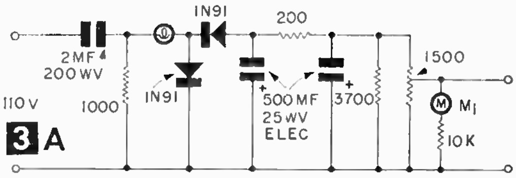
2

FULL SIZE CIRCUIT AND DRILLING LAYOUT

1-19 #50 DRILL

20 AND 21 #26 DRILL (FOR #6-32 SCREWS)





3 A

MATERIALS LIST—MINIATURE POWER SUPPLY

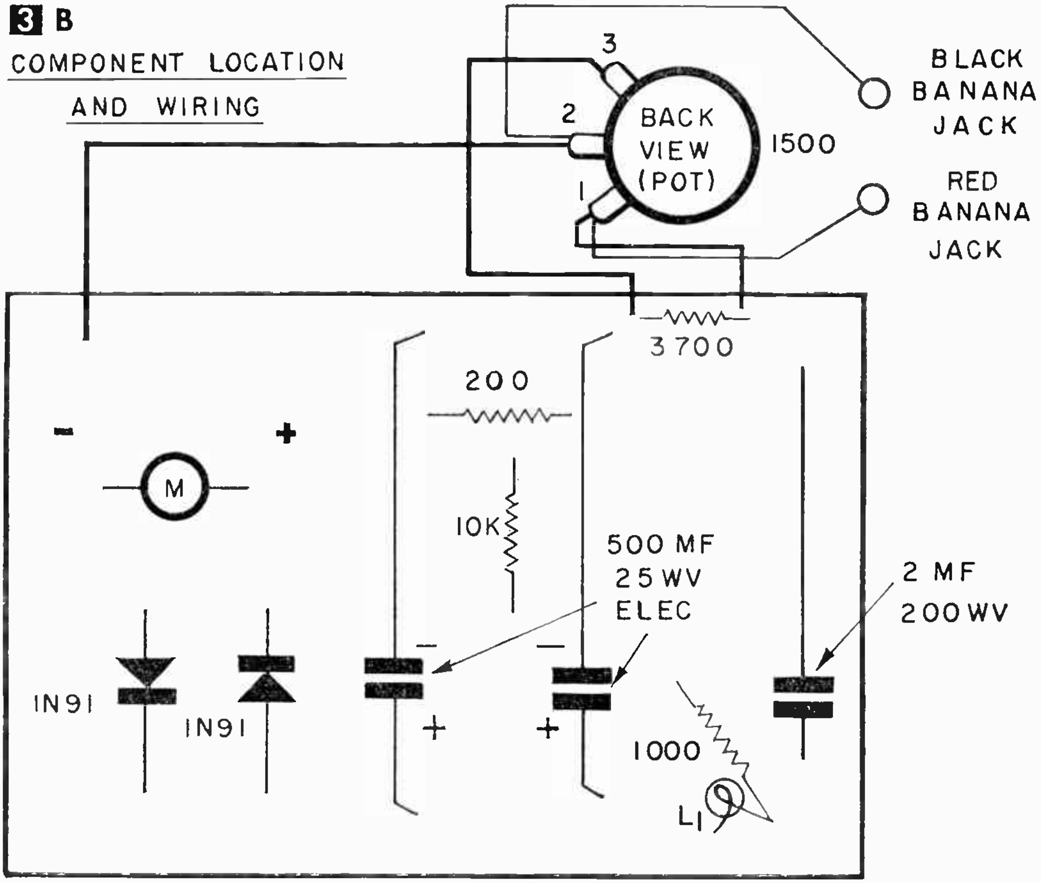
Desig.	Size and Description
C1	2-mfd, 200-v metalized paper capacitor (Aerovox P82Z)
C2, C3	500-mfd. 25-v dry electrolytic capacitors (C-D Type 5002)
CR1, CR2	GE 1N91 germanium rectifiers
L1	GE #51 pilot lamp
M1	0-5 dc milliammeter (Lafayette miniature panel meter TM-401)
R1	1000-ohm, 1/2-watt carbon resistor
R2	200-ohm, 1/2-watt carbon resistor
R3	3700-ohm, 1/2-watt carbon resistor
R4	1500-ohm, 2-watt wire wound potentiometer (Mallory R1500L)
R5	10K-ohm, 1/2-watt ±1% precision resistor (Aerovox Carbofilm)
Case	Lafayette Bakelite case #MS-216 and panel #MS-217
	Banana jacks, zip cord and plug
P. C. Material	XXXP copper laminate—one side—3 x 4 1/2" (MS-512)
	6 oz. of etchant (PE-3)
	Tape resist 1/16" (PRT-2)
	Tape resist circles (PRTD-6)

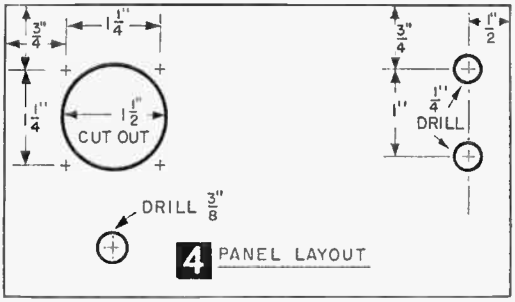
As indicated in Fig. 2, drill points 1, 2 and 4-19 with a #50 drill (about 1/16-in.) and 20 and 21 with a #26 drill. Match the distance between points 20 and 21 with your meter lugs to get a good fit.

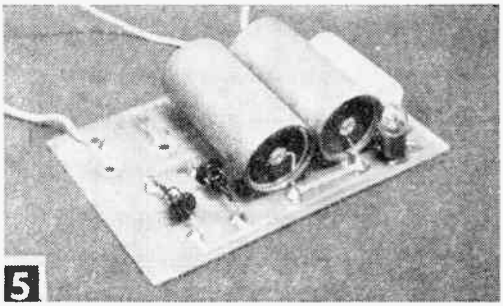
Now, using a hot soldering iron and working quickly to prevent blistering of the copper laminate, mount the following components in the order given, following schematic-pictorial of Fig. 3. Mount all components on the etched side of the board. Bend the leads of C1 down and push them through the holes at points 1 and 2. Push the capacitor down against the board and solder points 1 and 2. Clip off the leads behind the board. In the same way, mount R1, R2, R3, R5, CR1 and CR2 but solder only points 5-9 and 14-17 inclusive. Be sure CR1 and CR2 are mounted with polarity shown in Fig. 3B. Mount C2 and C3 with their positive ends at 11 and 13 respectively. Solder a piece of bare wire to the shell of L1 and tin the button on the bottom, then tin point 3 at the same time, pressing the lamp firmly into place. Solder point 4. Strip ends of three 5-in. pieces of insulated wire (about 1/4-in.) and push them into the holes at points 18, 19 and 22. Solder these three points and clip off all the leads on the

3 B

COMPONENT LOCATION AND WIRING







P.C. board-mounted components.

opposite side of the board, leaving that side as smooth as possible.

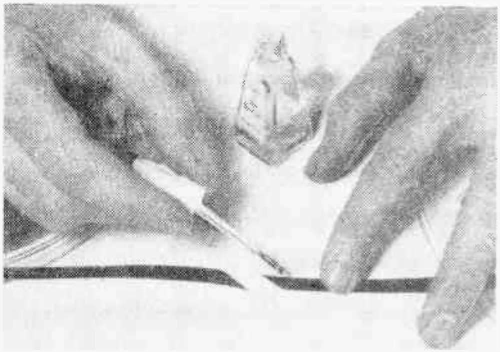
Assembly. Lay out and drill the front panel as shown in Fig. 4. The meter cutout is best made with a fine tooth coping saw or jigsaw. Drill a ¼-in. hole for the line cord (centered and about ¾ in. down) on one end of the case. Mount the meter using four 4-40 machine screws and nuts, and mount the potentiometer and banana jacks. Sandwich the components between the printed circuit board and the front panel and using the screws supplied with the meter, attach the printed circuit board to the meter lugs through holes 20 and 21. Complete the wiring according to Fig. 3A. Tin the ends of the line cord and run it through the hole in the case. Tie a single knot about two inches back from the tinned ends and solder one lead to 23, the other to 24. Now carefully recheck the wiring and attach the panel to the case with 6-32 screws.

Testing. Turn the potentiometer completely counter-clockwise and plug the unit into the receptacle. Turn the pot clockwise (up) and you should get a reading on the meter. The maximum reading will be between 20 and 30 *v*. Turn the pot down again and put a multimeter, set to read *at least* 100 *ma*, across the output leads. Again turn the pot up *slowly*. The reading will go to about 50 *ma* and drop back to between 30 and 40 *ma*. The voltmeter will indicate a very low voltage. This latter test is not necessary, but serves to show the inherent safety in the power supply.

There are one or two precautions to observe. Always turn the pot up *slowly* to the desired voltage to prevent sudden current surges, and before disconnecting or connecting the load, always turn the pot all the way down (zero voltage). That's all! Enjoy your experiments.

Tape Splicing Technique

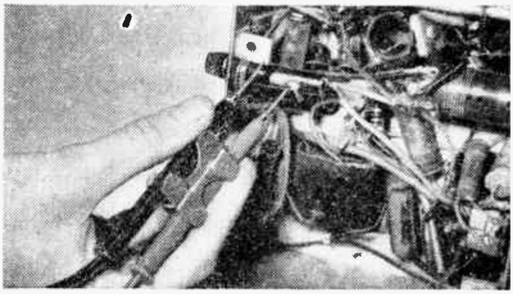
• Clear fingernail polish serves as an excellent cement when splicing recording tape. Taper cut the two ends of tape at a 45° angle, then daub some of the polish on the leading edge of one

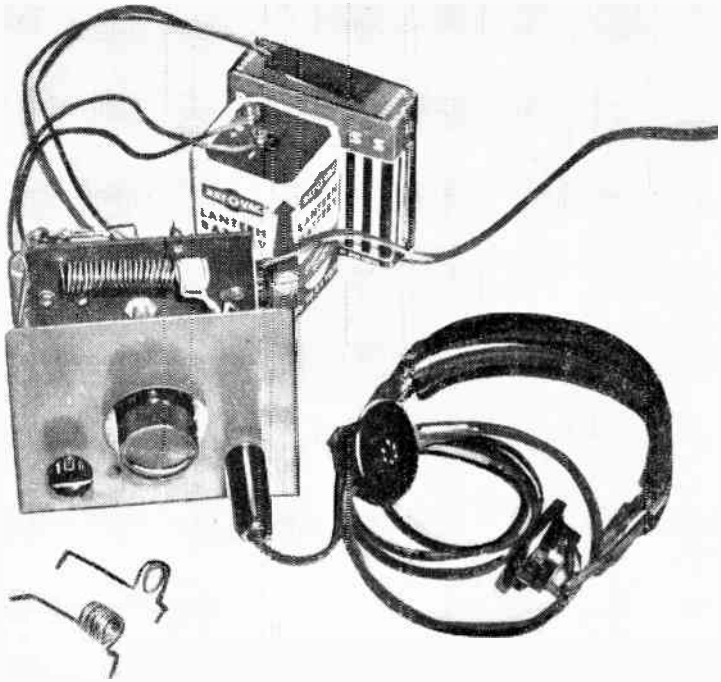


piece and overlap the other piece ⅛ in. Let dry for about ten minutes, then daub polish on the overlapping edges to insure a perfect splice. You'll have a firm, long-lasting splice that can withstand considerable tension and flexing as the tape passes through the recording machine, and is just as good as one made with cellulose splicing tape.—John A Comstock.

Fuse Holder Eases Testing

• Ever wish there were some way you could hang on to both of your test prods with one hand while the other works the meter knob? Take one of those fuse holders used when you replace a pigtail fuse with an ordinary fuse and snap the barrels of your test prods into it. You can often touch the red prod to a hot terminal and the other to a chassis ground point nearby. If the two test points are located farther apart, take the barrel of each prod out of the clips at the lower end of the holder and this will put the prod tips farther apart. You can even use the fuse holder to keep pairs of test leads from becoming separated when many are stored together.





1

With four coils, this one-tube receiver covers the range from 27 to 200 megacycles.

One-Tube VHF Receiver

By JOE A. ROLF, K5JOK

IF you're a short-wave listener, signals from Europe, South America, and Asia are probably old friends. Many interesting signals, however, originate within a few miles of your home that your receiver does not hear. Here is a simple receiver that will pick up those signals—those above 30 *Mc*—and bring the police, fire department, and a dozen other local stations right into your shack.

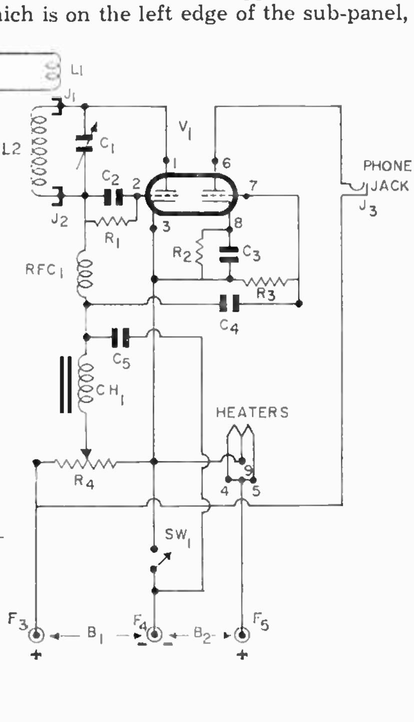
Since the 10-meter Amateur band is covered, there's also plenty of DX. Besides most of the VHF stations within 50 miles, this receiver (in Jonesboro, Ark.) has logged hams in Mexico, Cuba, Alaska, and Japan; paging services from California to Puerto Rico; and South American Police nets—all with only a 4-ft. antenna! The surprise came when it was hooked to a beam antenna and received signals from the BBC Television Service in London. . . . DX in anybody's book!

The receiver covers 27 to 200 *Mc* with four coils. The type of stations you'll hear are listed with the coil winding chart. In many localities signals from ships, highway departments, motion picture studios, pipelines, ambulances, and industrial plants can also be heard.

The set uses only one tube, but is actually a two-tube receiver. The 12AT7 has two tubes in the same package, one operating as a super-regenerative detector and the other as an audio amplifier. The detector (so sensitive that it makes electron noise sound like a frying egg) detects FM or AM signals which the second section of the tube amplifies. The receiver is battery powered and can be operated anywhere.

The base of the chassis is a piece of 3/4 x 5 x 5-in. pine, the panel is 1/16-in. aluminum sheet, 5 x 5½-in. Round the panel corners with a file and wash it in vinegar to give it a dull satin finish. The sub-panel is a piece of 1/8-in. Masonite, 3¼ x 4¼-in. Two 3/4 x 3/4-in. brackets of 1/16-in. aluminum hold the sub-panel to the base with machine and wood screws. The sub-panel is placed 1½ in. from the rear edge of the pine block.

A small aluminum bracket supports the tube socket which is on the left edge of the sub-panel,



2 SCHEMATIC

about ¾-in. from the top. The tuning capacitor (C1 in Fig. 2) is in the center of the sub-panel, 1½ in. from the top. Antenna jacks (F1 and F2) are on the right side, ¾ in. apart, and the coil jacks (J1 and J2) are mounted 2 in. apart and ¼ in. from the top edge of the panel. Screwfasten the front panel to the pine block.

Center the hole for the tuning capacitor shaft in the panel 2¼ in. from the top edge. The regeneration control (R4) and headphone jack (J3) are mounted directly to this panel; J3 is insulated from the panel by drilling the mounting hole a little larger than required and using two fiber washers for insulation.

It is necessary to modify the tuning capacitor (C1) before mounting it. With pliers, carefully remove all but the middle, stationary plate of the capacitor. Do *not* remove any of the plates that rotate. The capacitor C1 must also be insulated from front panel to avoid changing the receiver's frequency when the panel is touched. If the regeneration control is purchased new, the shaft will be longer than necessary and most of it will have to be cut off with a hacksaw. Slip a 1-in. piece of small rubber tubing (¼-in. ID) over the shaft of C1 and slip the shaft from the regeneration control into the other end of the tube. The fit should be tight, but the two metal shafts should not touch. Use a panel bearing or rubber grommet to support the shaft at the front panel.

The battery clips (F3, F4, F5) are mounted with small wood screws on the right rear of the chassis (see Fig. 3). Identify each clip to avoid mistakes in connecting batteries. Solder the antenna coupling coil (L1) to terminal lugs on the machine screws holding the antenna terminals. The leads on this coil are twisted together and long enough to permit the coil to be brought next to L2.

Choke Ch-1 is mounted next to the regeneration control (R4). This part can be a small audio choke or the primary winding of a miniature output transformer (found in most scrap boxes or obtained from an old radio at a radio service shop. This part can also be purchased new and is less expensive than a coupling transformer.)

It is important, in wiring the receiver, that the leads connected to J1, J2, and C1 be kept as short as possible. Solder one lead of RFC1 to the terminal of C1 and the other to a terminal lug mounted on the chassis. Connect one lead of C4, C5, and Ch-1 to the lug on the chassis also. The other lead of C4 can be connected to another lug with a piece of hookup wire leading from the lug to the tube socket. Connect C5 to F4.

Wind the coils on ½-in. forms (see Table A) and then slip them off and spread to the right length. Bend the ends of the coils so they plug easily into J1 and J2. The single strand #12 copper wire used in house-wiring is easiest to obtain for these coils. Strip off the insulation and clean the wire with fine sandpaper.

When the wiring is completed, connect the batteries, plug in headphones and Coil A. After the set has been turned on and has warmed up, a loud hissing noise should be heard in the headset as the regeneration control is rotated clockwise. If this frying sound is not heard, check to see that the tube filaments are lit. If not, there is a wiring mistake or the tube is bad. If filaments are lit, check the wiring again and try a .002 or .003 *mf* capacitor in place of C5. The capacitor C5 is critical and the correct value may vary with different receivers.

Once the hissing sound is heard,

TABLE A—COIL WINDING DATA

▶COIL A—27-45 Mc.
- TURNS—19
- LENGTH—2 in.
- STATIONS HEARD

Amateur (10 meters)
City, State Police Services
Foreign Police Services
City Transit Companies
Towing Companies
Motor Carrier Services
Highway Trucks
Utility Companies
Paging Services
Foreign Television
Russian Satellites

▶COIL B—40-65 Mc.
- TURNS—10
- LENGTH—1 in.
- STATIONS HEARD

Amateur (6 meters)
Utility Companies
Logging Vehicles
Television (domestic)

▶COIL C—60-140 Mc.
- TURNS—2
- LENGTH—⅜ in.
- STATIONS HEARD

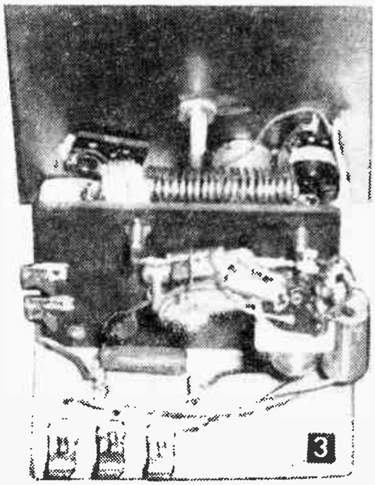
FM Broadcast
Television (domestic)
Military
Air Navigation Services
US Satellites

▶COIL D—130-200 Mc.
- TURNS—1
- LENGTH—¼ in.
- STATIONS HEARD

Amateur (2 meters)
Television (domestic)
Local Police
Logging Vehicles
Utility Companies
Railroads
Taxi Companies

Coils are all ½ in. in diam., of #12 copper wire. Close-wind coils and spread turns evenly to given length with a knife or screwdriver blade. To raise frequency coverage of coils, increase spacing between turns; to lower frequency, squeeze coil so spacing is decreased.

Base of receiver is ¾-in. pine stock, sub-panel (behind front panel) is ⅛-in. Masonite.



MATERIALS LIST—VHF RECEIVER

Desig.	Description	Desig.	Description
B1	67½-v. battery, Burgess K45 with snap-on connector	R2	500 ohm, ½-watt resistor
B2	6-v. lantern battery, Burgess, Eveready, or Ray-O-Vac	R3	1 megohm, ½-watt resistor
C1	3-15 mmf. variable capacitor, Bud MC 1870, modified according to text	R4	50,000-ohm volume control, Centralab B-31 with KB-1 switch (Sw 1)
C2	47 mmf. mica capacitor	RFC1	1 mh RF choke, National 5-50, or 6' to 8' of #28 dcc solid copper wire wound on ¼" form
C3	.25 mf. 100-v. tubular, Sprague 68P19	V1	12AT7 radio tube
C4	.01 mf. 400v tubular, Sprague 68P8	1	9-pin miniature tube socket
C5	.001 1 kv. disc ceramic	1 pr	magnetic headphones
Ch1	midget audio choke or primary of midget output transformer	10	#8 terminal lugs
F1, F2, F3, F4, F5	medium Fahnstock clips	6	6-32 x ¼" machine screws with nuts
J1, J2	metal or molded tip jacks	10	small wood screws
J3	standard phone jack	1	coil of solid strand hook up wire
L1	5 turns copper hookup wire, closewound ½" dia.		1/16" aluminum sheet, ¾" pine, and Masonite for chassis, brackets and panel
L2	#12 copper wire wound according to Table A		tuning dial and knob
R1	4.7 megohm, ½-watt resistor	1 pc	rubber tubing 1" long with ¼" inside dia.
		2	fiber washers ¼" I.D. and ⅝" O.D.

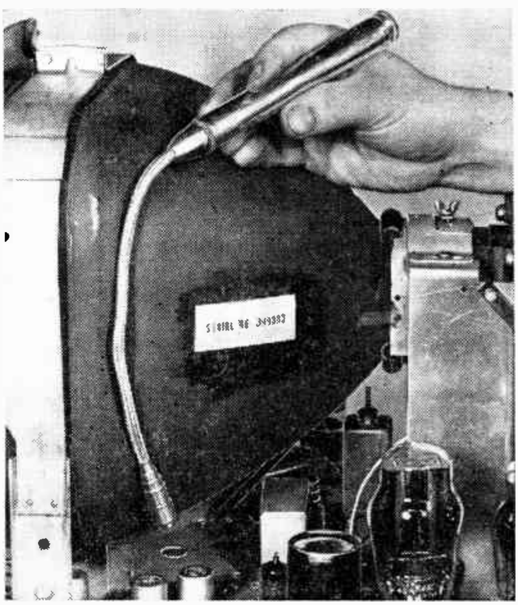
connect an antenna and move L1 close to L2. Tune across the band until a station is heard, then adjust the regeneration control for the best reception. If the hissing sound is not present all across the band, move L1 away from L2 until the receiver regenerates at any setting of C1.

Naturally, any radio works best with a good antenna, but this receiver will do surprisingly well with only a short piece of wire as an antenna. For best performance, the antenna should be cut exactly to your favorite frequency and it should be as high as possible. A simple folded dipole or vertical antenna will work well and, in some cases, it is best to ground one of the antenna terminals.

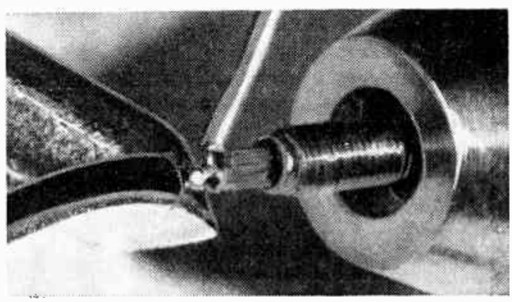
If you happen to live in an area where TV signals are weak, this receiver may interfere with nearby TV sets when tuned to a TV station. This is because the detector generates a weak signal which the TV set receives. If such interference is noted, do not listen to TV stations when it may disturb a nearby set.

Light for Tube Replacement

• When replacing miniature tubes in a TV set, a penlight flashlight with an 8- to 10-in. flexible extension (available at tool and surplus stores) will provide light at sockets which can not be otherwise lighted.—H. Leeper.



Drill's Chuck Vises Work



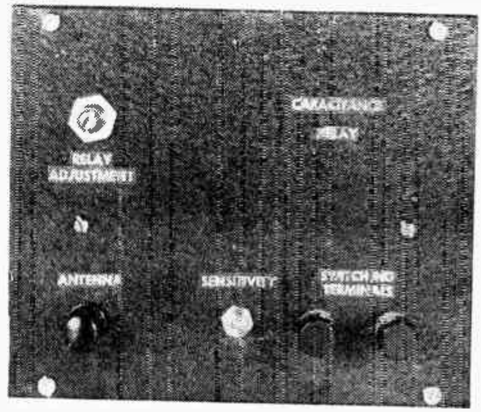
• A drill's chuck can double as that extra hand that's needed to hold small lugs, jacks, plugs, and other parts while you solder wires to them. Soldering is a lot easier and there's no chance of painfully burning your fingers on hot parts by trying to hand-hold them. You can use an ordinary hand drill for the purpose or an electric drill—either does the job nicely.—J.A.C.

Hum in Iron-Core Transformer

In the case of hum due to vibration of the laminations in an iron-core transformer, loosen the mounting screws so the laminations will spread apart slightly, paint the edges of the laminations with shellac or varnish, allow to dry for several hours, then tighten the mounting screws.

1

A compact and efficient unit designed for continuous service—a transistorized capacitor relay, front-panel and under-chassis views.



Transistorized Capacitance Relay

By W. F. GEPHART

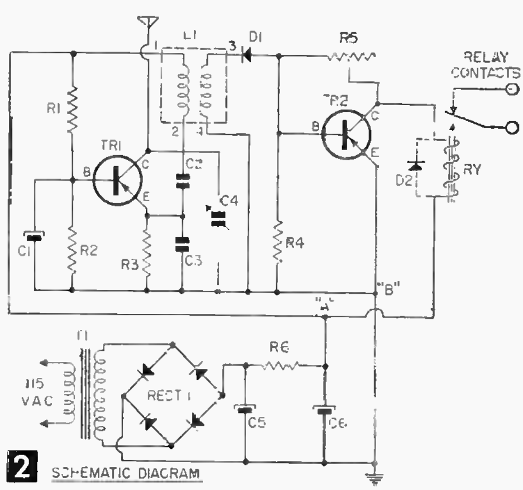
Vacuum-tube capacitance relay circuits have several disadvantages in certain applications such as burglar alarm and other continuous-duty circuits. This transistorized unit overcomes those disadvantages

VACUUM-TUBE capacitance relay circuits consume appreciable power, requiring line voltage or excessive battery replacement, and are prone to trouble due to the tubes and high voltage required. Transistorizing these circuits, though it sacrifices sensitivity to some extent, provides a means of continuous trouble-free, economical operation. The unit shown in Fig. 1, for instance, will operate continuously on *ac* for less than half-a-cent a day and operation cost is very little more on battery operation. And, since transistors are used, shock hazard is eliminated and the chance for circuit breakdown is greatly reduced.

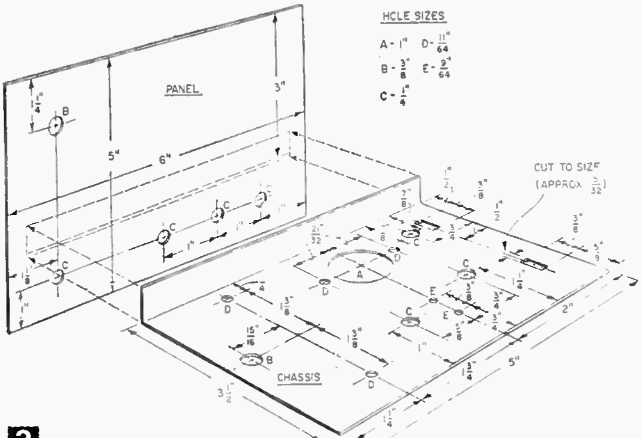
The circuit (see Fig. 2) consists of a transistor oscillator feeding a transistor-controlled relay. The oscillator biases the second transistor to the point of conducting enough current to close the relay, and when an outside capacitance stops oscillation, current flow in the second transistor is reduced and the relay opens. Even though the relay is *energized* under "normal" conditions, the current flowing through its coil (1.8 *ma*) is far below the coil's continuous-duty rating.

Several types of coils may be used for the oscillator coil (L1). The one shown is a broadcast band antenna coil, but a BC band oscillator coil or IF transformer may also be used. The connections for the coils that can be used are:

Terminal on Schematic, Fig. 2	Antenna Coil	BC Osc. Coil	IF Transformer
1	Grid	Grid	Plate
2	AVC	Ground	B+
3	Antenna	Plate	Grid (or diode)
4	Ground	B+	Grid (or diode) return



2 SCHEMATIC DIAGRAM



3 CHASSIS AND PANEL LAYOUT

the trimmer capacitor should then be disconnected. If the capacity of the lead is still too great, the unit must be moved closer to the antenna to enable a shorter lead to be used.

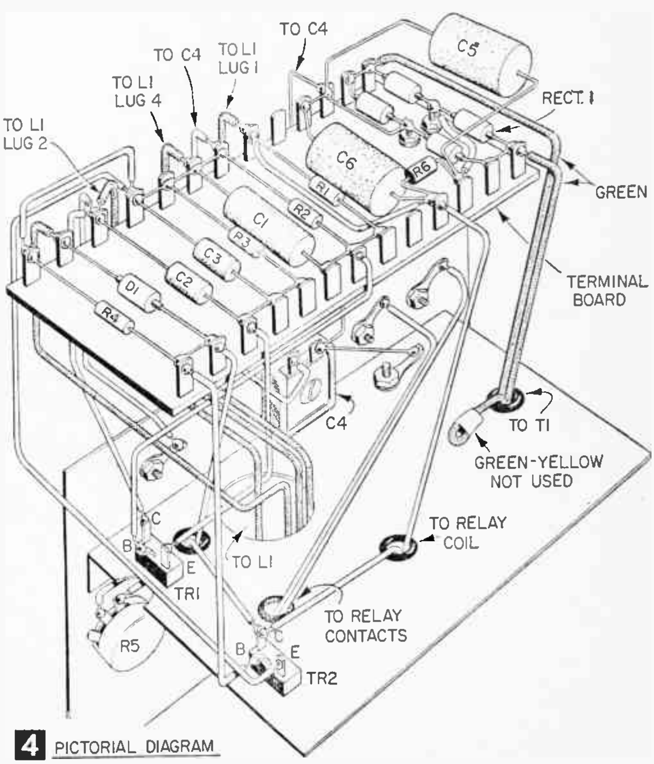
Figure 3 shows the panel and chassis layout. Any layout could be used, but the unit should be enclosed in a steel cabinet in all cases. The unit is shown with a built-in *ac* power supply, although batteries could be used by connecting a 15-*v* battery supply to points "A" and "B" (Fig. 2), observing proper polarity. The *ac* power supply shown delivers in excess of 15 *v* under full load, and this voltage must be reduced to the 15-*v* limit of the transistors by selecting a proper value for R6. Normally, 800-900 ohms will be correct. An *ac* switch was not included in the unit shown, since it was intended to be wired into the power lines, but one can be placed on the front panel.

Terminal board wiring was used in the unit shown, and the terminal board was mounted on ½-in. spacers under the chassis. If a surplus terminal board is not available, one can be made out of a 2½ x 5-in. piece of plastic or Bakelite, spacing thirteen ½-in. 2-56 machine screws along each side, and centering two at one end. The transistors could be wired directly into the circuit, but the use of sockets simplifies replacement.

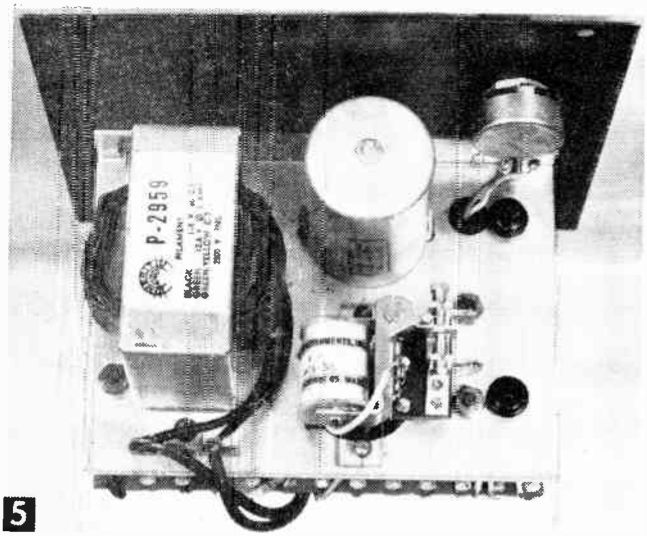
In all cases, the coil should be shielded. If you use an IF coil, use a 270 *kc* version to avoid the possibility of interfering with nearby radios. Except when an IF coil is used, no capacitor is used across coil; the distributed capacity of the coil and wiring is utilized for oscillation. In the unit shown in Fig. 1, with a BC antenna coil, the oscillation frequency of the components will be approximately 100 *kc*.

The "antenna" is connected to the collector of TR1, and touching it provides a capacitative ground between the collector and emitter, and stops oscillation. In burglar alarm applications, this lead can be connected to the metallic frame of the item to be protected (cash register, safe, door knob, etc.), so that touching it will stop oscillations. In other cases, a metal plate may be fastened to a window sill or other place to achieve the same result (see *Radio-TV Experimenter*, No. 555, 75¢, "Experimenting with a Capacity Control," p. 143), or the lead may be attached to a door or window screen. If the "ground" lead (+15 *v*) is connected to another metal plate in the vicinity of the antenna plate or screen, often the circuit will trip without the person actually touching the antenna plate. The voltage is so low that touching both leads is harmless and cannot be felt.

A trimmer capacitor (C4) is connected between the collector of TR1 and ground to minimize the additional capacity required to stop oscillations. With the antenna connected, this should be adjusted so that oscillations are just maintained at a level that will hold the relay closed, and any additional capacity in the circuit will cause the relay to open. Sometimes, in the case of long antenna leads, the distributed capacity of the lead itself will stop oscillations, and



4 PICTORIAL DIAGRAM



5

Back-of-panel, top view of unit showing transformer, coil, relay, sensitivity control and two transistors.

MATERIALS LIST—CAPACITANCE RELAY
(All resistors are ½ watt)

Desig.	Description
R1	.1 megohm
R2	47K
R3	10K
R4	2.2 megohm
R5	5 meg potentiometer
R6	820 ohms (see text)
C1	.01 mfd., 200 v
C2, C3	22 mmf. ceramic
C4	70-480 mmf. trimmer capacitor
C5, C6	25 mfd. 50-v electrolytic
L1	oscillator coil (see text)
T1	12.6-v filament transformer (Merit P-2959)
TR1, TR2	2N107 PNP transistor
D1	1N48 diode
D2	1N38 diode
Ry	SPDT relay, 8000-ohm coil (Sigma 4F-8000-S/SIL)
Rect. 1	four 1N48 diodes, bridge-connected
	Steel cabinet 4 x 5 x 6" (Bud CU-729); two transistor sockets; three insulated binding posts; miscellaneous hardware

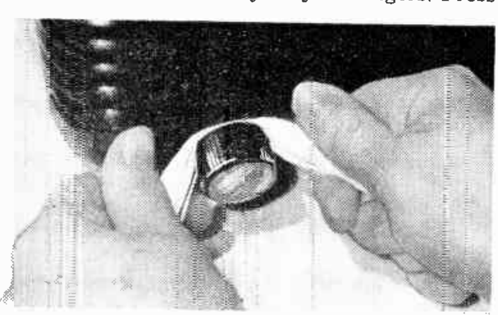
If the unit is to be placed in a service where the relay will operate frequently, such as in a counting circuit or, say, a customer-activated window display, place a diode (D2) across the relay coil (shown in dotted lines in Fig. 2). The inductive pulse from the relay coil when it releases is hard on the transistor, and frequent usage would ultimately damage TR2 unless the diode D2 is used.

The relay specified in the Materials List is adjusted to close on 1.5 *ma* at the factory. This adjustment should not have to be changed since TR2 will normally draw about 1.8 *ma* when biased by the oscillator output. Potentiometer R5 is used to adjust the "no-signal" bias on TR2 so that the relay barely closes when the circuit is oscillating normally. A reduction in the amplitude of, or the cessation of oscillations then causes the relay to open, closing the circuit to the external terminals.

The circuit can be used for burglar alarms as mentioned, or for any other "touch" or proximity operated circuit switching. By placing two metal plates close together, where a raindrop will bridge the gap between them, the circuit can be used as a "rain alarm." The high resistance direct connection between the plates (one connected to "antenna" and one to "ground") will not damage the power supply, but will stop oscillations. However, in the case of a direct, low-resistance connection between the "antenna" and "ground," the circuit should be disconnected promptly after the alarm to minimize drain on the power supply, particularly if batteries are used.

Cloth Removes Stubborn Knobs

• When you wish to remove a stubborn press-on type of radio or TV knob, just loop a twisted scrap of strong soft cloth behind the knob, gripping the loose ends firmly in your fingers. Press



against the cabinet front with your thumb tips, at the same time pulling firmly at the cloth. The knob should work free without damage to cabinet or knob.—Frank A. Javor.

It's an infinite baffle—

Six-Meter Station for the VHF Amateur

By C. F. ROCKEY, W9SCH/W9EDC

For hams only, the new improved six-meter rig that reaches out.

SPECIFIC features provided in this six-meter station are:

1) A stable, sensitive superheterodyne receiver, free from overloading effects under reasonable operating conditions.

2) A variable-frequency oscillator, controlling the transmitter output frequency. This makes it possible to move out from under powerful interfering stations, and to select a clear operating frequency.

3) Transmitter power input of 15 to 17 watts. This is sufficient for consistent six-meter work.

4) Provision for CW radiotelegraph operation on the six-meter band. This feature is not usually provided on many commercially-built units.

5) Clean, crisp signal quality, even when an inexpensive carbon microphone is used.

6) All parts are readily available from any well-stocked amateur parts distributor. No expensive, "special" tubes are required. (Furthermore, many of the more-expensive parts used in the first unit—see copy beneath dotted line below—can be appropriated for this one. But even if all new parts are purchased, the total cost should not exceed $100.)

As with all VHF equipment, construction of this unit requires a degree of experience and judgment, but the unit itself is neither difficult nor tricky to set up. Before you start this, or any other serious VHF project, make sure you have a good grid-dip meter at hand (see pp. 130-131).

Power Supply, AF Circuits, Receiver. Begin construction by drilling and punching the major holes in the chassis, as shown in Fig. 2. Make the power transformer cut-out with a 1-in. square Greenlee punch (taking successive bites from the corners) or with a nibbling tool. All socket holes, except the rectifier and voltage regulator sockets, should be punched with a ¾-in. dia. Greenlee punch; the rectifier and voltage regulator socket holes are punched with a 1⅛-in. dia. Greenlee socket punch. The clearance hole for the pivot of the Send-Receive switch, and the lug-holes for the receiver IF transformers may likewise be punched with the ¾-in. punch, elongating the latter with a ¼-in. rat-tail file until each provides ample clearance for the transformer connecting lugs. Although the mounting holes for them should be drilled and checked, do not mount the power transformer, IF transformers, modulation transformer, or filter choke until they are actually wired into the circuit.

The small mounting holes are best located by using the particular component to be mounted as a template, or measuring directly from it. Tube socket key or pin positions are best decided by direct reference with the under-chassis photo

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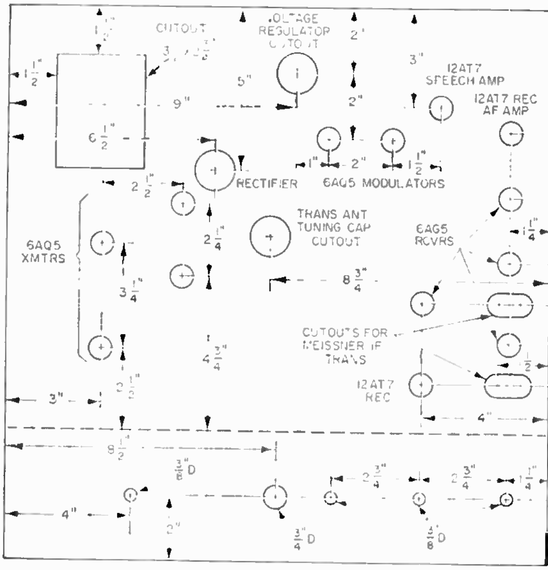
In Volume 6 of the *Radio-TV Experimenter* (No. 555) we described a six-meter amateur radiophone station, suitable for the beginning or "technician-class" operator. Reader response to this project was so enthusiastic we felt an improved model of such a station in order. While the first station is still a useful and interesting project, it does possess a few disadvantages, particularly when used in regions of intense amateur VHF activity such as the Chicago, New York, and New England areas where occasionally transmitter output power becomes insufficient for consistent communication. Likewise, while sensitive, the simple receiver is occasionally overridden by powerful nearby stations in metropolitan areas.

This *improved six-meter station*, on the other hand, has proven itself practical in both big cities and in the less active VHF regions. Here in the Chicago area, for instance, it has seldom failed to provide enjoyable contact whenever turned-on, even though only a simple dipole antenna is used with it. A good directional, "beam" antenna will enable it to compete anywhere, and against commercially built equipment costing several times as much.



2

(Fig. 4) and by reference to circuit diagrams (Figs. 5, 6 and 7). Provide the shortest, most direct grid and plate leads in each case. Mount each socket to the chassis, using 4-36 *rh* screws and hex nuts for the miniatures and 6-32 *rh* screws with nuts for the octals. Place a soldering lug under one of the screws of each socket to provide a common ground point for that stage. Mount the insulated tie-lug strips using the under-chassis photo (Fig. 4) as a guide. A liberal use of insulated tie-lug strips makes possible a neat and mechanically rigid wiring job. If you plan portable operation, put lock washers under all nuts for increased mechanical security. Mount all tube sockets and the terminal strip, as well as most insulated tie-lug strips before beginning the wiring, as well as the four-pole Send-Receive switch.

Wire all of the power supply (Fig. 5), except the power transformer, then mount and wire the power transformer, running *ac* power line connections, B+ supply leads, and 6.3-*v* heater supply leads along the edges of the chassis. Fasten electrolytic filter capacitors, by their leads, between suitable lugs, to hold them firmly in place.

When you have finished wiring the power supply, including a B+ lead to the Send-Receive switch, measure the *dc* resistance from B+ to ground with a serviceman's ohmmeter. There is no limit as to how high this resistance should be, but it should not be less than 50,000 ohms.

Now, connect a line cord to the *line* terminals on the terminal strip and plug in the 5U4 and the VR 150/OD3 regulator tube.

Turn on the switch on the regeneration control potentiometer and plug the cord into the power line. The rectifier (5U4) filaments should glow a dull red, and the VR tube should be filled with a pale purple glow. Measure the *dc* B+ voltage to the chassis. Any value between 400 and 500 *v* is normal. Between pin No. 5 and ground the voltage should be very close to 150 *v*. Under load, the full voltage will be about 350 *v*.

With the power supply completed and checked out, complete the audio frequency sections in both the receiver (Fig. 6) and the transmitter, (speech amplifier and modulator, Fig. 7). Each 12AT7 triode section comprises a separate and distinct AF amplifier stage. (Refer to Table A to insure correct connections to the pins of these and all other tubes.) To check the operation of each stage as it is wired, plug in the tube and apply power. Connect a ceramic or mica capacitor of at least 1000 *mmf* in series with a good pair of magnetic headphones, ground the other wire of the phones and connect the free end of the capacitor to the plate of each AF stage as it is completed. Now touch a screwdriver to the *grid* of that same tube. If the circuit is operating correctly, a characteristic clicky buzz will be heard in the phones.

For an overall check of the receiver audio amplifier when this section is completed, plug the phones into the energized circuit (Send-Receive switch in Receive position) and listen for the clicky buzz when each grid is touched in turn. The transmitter AF system can be given an overall check by connecting a 100-K ohm resistor in series with phones and connecting this series combination between the green and black (across the secondary) of the modulation transformer. With all tubes in place, power applied, and the S-R switch in Send position, loud, clear speech should be heard when the mike (connected to appropriate terminals) is spoken into.

With audio-frequency and power-supply circuitry completed and checked, begin on the receiver second detector by winding the coil for this stage, L_4 (see Fig. 8). Be sure that this, and other coils are wound *exactly* as described. More trouble probably can arise over an improperly-wound and connected coil than from almost any

TABLE A—TUBE PIN CONNECTIONS

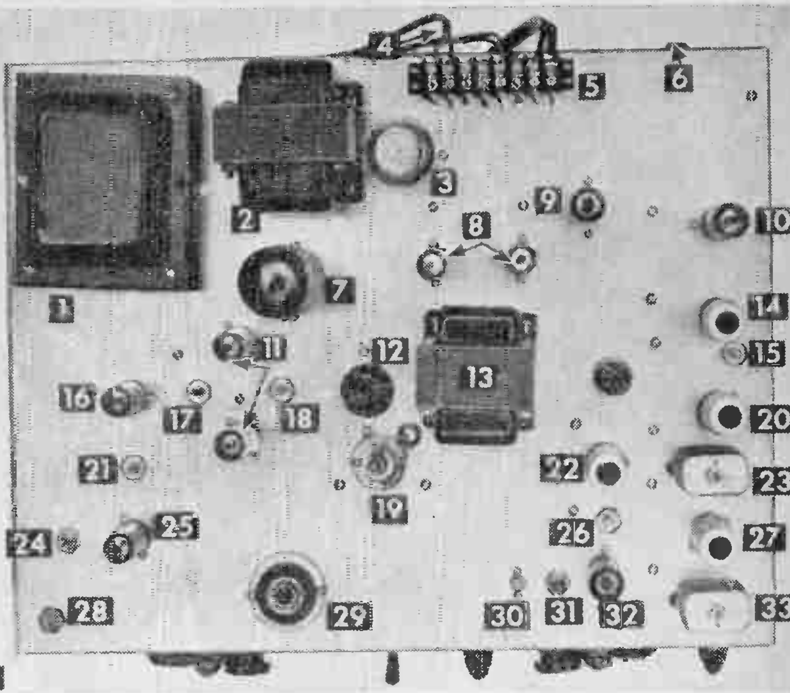
5U4	6AQ5		12AT7	Triode No. 1	Triode No. 2	6AG5		VR150
Fil. 2 and 8	Heaters	3 and 4	Heaters	4 and 5 (Tied together) & 9		Heaters	3 and 4	Pin 2 Ground
Plates 4 and 6	Grid No. 1	1 or 7	Grid	2	7	Grid No. 1	1	Pin 5 to 6000 ohm resistor and B+
	Grid No. 2 (screen)	6	Plate	1	6	Grid No. 2 (screen)	6	
	Plate	5	Cathode	3	8	Grid No. 3	2	
	Cathode	2				Plate	5	
						Cathode	7	

(Note: Grids numbered starting from cathode) other error. Be sure that the specified *iron* slug forms (National XR-50) are used in all instances.

The regeneration-control potentiometer controls the screen grid (grid No. 2) voltage on the 6AG5 second detector tube.

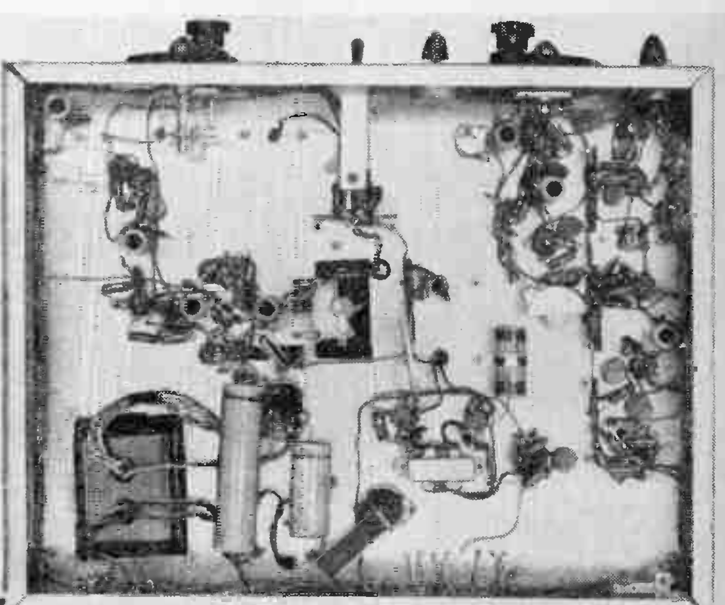
Wire this, and the rest of the second detector by reference to Fig. 6. Keep the grid, plate and cathode leads short and direct, although the heater, B+, and screen supply leads may be run in the corners of the chassis for convenience.

You will note that the second detector receives its B+ supply directly from pin No. 5 on regulator tube. Be careful to avoid shorts between the pins of the tube socket, (use no more solder than necessary upon any connection) and don't forget the 50 *mmf* ceramic capacitor across the coil. When the second-detector wiring is completed and checked for errors, plug in the 6AG5, the receiver 12AT7 and the phones. With power applied and the S-R switch in Receive position, slowly advance the regeneration control toward the right. A smooth, quiet "thud" indicates that this circuit is operating correctly. If there is no "thud," recheck wiring; if tube is



3

1) Power Transformer; 2) Filter Choke; 3) VR150 Voltage Regulator; 4) Line Cord; 5) Terminal Strip; 6) Phone Jack; 7) 5U4 Rectifier; 8, 9), 6AQ5 Modulator Tubes; 10) 12AT7 Receiver A.F. Amplifier; 11) 6AQ5 Transmitter Power Amplifiers; 12) Antenna Tuning (Transmitter); 13) Modulation Transformer; 14) 6AG5 Second Detector; 15) Second Detector Tuning Slug; 16) 6AQ5 Frequency Doubler; 17) Frequency Doubler Coil Slug; 18) Transmitter Power Amplifier Tuning Slug; 19) Tuning Lamp; 20) 6AG5 Second I.F. Amplifier; 21) Oscillator Plate Tuning Slug; 22) 6AG5 R.F. Amplifier; 23) I.F. Transformer; 24) Transformer Oscillator Tank Capacitor (100 mmf); 25) 6AQ5 Oscillator; 26) R.F. Amplifier Tuning Slug; 27) 6AG5 First I.F. Amplifier; 28) Transmitter Oscillator Slug; 29) V.F.O. Push Button; 30) Receiver Oscillator Tank Capacitor; 31) Receiver Oscillator Tuning Slug; 32) 12AT7 Oscillator and Mixer; 33) I.F. Transformer.



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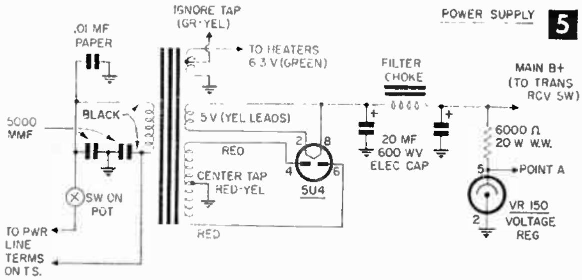
Under-chassis view of six-meter rig, showing typical placement of circuit components.



POWER SUPPLY 5

good, little else can cause difficulty except an improperly wound or connected coil. When the detector is thus apparently operating, bring the lead-in from a fairly large antenna near (but not touching) the coil. By rotation of the slug of this coil, it should be possible to hear a number of shortwave code and phone stations in the 10-

TABLE B
RESONANT FREQUENCY DATA FOR COIL ADJUSTMENT:

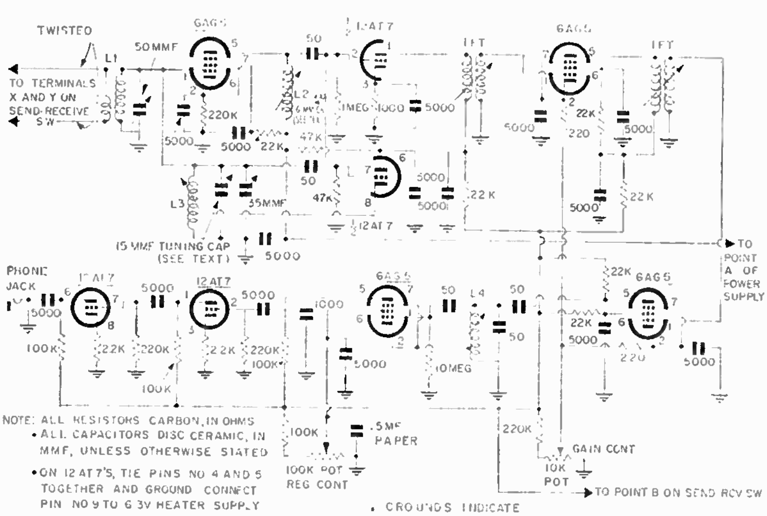
Coil No.	Resonant Frequency	Remarks
L_1	51 Mc	Peak with 50 mmf
L_2	51 Mc	
L_3	Should tune from about 30 to 43 Mc as receiver tuning capacitor is rotated	Adjust both coil slug and 35 mmf oscillator tank capacitor
L_4	Peak at 10.7 Mc	
L_5	Should tune from about 6.24 to about 6.75 Mc as trans. VFO tuning dial is rotated	Adjust both slug and 100 mmf VFO tank
L_6	Peak at 12.5 Mc	
L_7	Peak at 25 Mc	
L_8	Peak at 51 Mc	
L_9	Peak for maximum output on operating freq. (50 to 54 Mc)	

to 12-megacycle region particularly at night.

Wire the two IF amplifier stages next. Keep all grid and plate leads in the IF amplifier as short and direct as possible, or they may couple with each other or with other leads, and cause the amplifier to oscillate. Uncontrolled oscillation is evidenced by loud squeals and other raucous noises in the phones when the circuit is tested. A properly operating IF amplifier contributes no noise other than a smooth hiss in the phones. If oscillation occurs with good tubes in the sockets and all shields firmly in place, the only cure is careful rearrangement of the leads. (The 10K-ohm gain control potentiometer controls the cathode bias upon the two IF amplifiers. Advancing the control to the right should bring the cathodes closer to ground potential and increase the amplification of the system.)

When the IF amplifier has been completely wired, check it over carefully for mistakes and for solder shorts. Insert the receiver audio tube, second detector, and both IF amplifier tubes, make sure all shields are in place upon those tubes requiring them, plug in phones and apply power. Then, using a grid dip meter, carefully adjust the second detector coil to resonance at 10.7 megacycles. Throw the S-R switch to Receive and turn down the IF gain control. Turn up the second detector regeneration control just past the "thud" point, on the oscillating side, and readjust the second detector coil tuning slug until the whistle of the grid dip meter is clearly heard in the phones. Now, turn up the IF gain control and adjust each tuning slug (top and bottom) on each IF transformer carefully for the loudest response from the grid dipper. Adjust the gain and the location of the dip meter with respect to the set to provide a clear whistle but to avoid overloading. The IF amplifier is now roughly aligned. Final alignment will be completed later.

Proceed with the 12AT7 oscillator-mixer. Wind the mixer coil (L2, Fig. 8) and the oscillator coil (L3, Fig. 8) carefully and install these under the chassis. Also mount the 35 *mmf.* oscillator tank capacitor and the 15 *mmf.* tuning capacitor. Since these circuits operate at high frequency, it is necessary to keep all grid, plate and cathode leads short and direct and return all grounds for one stage to the same lug on the chassis, insofar as possible. Heater and B+ supply leads again should be run around the corners of the chassis. (The os-



RECEIVER 6

MATERIALS LIST—SIX-METER RIG

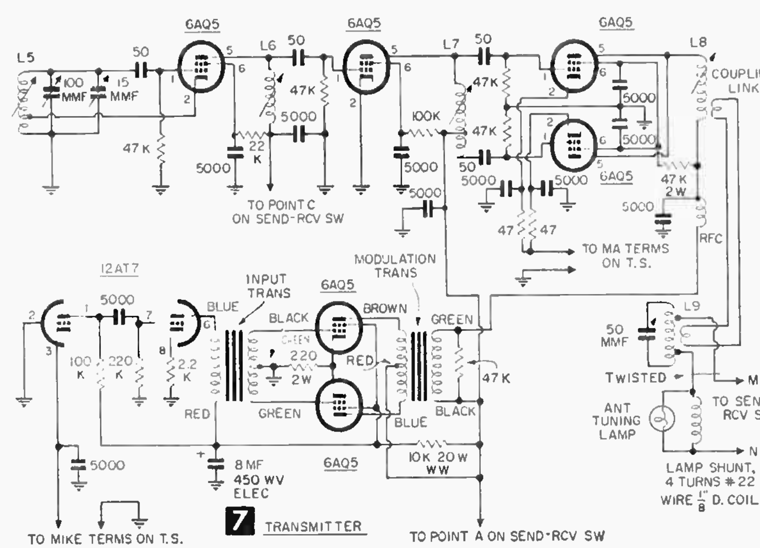
No. Req'd	Description
1	Jones barrier terminal strip, 8-terminal (Model No. 8-140)
1	aluminum chassis 4 x 13 x 17"
2	8-prong, octal tube sockets, Amphenol
6	7-prong miniature tube sockets, Amphenol unshielded
4	7-prong miniature tube sockets, Amphenol unshielded, with fitting for shield
4	shields for above, Amphenol, to fit 6AG5 tubes
3	9-prong miniature tube sockets, Amphenol, unshielded
1	common push button (from any hardware store)
1	miniature porcelain cleat socket (from any hardware store)
2	FM I.F. transformers 10.7 megacycle (type: Meissner 16-6665)
1	line cord and plug
1	4-pole double-throw Federal anti-capacity switch (type 1424)
2	vernier tuning dials (National type BM)
4	plastic knobs, for 1/4" shaft
1	single-circuit phone jack (Mallory)
1 pr	good magnetic head phones (Trimm)
1	single-button carbon microphone (carbon type F-1 from Telephone Engineering Co., Simpson, Pa.)
1	driver transformer (Thordarson type 20A22)
100'	plastic insulated solid hook-up wire (one roll)
1/4-lb.	No. 22 double cotton covered magnet wire
1/4-lb.	No. 26 double cotton covered magnet wire
	Assortment of tie points, insulated, 2, 3, and 4 terminal
1 pkg	rubber grommets 1/4-in. wire hole
1 length	No. 14 tinned-copper wire
	rosin core solder
	4-36 *rh* machine screws 1/4" long with nuts
	6-32 *rh* machine screws 1/4" long with nuts
25	5000 mmf ceramic disc capacitors
8	50 mmf ceramic disc capacitors
1	1000 mmf ceramic disc capacitor
1	.5 mfd, 200 working volt, paper capacitor
1	8 mfd, 450 working volt, electrolytic capacitor (tubular type, Mallory)
2	20 mfd, 600 working volt, electrolytic capacitors (tubular type, Mallory)

No. Req'd	Description
1	.01 mfd, 600 working volt, paper capacitor (Aerovox)
3	1-watt carbon resistors, 220 ohm
6	1-watt carbon resistors, 22K ohm
3	1-watt carbon resistors, 47 ohm
6	1-watt carbon resistors, 47K ohm
1	1-watt carbon resistor, 1000 ohm
5	1-watt carbon resistors, 100K ohm
4	1-watt resistors, 220K ohm
2	1-watt carbon resistors, 1 megohm
1	1-watt carbon resistor, 10 megohm
2	1-watt carbon resistors, 2.2K ohm
1	2-watt carbon resistor, 220 ohm
1	2-watt carbon resistor, 47K ohm
1	10K ohm, 20 watt, wire-wound resistor, I.R.C.
1	6000 ohm, 20 watt, wire-wound resistor, I.R.C.
1	100K linear taper potentiometer with switch (Mallory)
1	10K linear taper potentiometer (no switch, Mallory)
2	50 mmf variable capacitors (Bud type No. 1873)
2	Bud 15 mmf variable capacitors (Bud type No. 1870)
1	35 mmf variable capacitor (Hammarlund type No. MAPC-35)
7	National type XR50 iron slug coil forms
1	power transformer (Thordarson 22R07)
1	filter choke (Thordarson 20C55)
1	modulation transformer (Thordarson 21M54)
1	5U46B tube
1	VR150/OD-3 tube
6	6AQ5 tube
3	12AT7 tubes
4	6AG5 tubes
1	No. 40 dial light 6-volt, screw base
1	beam antenna (Newark Electric Co., Catalog No. 92-F-216 or similar)
	For tuning and adjustment:
1	technician's volt-ohmmeter
1	grid-dip meter (B and W, Heathkit or Millen)
1	0-150 dc milliammeter
1	7.5-watt, 120-v lamp bulb and socket
1	2-watt neon lamp bulb

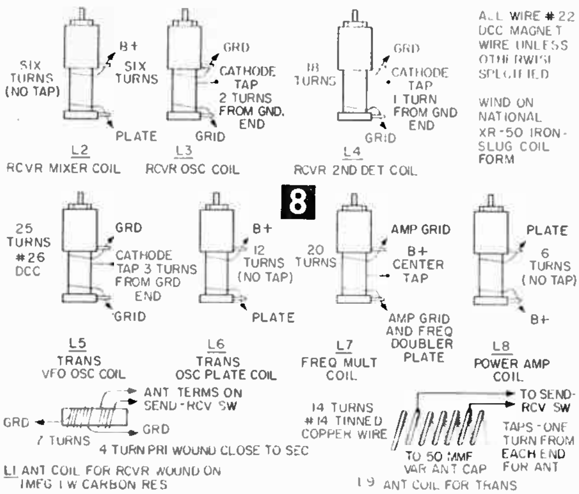
cillator section receives its B+ supply from the voltage regulator tube, pin No. 5, point A in power supply, Fig. 5. The "gimmick" in Fig. 6 is a small capacitor which couples the oscillator signal into the mixer. Make it by twisting five turns of plastic-insulated hookup wire, (insulation still in place, tightly together. No trouble will be experienced if you carefully arrange that the two wires can *not* come into metallic contact. This gimmick must be connected in place before the following oscillator frequency adjustments are made.)

When the oscillator-mixer section has been wired, carefully check it out and then insert the 12AT7 tube in the socket. Close the plates of the tuning capacitor (15 *mmf.*, with vernier dial) completely, and set the oscillator tank capacitor (35 *mmf.*, on chassis) plates exactly half-meshed. Now, adjust the slug in the oscillator until the oscillator coil resonates at 39 megacycles, as determined by grid dipper. Apply power and use the grid dipper to check for oscillation by coupling it to the coil L3. Lack of oscillation indicates an incorrect coil, wrong wiring, or a bad tube.

Receiver wiring is completed by wiring the RF amplifier stage, 6AG5. The only precaution which must be taken here is to keep the grid



7 TRANSMITTER



and plate leads short and direct. The receiver antenna coil, L1, is made by close-winding seven turns of No. 22 DCC wire around a one-watt, one-megohm carbon resistor. The end leads of this coil are soldered to the resistor leads. The primary coil consists of four turns of the same wire wound directly over the ground end of the seven-turn coil. The seven-turn coil is then connected directly across the terminals of the 50 *mmf.* capacitor; it is held firmly in place by the stiff leads of the resistor.

When this coil is soldered in place across the capacitor, mount the latter in position upon the chassis and complete the wiring of the RF stage. Twist and connect the antenna coil primary leads to the receiver (X and Y) antenna connections on the S-R switch. This *tightly twisted* pair of leads may be run around the corner of the chassis with the power leads for appearance's sake, if desired. Treat the tightly-twisted pair of leads from the antenna switch blades to the antenna terminals (on terminal strip) the same way.

Plug all tubes into the receiver and power supply, and place shields firmly upon all tubes requiring them. Before applying power, "grid dip" both L1 (with 50 *mmf* capacitor) and L2 (with slug) to resonance at 50 megacycles.

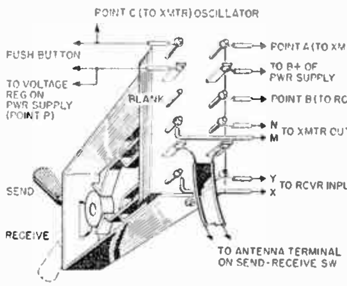
Now, apply power, and switch the S-R switch to Receive position. Turn up the IF gain control until a slight hiss is audible in the phones and turn up the regeneration control just beyond the thud-point. With the tuning capacitor fully meshed and the grid dip meter oscillating, rotate the grid-dip meter dial slowly about the 50 megacycle point until you hear its whistle in the phones. If overloading occurs, turn down the IF gain. (If you have performed your previous alignment work carefully, this signal should be close to 50 *Mc.*) Now, readjust the tuning controls of L1 and L2 for maximum signal strength, turning down the IF gain to avoid overloading if necessary. When these have been peaked-up, carefully readjust *all* of the IF transformer slugs for the strongest possible signal. You have now aligned the receiver. Connect a six-meter antenna (or, if that is not available yet, a TV receiving antenna) to the antenna terminals on the terminal strip. If there is an amateur six-meter station on the air in your locality, you should have no trouble hearing it. When you do tune in an on-the-air signal, use it to make a final touch-up of all slugs and adjustments. Finish off by installing the vernier dial and knobs.

You will receive radiotelephone signals best with the regeneration control just below the thud point. Radiotelegraph CW signals will be received best just above it. Also the regeneration control may be used as an additional volume control on strong voice signals, in addition to the IF gain control. You will also observe that this receiver, while being very sensitive to six-meter signals, is remarkably free of the spurious TV and FM broadcast responses.

The Transmitter. With the receiver completed, and the audio and power circuits checked-out, you are ready to start on the transmitter—if you have a suitable *station* and *operator* license. The United States radio law provides penalties of up to $10,000 fine and/or a two-year federal prison term for those who use a radio transmitter without proper government authorization. You must hold either a *general class* or a *technician class amateur* license to use this transmitter. A novice class amateur, or a Citizens Radio license *will not* do. You may obtain exact information as to the requirements and examinations for such licenses by writing to the field office of the *Federal Communications Commission* nearest you. (The Canadian, Mexican, and the governments of most other countries have, and enforce similar regulations within their own jurisdiction.)

Assuming you are properly licensed, begin by winding the transmitter VFO oscillator coil, L5, Fig. 8. Wind this coil exactly as shown, since the frequency-stability of the entire transmitter depends upon it. When completed, fasten this coil into place and mount the 100 *mmf* VFO tank capacitor and the 15 *mmf* VFO tuning capacitors. (The vernier dial for the latter should not be installed until later.) Next, wire in the heater, cathode, and grid circuits of the VFO, carefully following the transmitter schematic, Fig. 7. Note that the VFO receives its B+ supply from the regulator tube (pin No. 5) through the Send-Receive switch contacts (see the Send-Receive switch diagram, Fig. 9). Also mount and connect the VFO push button, stuffing several layers of friction tape under the push button, between the terminals and the chassis, to forestall shorts. (Gulch's Fourth Law: "Anything that has the slightest chance of shorting is certain to do so," operates here as it does everywhere else in amateur equipment.)

Now, wind the transmitter oscillator plate coil (L6, Fig. 8), mount it, and finish wiring the VFO oscillator circuit. After this is checked, and any possible shorts between tube pins or elsewhere have been cleared, insert the rectifier tube, voltage regulator tube, and 6AQ5 VFO tube, and apply power. After tubes have warmed-up (with the S-R switch in center or neutral position), press the push-button. The voltage regulator tube should dim noticeably but *not* go out. If it does go out, or if it does not dim, check your wiring, and examine the pushbutton carefully. When it dims, release the push button and throw the S-R switch to Send position. With the tuning (15 *mmf*) capacitor fully meshed and the VFO *grid* coil slug screwed all the way *in*, adjust the 100 *mmf* tank capacitor until a definite indication of oscillation is observed on 6.25 megacycles with the grid dip meter. You should find this condition occurring with the 100 *mmf* tank capacitor about 90% meshed.



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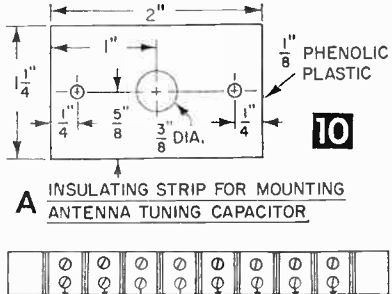


10

A INSULATING STRIP FOR MOUNTING ANTENNA TUNING CAPACITOR

B TOP VIEW OF TERM. STRIP

With the circuit oscillating at 6.25 *Mc.*, move your grid-dip meter over to the plate coil and adjust the slug for maximum output at 12.5 *Mc.* With good, strong indication of output here, remove tubes and de-energize before continuing work and move on to the frequency multiplier (doubler) stage, the only critical part of which is the coil. Make *sure* that the center-tap is in the electrical center. This will insure equal drive to both tubes of the final stage, and will minimize spurious responses. Wind the coil exactly as shown in Fig. 8. (If for any reason it should be necessary to alter the number of turns on this coil, a remote possibility, be sure that you add or remove *two* turns at a time, one on each side of the center-tap, to preserve electrical balance.) Install this coil and complete the wiring.

You will not be able to test the frequency-multiplier until you have also completed the wiring of the grid and cathode circuits of the final amplifier. This is because the grid to ground capacitance of these latter contribute significantly to the tuning capacitance of the frequency multiplier output circuit. So, wire-in the grid and cathode circuits of the final amplifier immediately.

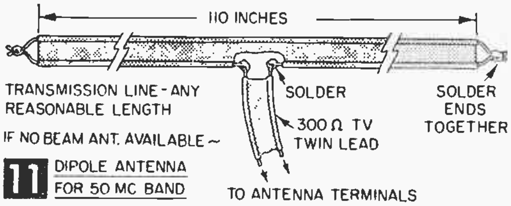
Observe that each of the final amplifier tubes has its own cathode bypass capacitor and 47-ohm isolating resistor. This is to insure stability and reliability of this circuit. The *dc* cathode current flows through the *M-A* terminals on the 8-terminal strip on the back of the chassis (see Fig. 10B); this makes possible a convenient check of the final amplifier cathode current later.

When the grid and cathode circuits of the final amplifier have been completed, as well as all of the circuitry of the frequency multiplier, the latter is ready for a checkout. After re-examining the wiring, plug in the VFO, frequency multiplier, and final amplifier tubes (as well as rectifier and voltage regulator, of course) and apply power. With the S-R switch in Send position, tune the frequency multiplier coil to maximum output on 25 megacycles, using the grid-dip meter. You should also now go back and touch-up the oscillator plate coil for maximum indication at the frequency multiplier output. A 6-*v* dial bulb, connected to a single loop of wire and draped around the frequency multiplier output coil should glow at nearly *full* brilliance, if everything is working—and tuned correctly.

With this accomplished, de-energize, remove tubes for safety's sake, and complete the wiring of the final amplifier. This is a push-push, frequency doubler, a self-neutralizing circuit noted for its effectiveness, stability, and rejection of spurious, harmonic frequencies. Note in Fig. 7 that the grid circuit is connected in push-pull, the plates of the tubes in parallel. Observe, also, that for stability both screen grids are individually bypassed, even though fed from the same *dc* source. Keep all high-frequency leads as short and direct as possible, the heater, B+ supply, and other supply wires may be run around the corners of the chassis for improved appearance.

Wind coil L8 as shown in Fig. 8 and install, and complete and check the wiring of the final stage according to the transmitter schematic, Fig. 7. When wiring is complete, insert all transmitter RF tubes, rectifier tube, and voltage regulator. Before applying power, adjust the final amplifier coil with the grid-dip meter, by tuning the coil slug. If you have trouble making it resonate on 50 *Mc.*, try squeezing together, or spreading apart the turns of coil L8. When resonance is found, secure the turns in place with celluloid cement.

Now, jumper the "MA" terminals on strip together and apply power. You should get a strong indication of RF output on 50 *Mc.*, but absolutely none on any other frequency within the range of the grid-dip meter. A 6-*v* pilot lamp, connected to a loop of wire and draped over the final output coil should burn extremely brightly (possibly even burn out, so be careful) when this stage is operating correctly. Touch up the tuning of the oscillator plate, the frequency multiplier, and the output of the final amplifier for maximum output on 50 *Mc.*



11 DIPOLE ANTENNA FOR 50 MC BAND

Complete construction by winding the transmitter antenna coil L9 (Fig. 8) with No. 14 copper or tinned-copper antenna wire. Tap this coil one turn from each end to make connection to the transmitting antenna through a tightly-twisted pair of leads, which may run around the corner of the chassis to the Send-Receive switch, points M and N, as shown in Figs. 7 and 10B.

The 50 *mmf* antenna tuning capacitor is insulated from the chassis by means of a laminated phenolic plastic strip (see Fig. 10A), upon which it is mounted. A 1 1/16-in. "socket" hole assures sufficient clearance from the chassis. *Both* sides of this capacitor must be insulated. Fasten the plastic strip to the chassis with 6-32 *rh* machine screws and nuts.

The antenna coil is coupled to the final amplifier output coil by means of a single-turn loop, coupled closely to each coil—the B+ end of the output coil, and the center of the antenna coil. A twisted pair link of plastic hookup wire connects the loops together. Each loop should be closely coupled to its coil, but this coupling should be adjusted for best results later.

The antenna tuning lamp socket is mounted atop the chassis (see Fig. 3). It is connected between point N on the S-R switch and a tap on the antenna coil. Keep the leads to the lamp socket as short as possible and bring them up through the chassis via a rubber 1/4-in. hole grommet adjacent to the socket. The lamp is shunted by a small 1/8-in. dia., 4-turn coil of close-spaced No. 22 DCC wire. Adjust the size of this shunt coil so that, with the antenna you are using, the lamp lights to only about one-quarter brilliance, enough to tune clearly by, but not enough to waste hard-earned RF power.

Final check on the transmitter consists of inserting all tubes and applying power. Connect a 7.5-watt, 120 *v* lamp bulb across the antenna terminals (terminal strip) as a dummy load. Make all RF tuning adjustments for maximum brightness of the bulb. Do not expect a full 7.5 watts of output from this transmitter, but when all tuning and coupling adjustments are optimized, a sizeable amount of output should be shown by the 7.5-watt bulb.

To check modulation, connect a single-button carbon microphone to the mike terminals, apply power, and speak into the mike. The antenna tuning lamp should flicker markedly if modulation is taking place. No modulation indicates possible error in the connections between the secondary of the modulation transformer and the final RF amplifier circuit.

Before putting this transmitter on the air using a live antenna, make sure that the transmitter frequency is definitely within the assigned 50-*Mc.* amateur band, from 50 to 54 *Mc.* Do not rely upon the calibration of your grid-dip meter for such a vital matter, but check against the known crystal frequencies of other amateurs you hear on the air, or with an accurate *heterodyne* frequency meter (often available on a loan basis from radio clubs).

You may compare the frequency of your own VFO with that of other amateurs by simply setting your receiver's second detector regeneration control past the thud point and, with the S-R switch in Receive position, pressing the VFO test push button. Tune the VFO vernier dial until you hear its whistle in the receiver. (You may have to turn down the IF gain to avoid overloading.) Now the transmitter will operate upon the same frequency as that to which the receiver is tuned. Use this technique to set your own frequency to that of the station you're working; this conserves spectrum-space, and makes for better operations. However, unless you wish to be considered a "lid," do not change your operating frequency while the S-R switch is in the Send position. Rather, use the push button to set the frequency, with the switch in Receive position.

A 0-100 *ma dc* milliammeter connected to the *M-A* terminals on the terminal strip should read between 45 and 60 *ma* when the transmitter is tuned-up and operating properly. Once preliminary adjustments have been made, remove the meter and place a jumper across the M-A terminals.

For radiotelegraph CW operation, connect a telegraph key to the M-A terminals instead of meter or jumper, and operate as any other CW amateur station. (When one can find a six-meter operator who will listen for CW signals, much greater distance ranges are possible under poorer conditions than could be obtained by voice operation.)

For best results with this or any other amateur station, thoroughly familiarize yourself with the correct adjustment and operation of all circuits and keep them in trim at all times. Install and use the highest, most-effective antenna you can, for the antenna used is by far the biggest technical factor in successful operation. If possible, use a directional, beam antenna, but a high dipole *will* work if the former is not feasible.

(A word on TVI—Because of its frequency proximity to television channel 2, this transmitter *may* cause some interference on that channel. If it does, have the TV receiver owner install a Drake HF-50 or other good high-pass filter with 54 *Mc.* cut-off design.)

• The wonder of radio is not, as some would have it, that it works at all; but rather that a device that works principally because of evacuated tubes can be responsible for so much hot air.—R. R. Doister

Transistorized Telephone Amplifier

The caller, shown at left, uses phone in normal fashion while amplifier unit at other end of line, shown at right above, enables group of people to listen and talk.

This loudspeaker phone attachment frees both your hands while you or a group of people carry on a phone conversation

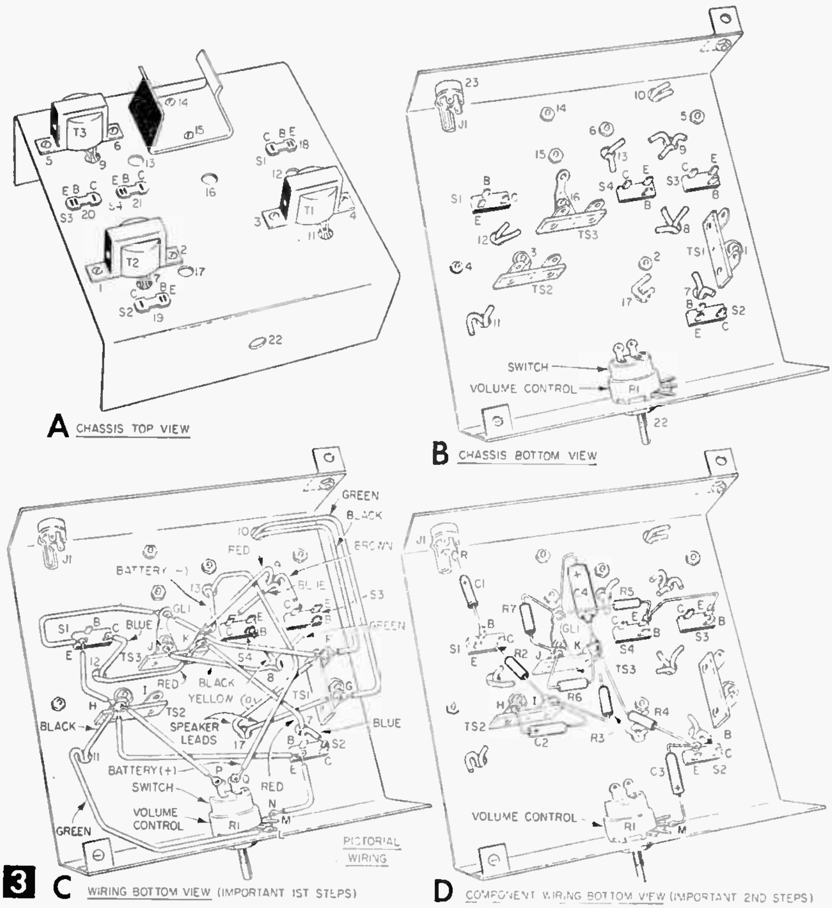
By HAROLD P. STRAND

ALTHOUGH this telephone attachment will enable you to speak and hear someone calling you on your phone as though you were using an intercom, you do not have to make any wiring connections to the telephone circuit.

Since the conversation is picked up inductively, you merely place the pickup unit under the phone cradle set, put the phone on the cabinet as in Fig. 2 and you're ready to start talking or listening. It may be used for incoming or outgoing calls and the whole family, as in Fig. 1, can talk to and hear the caller simultaneously as though he were in the same room. It's very useful for business too, for group phone discussions or taking notes, typing, etc., which requires the use of both hands while carrying on a phone conversation.

Placing the phone hand set in position on the amplifier cabinet when receiving or making a call automatically turns on amplifier switch.

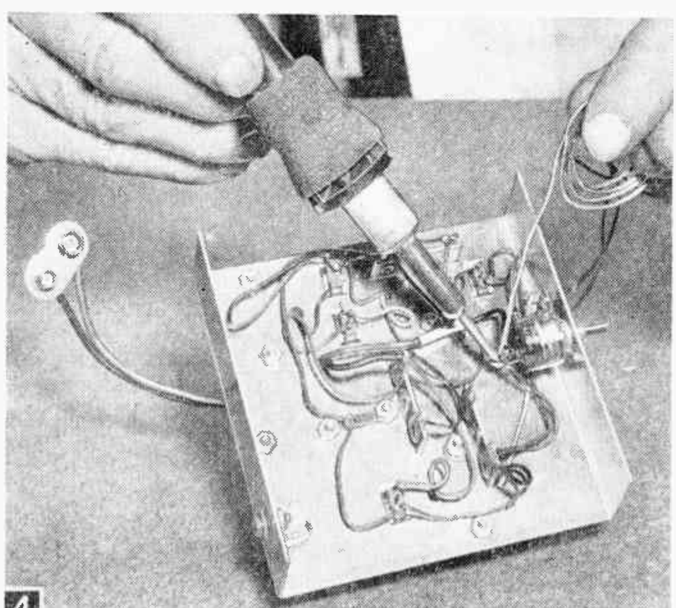
The unit is built around a telephone amplifier kit which is modified for two-way conversation. Complete parts list and source of supply are given in the Materials List. Start by assembling the transformers, battery clip and transistor sockets to the prepunched chassis as in Fig. 3A carefully following the step-by-step instructions included with the kit. The sockets are locked in place by a rectangular spring ring that is forced down over the lower end of the socket with a



screwdriver. Be sure to place sockets in their holes so the terminal with the widest spacing is positioned as in Fig. 3.

When mounting the transformers, check with Fig. 3C to make certain you have them positioned so that wires of the correct color can be inserted through the holes intended for them. For example, transformer T2 in Fig. 3A must have a blue and red wire going through hole 7 and a green, yellow and black wire through hole 8 as shown in Fig. 3C.

Before installing the volume control and switch (Fig. 3B), cut off the shaft so it will be 7/16 in. long instead of 3/8 in. as called for in the kit instructions. The additional length is needed because a wooden cabinet will be used in place of the metal one supplied with the kit. Now mount the terminal strips and jack as in the bottom view, Fig. 3B, and prepare to wire the unit.

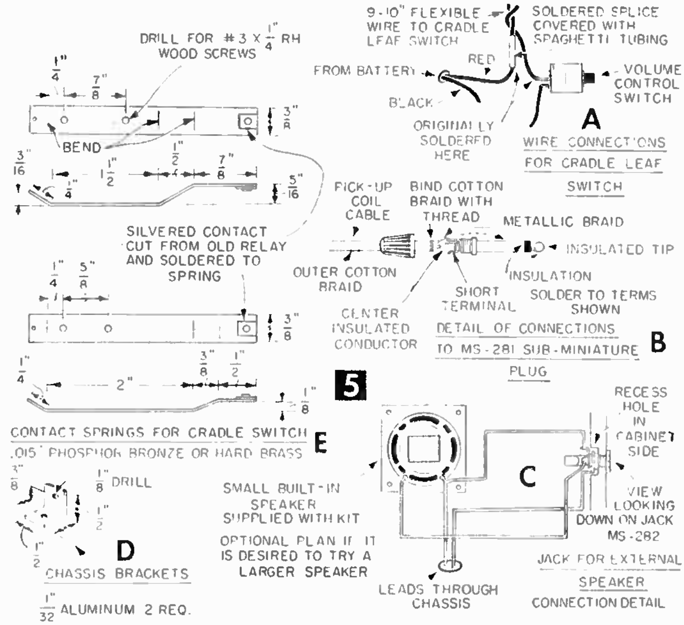


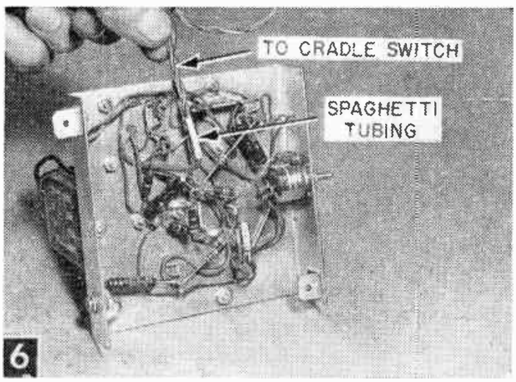
Flow the solder into the joints but avoid excessive use of solder which builds up a bulky joint.

Use a small *Ungar* soldering pencil as in Fig. 4 and the resin-core solder furnished with the kit. You will have to splice on additional wires in two instances so the leads can reach their terminals. Slip a small piece of spaghetti tubing over the splices for insulation. It will also be found that spreading the transistor socket terminals a bit will aid in keeping the connections from shorting each other. Where a heavy lead from a resistor or capacitor must be soldered to a socket terminal which already has wire attached, do not attempt to wrap this around the terminal too, as it will make a rather bulky joint. Simply place the end of the lead against the terminal and depend on a good soldering job to secure it.

Take particular note of the plus sign on capacitors C1, C2, C3 and C4 and connect them to points shown in Fig. 3D. Two 10-in. speaker leads are specified and after connecting them to points F and G in Fig. 3C, carry them through hole 17 for connection to the speaker. Insert a small sewing needle into the transistor sockets to spread them slightly so you will not have difficulty getting the transistor leads, which have been cut off to 3/8-in. long, started in their sockets without bending.

To test the unit, put the battery in its clip and connect it, and insert the phono pick-up coil plug into jack J1 in Fig. 3. Place the pick-up coil under the phone base about two-thirds of the way back, and turn on the amplifier switch by rotating the knob shaft about half way to the right. Then lift the

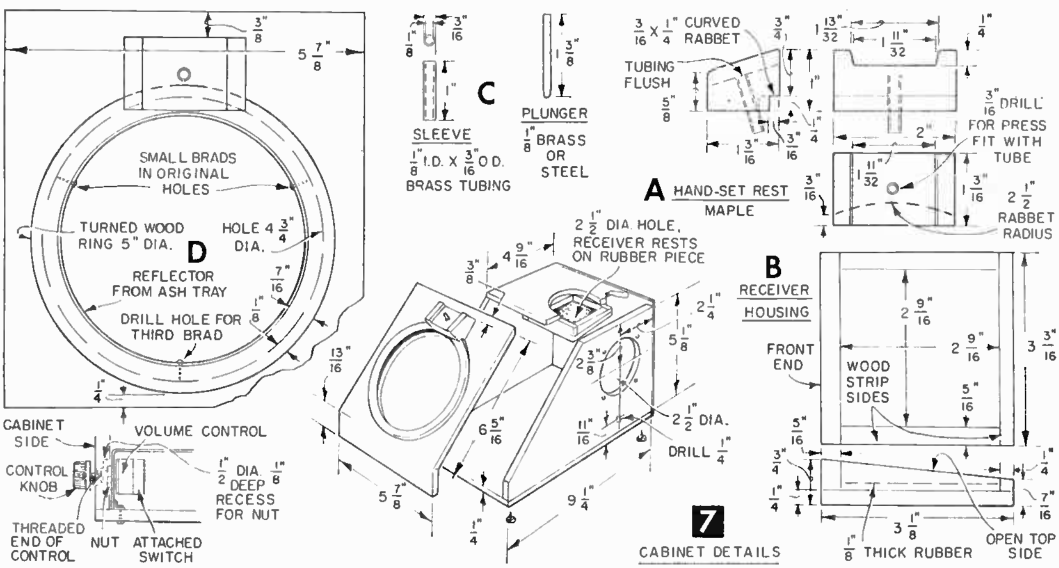




phone hand set and see if you get a dial tone from the speaker. Turning the volume control shaft to the left should lower the volume and to the right increase it. When you turn it to the right too much, however, you will probably get an annoying howl resulting from feed-back oscillations that can be avoided by keeping the tone level below this point at all times.

If you get no sound from the speaker or the volume level is unsatisfactory with the control all the way to the right, you have probably made some error in the wiring or it could be due to a defective transistor. Go over the wiring first,

Slide a piece of spaghetti tubing over the soldered splice after connecting leads for cradle switch.



MATERIALS LIST—TELEPHONE AMPLIFIER

No. Req.	Size and Description
1	telephone pick-up coil MS-16
1	Burgess 9-volt battery 2N6
1	telephone pick-up amplifier kit KT-131 consisting of the following parts:

No. Req.	Size and Description	Symbol	Part No.
1	2MFD-6MFD, 6v-15v electrolytic capacitor	C1	
1	8MFD, 6v-15v electrolytic capacitor	C2	
1	2MFD, 6v-15v electrolytic capacitor	C3	
1	6MFD-10MFD, 15v electrolytic capacitor	C4	
1	5,000-25,000 ohm volume control with switch	R1	
1	470,000 ohm 1/2 watt resistor	R2	
1	150,000 ohm 1/2 watt resistor	R3	
1	270,000 ohm 1/2 watt resistor	R4	
1	12 ohm 1/2 watt resistor	R5	
1	4700 ohm 1/2 watt resistor	R6	
1	68 ohm 1/2 watt resistor	R7	
1	transformer	T1	AR104 (or equiv.)
1	transformer	T2	AR109 (or equiv.)
1	transformer	T3	AR119 (or equiv.)
4	transistors (CK722, 2N107, or equiv.)	TR1, TR2, TR3, TR4	
4	transistor sockets with retainer clips	S1, S2, S3, S4	MS-275
1	speaker, PM-3.2 ohm voice coil		
1	chassis		131-500
1	cabinet		131-549
1	knob for volume control		
1	battery snap assembly		Eby 45-2
3	terminal strip, 2 insulated lugs	TS1, TS2, TS3	
13	4-40 x 1/4" screws, cad. plated		
13	4-40 x 1/4" hexagonal nuts		
1	#6 solder lug	GL1	52
1	jack	J1	MS-282
1	plug	P1	MS-281
	nut, hexagon (for volume control bushing)		
	wire, spaghetti, solder		

The above kit and parts can be obtained from Lafayette Radio, 165-08 Liberty Avenue, Jamaica 33, N. Y.

No. Req.	Size and Description
1	lazy boy ash tray #1435 (cigar and department stores about $1)
2	about .025 x 3/8 x 3 1/2" phosphor bronze or hard spring brass for cradle switch
2	silvered contacts cut from an old relay for cradle switch
1	1/8" I.D. x 3/16 O.D. x 1" long brass tubing for cradle switch
1	1/8" dia. x 1 3/8" long brass rod for cradle switch
1	3 1/2 x 3 1/2" grille cloth for speaker opening
1 pc	1/4 x 12 x 30" birch or gum plywood for cabinet
1	1 1/16 x 1 3/16 x 2" solid maple stock for hand-set rest block
1	3/4 x 5 1/4 x 5 1/4" solid birch or pine (turn to make ring for large front opening)
1	1/8 x 2 1/2 x 2 1/2" rubber for bottom of receiver housing
2	.025-.030 x 1/4 x 1" sheet aluminum or other metal for chassis holding brackets
4	4-40 x 1/4" *rh* machine screws
1	1/16 x 5 7/8 x 5 5/8" black Bakelite or 1/8" plywood for back cover
	Misc. screws, nuts, stain, shellac or enamel, brads, glue, etc.

and if you find it to be okay, have the transistors tested at your local radio repair shop. Also try placing the pick-up unit at various places against the side of the phone base. With the new-type phones it may be found that the loudest signals can be obtained with the pick-up taped to the right side of the phone base.

When everything is working satisfactorily cut the red battery lead from the volume-control switch and solder on two leads as in Figs. 5A and 6 that will later go to the phone cradle switch.

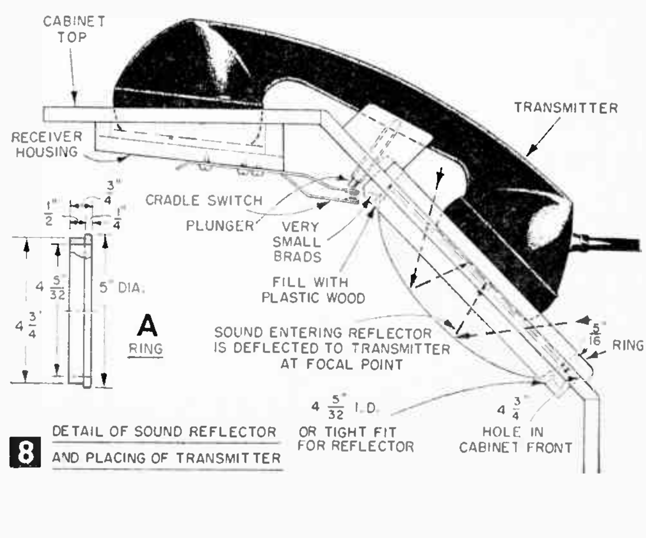
To anchor the chassis to the new wooden cabinet, make up two aluminum brackets as in Fig. 5D and fasten them to the chassis as in Fig. 3D with 4-40 x 1/4-in. *rh* screws.

With the chassis completed, make the wooden cabinet from 1/4-in. birch plywood as detailed in Fig. 7. Cut the holes in the right side, top and front pieces before assembling. Use glue and brads on all joints and fill countersunk brads with wood putty. The back of the cabinet is left open for inserting chassis, speaker etc., and later covered with a piece of 1/16-in. *Bakelite.*

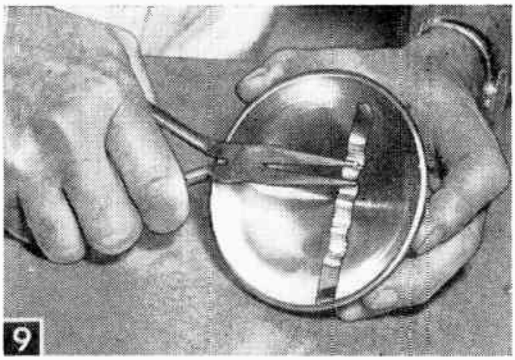
A metal disc from a #1435 *Lazy Boy* ash tray is used to gather and reflect the sound of your voice into the transmitter of the phone hand set as in Fig. 8. This tray is parabolic in shape and serves the purpose very well. Cut off the fabric base and remove the cigaret holder bar with a pliers as in Fig. 9.

To support the ash-tray, turn a wooden ring to the dimensions given in Fig. 8A. Turn the inside diameter of the ring for a snug fit with the ash tray. Set the rim of the tray about 5/16 in. from the outer edge of the ring and fasten with three 1/2-in. long wire brads. Two of the brads can be driven through the original holes in the tray and one additional hole drilled. Fill the space between the tray and wooden ring at the back with wood putty. Assemble the ring into the hole cut in the cabinet front with glue.

To support the receiver end of the phone hand set, make up the shallow box-like housing detailed in Fig. 7B. Cement a 2 1/2 x 2 1/2-in. piece of 1/8-in. thick rubber inside the housing to protect the receiver, and fasten the housing to the underside of the cabinet top with the 3/4 in. side facing front.



8 DETAIL OF SOUND REFLECTOR AND PLACING OF TRANSMITTER



Pinch the bends in the cigaret bar together to remove it from the ash tray.

Make the hand-set rest from solid maple stock as in Fig. 7A. A Handee motorized hand tool was used to cut the curved rabbet, however, hand chisels could be used instead. The rabbet should be large enough to clear the rim of the ring holding the ash tray. Then drill a 3/16 in. hole for the sleeve Figs. 7A and C. Place the hand-set rest in position on the front of the cabinet to locate and drill the 3/16-in. hole through the cabinet top. Also drill four small holes through top for #2 x ½-in. *rh* screws.

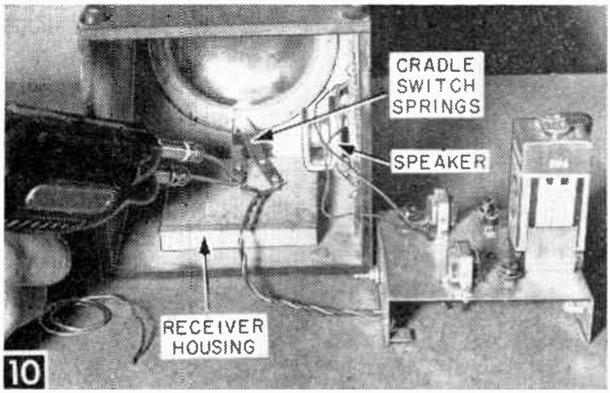
Before fastening the hand-set rest permanently in place finish the cabinet and rest piece with stain, white shellac and varnish for a natural finish, or enamel undercoater followed by a coat of semi-gloss enamel of the color you desire. Sand lightly between all coats except the last one.

When the unit is in use, the phone hand set is placed in position on the cabinet as in Fig. 1. The weight of the hand set automatically turns the unit on because the plunger in the rest is forced down and depresses the switch contact springs and closes the switch as in Fig. 8. Make the two contact springs as in Fig. 5E and cut two contacts from an old relay to solder to the spring ends. Then mount the springs to the underside of the receiver housing as in Fig. 10 so the contacts meet when the plunger is pressed down, and solder on the two leads from the volume-control switch and battery (Fig. 5A). Cement a piece of speaker grille cloth to the inside of the cabinet side over the speaker opening and bolt the speaker in place with four 4-40 x ½-in. screws. Set the chassis inside the cabinet and bolt it down with two 4-40 x ½-in. screws through the chassis brackets.

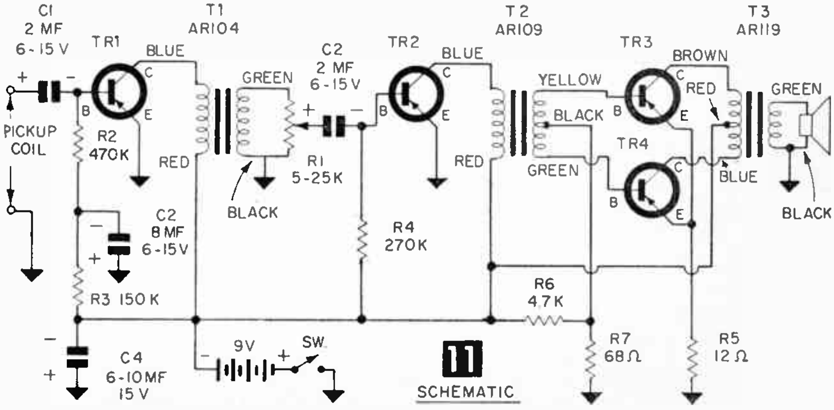
To cover the open back of the cabinet, use a piece of 1/16-in. Bakelite or ⅛-in. plywood and fasten with #2 x ½-in. *fh* screws. A slot can be cut in the cabinet side or back to clear the wire from the phone pickup unit.

To operate the telephone amplifier, place the pickup unit under the phone cradle-set base or tape it to the side, whichever works best, and adjust the volume control about half way to the right. Then pick up the phone hand set and dial the number you're calling in the usual manner. The phone can either be held in your hand while dialing or placed on the cabinet rest. If placed on the cabinet you should be able to hear the dial tone through the loudspeaker. When your party answers, adjust the volume control to bring in the speaker's voice as loud as possible but below the point which causes an annoying howl due to feed-back oscillations.

When you speak, project your voice into the ash tray surrounding the phone transmitter. You need not be closer than 18 in. as long as you are in front of the cabinet and talking in a clear voice. Speaking a little louder than normal, you can carry



Solder leads connected to red battery lead and volume-control switch to cradle switch springs.

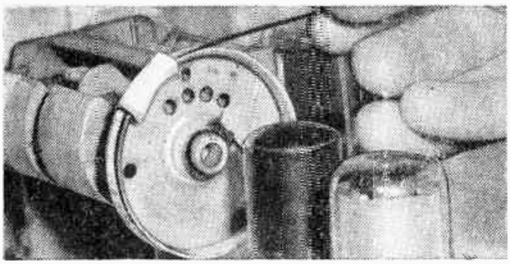


11 SCHEMATIC

on a conversation standing back as far as 6 ft.

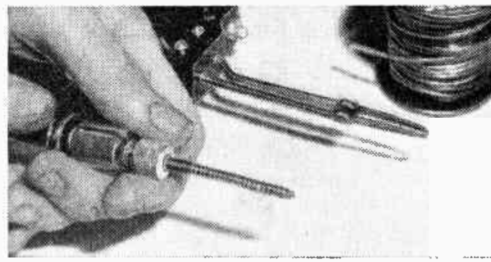
An additional and larger speaker can be added if you wish to have the caller's voice heard louder or in another room. Use a 6-in., 3 to 4 ohm speaker connected with a plug and jack as in Fig. 5C. Plugging in the jack will automatically cut out the small speaker. Removing the plug will again put the small speaker back in the circuit.

Easier Dial Restringing



• If you have ever attempted to restring a radio's dial cord, you know how easy and frustrating it is to have the cord slip from a pulley just as you have the job almost finished. There's no need to make several attempts before finishing the job—do it the first time by using strips of masking tape to temporarily hold the cord in place.—J.A.C.

No-Clog File for Solder

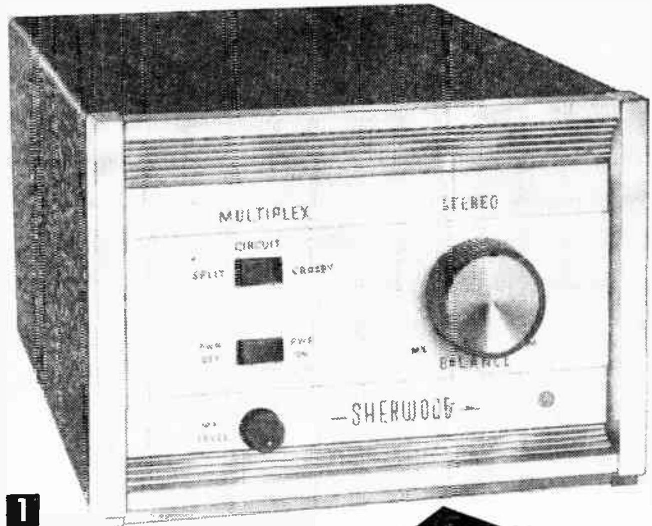


• Ever try filing excess solder from a part with an ordinary file? Didn't the file teeth soon lose their bite because they filled up with the soft solder? A headless woodscrew chucked in an interchangeable screwdriver handle makes a "file" that will not ever clog. You can also use it on aluminum, Bakelite, and other soft materials with no danger of its teeth clogging.—J.A.C.

New VOICE for Stereo and Hi-Fi

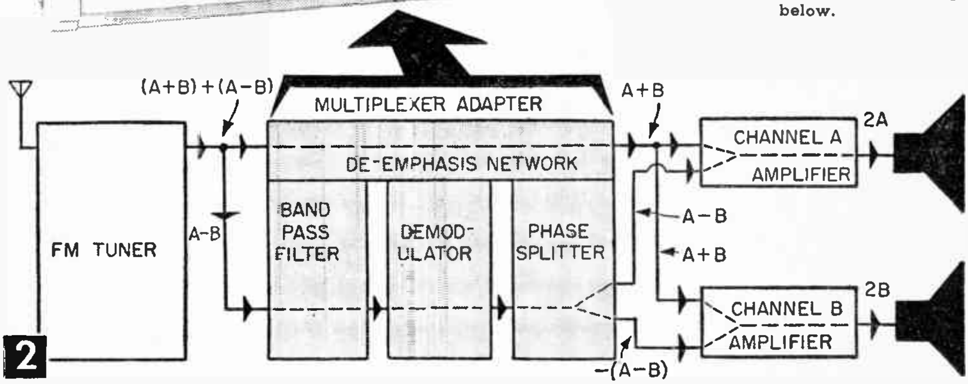
We've had stereo tapes, discs and two-station broadcasts. Now new compatible systems—including multiplexing—make one radio station twins

By CLIFF HALL



1

New Sherwood multiplex adapter, retailing for about $55.50, is designed to adapt conventional FM tuners to receive multiplexed stereo broadcasts. Function it performs is indicated in drawing below.



2

IN the broadcasting of stereophonic sound, the big word at the moment, and we think for some time to come, is "multiplexing."

And multiplexing, at the time of writing, has more aspects than a tomcat under attack by six dogs, moves about as fast and is the center of about as heated a controversy. We will get back to multiplexing in a moment, but first let's view the stereo broadcast picture. Stereo can be gotten into your home by radio waves as well as on recordings. And how best to do so has recently set the entire broadcasting industry on its ear.

It's a matter of "you take the A channel and I'll take the B channel"—and we have to get them both to your home at the same time. At a glance, it would appear that two complete radio broadcasting units would be required to radiate the two stereo channels, just as two amplifiers and two speaker systems are required to present them in the home. And in fact, most of the actual stereo broadcasting that has been done until recently has used just this method.

Hands Across the Channels. In many areas, friendly or affiliated AM and FM stations have combined facilities for stereo broadcasts, with each station putting out one channel. In many cases this will continue, at least for a time.

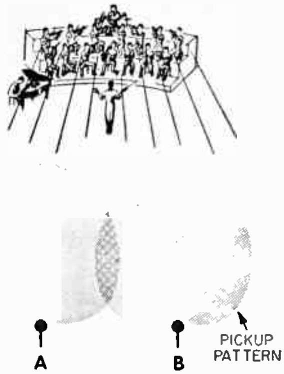
This practice has led to the birth of the so-called stereo tuner which is, actually, an AM and an FM tuner, with separate controls and dials, are mounted on a single chassis. They can feed the two sides of your stereo amplifier simultaneously from any combination of AM and FM stations in your area, and they offer the economy advantages of a power supply and some other parts used in common.

Or you can simply use an AM and an FM radio, appropriately placed, and have a stereo effect of sorts, although without a high level of fidelity nor the advantages of balance and phasing.

Again, in some cases, the two stereo channels have been put on the air by cooperating TV and broadcast stations, as in recent experiments by WTTW, Chicago's non-profit educational television station, and WFMT (FM). This latter method, incidentally, can yield reasonably high fidelity, since the TV sound signal is actually a very high frequency FM signal.

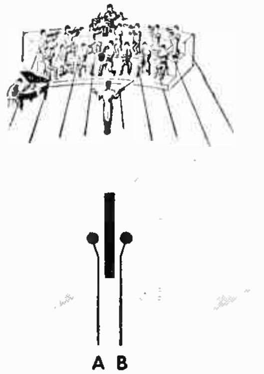
3

A



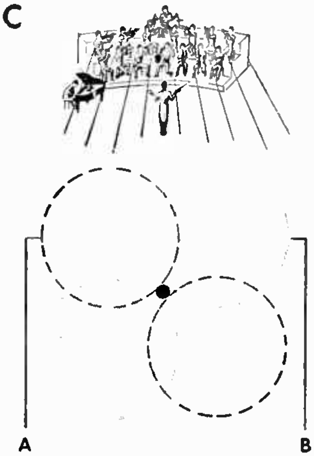
Conventional Concept: 2 cardioid mikes at "normal" listening angle.

B



Binaural Approach: 2 cardioid mikes separated by solid obstruction-like ears.

C



Stereosonic Recording: 2 cosine mikes together separating channels by direction.

Major disadvantage of this broadcast method should be obvious: There's no profit in it. Not only are two broadcasting facilities being tied up to put out a single program, but neither station is putting out a "full" program. In other words, when you tune to only one of the cooperating stations during a stereo broadcast, you hear the full orchestra all right, but you hear it as though you were sitting way at the side of the auditorium. Actually, what you are hearing is the same thing you would hear by playing only one channel from a stereo recording.

Thus, for the millions of listeners who *do not* have stereo tuning facilities, this program is something less than adequate. What's more important, it's mighty close to impossible for this reason to sell to a sponsor, and especially is this true in TV with its vastly higher costs.

Compromises Tried. One of the efforts to lick the problem attempted by some broadcasters has been to increase the "dilution" of the stereo effect, some of which—deliberately—is always present in any case.

While we are accustomed to thinking of stereo as coming from two microphones placed at an appropriate listening angle, this in fact is not usually the case. Depending upon the studio, the program material and the recording method, sound engineers might use a variety of setups.

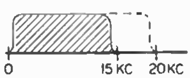
These might vary from the older "binaural," involving two omni-directional mikes about six inches apart with a solid object between them—like the ears on your head—("B" in Fig. 3); through such others as the "stereosonic," using two cosine (two-directional) mikes close together ("C" in Fig. 3); the "longitudinal," using several omni-directional mikes spaced front to back and recording differences by time delay ("D" in Fig. 3); the "mid-side," employing a cosine and a cardioid (one-directional) together, from which A, B and C channels can be derived ("E" in Fig. 3); combinations of any of these methods, or a much larger bank of individually placed mikes.

In recent practice, the last method is the most frequent, with as many as six tapes sometimes recording at once, later to be mixed selectively (some with echo chamber effects, etc.) in making the final master record. In any case, each of your two stereo channels always contains a certain amount of the total or "sum" information, except in some of the stereo demonstration records to which deliberate hokum has been applied.

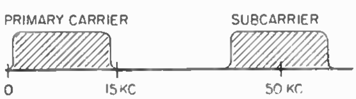
Thus, some broadcasters have tried diluting the stereo effect enough that each channel held enough sum information to be satisfactory heard alone.

Finally, FM multiplexing has come over the horizon as a "new" stereo broadcasting method, which many think holds the essential answers.

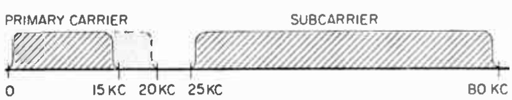
4



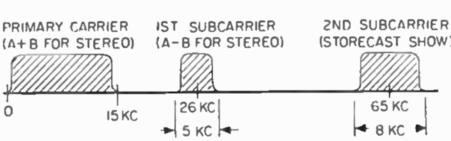
Conventional FM carrier modulates 15-20 *kc*.



Storecast multiplex broadcasts public show on primary carrier cutting off at 15 *kc*, commercial program on subcarrier centered at 50 *kc* (approx.). Gap is used for switching pulses.

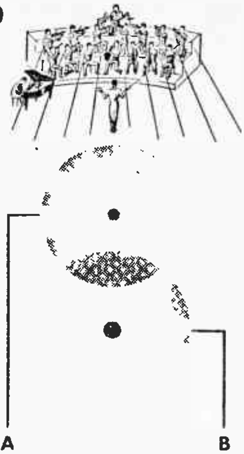


"Ideal" multiplex for stereo might use 1st 15-20 *kc* A+B signal, rest of modulation spectrum to insure fidelity of A—B signal.



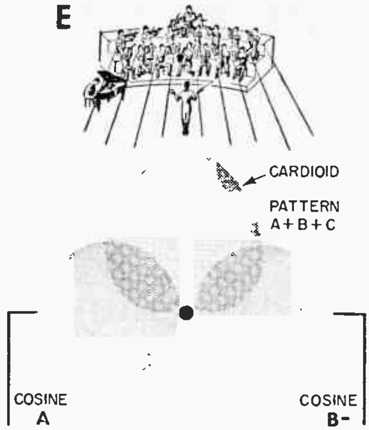
KMLA-FM system compresses stereo "difference" signal into 5-*kc*-wide band at 26 *kc*, broadcasts commercial monophonic program at 65 *kc* separately.

D



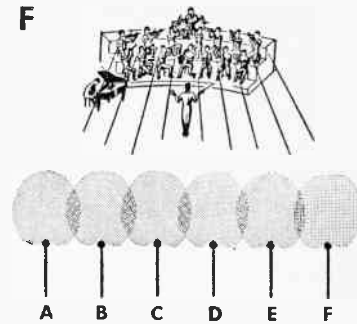
Longitudinal Method: omni-directional mikes separate sound by time delay.

E



Mid-Side Recording: Cosine mike picks up A channel and out-of-phase B channel; B phase is reversed and some cardioid pickup added to both.

F



Current Practice: Mikes placed for individual purpose, separately taped, "mixed" in laboratory.

It permits the broadcasting of a "full" program for listeners who have only monophonic equipment, and the simultaneous broadcast of fully separated stereo over the same station—and more as well.

Poor Broadcaster's Friend. With the burgeoning of TV after World War II, radio time sales became so competitive many FM stations were threatened with extinction. To save themselves, hordes of them went into the background music and storecasting business, leasing receivers to factories, offices and stores and patterning their programs to these commercial clients.

None too happy that this constituted "public" broadcasting in the accepted sense, the FCC none-the-less didn't know what to do about it—until someone thought of multiplexing.

Really, the principle is not new at all. It can be compared with the method by which the phone companies send a number of messages over the same wire or radio relay. The basic message travels, of course, at normal sonic frequencies (referred to as the primary carrier). Then, the next message is translated electronically into a supersonic frequency band (first subcarrier) and travels right along with the first. A second subcarrier at still higher frequency can be placed above the first, and so on. At the receiving end, matching electronic equipment simply translates the subcarriers back to the sonic range.

Adapted to FM, this means the station can broadcast one program, for the general public, on its primary carrier, using the spectrum up to 15 or 20 *kc*. Then, by multiplexing a subcarrier band above that, say centered about 50 *kc*, it can simultaneously transmit an entirely separate program, inaudible to the "public," for its commercial clients. Lo, one FM station is now two, but requiring only a single assigned wavelength, a single transmitter, single antenna tower, etc.

Stereo Weds Multiplex. *But*, to satisfy his advertiser, the broadcaster must put out the full program—channel A plus channel B—over his primary carrier, so that the thousands who do not yet have stereo can hear a full monophonic program.

Next, to modify this primary signal (A+B) so that it can be unscrambled by the receiver into a separate A channel and B channel for stereo listening, he must broadcast over his subcarrier (by multiplex) a signal capable of modulating the primary signal into its components.

A great many engineers are still at work perfecting methods, the FCC has not yet established standards and there are some differences of opinion on how best to do the job. Yet, in general, the "sum and difference" method is being used. Stated as an algebra problem, this means that while the primary carrier is broadcasting A+B, the multiplex carrier is broadcasting A-B, or the difference between the two channels. Then:

$(A+B) + (A-B) = 2A; (A+B) - (A-B) = 2B$

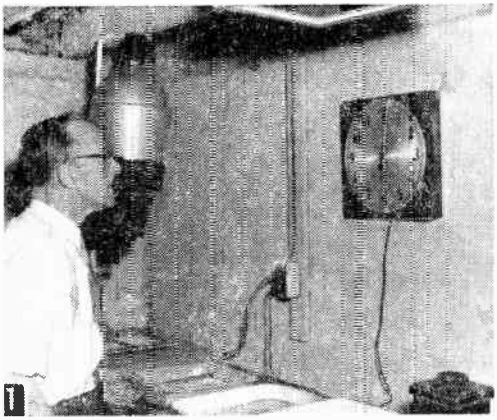
—which looks simple on paper. Actually, such problems as evolving the A−B signal and eliminating cross-talk are still bothersome.

In practice, the A+B signal is ordinarily passed through a de-emphasis network and straight on to both stereo amplifiers (Fig. 2). Meanwhile, the A−B signal is picked off by a bandpass filter ahead of the de-emphasis network, is demodulated and is translated by a phase splitter which passes the in-phase portion of the signal to the A amp and the out-of-phase portion to the B amp, thus restoring the stereo effect.

All of this is accomplished within a small multiplex adapter (Fig. 1) which is fed by your conventional FM tuner and which in turn feeds your stereo amplifiers.

Current multiplex adapters are all of the wideband type, translating into an audible signal whatever material is being broadcast by the station's subcarrier. Thus, if two separate signals are being broadcast at once (as is being done, for instance, by KMLA-FM, Los Angeles, experimentally), both signals would be heard at once, garbled together. To separate them will require adapters specifically designed for the job.

Seconds Timer for Photo Printing



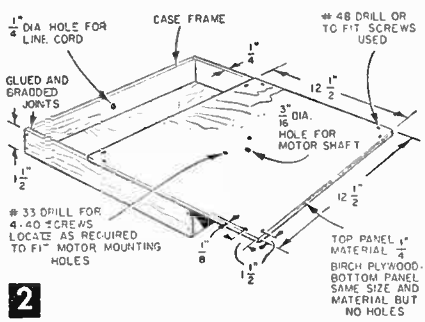
This photo lab timer is easily seen even when the safe light is used. The single hand revolves once a minute, with each major division representing five seconds.

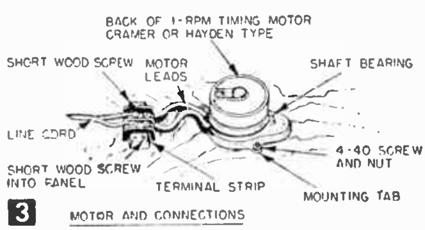
MATERIALS LIST—PHOTO TIMER

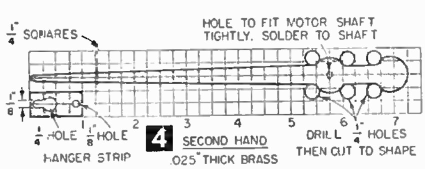
Amt.	Description	For
2	¼ x 1½ x 12" birch plywood	frame
2	¼ x 1½ x 12½" birch plywood	frame
2	¼ x 12½ x 12½" birch plywood	front and back panels
1	11½-12" dia. clock dial from old commercial clock or letter on white cardboard clock face	
1	synchronous timer motor such as Hayden, Cramer or Telechron, rated at 115 v., 60 cy., 1 *rpm* (available for $1.49 from Radio Shack, 167 Washington, Boston, Mass. Cat. #R-6821)	
1	terminal strip, Jones type 2-140	wire connections
7 ft	rubber or plastic parallel lamp cord with male plug	line cord
1 pc	1 x 7½" sheet brass, 0.025" thick	hand
1 pc	1/32" thick scrap aluminum or brass	hanger strip
2	4-40 x ⅜" screws and nuts	motor
4	#4 x ¼" *rh* wood screws	dial
2	#4 x ⅜" *rh* wood screws	terminal strip
8	#2 x ½" *rh* brass screws	front panel
	small brads, glue, walnut penetrating oil stain, white shellac, paste wax, acid core solder, flat-black paint	
1	#4 x ¼" *rh* screw hanger strip	

LARGE enough to see in the dim light of your darkroom, this photo timer, which can be made in one evening for a few dollars, will aid you in controlling exposure and development timing to produce uniform prints (Fig. 1).

Make the case (Fig. 2) of ¼-in. birch plywood, cutting the pieces to size and dressing the edges square on a sanding disc. When cutting and sanding front and back panels, brad them together so that they will be exactly the same size. Drill a ¼-in. dia. hole in one of the 12-in. sides, centering it each way for the line cord. Using glue and brads, assemble the case sides, then before the glue sets, attach the back panel with glue and brads. Drill holes in front panel as in Fig. 2, and apply walnut penetrating oil stain to both case sections. Allow to dry for about 5 min., then wipe off surplus stain with a cloth. Set aside to dry for about 2 hours, then apply 2 coats of thinned white shellac, smoothing when dry with fine steel wool. Finish with a coat of paste wax.







Our clock dial came from an old commercial clock found in a repair shop. Use a similar one or letter a piece of white cardboard. Glue or screw-fasten at 12, 3, 6 and 9 to the front panel.

The motor is of the synchronous timer type that can usually be picked up for right around about $1.50 (see Materials List). With motor shaft projecting through the dial, attach motor to back of front panel with 4-40 screws and nuts (Fig. 3). Attach a terminal strip to make the connections between the motor leads and the line cord which runs through hole in frame bottom. Knot cord just inside the frame to prevent strain on terminal strip. Now turn front panel over and attach to case with #2 or 3 x ½-in. *rh* brass screws.

Lay out clock hand on sheet brass as in Fig. 4. Drill ¼-in. holes and cut out roughly to size with tin snips, then file to final shape. Drill the hole for a tight fit with the motor shaft. If the shaft has a square end, file the hole square. Solder the hand in place with a drop of acid core solder and apply a coat of flat black paint. Lastly, make a hanger strip (Fig. 4) and fasten to back of case with an *rh* screw. Mount the timer, plug in, and you're ready to go. The hand makes a round trip each minute so read as you would the clock second hand.—H. P. STRAND.

Transistor Audio Amplifier

By HAROLD P. STRAND

This amplifier converts a transistor earphone radio receiver to loudspeaker operation. After testing, it will be mounted in the enclosure for a 6 in. speaker shown at right in photo.

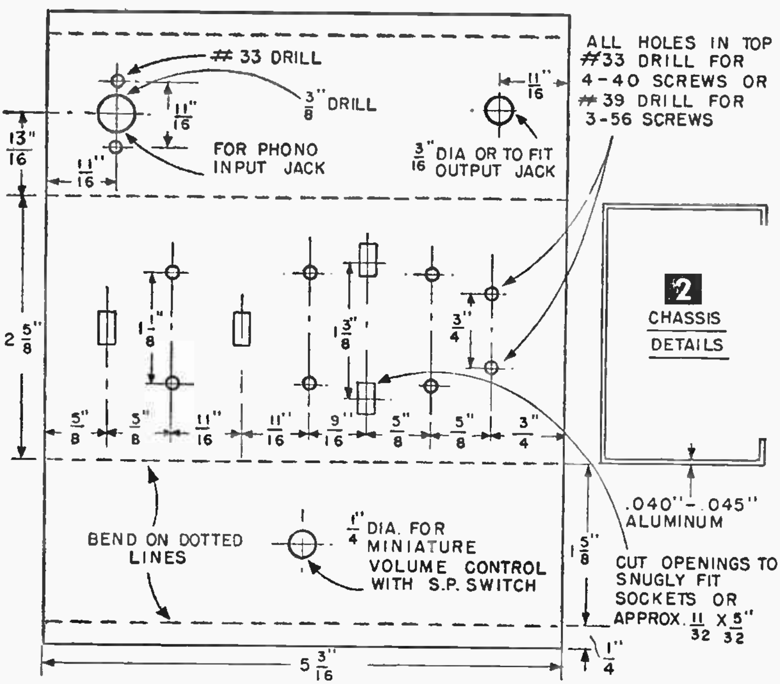
1

TRANSISTOR experimenters who have built a radio for earphone reception soon find that they would like an amplifier to which the radio can be connected for loudspeaker operation. The amplifier shown here (Fig. 1) was designed especially for this purpose and will provide excellent volume with a 6 in. or larger speaker having a 3-4 ohm voice coil. The total cost of building the amplifier will be around $18.00, including $8.85 for the coupling transformers.

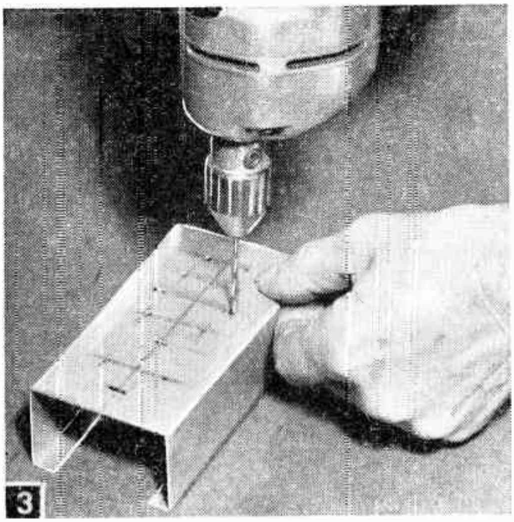
Four transistors are used in a transformer coupled circuit for maximum gain. If you wish you can substitute Raytheon CK722 transistors for the G.E. 2N 107 transistors used in the original amplifier, or you can obtain somewhat greater gain by using CK721 in the first two stages and CK-722 in the push-pull output. While several of the other PNP types should work out about as well, do not use the NPN transistors, such as the Sylvania 2N35, since their battery polarity *must* be reversed from that shown in the diagrams or they will be ruined. Transistors require very close matching between stages and also between the output and the speaker if distortion is to be avoided. Transformers provide the best method of matching impedances.

Shape the chassis from sheet aluminum (Fig. 2). Note that the volume control and switch are placed on the front of the chassis and the two jacks at the back. While this is suitable when amplifier is used on the bench for experimental purposes, switch and jacks can all be located on one side for more convenience if you prefer to mount chassis in speaker cabinet or baffle.

Lay out top chassis holes and drill, starting the socket holes as a marked rectangular area and finishing with a small file (Fig. 3). Sockets offer a decided advantage over soldering leads directly to terminals by avoiding damage from the heat of soldering, and permitting you to change transistors around in the circuit when testing a new unit in order to obtain minimum distortion and best gain. Each socket has a locking ring which is pushed down over the lower end of the socket to hold it firmly in place. The other holes are made with a #33 drill to take 4-40 screws which, with



2 CHASSIS DETAILS



3 Drilling the top holes in the sheet aluminum chassis. Lay out socket openings to size with a pencil, then drill and file to shape them to fit socket snugly.

nuts on the bottom side, are used to secure the transformers and the battery clip. If you prefer to use 2-56 or 3-56 binder head screws about 3/16 in. long, for neater mounting of these miniature parts, use a smaller drill.

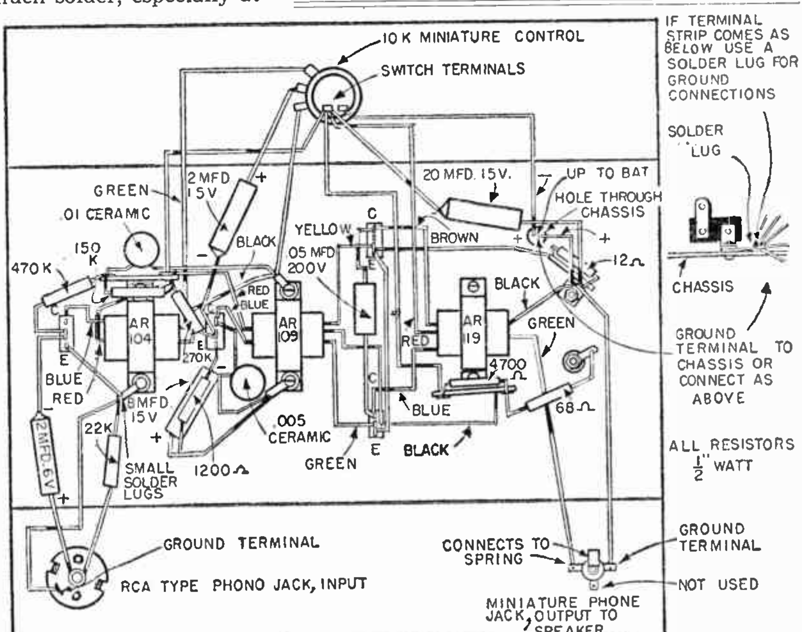
Assemble the parts, soldering all connections (Fig. 4). Use a small soldering pencil such as the Ungar type for most soldering at terminals. Where the heat is not sufficient to thoroughly flow the solder, as at larger terminals or where several wires connect, use a soldering gun or small iron. Avoid using too much solder, especially at transistor socket terminals, since it takes only a bit of rosin-core solder to make a perfect joint on clean metal and excess solder may run down and short-circuit to some other terminal or connection.

Be sure to select the correct values of resistors and capacitors as detailed in Figs. 4 and 6. Capacitors are marked for their values, and resistors use a color code which can easily be determined by checking a color code chart of RETMA standard color code values. When installing capacitors, make sure you observe the plus and minus ends of each electrolytic capacitor and place them in the circuit with relation to this polarity as given in the diagrams. When soldering to transistor socket terminals, which are closely

MATERIALS LIST— TRANSISTOR AUDIO AMPLIFIER

All parts except sheet aluminum available from Lafayette Radio, Dept. SM, 165-08 Liberty Avenue, Jamaica 33, N. Y.

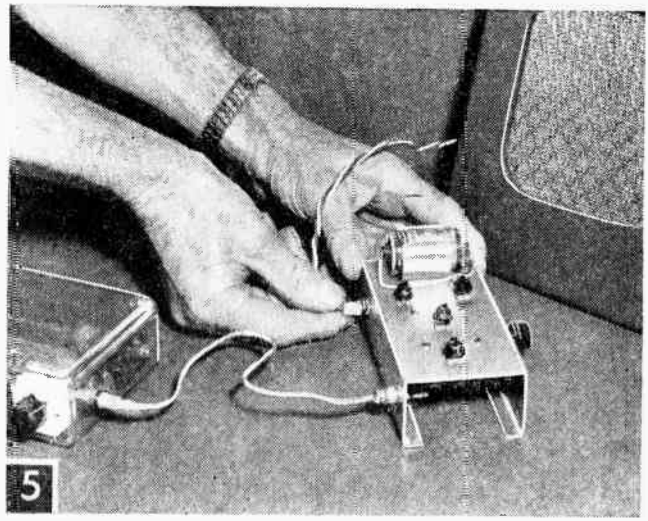
No.	Description
1 pc.	sheet aluminum .025-.030 x 1 1/8 x 2 7/8" (battery holder)
1 pc.	sheet aluminum .040-.045 x 5 3/16 x 6 3/8" (chassis)
4	transistors, G.E. 2N107 or Raytheon CK722 (99¢ each)
4	transistor sockets MS-275 (19¢ each)
1	RCA VS-300, 9 volt battery
2	battery terminal clips for VS-300 battery (1 plus, 1 minus)
1	miniature volume control with switch 10,000 ohms VC-28
1	miniature knob for 1/8" shaft MS-185
1	RCA-type phono jack MS-168 and plug MS-167 (13¢ per pair or KI-49, 10 pairs for 79¢)
1	miniature phone jack MS-282 and MS-281 plug
1	AR 104 input transformer
1	AR 109 driver transformer
1	AR 119 output transformer
1	20 mfd 15 volt Argonne capacitor
1	2 mfd 6 volt Argonne capacitor
1	2 mfd 15 volt Argonne capacitor
1	8 mfd 15 volt Argonne capacitor
1	.05 mfd 200 volt paper capacitor
1	.005 mfd disc capacitor
1	.01 mfd disc capacitor
1	470 K 1/2 watt resistor
1	150 K 1/2 watt resistor
1	270 K 1/2 watt resistor
1	1200 ohm 1/2 watt resistor
1	12 ohm 1/2 watt resistor
1	4700 ohm 1/2 watt resistor
1	68 ohm 1/2 watt resistor
1	22 K 1/2 watt resistor
2	two-terminal Bakelite mounting strips MS-232
1	one-terminal Bakelite mounting strips MS-231 (mounting foot should extend up for ground connections or otherwise use a solder lug under foot).
5	small solder lugs
	SPEAKER
1	6" speaker Utah or similar make
1	speaker enclosure or baffle SB-10 or similar type for 6" speaker
4 ft.	light plastic-covered 2-conductor cord
1	miniature phone plug MS-281
	4-40 screws and nuts for mounting parts, hook-up wire, solder, etc.



4 PICTORIAL DIAGRAM

spaced, first bend the terminals apart slightly so that there will be no danger of a short between them from soldered wires or leads. Leads should be only long enough to reach terminals.

Final assembly steps are to place the transistors in their sockets and fit the battery in its clip, which is bent from sheet aluminum and screwed to top of chassis (Fig. 5). Solder the snap-on clips to insulated leads that have been brought up from under the chassis through a drilled hole. Be sure to solder the clip that fits on the positive (plus) side of the battery to the lead that connects to the chassis as ground through the grounded terminal of the terminal strip. The other clip (negative or minus) connects to the other lead which goes to one side of the switch on the volume control. An error in battery polarity can result in ruined transistors.



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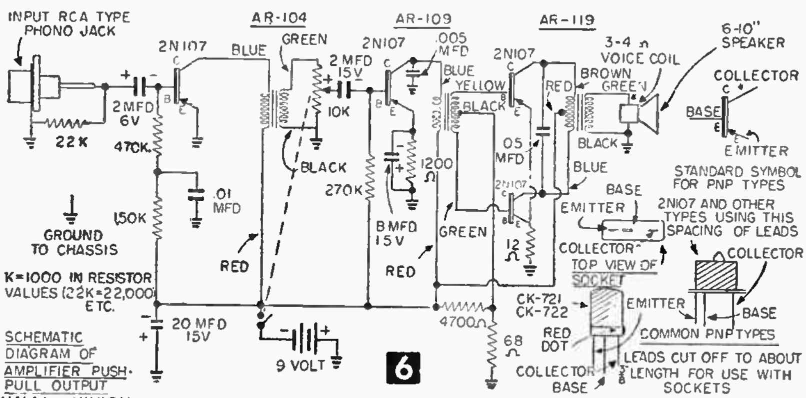
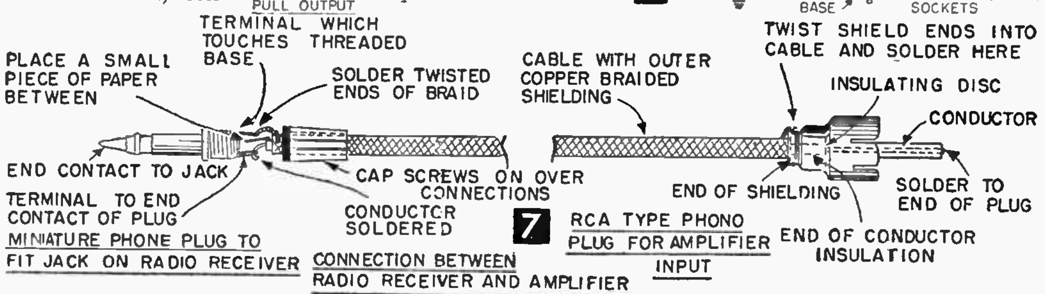
Connections between the radio and the amplifier and the amplifier and the speaker are made with plug-in cables. Shielded cable is used between radio and amplifier to avoid hum and other disturbances.

Before using, test the transistors in a transistor tester (see p. 128 of Vol. 4, No. 545, RADIO-TV EXPERIMENTER, available for 50¢) to save time you may consume looking for trouble in a circuit which lies directly in a defective transistor. A transistor should test with low leakage and a gain of at least 25 for the G.E. 2N107 or 22 for the Raytheon CK722, with a preference for transistors placed in some parts of a circuit that show a gain above these values.

Connect the radio to the amplifier (Figs. 5 and 7) with a piece of shielded cable with plug connections to fit the radio and amplifier jacks. This eliminates or reduces possible hum or stray pickup. Connect the amplifier to the speaker with ordinary rubber- or plastic-covered wire and a miniature phone plug.

To turn on the amplifier, rotate the volume control shaft clockwise until a click is heard, continue to turn to increase volume. With a speaker with a 3-4 ohm voice coil plugged into the output jack and the volume control fully advanced, you should hear a good hum when you touch a finger to the center terminal of the input jack. The hissing sound in the background is typical of transistors and cannot be helped. However, it will be reduced at lower volume levels or when a radio receiver is plugged into the input jack.





Combination Intercom-Radio Set

For party line service *and* music, you need only two or more crank-type telephones, an ac-dc receiver and hookup wire

By THOMAS A. BLANCHARD

THE quaint rural crank-type telephone is rapidly vanishing from the American scene. Interior decorators have been buying up these bits of Americana and converting them into costly antique conversation pieces such as Spice Cabinets, Pin-Up Lamps, Liqueur Chests, etc. Here, we have used one of these antique telephones as a novel radio cabinet while preserving its original function as an intercommunicating device. Two or more of these wall phones may be rewired as in Fig. 5 and used to provide party line service (Fig. 1) between the several floors of the home; or home to garage or barn.

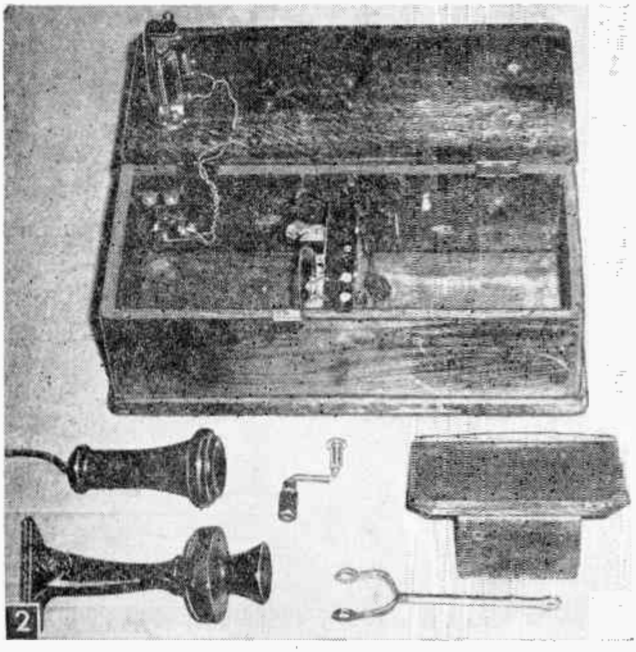
Since most every home has a small table-model radio set of the ac-dc type that has been set aside because of a broken cabinet, missing knob, or a minor circuit defect, we will make use of such a set. If you do not have one of these radios you can pick up a traded-in set at your local appliance store for a couple of dollars. Readers who desire to put an old set into good working order will find complete data in Vol. 3 of Radio-TV Experimenter, No. 538, which is available for 50¢.

1

Rural crank-type telephone houses radio. Youngster is listening to other member of family through intercom hook-up of old telephone.

The wall telephone used was obtained from Telephone Repair & Supply Co., 1760 W. Lunt Ave., Chicago 26, Ill. The unit's supplier calls it their #4 magneto wall telephone with separate transmitter and receiver. Price is $7.00, plus postage (20 pounds). Since many of these phones have seen 50 years service, both cabinet and exposed metal parts (Fig. 2) require refinishing in most instances.

To refinish the cabinet remove the exterior metal parts, hinge screws from the door and wood screws hold-



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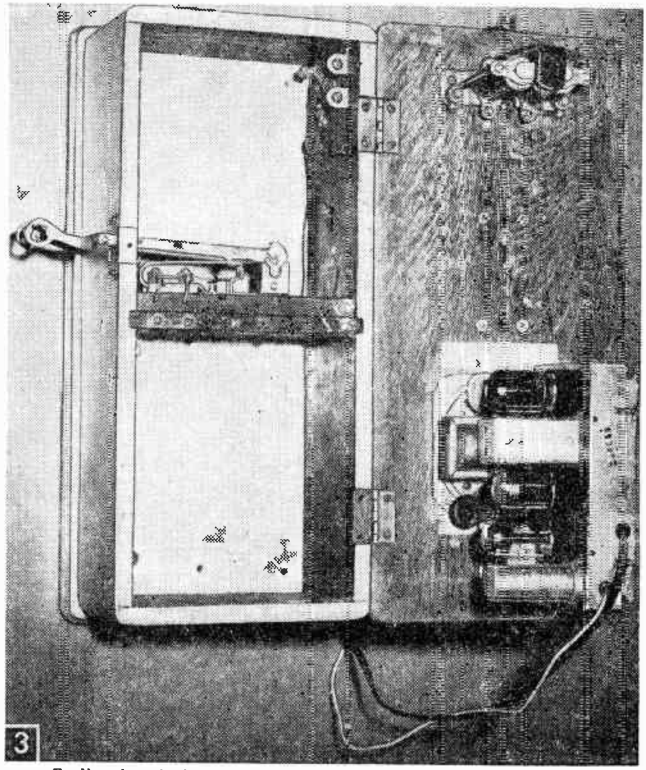
Wooden telephone cabinet and metal parts in "as purchased" condition.

ing the back of the cabinet. Strip off the old finish with paint and varnish remover of the 15% phenol type. Do not use a powder-type caustic paint remover mixed with water because it may warp the solid oak cabinet. Using an old brush, flow the remover on the wood and wait about a minute for the old finish to wrinkle. Then lift off the varnish or paint with a putty knife. Repeat the treatment again, this time wiping off any of the old finish remaining with steel wool. Then rub the wood with a rag soaked with turpentine to neutralize any phenol remaining in the wood grain.

Radio Installation. Because of the thousand and one shapes of radio chassis in existence we can not cover the installation of each. However, the following suggestions will take care of any and all sets. The total interior space available is 4⅜ x 6½ x 16 in. A removable shelf (Fig. 2) divides the cabinet into two compartments. With the set shown, it was not necessary to remove this shelf. However, if the radio chassis will not fit into the lower compartment, remove all of the shelf except the small strip required to support the phone *hook switch*. In fact, all of the shelf may be removed by mounting the switch on a small metal bracket. Small table sets have the speaker mounted to the chassis. To fit within the phone box it is usually possible to leave the speaker intact. However, if you are posed with a mounting problem, remove the speaker from the chassis and extend the wires connecting speaker to set. In this way, the speaker can be mounted in the front, top or side of cabinet where it fits most conveniently.



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Radio chassis is fastened to rear of telephone cabinet door.

If, as in our case, the set is small enough to mount directly on the cabinet door (Fig. 3), the old radio cabinet may be used as a template for drilling the tuning and volume control shafts holes and location of the large speaker opening. Place a sheet of paper over the front of the old radio cabinet, and trace position of openings. Then transfer the hole locations to the door of the phone cabinet. In our conversion, the speaker opening was made with a "fly cutter" set for a 3¼ in. dia. hole (Fig. 6). The round opening is optional since a square sawcut opening or series of ½ in. holes will serve just as well. The control shaft openings are drilled with a ½ in. wood bit. Because we have concealed the tuning and volume control knobs under the writing shelf (Fig. 4), it was also necessary to drill two ½ in. holes through the steel bracket supporting the shelf.

Now, check the chassis for fit. Do not be alarmed if you find that the control shafts are too short for attaching the original knobs. Any radio parts supplier can furnish "push on" knobs with an extended shank or ferrule. If the radio employed "push on" knobs merely replace with the extended type. On the other hand, if your set employed set-screw knobs a little extra work is required.

The round control shafts are ¼ in. dia. whereas the "push on" knobs are designed to fit a splined and slotted 7/32 dia. shaft. Since the new knobs are made of soft polystyrene plastic, simply ream out the knob ferrule with a ¼ inch drill. Insert the drill in a pin vise, or wrap a piece of cloth around the shank and twist by hand only. Heat generated by a power-driven drill will melt and distort the plastic. Because polystyrene has an elastic quality, these knobs will grip a smooth round shaft without the use of set-screws.

To allow for the displacement of heat generated by the radio tubes, a row of ¼ inch holes may be drilled in the top and bottom of the phone cabinet. The last remaining detail is the installation of the loop antenna if the radio was so equipped. If this unit will not fit into the cabinet even though the excess cardboard backing is trimmed off, replace it with a non-directional ferrite rod-type loop. This tiny antenna is available from most radio supply houses for about $1 complete with simple instructions for installing it.

We installed the radio chassis to the door of

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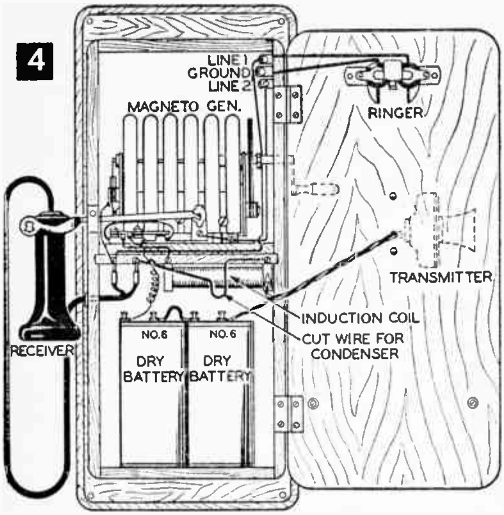
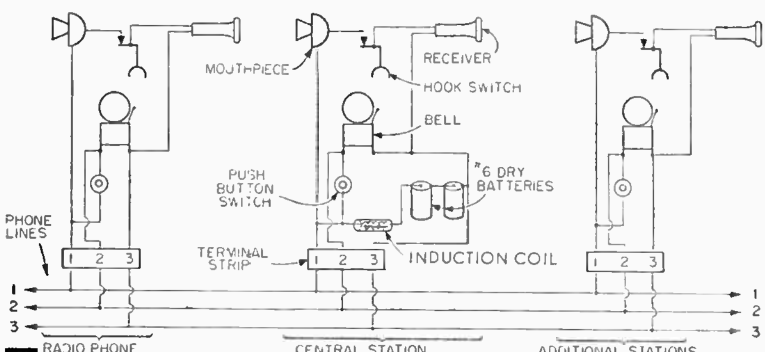


Original factory diagram of wall type magneto telephone. This was model 697 made by American Electric Co., Chicago. Rewire as shown in Fig. 5.



5 HOME PHONE SYSTEM HOOKUP

the phone cabinet with two #6 x ½ in. roundhead (*rh*) screws and washers. One screw in the unused speaker mounting hole, the other diagonally in the corner of the set chassis. Having checked alignment of radio chassis, remove it and set aside until cabinet is finished. There are several types of finishes that can be used, however each requires first filling the open-grained oak with paste wood filler. The cabinet may be given several coats of white shellac, and rubbed down with linseed oil and fine sandpaper. A limed-oak finish can be achieved by filling the oak with white paste-type wood filler. Follow with shellac as mentioned above. The cabinet may also be enameled in any desired color and decorated with decals.

While the cabinet finish is drying, clean the grease and rust from all metal parts with the phenol paint remover and steel wool. Follow by sanding or wire brush buffing before applying a new finish. Although the phenol solution will not remove the baked-on black enamel, it will remove all varnish and gum so that the parts can be painted with aluminum paint, black enamel, or gold if you wish. Radio supply shops stock General Cement's *Telephone Black* and *Chrome Paint*.

If you do not wish to use the telephone as an intercommunicating device, the various unwired parts may be reassembled on the cabinet. Should you wish to use two or more phones as an intercommunicating system, the following applies:

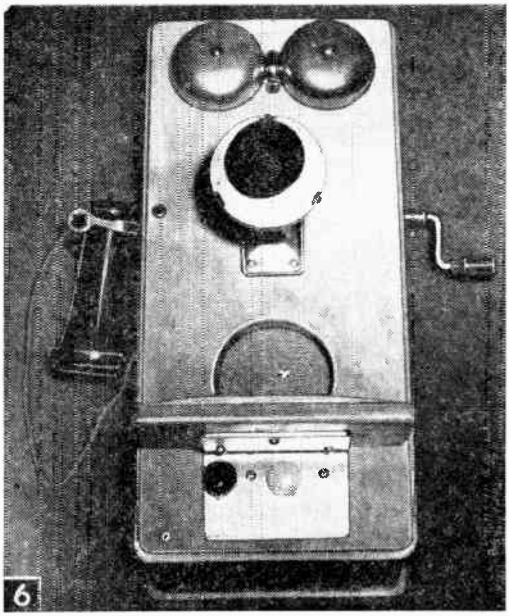
Wiring a Home Telephone System. The original rural telephone employed two electrical circuits (Fig. 5). For handling speech, two No. 6 dry cell batteries wired in series provided *talking current* to each phone. The 3 volts supplied by the batteries was not sufficient however, to ring the operator. Therefore, each phone was equipped with a hand-cranked magneto generator to provide the *ringing current*.

Many rural modernization jobs still required the magneto, and these units are removed from the old wall phones before they are offered to the public for sale. While the phone supplier includes the magneto crank for decorative use, he does not include a generator. For operating a phone system over short distances, the magneto is not necessary since the line resistance is low and the batteries can handle the ringing job quite well.

To put two or more telephones into operating condition, remove the old wiring and rewire with radio hookup wire, or plastic covered bell wire (Fig. 5). Each phone will require a 3-terminal, Jones-type barrier strip available from radio parts houses, and a door-bell push button. The push button may be installed over the hole formerly occupied by the generator hand crank.

Note in Fig. 5 that the central station unit includes an induction coil and dry cells. When three or more telephones are purchased, an induction coil will be furnished free if you ask for it. Other phones on your line require *no* coil or battery power. The central station can be located anywhere on the line . . . garage, basement, barn, etc. However, a central location on the line will prove most efficient. Phones may be inter-connected indoors by using two or three-conductor bell wire known as *thermostat wire*. While the phone system shown requires three lines, line 2 may be a ground return so that only two wires are used. In this instance, a water or steam pipe must be handy at each phone location. Scrape off any paint from the pipe and attach a radio ground strap with a wire long enough to connect to phone terminal 2.

The two wire hook-up greatly simplifies outdoor installations since two-wire twisted phone line is in plentiful supply in the surplus market.



Refinished cabinet showing radio control knobs beneath writing shelf. Knobs of different colors were used to distinguish between volume and tuning. Speaker grille is 4 x 4 in. piece of aluminum fly screening taped to cabinet.

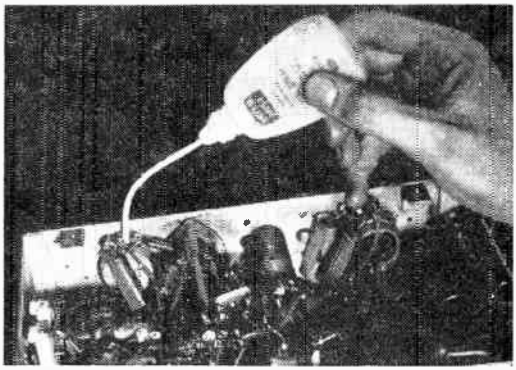
Moreover, for outdoor runs, TV lead-in wire is excellent and very inexpensive. When installing an outdoor line, it is important to provide lightning protection. Connect a TV arrestor across the line, and ground the center terminal to a water pipe. If a 3-wire line is used, connect the arrestor terminals to lines 1 and 3 and attach remaining ground terminal on arrestor to line 2. Then ground line 2 to earth via water pipe.

When several phones are installed on your home phone system, simple code ringing signals may be employed. Give each phone a number: 1, 2, 3, etc. To reach a certain phone, merely pulse the push switch the desired number of rings. Any phone on the line may be used to originate or receive a call.

If the telephone line involves a long run of wire, additional battery power may be required. Add additional dry cells in series if ringing current isn't adequate with two cells. After the line is installed, check each phone receiver for correct polarity. With receiver off hook, unscrew cap. The metal diaphragm should be securely held by the magnet both when phone hook is up and pulled down. If disc slides off receiver with hook up, the battery polarity is reversed at the receiver. Disconnect the cable at receiver terminal screws and reverse the connections. When each diaphragm is "sucked in" by the receiver magnet, when hook is up, polarity is correct.

Squeeze Bottle Dispenses Radio Chemicals

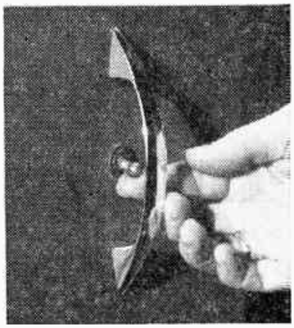
• Plastic squeeze bottles used for medicinal nose sprays make handy injectors of radio and TV control cleaning chemicals. Just remove the plug from the neck of the bottle, and pull off the spray tube attached to the inside of the plug. Wash out



bottle, then enlarge the hole in the plug to accept the spray tube from the outside. Pour the cleaning fluid into the bottle and push the plug and spray tube back in place. Seal any leaks around the plug with service cement or any other cement that can be used to mend plastics.

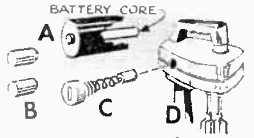
The dispenser holds enough cleaner to clean several noisy controls without refilling. and the tiny hole in the center of the spray tube will let you squirt cleaner into tiny control openings easily.—JOHN A. COMSTOCK.

Toggle Switch Safety Guard



• An exposed toggle switch is not only open to damage to itself, but it can also be a source of injury if it is flicked on unexpectedly. To cut down on this hazard, fit an ordinary cabinet or drawer pull over the switch. This will take the brunt of accidental blows, and you will have to reach under the arch to turn on the equipment.—FRANK A. JAVOR.

Flashlight Battery Cores Sub for Brushes

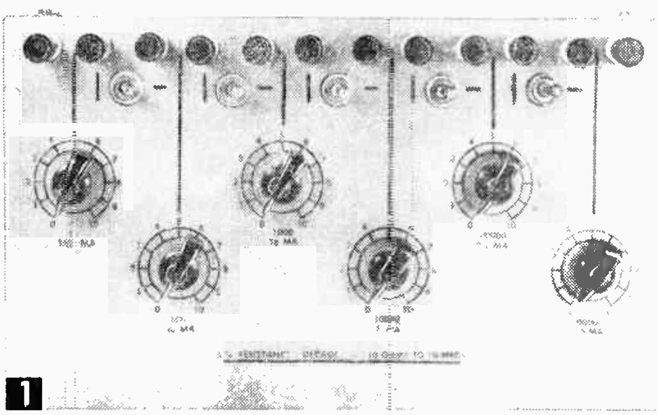


• If worn-out brushes cause your electric food mixer or other small electric motors to lose power and quit running, here's how you can avoid loss of usefulness while new brushes are being ordered. Remove the carbon core from a used flashlight battery (A), grind two pieces down to the desired size on an emery wheel (B) and insert in place of the worn-out brushes (C and D).—GLEN A. NORBERG.

Simplified All-Purpose Decades

Resistor and capacitor decades are quite useful in both servicing and experimental work, but often the units lack flexibility and are expensive. Here's a unit that's both flexible *and* inexpensive

By W. F. GEPHART



1 Front-panel view of a six-section, all-purpose resistance decade for experimental work.

UNLESS special features are incorporated in most resistor and capacitor decade units, they can only be used for one function at a time. Also, their accuracy and power capacity are sometimes insufficient for the use desired. One solution to these problems is to have several wide-range units, such as a 1% unit, a 1-watt (5% or 10%) unit, and a 2-watt (5% or 10%) unit.

There are three general uses for decades: 1) In servicing work, to determine (by trial-and-error substitution) the value of parts to be replaced, where the original value cannot be determined. 2) In experimental work, to act as variable resistors or capacitors in circuits to determine optimum values by operating tests. 3) In measurements, to act as external bridge components or as comparison resistances or capacitances.

In the first usage, reasonable power capacity is most important; in the second usage, power capacity and accuracy are both important; and in the third usage, accuracy is of greatest importance. The overall solution would be to have a decade of both high-power capacity and high accuracy, such as a 2-watt 1% unit.

Another problem, particularly in the first two usages, is the need for multiple units. For example, in an experimental circuit, it might be desirable to vary both the cathode resistance and plate resistance simultaneously to determine best operating point. Since these circuits must be isolated, the usual single-decade unit cannot be used for both functions simultaneously, and two conventional-type units would be required.

Using conventional designs, such usage would require a 0-10 megohm, 1%, 2-watt decade (for measurements, grid and cathode resistor substitution), and a 10,000-ohm to 1-megohm, 10%, 2-watt unit for plate resistances. If 1-ohm steps were used on the 1% unit, and 10,000-ohm steps on the 10% unit, these two units would require nine switches, 70 1% resistors and 20 10% resistors. All of this would represent a substantial cost.

This decade unit system (Fig. 1) can meet requirements at substantially less cost than conventional units, and can be altered (from a tolerance or current capacity standpoint) economically, since it only uses four resistors per decade section instead of the conventional ten. The switches are more expensive, but in the 1% and 5% tolerance ranges, this is offset by the savings in resistor costs. For example, a conventional single-decade section of 1-watt, 1% resistors would cost approximately $6.70 (resistors and switch), while the cost of a similar unit under this plan would be $4.50. In the 5% type, relative costs are about equal, and the conventional type would be somewhat cheaper in the 10% type. However, if a conventional unit is made on a 10% tolerance basis, and it is decided

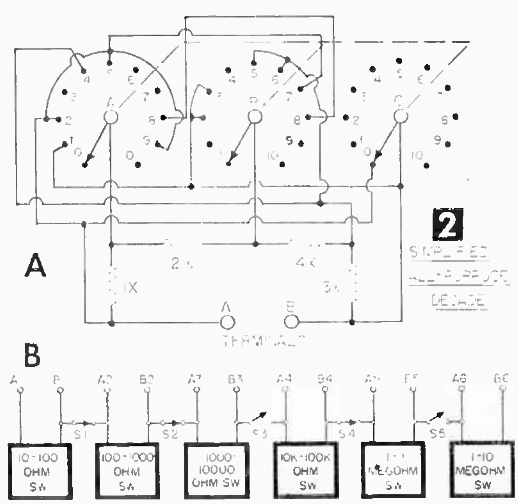


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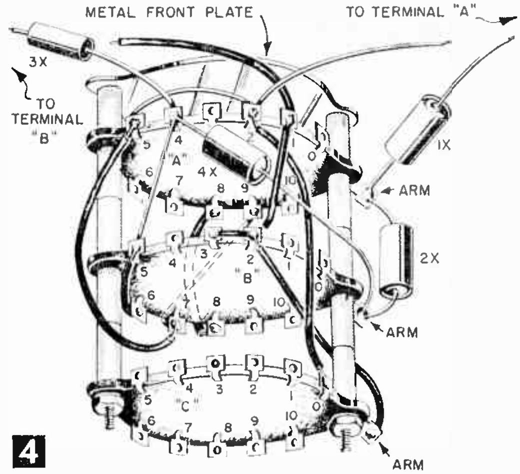
Table A—Maximum Current Capacity of Various Resistors

Ohms	Resistor	Maximum ½-watt	Milliampere 1-watt	Capacity 2-watt
10	(1X)	225	318	550
20	(2X)	160	225	318
30	(3X)	130	183	258
40	(4X)	112	160	225
100	(1X)	72	100	142
200	(2X)	50	72	100
300	(3X)	41	58	82
400	(4X)	35	50	72
1000	(1X)	22	32	45
2000	(2X)	16	22	32
3000	(3X)	13	18	26
4000	(4X)	11	16	22
10,000	(1X)	7	10	14
20,000	(2X)	5	7	10
30,000	(3X)	4	5.8	8.2
40,000	(4X)	3.6	5	7
.1 meg	(1X)	2.2	3.2	4.5
.2 meg	(2X)	1.6	2.2	3.2
.3 meg	(3X)	1.3	1.8	2.6
.4 meg	(4X)	1.1	1.6	2.2
1 meg	(1X)	.7	1.0	1.4
2 meg	(2X)	.5	.7	1.0
3 meg	(3X)	.4	.6	.8
4 meg	(4X)	.35	.5	.7



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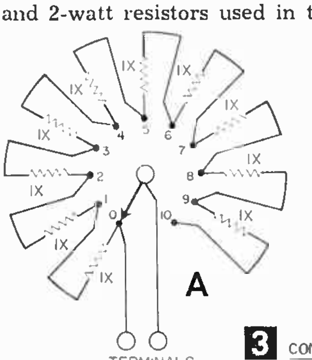
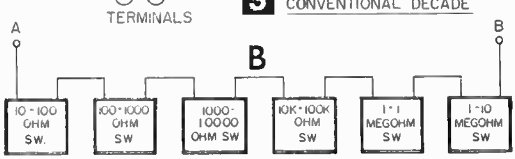
to convert it to 1% tolerance, the total cost (original plus conversion) would be $8.20, while the total cost of converting this type section from 10% to 1% would be $5.65. A comparison of Fig. 2A and 3A shows the savings in resistors.

Further savings can be effected with this type unit in connection with wattage capacity. The current that can be carried by a decade section is limited to the current capacity of the resistors and, for a given wattage, the higher the resistance, the less the current capacity. In the conventional decade where all resistors are of the same value, each resistor must be of sufficient wattage to carry the peak current desired. In this unit, where resistors are of different size (and therefore different current capacity), and where they are not all in the circuit except on one range, varying wattage sizes can be used to get high current capacity.

Table A shows the current capacity of ½-, 1- and 2-watt resistors used in this decade system. Notice that by using a 1X ½-watt, a 2X 1-watt, a 3X 2-watt and a 4X 2-watt, the entire section would have the equivalent of a 2-watt capacity even though some of the resistors in it were less than 2-watt. In the 5% tolerance type, a conventional decade system would require ten 2-watt resistors costing $4; in this system, equal results can be secured with one ½-watt, one 1-watt and two 2-watt resistors at a cost of $1.30.





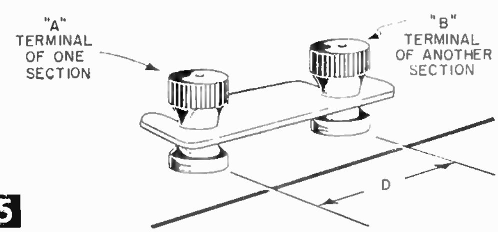
3 CONVENTIONAL DECADE

Table B—Switch Wiring Instructions

Abbreviations: (S)—Solder; (NS)—Do Not Solder; A3—Contact #3 on switch wafer "A", etc.

Step	Connection
1	R2X to A-arm (S) and to B-arm (NS)
2	one end of R1X to A-arm (S)
3	R4X to B-arm (S) and to A4 (NS)
4	one end of R3X to A4 (NS)
5	jumper from A4 (S) to B5 (S) and B6 (S)
6	jumper from A1 (NS) to B2 (NS) and B3 (S)
7	wire long enough to go to Terminal "B" to A1 (S)
8	jumper from B2 (S) to C-arm (S)
9	jumper from A9 (S) to B7 (S) to A5 (S) to A2 (NS)
10	jumper from CO (S) to A2 (NS)
11	wire long enough to reach Terminal "A" to A2 (S)
12	jumper from A8 (S) to B8 (S)

In planning a decade, it is best to analyze minimum requirements and build accordingly, since conversion to higher accuracy or current capacity can be done economically later. If the primary usage is for measurement purposes, 1% resistors should be used, but initial cost might be reduced by limiting the number of decade sections originally included. For example, the original unit might be for 100-100,000 ohms (three sections), and later expanded to greater and lesser resistances. Of course, the original housing should be large enough for ultimate requirements, and the layout should permit orderly expansion. If the primary usage is for servicing work, 10% tolerance sections would be sufficient, but current capacity should be fairly high.



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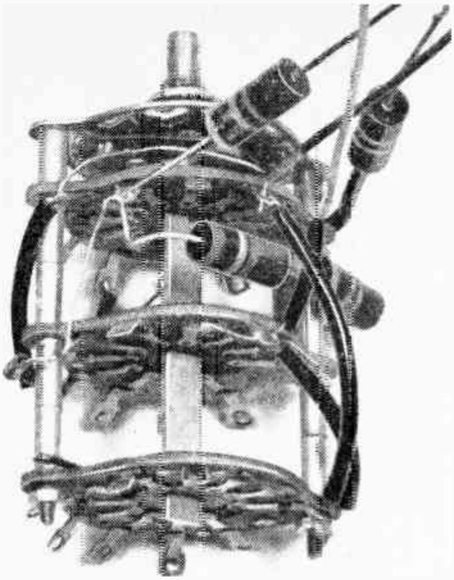


6 Switch wired (see Fig. 4) and ready for installation.

This decade design also permits the use of any section or sections of the unit independent of the other sections. Figure 2B shows how the sections are coupled together with switches (or "jumper" bars) with separate binding posts for each section. In this way, a 10-ohm to 10-megohm unit, for example, could be divided into a 10- to 10,000-ohm unit (with 10-ohm steps) for cathode resistances, a 10,000- to 100,000-ohm unit (in 10,000-ohm steps) for plate resistances, and a 1- to 10-megohm unit (in 1-megohm steps) for grid resistances. This arrangement is shown in Fig. 2B, and its application is shown in Fig. 7E. With the conventional decade, three separate units would be required, since sections cannot be isolated (see Fig. 3B).

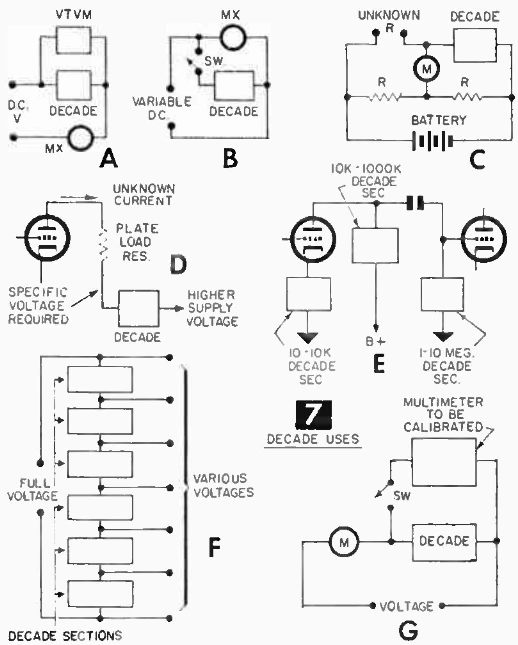
Jumper bars can be used instead of switches for dividing the sections if desired. These are small strips of aluminum cut as shown in Fig. 4, and are used to connect the adjacent binding posts of each section. The distance "D" must be the same as the center-to-center distance between the binding posts, and should be the same between all sections. All bars should be in place when the entire unit is used, and appropriate bars removed to isolate sections.

Figure 1 shows the panel view of a 10-ohm to 10-megohm unit. Layout is not too important, except that the binding posts should be in one line and spaced evenly if jumper bars are to be used. It is desirable to have both binding posts and resistance switches in a line for ease of operation.

Most of the wiring of the decade sections should be done on the switch before it is fastened to the panel. Figure 6 shows a decade switch completely wired. While the diagram for it (Fig. 2A) seems complicated, each switch can be wired in the 12 steps outlined in Table B. After this pre-wiring, attach the switches to the panel and

MATERIALS LIST—ALL-PURPOSE DECADE
(For each decade section)

No. Req.	Description
1	rotary switch; 2 poles with 11 positions & 1 pole with 1 position (Mallory 1331L, Centralab 1009, etc.—see text)
1	1X resistor) "X" = ohm step of decade section, i.e. 10-ohm,
1	2X resistor) 1000-ohm, etc. Tolerance and wattage optional.
1	3X resistor) For wattage, also see Table A.
1	4X resistor)
2	binding posts
1	SPST toggle switch (optional)
1	pointer knob
1	0-10 dial plate (Optional—Mallory Type 380)



7 DECADE USES

make connections to the binding posts (and toggle switches, if used).

If a low-range (less than 1-ohm) section is used, special low-resistance switches should be used, and all wiring done with No. 14 or No. 16 wire. In wiring high ranges (over 1-megohm) no wires, even though insulated, should touch, to prevent leakage resistance from affecting results. Other than this, no particular care is required in wiring.

You can reduce costs by using surplus parts wherever possible. In my unit, spring-type binding posts and toggle switches were cheaper than screw-type binding posts alone, since the items were surplus stock, so they were used. The decade switches were made by buying surplus switches (with three wafers, each suitable only for the "C" section) and buying two, new, large switches to get sufficient 11-contact wafers. Surplus 1% resistors can often be purchased for less than standard 5% units. Technical Apparatus Builders ("TAB"), 111 Liberty Street, New York 6, N. Y., has an excellent supply of 1% resistors at a reasonable price.

Decade Uses. Figure 7 shows a number of uses for decades other than for servicing work. In Fig. 7A, the decade is used to determine the current range of an unknown meter. The decade is adjusted to give full-scale reading on the unknown meter, the voltage across the decade measured, and the current determined by Ohm's Law. The same set-up can be used to determine the series dropping resistor required to convert a milliammeter to a voltmeter of desired range by applying the desired voltage, adjusting the decade for full-scale meter reading, and noting the resistance.

The internal resistance of a meter can be found as shown in Fig. 7B. The switch is opened and the voltage adjusted to give full-scale meter reading; the switch is then closed and the decade adjusted to give exactly half-scale reading, at which time the decade resistance will equal the meter resistance.

In Fig. 7C, the decade is used, with two external 1% resistors, to form a Wheatstone Bridge. The two other resistors should be of equal value (approximately 1000 ohms), and a zero-center meter used.

Often when the exact current being drawn by a tube is unknown, and a plate voltage dropping resistor is required, the decade can be used as shown in Fig. 7D.

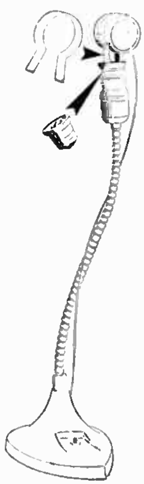
Figure 7E (and Fig. 2B) show how this type of decade can be used as three variable resistances in determining resistance values for experimental circuits, and Fig. 7F shows how the unit (or part of it, depending on how many jumper bars or switches are closed) can be used as a voltage divider.

Figure 7G shows how the decade can be used to calibrate a multimeter or VTVM, using an external milliammeter of any value. In this case, the decade and/or voltage is adjusted to various current values, the voltage drop across the decade calculated by Ohm's Law, and the voltmeter calibrated accordingly.

In the above uses, 1% tolerance should be available in cases A, B, C and G. Care should be exercised in connection with peak current in all cases, but particularly in cases D, E, and F.

Specific dimensions have not been mentioned, since they will depend on the number of sections included in the unit, the type and size switches used, etc. If 30° indexing switches are used, Mallory Type 390 Dial Plates ("Off" and "1-10") may be used instead of making dials with decals as shown.

Generally speaking, the principles covered above (except usages) also apply to capacitor decades, except that voltage rating must be considered instead of wattage.



Desk lamp mike stand

Record that tall story using the desk lamp reflector to increase the range of your hand mike

A MICROPHONE stand for hand mikes (such as those that come with less expensive tape recorders) can be improvised from a flexible neck desk lamp with its cord removed (or at least disconnected), a plug to fit the lamp's socket, and a ⅛ x ⅜ in. metal strip. Bend the metal strip to the size necessary for the mike in question, and use as shown. To pick up faint sounds attach the lamp's bowl-type reflector to the lamp's socket to "funnel" or focus the sound into the mike. Face the mike toward the inside of the reflector.—ANDY VENA.

Keeping Tube Numbers Readable

• After tubes used in experimental circuits have been handled for some time, the type numbers on the glass envelope wear away and are almost impossible to read. To prevent this and keep numbers readable indefinitely, apply clear fingernail polish to the numerals when tubes are new. If the numbers on older tubes are illegible, apply ammonia with a piece of cotton and let it dry to bring numbers out clearly.—JOHN A. COMSTOCK.

Grommet Is Pilot-Light Bumper

• In some electronics gear, pilot bulbs are placed in locations that make them especially vulnerable to breakage. To prevent such breakage, slip a snug-fitting rubber grommet over the bulb's glass envelope as shown. The grommet will serve as a bumper to ward off damaging blows.—J.A.C.

1 Strong TV signals may cause rapid and slow rolling of picture by triggering the vertical synchro on your TV set.

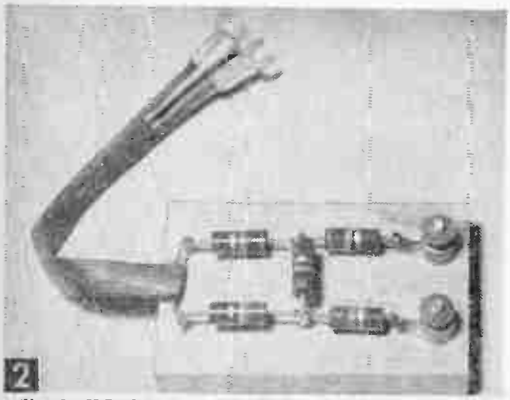
H-Pads Stabilize Rolling TV Pictures

THE combination of the modern ultra-sensitive cascode tuner in TV sets made during the past few years, plus the greatly increased operating power of TV stations, may make the housetop antenna deliver too strong a signal.

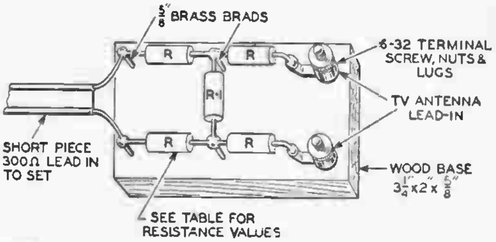
The result is that the TV picture may roll (Fig. 1), blacken and pull to the right of the screen between "station breaks" or when the picture contrast control is advanced. These conditions can, of course, also be caused by defective components in the vertical synchro section of your receiver. But, where the trouble is due to your antenna delivering too strong a signal, what happens is that the vertical circuitry loses its stability and cannot lock the picture in frame.

To eliminate this triggering action of strong TV signals, you can insert a simple resistance network between your set and the TV antenna. Because of the arrangement of the resistors (Figs. 2 and 3), this picture stabilizer is known as an "H-Pad."

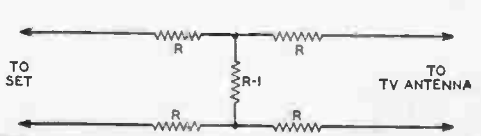
In simple language the H-Pad is a picture volume control which reduces the R.F. signal delivered to the set's tuner input by the antenna.



2 Simple H-Pads may be assembled on a small wood baseboard and connected in series with TV antenna.



3 PICTORIAL



4 SCHEMATIC

The strength of the signal reaching your TV receiver is expressed in decibels, which are convenient units for measuring intensity logarithmically (you hear, by the way, in proportion to the logarithm of the intensity rather than in direct linear response to it). The H-pad resistor combinations, which you will use to reduce the signal strength, are proportional to the degree of reduction (attenuation) of signal strength required. Thus, where the vertical circuit is only triggered infrequently by a slow roll, a 5-*db* (decibel) H-Pad may be all that you need. This unit has low series resistance and high shorting resistance. On the other hand, if your pictures are double or triple-triggered as evidenced by rapid rolling, up to 30-*db* attenuation may be required. Here the series resistors are high and the shunt or shorting resistor low. Table A indicates various resistor values needed to provide various degrees of attenuation.

For most vertical sync problems a 20-*db* stabilizer should prove about right. The unit shown in Fig. 2 was assembled on a ⅝ x 2 x 3¼-in. block of wood. Holes were drilled and countersunk in one end for two 1⅛-in. *fh* 6-32 machine screw binding posts.

Drive four ⅝-in. long brass brads into the block, leaving 3⁄16 in. of the nail exposed. Then cut off excess portions of the resistor pigtail leads

TABLE A—H-PAD RESISTOR VALUES

Attenuation	Resistors R	Resistor R-1
30 db	150 ohms	22 ohms
25 db	150 ohms	33- 36 ohms*
20 db	120 ohms	56- 62 ohms*
15 db	120 ohms	120 ohms
10 db	82 ohms	220 ohms
5 db	47 ohms	470-510 ohms*

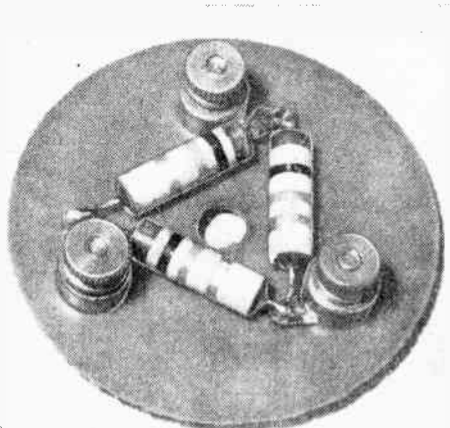
*Use the larger value if available. Otherwise substitute smaller resistance value which all dealers stock.

and carefully solder resistors to the brad heads in a neat and rigid arrangement as shown in Fig. 2. A short length of 300-ohm TV lead-in wire allows the H-Pad to be attached to the set's antenna terminals, while the antenna itself is attached to the binding posts.

The resistors for any of the six H-Pads listed may be as small as ¼-watt size. If you prefer not to experiment with your own homemade H-Pads, you can purchase printed circuit H-Pads from the larger TV supply houses (see pages 73-74). Centralab Division, for instance, makes 10, 20, 30, and 40-db attenuators.

Centralab also has a tap switch unit containing all four printed circuits to allow change-over from 10 to 40 *db* by turning a switch knob. Usually one H-Pad is sufficient, but if it reduces the signal of more distant stations normally received, it should be switched out of the antenna lead-in when set is tuned to the distant stations that do not cause picture roll.—T. A. BLANCHARD.

Two Sets-One Antenna *with this* TV COUPLER



1

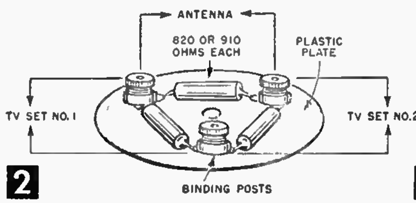
TWO TV receivers will operate efficiently off the same rooftop antenna by using this simple resistance bridge coupler. To assemble it, all you need are three 820 or 910 ohm composition resistors, three 6-32 x ⅝ in. machine screws and six matching nuts.

Arrange the resistors in a triangle on a small round or square piece of fiber or plastic (Fig. 1). For a neater appearance you can enclose them in a small plastic cosmetics box.

Connect the antenna lead-in to any adjacent pair of binding posts, running another piece of lead-in to TV set #1, and a third lead to set #2 (see Figs. 2 and 3). Since the resistance network is balanced, any pair of terminals work equally well as antenna input or TV coupling.

Resistors may be rated as little as ¼-watt, and the choice of values is dependent upon availability. The 910 ohm size is ideal for flat, oval or round 300 ohm lead-in. If this size is not available, use the more popular 820 ohm units. The latter resistance also happens to provide a perfect match for the new 270 ohm foam rubber round lead-in now becoming popular.

Some early TV sets were designed with an unbalanced 72 ohm input. Fair to good results may be obtained if one of the sets attached to coupler uses a 72 ohm co-ax lead-in from set to coupler, but line from antenna to coupler must be the modern 270 or 300 ohm impedance type.—T.A.B.



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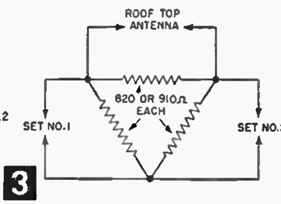


3

Pocket-Size Transistorlab

The turn of a switch demonstrates any of three unique functions of transistors and solar cells: radio, radiated energy control or solar-electronic switch

By THOMAS A. BLANCHARD

The 3-in-1 Transistorlab with switch in A-position functions as a solar-powered radio, here being activated by the beam of a flashlight.

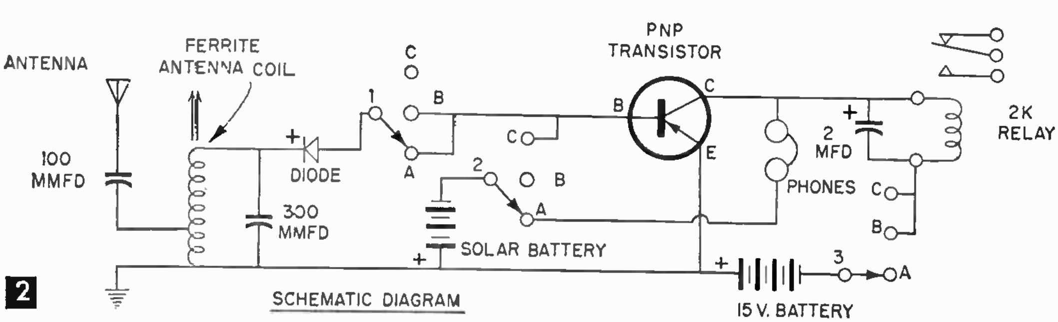
TUCK this 3-in-1 *Transistorlab* in your pocket, and you have ready for instant use a solar-powered pocket radio, a radiated energy control or a solar-electronic switch. An inexpensive rotary switch enables you to change from one application to another immediately for use in your own experiments or as a demonstration unit for school or club.

All components fit nicely into a plastic trinket box measuring 1¼ x 3¼ x 4¼ in. which was picked up at the notions counter in a dime store (Figs. 1 and 4). A 3/16 x 1½-in. slot was cut in the plastic box and the solar cell mounted in place with a strip of self-stick masking tape (Figs. 3 and 4). So long as wiring is correct (Figs. 2 and 3), and relay armature tension adjustment set so it can pick up on 1 milliampere, you can make any physical layout changes that may be necessary to suit housing you select. Note that none of the D-contacts on the switch are used, and only those indicated in the A, B, and C positions are wired, the others being idle. The control has been wired for an RCA 2N109 transistor. Other PNP transistors, such as the CK722 and 2N107 will also work but the high beta 2N109 is less critical and gives more consistent results.

When the rotary switch is in the A-position, the Transistorlab switch sets up the circuit so that RF signals from the air are tuned by the ferrite antenna coil, rectified by the diode detector, then amplified by a direct-coupled PNP transistor amplifier, powered by the inexpensive International Rectifier 3.2v., 2ma. silicon solar battery.

A subminiature jack provides plug-in connection for a miniature magnetic, high-resistance earphone. Many experimenters run afoul by trying to use less expensive crystal phones in transistor circuits. These can be used in conjunction with a shunt resistor, but results are too poor to bother with them in this case.

When the switch is moved to B-position, the circuit disengages the solar battery and substitutes the sensitive Sigma Model 4F relay for the earphone. It also connects the miniature 411E



hearing-aid battery into the amplifier circuit. With a suitable antenna and ground attached to terminals the Transistorlab will now demonstrate how energy radiated by more powerful or nearby local stations can be made to operate other electrical circuits.

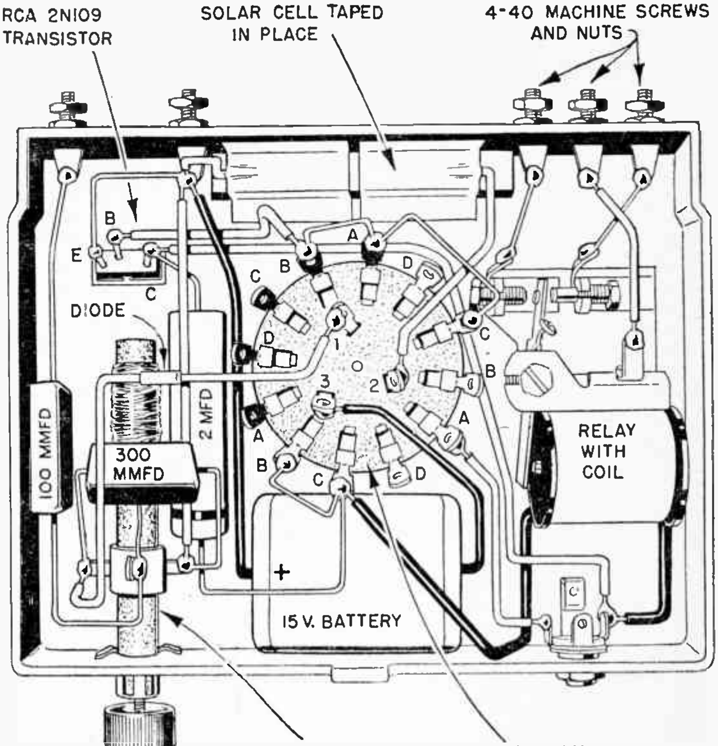
Having the antenna coil knob tuned to a loud radio station beforehand, you will discover that when the antenna is attached to its post, the relay contacts close. Tuning away from the station will cause the contacts to release.

As a mere idea of applying radiated energy to a more practical purpose, consider the chicken farmer who could rely on his strong local radio station going on the air in the early morning to automatically turn on the lights in the hen houses. Or, this same radiated energy could be used to turn off street lights or billboards. This is especially interesting since many radio stations are allowed to broadcast only from sunrise to sunset, since they are on channels assigned to larger stations with "clear channel" night-time rights.

When daytime stations sign off, the circuit of the radiated energy control draws very little current. Only when a signal reaches the diode detector circuit does any appreciable current flow from the transistor's *emitter* to *collector*. Another use for this radio carrier operated relay is as a Conelrad air raid warning service.

Finally, with the selector switch in C-position we have a form of electronic switch that is "triggered" by light striking the solar battery which has now been cut into the circuit to replace the RF tuner. Here a stronger current than the previous radiated voltage is applied to the *base* of the transistor. A small current flowing in the *base* circuit causes a much larger current to flow in the *emitter-collector* circuit of transistor.

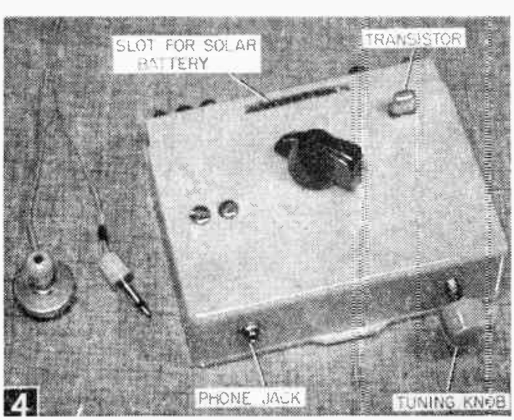
When sun or artificial light (except neon or fluorescent) strikes the solar cell, it becomes active and the relay circuit closes. The effect of a beam of light is like that of the well known photoelectric controls with the outstanding feature of the transistor being in evidence—its ability to work on as little as 9 v. as compared to vacuum tubes requiring from 90 to 150 for satisfactory results.



3 PICTORIAL DIAGRAM

MATERIALS LIST—TRANSISTORLAB

No. Req.	Description
1	1¼ x 3¼ x 4¼" or larger plastic box
1	ferrite antenna coil (loopstick, Miller No. 2002)
1	general purpose germanium diode, 1N34 or equiv.
1	RCA 2N109 transistor
1	transistor socket
1	subminiature phone jack
1	Sigma #4F sensitive plate circuit relay with 2,000 ohm coil
1	2 mfd 25v. electrolytic capacitor
1	300 mmfd mica capacitor @ 300v.
1	100 mmfd mica capacitor @ 300v.
1	solar cell strip No. MS-420 (Lafayette Radio, 165-SM Liberty Ave., Jamaica 33, N. Y.)
1	Mallory #3234J (non-shorting) rotary switch; 3-poles, 4-positions
1	15-volt #411E midget battery
5	4-40 machine screws ⅜" long for terminals
10	4-40 nuts
5	soldering lugs
	hook-up wire and knob



Transistorlab fits easily in a 1¼ x 3¼ x 4¼-in. plastic box.

Stereophile Heaven

Howard Souther's Stereophile Heaven showing at far end of room two professional Ampex tape machines and one Magnecorder, used for duplicating and for various sound effects. Control console is at center of photograph.

IF you decided you wanted the best stereo sound available—and were not worried about the cost—you might wind up with a dream system that looks like the one shown here.

The control console in the center of the array shown above was constructed over a period of a year in spare time. The rest of the equipment consists of standard professional components, except that the tape machines are housed in a specially constructed cabinet (top right in photo) to allow easy working from a standing position. Actually, the control console is two consoles in one, for the left and right channels are separate and symmetrical each side of center. Two meters in the center of the instrument panel measure the power level of right and left sound while the two outside meters measure limiting, or compression action for recording or dubbing operations. The limiting amplifiers achieve highest levels of sound without overload and system hiss.

Three microphones, inputs for right and left respectively, can be mixed by the control knobs on the first row of the console, along with stereo AM-FM radio, disc or sound from two stereo tape machines. The monaural central tape deck is used for single track sound effects available from an extensive tape library. Key switches located over each mixer pot allow flexibility in operation by actually doubling the number of inputs, 20 in all, although only 10 can be mixed or recorded at one time, five on the right and five on the left.

Directly over the mixer knobs on the first row are remote push-button controls for two of the tape machines. These allow one-man operation of even the most complex mixing or recording set-ups.

Located each side of the remote control cluster are "program equalizers," which act like tone controls on a high-quality amplifier, but allow more accurate settings.

The system of loudspeakers consists of two Electro-Voice Cardial Klipsch systems on the extreme sides, and three diminutive E-V Stereons, the odd one of which is placed on top of the control console center. The two outside Stereons, playing only stereo-significant sounds above 300 *cps*, are simply in parallel across the two Cardinal loudspeaker systems. The other Stereon receives "mixed" sounds which actually constitute a reformed third channel in the center. To insure proper reconstitution of this third, or "phantom" channel, a small square control box at the extreme right side of the meter panel allows reversal of phasing through a special transformer. This is necessary because many records and tapes are non-uniform in this respect. When properly phased, this third channel gives much better stereo effect, and permits the listener to move about the room without rebalancing channels. This third channel also prevents violent shifting of the playing instruments from one place in the orchestra to another, and "locks-in" the soloist when he sings or plays centrally.

A transcription turntable for playing stereo phonograph records completes this reproduced music paradise, but as tapes for purest sound are generally employed, it is kept rolled away in a closet. Not shown in the photograph is a long lounge directly opposite the control console where Howard Souther, General Merchandise Manager for Electro-Voice, luxuriates in 3-D Sound at its finest.

What would it take to duplicate Souther's custom-made set-up? "A real love for well reproduced music, a year's spare-time," says Souther, "and more money than I care to admit!"

The Jim-Jam Box

By ROBERT GANNON

FROM old components lying idle in your scrap box, or for a total of a little over $6 for new parts, you can easily construct a "Jim-Jam Box." Essentially nothing more than three elementary blinker circuits, a Jim-Jam Box, with three (or more) neon lights flashing intermittently, easily simulates anything from a Geiger counter to a miniature, electronic brain.

Circuit consists of a trio of resistors, capacitors and neon lights, wired in parallel and powered by a 90-*v* battery (see Fig. 2). By varying the values of the components, the lamps can be set to flash at a variety of speeds, in sequence or at random.

Container for the Jim-Jam is a 4-in. meter case. A small piece of sheet metal is fitted from the inside to the front of the case with two machine screws, and the lights—held in place by close-fitting grommets—protrude through three holes in the plate.

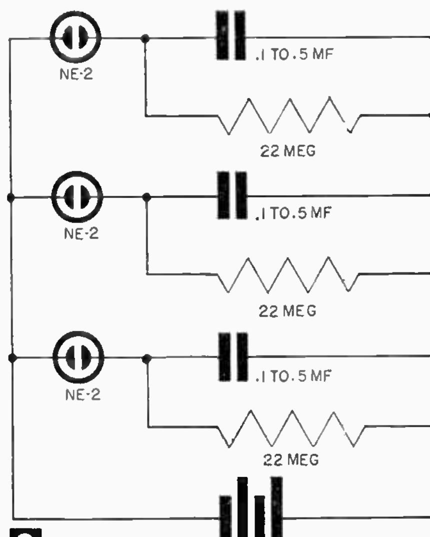
The back, metal or opaque plastic, is attached with sheet metal screws or machine bolts screwed into threaded holes. (A small threading tap costs about 85¢ at most hardware stores.)

To construct, solder three ¼- or ½-watt resistors of about 22 megohms to three capacitors of from .1 to .5 microfarads, and of whatever voltage rating you have on hand (600 *v.* is fine).

Tape the three resistor/capacitor pairs together (see Fig. 3) and solder the lamps in place. Use spaghetti for insulation. Then carefully push the three lights through the holes in the face-plate. Cushion the components by wedging them lightly against the bottom front of the box with some crumpled newspaper. The battery slides into place easily with just a bit of jiggling.

With the back screwed in place, your Jim-Jam Box is ready for a half-year of thaumaturgic blinking—on a single battery. Yes, that's all it does—sits there and blinks. But it's surprising how this mystifies, moves and even amazes your guests.

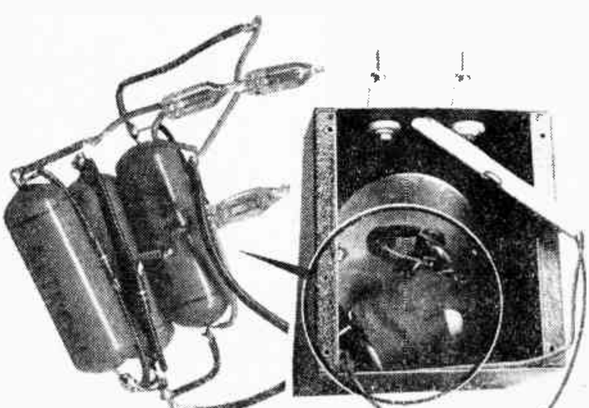
A completed Jim-Jam Box.



2 SCHEMATIC

MATERIALS LIST—JIM-JAM BOX

No. Req'd	Size and Description
1	4 x 4 x 4¼" meter case
3	NE-2 neon glow lamps
3	½-watt, 22-Meg resistors
3	.1 to .5 mfd., 600-v tubular capacitors
3	½" grommets (center hole to fit NE-2)
1	90-v battery (R.C.A. VS090, Eveready 490 or Burgess N60)
	Misc. screws, bolts, wire, spaghetti, solder, etc.



3

Components are tucked in place, and a wadded pad of newspaper holds them lightly against case front. The two terminals serve no useful function; they come with the meter case. At left in photo are components soldered in place before protective tape is applied.

Antenna-Coupler and Low-Pass Filter

Novice hams, if you want to combine some of the odd "outboard" pieces of apparatus around your station into a single unit this device will do it! It combines a flexible antenna coupler with an efficient low-pass filter, both designed for the low-powered transmitter operating at plate inputs of less than 150 watts

By RALPH SCHACHAT (W1GIF) and MARTIN GLICKSMAN

THIS antenna-coupler and low-pass filter can be constructed in an evening or two from readily obtainable parts. The two variable capacitors needed can be of almost any value and can be easily salvaged from a couple of discarded receivers. The chassis used is an inexpensive "store-bought" model with a small piece of Masonite attached as a front panel. Most of the coils for the antenna-coupler come prewound; the proper lengths are simply cut off to form the correct size coils.

1 Ham at rig, coupler-filter upper right

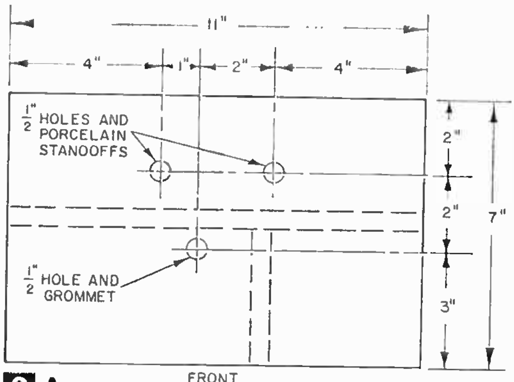
The low-pass filter portion consists of a series of five coils and four high-voltage capacitors built into three isolated chambers (see Fig. 3). The filter circuit serves to attenuate interfering harmonics by by-passing them off to ground. In Fig. 3, coils of insulated #12 wire are shown, but bare wire is satisfactory and easier to handle. Hence, all directions are given for bare wire. If insulated wire is preferred, then all measurements must be accordingly adjusted to allow for the thickness of the insulation.

Construction. Obtain a stock chassis measuring 3 x 7 x 11 in. and fasten a piece of Masonite 8½ in. high by 11 in. to its front with screws and nuts. Fasten a strip of aluminum, 2½ in. wide by 7½ in. high to the rear of the chassis (Figure 4). One SO-239 coaxial socket (S2) is fastened to the top of this strip of aluminum by drilling a hole slightly larger than the socket (about ⅝ in.) and fastening the socket in place with small screws and nuts.

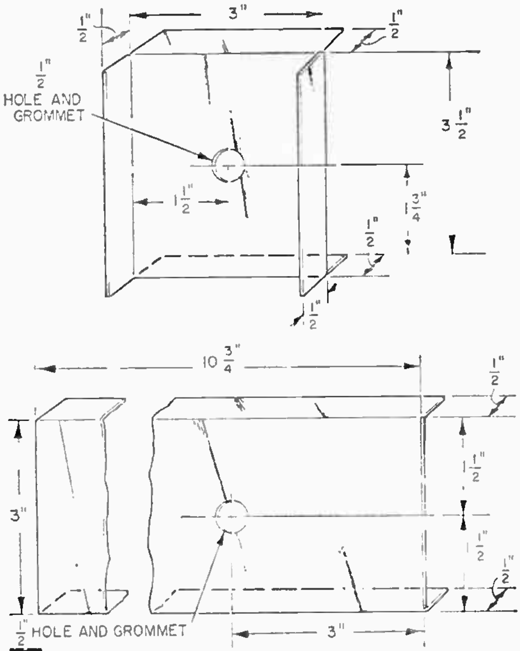
A second coaxial socket (S1) is similarly installed in the center of the rear side of the chassis. Note that if twin-lead cable is to be used instead of coaxial cable, the S2 socket and the aluminum strip are not needed, since the twin-lead cable terminates in small clips (A2, A3) which are hooked directly to coil L7.

Three ½-in. holes are drilled in the chassis (see Fig. 2A) and fitted with rubber grommets. Two porcelain stand-off insulators are then mounted in these holes.

Now make two aluminum dividers from



2A CHASSIS



2 B ALUMINUM DIVIDERS

flat pieces of aluminum stock (see Fig. 2B). Scribe the flat pieces of aluminum along the sides to be bent, bend the aluminum and drill and fit with rubber grommets two ½-in. holes as shown. These dividers are then fastened in place under the chassis with machine screws and nuts as shown in Figs. 2A (dotted lines) and 3.

The two variable capacitors (C5, C6) are mounted as shown in Fig. 4. One of these is a two-gang capacitor (C6) and must have both gangs of the same value. The other (C5) can be a one-gang capacitor. (A two-gang unit was used because it was available, but one gang was not used in the circuit.) The small mica trimmer capacitors often found on such variable capacitors should be removed if present. They will be found on either side of both stator sections. Remove by unscrewing the adjustment screw and discarding it, along with the mica spacer. The remaining adjustable plate may then be wrung-off with a pair of long-nose pliers.

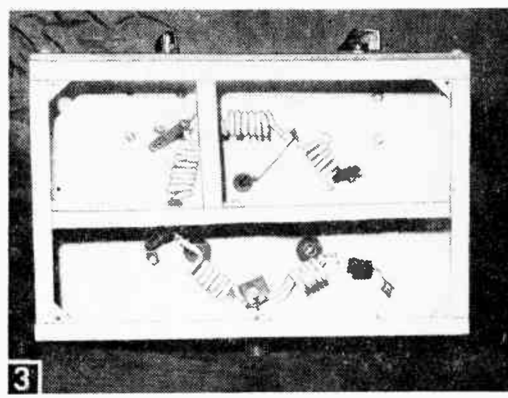
Coils L1 to L5 are made by winding #12 bare around a ½ in. form at a spacing of 8 turns per in. Coils L1 and L5 have 5 turns; L2 and L4 have 7 turns; and L3 has 8½ turns. The large coil (L7) can be made by winding 24 turns of #14 bare wire around a 2½-in. form, using a spacing of 8 turns per in. It is far easier and more convenient, however, to cut a 24-turn section from a commercial coil such as Barker and Williamson Type 3906 "Air Inductor." In either case, an extra 1 or 2 in. of wire should be left on each end of the coil to serve as leads.

The small coil (L6) can be made similarly by winding 9 turns of #14 bare wire around a 2-in. form at a spacing of 8 turns per in. Likewise, cutting a 9-turn section from a commercial coil is preferable. Long leads of about 6 in. should be left at each end of this coil.

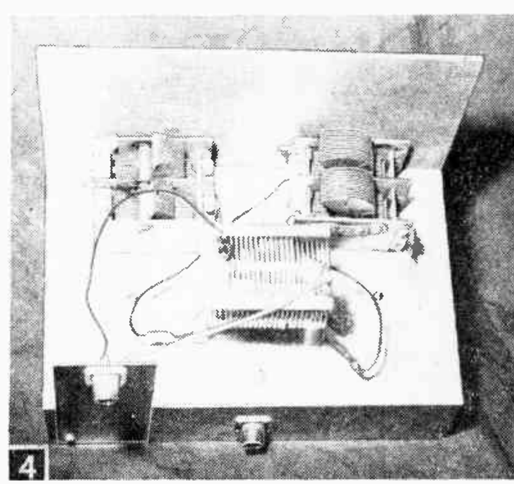
Carefully center the small coil (L6) within the large coil (L7) so that the long 6-in. leads of the small coil come out conveniently between the turns of the outer coil. The leads are covered with spaghetti to avoid shorting of the coils, and the inner coil is fastened in position by gluing small spacer strips of Bakelite (or other rigid, non-conductive plastic material) between the inner and outer coils. The small Bakelite strips can be cut from a large piece of Bakelite with a bandsaw or hacksaw. Duco cement, or preferably a commercial coil cement is used to glue the plastic in place.

The two leads of the large coil (L7) are fastened to the porcelain stand-off insulators and the excess wire is clipped off (see Fig. 4).

One lead of the small coil (L6) is run through the ½-in. hole in the chassis to the low-pass filter section. The other lead is soldered to the hot terminal of variable capacitor C5. The wiring is then completed as shown in the wiring diagram,



3 Bottom view of unit.



4 Top view of unit.

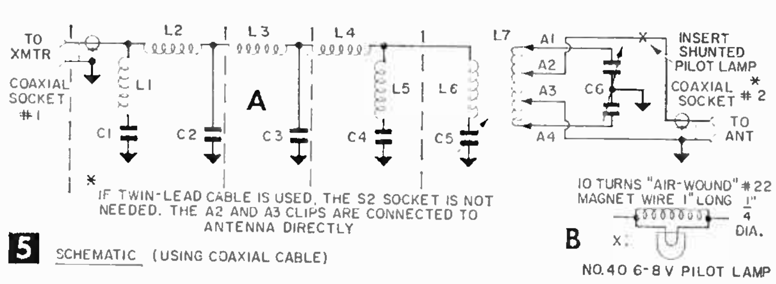
MATERIALS LIST—COUPLER-FILTER

No. Req'd.	Description
1	chassis, 3 x 7 x 11"
1	Masonite panel 8½ x 11"
1	aluminum strip, 4 x 10¾"
1	aluminum strip, 4 x 4"
2	capacitors, 46mmfd (C1, C4)—Mica—Allied Catalog #74-L-335
2	capacitors, 154 mmfd (C2, C3)—Ceramic—Allied Catalog #11-L-052
1	Barker & Williamson Coil—(L6—Radio Shack Catalog #21-520)
1	Barker & Williamson Coil—(L7—Radio Shack Catalog #21-097)
2	Alligator clips—(A1, A4—Radio Shack Catalog #32-774)
1	variable capacitor—(C5—1-gang—Allied Catalog #61-H-009)
1	variable capacitor—(C6—2-gang—Allied Catalog #61-H-059)
6	#12 bare wire (L1 to L5)
24	#14 bare wire, or 2 Barker and Williamson Type 3906 "Air Induction" (L6, L7)
3	coaxial cable, RG59U—Allied Catalog #47-W-552
6 strips	Bakelite, about ¼ x 3/16 x 1½"
2	porcelain stand-off insulators, about 1" high
2	knobs, to fit variable capacitor shafts
1	porcelain electric light socket
1	electric light bulb, 15 watts
1	No. 40 pilot bulb and miniature screw-base socket
	Miscellaneous nuts, screws, grommets, solder, etc.
If Coaxial Cable is used:	
1	aluminum strip, 2½ x 7½"
2	coaxial sockets, SO-239 (S1, S2)—Allied Catalog #40-H-352
	coaxial cable, RG59U
If Twin-Lead Cable is used:	
1	coaxial socket, SO-239 (S1)
5	Polarized connectors, Mosley, Type 321—Mosley Electronic Catalog #321
2	No. 40 pilot bulbs and miniature screw-bare sockets
	Twin-lead cable, 300 ohms, to dipole antenna—Allied Catalog #49-T-385

Fig. 5. An aluminum cover plate can be fastened over the bottom if desired. Both the transmitter and the coupler chassis should be individually grounded before operation. The coupler and transmitter are connected to each other with a short piece of coaxial cable having a PL-259 plug on each end. The antenna can be connected by coaxial cable or by a form of balanced line, such as twin-lead cable. The general operation of this particular antenna coupler is particularly suited to balanced line installation. However, coaxial cable can be used, and directions will be given for the use of both types of transmission lines.

Ordinary TV 300-ohm twin-lead cable serves as an excellent transmission line between a low-power transmitter and antenna and has been found to work very well with this coupler.

The setting of the clips depends greatly upon the impedance of the antenna feed system at the point of connection. It is suggested that clips 2 and 3 be set closely together near the center to begin, and capacitor C6 adjusted to resonance. Then clips 2 and 3 should be moved outward, meanwhile adjusting C6, until best antenna current is obtained. Naturally the transmitter is turned off when clips 2 and 3 are being adjusted; otherwise, the user may get an unpleasant shock. If the clips are set too far out to begin with, the shunt impedance of the feed line may "kill the Q" of the circuit, and no tuning effect will be observed. This would be most disconcerting to one not acquainted with an antenna-system's whims.



5 SCHEMATIC (USING COAXIAL CABLE)

(While the use of a lamp bulb as a dummy load is excellent practice for tuning a transmitter and testing its operation, the impedance of an actual antenna would approach the impedance of a 15-watt lamp, or about 1000 ohms, slightly inductive, only by the luckiest happenstance. Actually, it would probably be best for the new ham to practice tuning-up on the lamp, as suggested below, until he knows perfectly what each adjustment is for. Then it would be better if he proceeded as above when tuning the "live" antenna. Most such systems would probably have a *much* lower impedance than the lamp.)

Coaxial cable is reported to lose less power by radiation from the transmission line, but the difference between coaxial cable and twin-lead is small, with properly operating equipment.

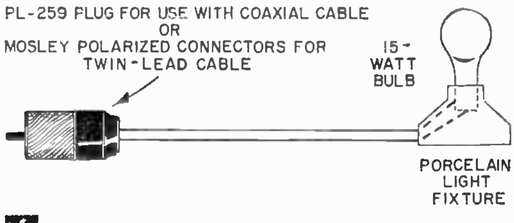
The antenna used to test the coupler was a 5-band dipole commercial trap antenna designed for use on 10-, 15-, 20-, 40-, 80-meter bands.

Transmission with Coaxial Cable. 1) Connect a dummy antenna lamp bulb to the antenna socket (S2). A 15-watt bulb was used for an AT-1 transmitter; for transmitters operating with higher power, use higher wattage bulbs. The dummy antenna is made by connecting a PL-259 plug to a porcelain electric bulb socket by means of two separate insulated wires as in Fig. 6. The proper size bulb is screwed into the porcelain socket and the PL-259 plug is plugged into the antenna socket (S2) of the coupler unit.

2) Alligator clips A1 and A4 are set at the ends of coil L7. Clips A2 and A3 are then set in about 1 or 2 turns from each end of the coil for 80-meter operation, and about 4 or 5 turns for 40-meter operation.

3) The transmitter is tuned up in the usual way and variable capacitors C5 and C6 are adjusted until the bulb lights to its maximum brilliance and the transmitter loads properly. A good "dip" must be obtained when the transmitter amplifier coil is tuned through resonance. The light bulb should glow with a good brilliance.

4) When the proper "dip" and bulb brilliance has been obtained, the dummy antenna is re-



6 DUMMY ANTENNA

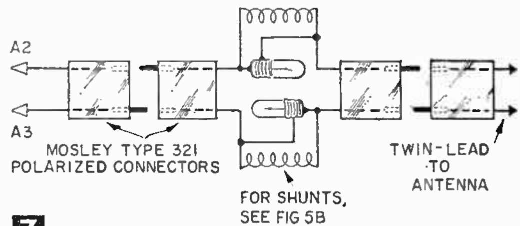
placed by the transmitting antenna. C5 and C6 are readjusted somewhat for "dip" and good loading. If poor loading or no "dip" is obtained, A2 and A3 are readjusted by changing their positions, and the transmitter is retuned as above. However, in order to indicate actual flow of RF current *in the antenna circuit itself* (imperative to proper transmitter adjustment) insert at point X in the schematic Fig. 5 a shunted pilot-lamp, No. 40, 6-8 *v* in series with the antenna feed line itself as shown in Fig. 5B.

Sometimes the beginner can *think* he has his antenna system tuned properly by meter when actually all of the RF output is being dissipated in the residual resistance of the tuner. However the glowing lamp in the feeder leaves little doubt that the "soup is going up the stack," as intended. This adds miniscule cost but great convenience to the coupler unit. Also, the power used in the lamp may be considered negligible (the lamp can be unscrewed after tuning if desired).

Transmission with Twin-Lead Cable. 1) The transmitter is tuned in the same way with the dummy antenna.

2) The dummy antenna is then removed, and replaced by a simple twin-bulb unit (Fig. 7) shunted as in Fig. 5B.

3) Clips A2 and A3 are adjusted to a proper position on coil L7. Capacitors C5 and C6 are adjusted until both bulbs light up with maximum and almost equal brilliance. This indicates that both sides of the antenna are loading equally. Although this may sound tricky or complicated,



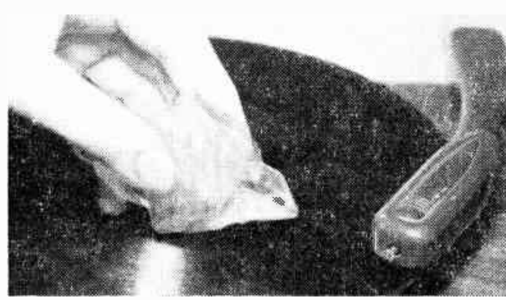
7 "TWIN-BULB" UNIT

it will be found to be a neat and relatively easy procedure.

4) The twin-bulb unit is removed and the transmitting antenna is plugged in. Usually, no further adjustments need be made as long as the transmitter "dips" and loads properly and the shunted pilot lamp glows.

Here, then, is a simple, easily built unit that will deliver the full power of the transmitter to the antenna in such a way that good balance between the "legs" of the dipole will be obtained. In addition you need have no qualms about operating during "TV hours" no matter how close your antenna is to your neighbor's TV antenna.

Charged Plastic Dusts Platter

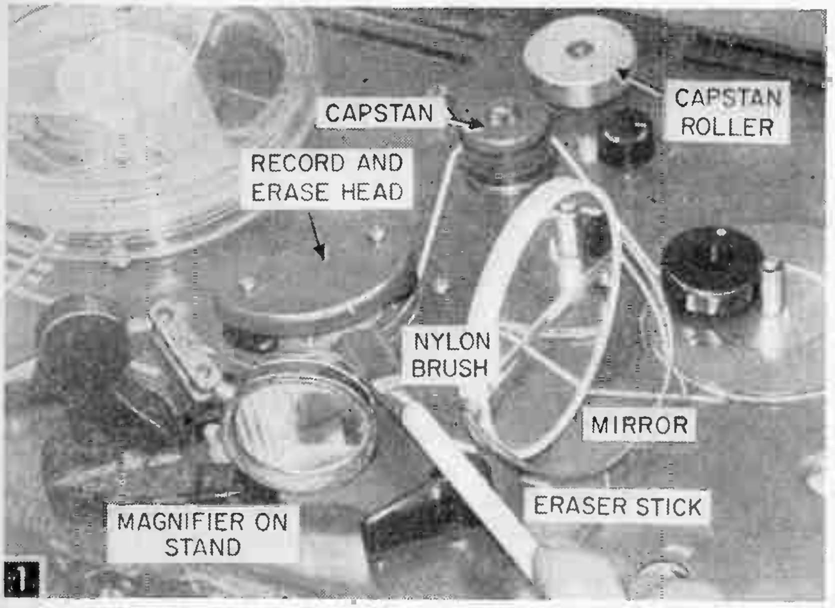


• If the grooves of your hi-fi phonograph records are filled with dust, here's how to remove it the harmless electrostatic way: Take a piece of Saran plastic wrap and crumple it in your fingers while holding it about an inch above the surface of the revolving platter. The static electricity produced by crumpling the plastic will attract the dust particles and hold them. If you watch very closely, you'll actually be able to see them jump from the platter to the charged wad of plastic.—J.A.C.

"The next sound you hear will be that of a startled mountain goat."

Tape Recorder Upkeep

By JAMES A. McROBERTS



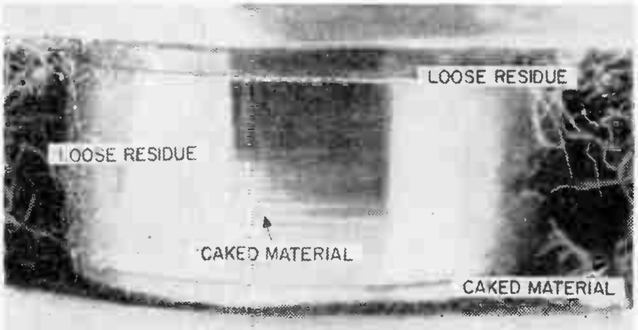
Top-chassis view of typical tape recorder showing use of brush, magnifier and mirror to clean heads.

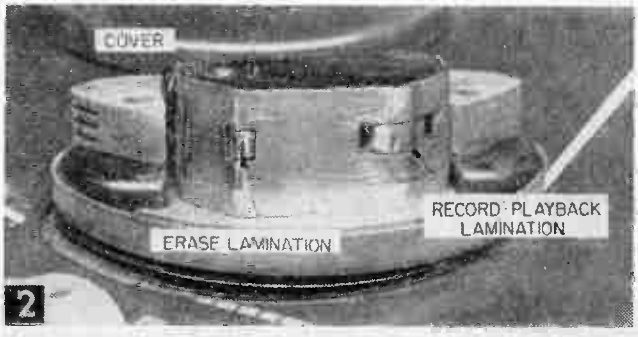
Many thousand hours of nearly flawless service are engineered into even the least expensive tape recorder. Here's your part in getting every one of these hours from your machine

IN every tape recorder, a tape transport mechanism *transports* (pulls) a tape from a *supply* reel past a magnetic recording-reproduce head (or heads) and winds it on a *takeup* reel. An electronic amplifier (or amplifiers), with associated record-reproduce heads and accessories are also essential in tape recording, the electronic accessories to include a volume control, recording level indicator, and an erase oscillator driving an erase-head winding.

A combined group of mechanical-electronic equipment accessories (controlled by the function switch) switch the amplifier, the heads, the erase oscillator, and also change tape direction and speed. Your owner's manual covers the placement of the heads, controls and other parts with specific lubrication instructions and other data applicable to your particular recorder. Those are specific instructions. With them, you'll also need a general schedule of inspection and lubrication. Lubrication should be performed every 500 hours of service, additional operations every 1000 hours. (Some work is on an *as-needed* basis and is so mentioned below.)

Mechanical Maintenance Schedule: 1) Clean the recording, reproduce (playback), and erase heads. Use a magnifying glass and mirror to reflect light on the

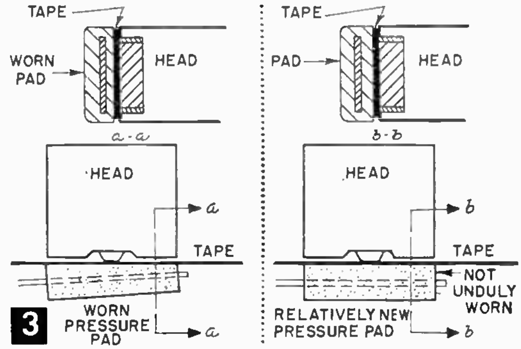


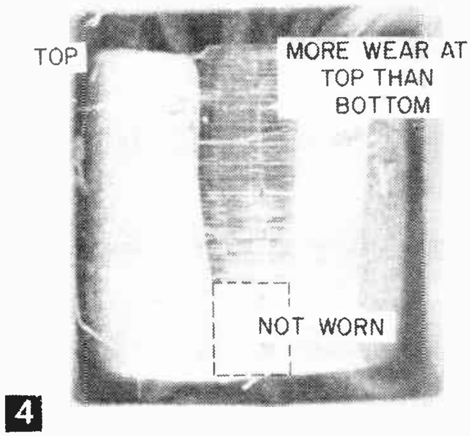


Business part of head showing erase lamination on left with record-playback lamination on right. Above, microphotograph of dirty head.

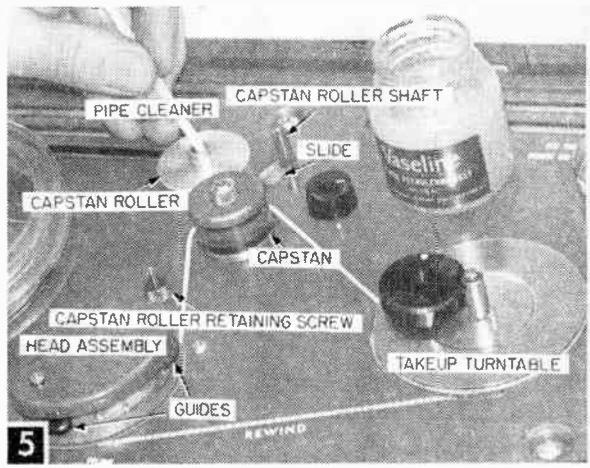
heads (See Fig. 1). A nylon brush on a typewriter eraser stick is an excellent tool for removing loose residue from the head structures. Loosen caked material with a lint-free rag moistened with rubbing alcohol or carbon tetrachloride wrapped around a wooden or plastic toothpick. Remove excess liquid with another clean rag.

Do not use metallic tools on the head laminations, or bring magnetized objects near them. Metallic objects scratch or dent the laminations, and can magnetically short-circuit them; magnetized bodies could magnetize the head, requiring





Badly worn single erase head.



Lubrication of capstan roller with petroleum jelly.

an unnecessary demagnetization. Do not use a pipe cleaner on the laminations. Use a nylon brush, a stiff bristle brush or a narrow toothbrush. Wipe the brush clean on a clean rag before the final brushing.

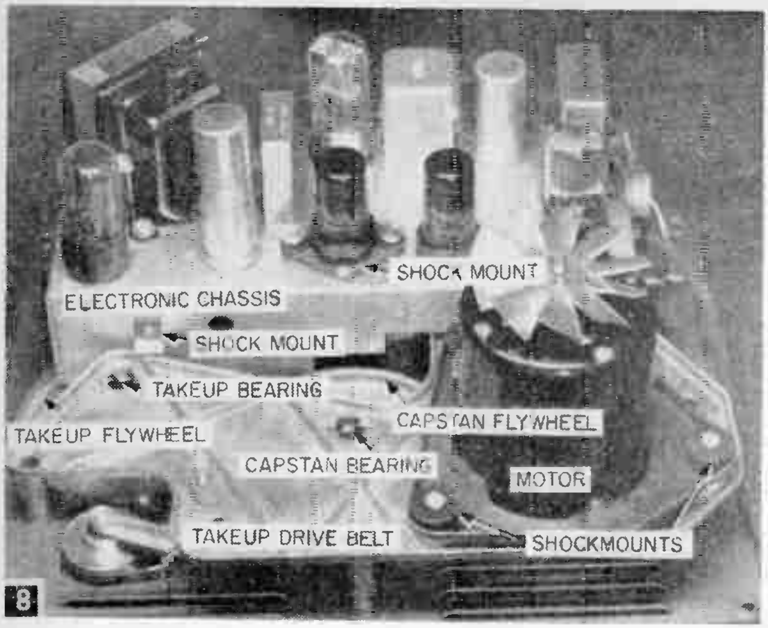
2) Inspect heads for uneven wear during cleaning. The cause of the uneven wear in Fig. 4 was uneven pressure of the tape against the head, the greater pressure being exerted at the top of the laminations (tape guides are employed in some recorders, pressure pads are used in other equipment).

To correct the cause of such uneven wear, the entire head structure can be rocked in some instruments to provide paralleled alignment of tape and the head structure. Most manufacturers of tape recorders which have pressure pads supply pads already mounted on arms for easy replacement. Try to detect excessive wear so that you may place an order well in advance for renewal pads. A reserve set is a good investment in continuous performance. If you can't purchase the pad-arm assemblies, then you must remove the old pads and cement on new ones.

3) Inspect pressure pads; replace if worn badly (see Fig. 3). Rocking the head to make the tape parallel must be done cautiously, however, since in some instruments the head can be moved sidewise (at an angle to the vertical in direction of tape travel). This is the azimuth adjustment which should *not* be touched if the high frequencies (the *ss's* and the *zz's*) reproduce satisfactorily. If such an adjustment is provided, and the high frequencies reproduce unsatisfactorily, make the azimuth adjustment by rocking the head sidewise so that the laminations gap is at right angles to the tape. Work carefully, preferably with the set-up shown in Fig. 1 (magnifying glass and mirror).

Remove old pads with a razor blade, scrape old adhesive from the pad arms. Replace with a new pad using adhesive (such as Duco cement) *sparingly*. Check parallelism of new pad with the head structure. Check spring tension of all pads against a piece of tape in the recording position. The pull on the tape—with tape taut from supply reel through the heads—should be about 2 oz. (half the weight of a ¼ lb. stick of butter). Loosen or tighten springs on the pressure pads, or adjust the brake on the supply drum as indicated by your inspection and "feel."

4) Inspect the capstan and roller. Test with a length of tape between these units. The pull for slippage of the tape should be about 2 lbs., approximately the weight of one qt. of water or milk. Rotate the capstan and roller manually through one revolution while making this check to see if the pull is uniform. Non-uniform pull



Underside rear view of typical tape recorder chassis.

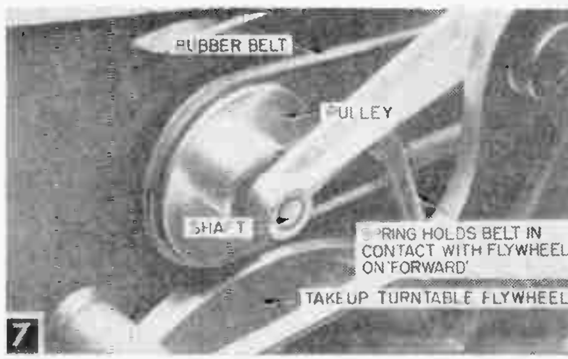
vide proper tension so that spillage does not occur.

Rubber friction drive may be accomplished by a belt in contact with a flywheel held by a spring (see Fig. 7), or by rubber-tired wheels driving the take-up reel. The cause of insufficient friction can be found by manual operation (power plug disconnected, function switch on Forward). The rewind is almost always another friction device operating at a higher speed. Inspect by manual movement of the motor drive pulley or belt (power plug disconnected, function switch in the Rewind position). Flats and reduced diameter are the principal troubles.

usually means a flat on either the capstan or the roller. Replacement is the only remedy. The cause of this defect is failure to push the movable member free when the recorder is left idle. Always separate these parts when your recorder is not in use.

5) Lubricate capstan and roller sparingly with clear petroleum jelly every 1000 hours of use. Figure 5 shows a roller being lubricated with a pipe cleaner. The sliding part may require similar lubrication. Use all lubricants sparingly—none must get on the *rubber* or on the *surface that contacts the tape.*

6) Inspect the take-up reel drive. Tape spillage will occur if friction here is inadequate (see Fig. 6). A spring drive may be employed; spillage of the spring compensates for the different speeds required. You can compress the spring with a pair of pliers, or open it, to pro-



Belt type friction drive assembly. Other type drive is accomplished by contact between rubber wheels and take-up reel.

7) Lubricate on schedule all bearings (such as the pulley bearing of Fig. 7) every 1000 hours of use with clear petroleum jelly from the top of a broom straw. Petroleum jelly is also a satisfactory lubricant for sliding parts with the exception of the high-speed bearing on the motor and some rewind pulleys. Here, several drops of #30 or #40 S.A.E. automobile engine oil should be applied with a straw or a narrow loop of thin wire.

It is extremely important that you do not *over*-lubricate; particular care should be taken to keep lubricants away from rubber parts. Clean rubber belts with a cloth moistened in rubbing alcohol every 1000 hours (use alcohol sparingly, it also attacks rubber).

You will find that some tape-recorder motors have built-in lubrication of their bearings and do not require lubrication.

Figure 8 is a back, or upside-down view of a

Tape spillage due to insufficient drive of take-up spindle. Too much tension would break the tape.

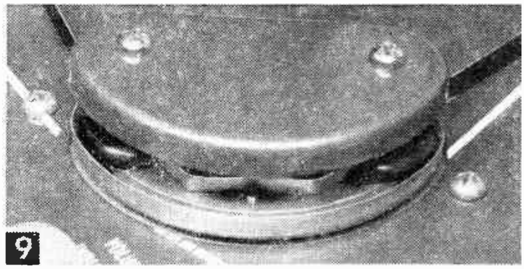
typical recorder chassis. The take-up reel and capstan reel bearings should be lubricated every 1000 hours with heavy motor oil or petroleum jelly. The supply reel bearing, behind the motor, will need lubricant at the same time.

8) Check the chassis-support bolts and shock-mounting rubbers of the electronic chassis (background of Fig. 8) by moving the parts they hold or shock-mount. Shock-mounted parts should give slightly, other parts should hold rigid. Replace rubbers or tighten bolts as required.

Electronic Maintenance Schedule. For the most part, electronic or electrical maintenance is far easier than mechanical. Some of this maintenance has been discussed under the care of the heads and their laminations already.

Every 1000 hours of use, test the tubes of your recorder at some reliable radio-TV store. Tubes should be checked every 1000 hours of operation (or at least once a year), because weak tubes that still play reasonably well may not draw the proper amount of current. Failure to draw rated current can cause a voltage rise which can damage other components. Also tubes with incipient short circuits can be detected before they damage or destroy other components.

1) If possible, test tubes for "quality" on a mutual-conductance type checker. Ask the salesman or serviceman to check for partial short-circuits also. This latter test is doubly advisable if the hum level of the instrument has increased since you bought it. Replace all tubes found to be unsatisfactory.



The time when heads must be demagnetized is hastened if tape is left in contact with the recording, erase, or playback heads when the machine is not in use.

2) A high background hiss level or noise level can be due to residual head magnetism (in the process of making a tape recording, we magnetize the tape, and magnetized tape will magnetize anything also capable of being magnetized with which it comes in contact). The amount of such secondary magnetization is a function of the intensity of the original magnetization of the tape and the time it is in contact with the heads.

When heads have accumulated enough residual magnetism to cause a high hiss, they must be demagnetized by subjecting them to a very strong alternating magnetic field for a few seconds, then slowly reducing this field to zero. Plans for a demagnetizer coil you can use for this purpose will be found on page 77 of *Science Experimenter* (No. 557), Vol. 1, a handbook available from SCIENCE AND MECHANICS for 50¢.

DXing "LIVE"

By C. M. STANBURY II

WHETHER you listen to standard, short-wave or TV broadcast stations, the news you get, the drama you hear comes to you secondhand. It has been cut, rearranged and sometimes distorted beyond recognition by the scriptwriter. Are you tired of it? Are you tired of the clichés and tired stereotypes that pass for reality? I was—and I did something about it.

Three-fourths of the radio spectrum is allocated to utility radio services such as aeronautical, marine and public safety, and it is here that the listener has his only chance to hear real people living real lives. The words transmitted by these stations come from no script. They come from life itself!

The most interesting, exciting listening is heard on emergency services such as the police and coast guard. Here, by knowing how and where to listen, you may hear men under pressure voicing the spine-tingling words of emergency.

But suppose you are a crime or mystery fan, then the frequencies assigned to law enforcement agencies may become your favorite bands. Here you will find realism that no magazine or book could ever bring you. Public safety radio services operate on both medium-wave and VHF (see Table B). Medium-wave is best for distant reception. See "One-Tube VHF Receiver," p. 45, on VHF reception. The first police band lies just above the standard broadcast band, starting at 1610 and going up to 1760 *kc*. In addition, a few such stations operate between 2300 and 2500 *kc*.

Major stumbling block to police listening is the use of coded number signals. All use a few of these, for example "ten-four," which means

TABLE A—THE PHONETIC ALPHABET

A Alpha	N November
B Bravo	O Oscar
C Charley	P Papa
D Delta	Q Quebec
E Echo	R Romeo
F Foxtrot	S Sierra
G Golf	T Tango
H Hotel	U Uniform
I India	V Victor
J Juliet	W Whiskey
K Kilo	X X-ray
L Lima	Y Yankee
M Mike	Z Zulu

TABLE B—THE POLICE BANDS

Range in Megacycles

1.61	to	1.75
2.3	to	2.5
31.14	to	32
33	to	33.12
37	to	37.44
37.88	to	38
39	to	40
42	to	42.96
44.60	to	47.68
153.74	to	154.47
154.62	to	156.24
158.7	to	159.48
166	to	173
454	to	456

POLICE STATIONS USING LITTLE CODING

KCA692 Newton, Mass.	1714 kc
New Hampshire State Police	1682 kc
KSA536 Milwaukee, Wis.	2450 kc
KCA281 Revere, Mass.	1714 kc
Ohio State Patrol	1730 kc
KQA387 Cincinnati, Ohio	1706 kc

that the contact is concluded. However some stations, such as KMA367 (of *Dragnet* fame) in Los Angeles, use almost nothing but code while others, like KCA962 in Newton, Mass., use a bare minimum of coding. Table B lists some of the police transmitters which will probably provide your best listening.

There is one disadvantage which cannot be overcome in police monitoring. The DXer can only hear one side of the picture: the viewpoint of the police dispatcher. Because of this, the Coast Guard distress frequencies 2760 and 2182 *kc* will sometimes prove more interesting and revealing. Balanced against this is the increase of both interference and dull traffic on these frequencies—2760 *kc* doubles as a general calling channel for Coast Guard stations. All contacts are made here (except on the Great Lakes) and then transferred to another frequency. The frequency 2182 *kc* is even worse for this since it is the international calling frequency for all ships. Table C lists the frequencies as well as the manner in which they are utilized by Coast Guard and distress traffic.

It comes down to a matter of patience—wherever you listen on the public safety and emergency channels, there will be the routine and matter-of-fact. Reality would not be reality without it—but only reality provides the compensating moments of spine-tingling actuality. Those with the least patience, will probably want to monitor the police frequencies. If you have a good deal of patience, the distress channels are for you.

Now, a few hints on identifying stations. On the Coast Guard channels, this is simple. These stations use their call letters or location on each transmission. Further, the letters are given phonetically, so there can be no error (see Table A). The headquarters station in each area is assigned a three-letter call sign—NMD, for example, at Cleveland. Other stations in the district add one or two digits to the HQ call, as NMD47, Buffalo. However, non-coast guard vessels in distress will merely call by location, for example, "Coast Guard Norfolk." Table C gives call and location of all CG district headquarters stations. Coast Guard vessels use four-letter calls.

Identifying police transmitters is touch-and-go. Some frequently identify; others, every hour; and, a few seldom announce their call or location. Police calls generally consist of three letters followed by three digits. They are not given phonetically. A complete registry of public safety systems in the U. S. can be obtained from Communications Engineering Book Co., Monterrey, Mass., for $4.

One can monitor a local broadcast station and when a disaster or search is reported tune to the appropriate CG or police frequency, but by then the action is already completed.

A note of caution: It is a federal offense to reveal the transmission of any utility station. So don't phone a scoop to your local paper. The wire services monitor the utilities so they'll have the story already anyway—but you are absolutely free to listen for your own entertainment.

TABLE C— THE COAST GUARD CHANNELS

Frequency in kilocycles	Service
2182	Distress. Calling, particularly on Great Lakes
2662	General traffic
2670	Calling and distress
2678	General traffic
2686	General traffic
2694	General traffic
2702	General traffic

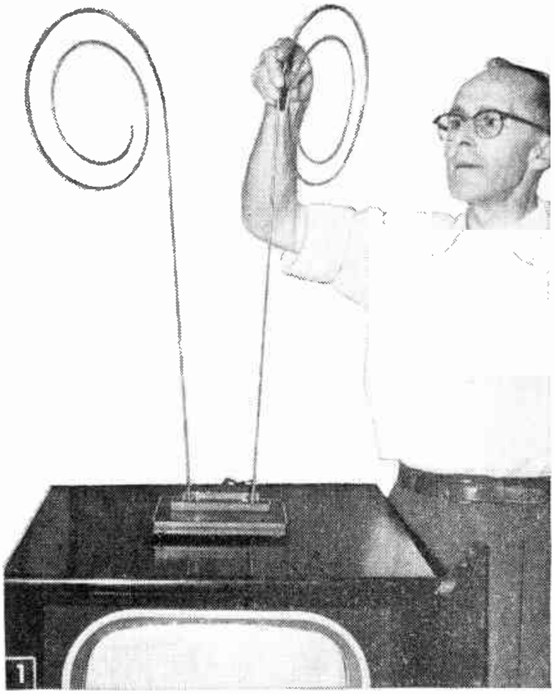
COAST GUARD DISTRICT HEADQUARTERS

NMA	Miami, Florida
NMB	Charleston, S. C.
NMC	San Francisco, Cal.
NMD	Cleveland, Ohio
NMF	Boston, Mass.
NMG	New Orleans, La.
NMH	Washington, D. C.
NMJ	Ketchikan, Alaska
NMK	Cape May, N. Y.
NML	St. Louis, Mo.
NMN	Norfolk, Va.
NMO	Honolulu, Hawaii
NMP	Chicago, Ill.
NMQ	Long Beach, Cal.
NMR	San Juan, P. R.
NMV	Jacksonville, Fla.
NMW	Seattle, Wash.
NMX	Baltimore, Md.
NMY	New York, N. Y.
NOY	Galveston, Tex.

Homemade Television Antenna

By HAROLD P. STRAND

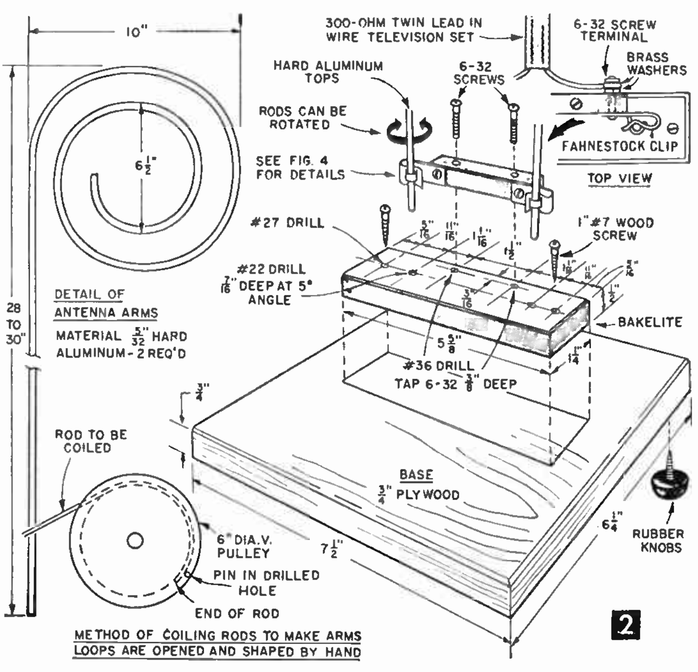
Save your money and improve your TV set's reception with this inexpensive, effective antenna



Each arm of this indoor television antenna can be rotated to bring the coiled sections in the best position for station reception.

AN INSIDE antenna usually works well for television reception from stations up to 25 miles or so away. After experimenting with the familiar "rabbit ears" form of interior antenna, I found that this homemade design definitely improved reception under certain local conditions. The aluminum rods coiled at the top ends (Fig. 1) are so attached to the base that they can be rotated, and this helps to clear up ghost images and improve the picture. These coils can be moved to be at right angles to each other, formed as a V or used in a flat plane, and the entire unit can also be rotated on the cabinet for further adjustment.

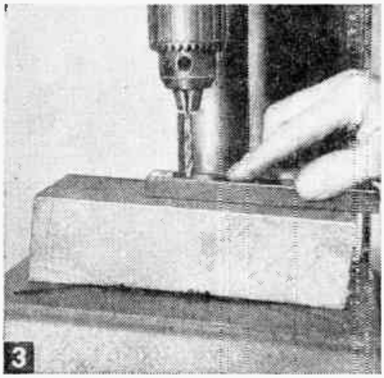
Each rod represents a 6-foot antenna arm, but when coiled, the total height is only about 2 feet 4 inches. A short piece of 300-ohm lead-in wire connects the terminals at the base of the antenna to the antenna posts of the television set.



For the ¾-inch birch plywood base, select some smooth grain stock and cut the piece to size (Fig. 2). Smooth the edges and slightly round the corners on a sanding disc. Then apply walnut or mahogany oil stain, allow it to dry for about 10 minutes, and then wipe off all surplus stain. After three or four hours apply two or more coats of shellac, lightly rubbing down each well-dried coat with fine steel wool. Finally, apply wax and rub briskly with a dry cloth for a pleasing soft finish.

As an insulated support for the lower ends of the rods, cut a piece of ½-inch thick Bakelite to size and drill the required holes (Fig. 2). Bore the two holes for the rods on about a 5° slant (Fig. 3).

Figure 4 shows the terminal strip made from a second piece of Bakelite. The lead-in wire attaches to the nut terminals

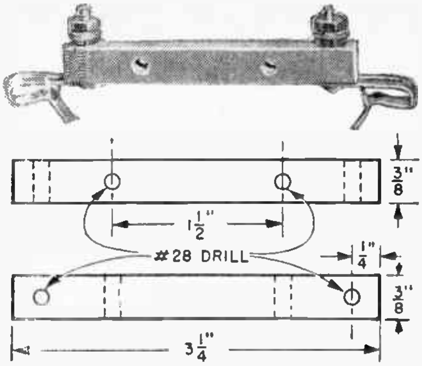


3 By tipping the drill press table the two holes drilled for the ends of the arms are given a 5° slant or you can hand drill by shimming up one end of the piece to get the right slant.

MATERIALS LIST—TV ANTENNA

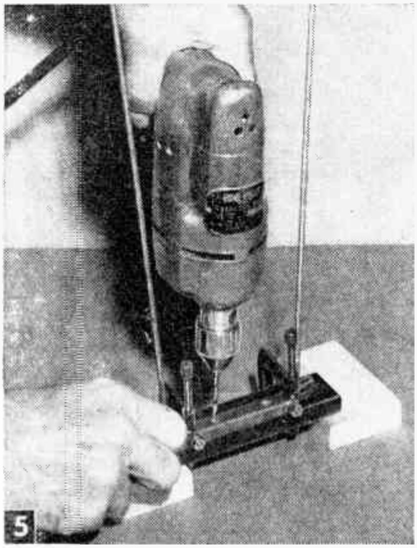
1 pc ¾" birch or pine plywood 6¼ x 7½"
1 pc paper base Bakelite ½ x 1¼ x 5⅝"
1 pc paper base Bakelite ⅜ x ⅜ x 3¼"
2 Fahnestock clips
2 pcs hard aluminum rod 5/32" diameter x 72" long
4 rubber drive-in base knobs (rubber tack bumpers)
2 #7 rh wood screws 1" long
2 6-32 rh machine screws (brass) ⅞" long
4 brass 6-32 nuts
4 brass washers
2 6-32 rh brass machine screws ¾" long
About 3 feet twin lead-in wire, stain and shellac

SOURCES OF SUPPLY: For Bakelite, try Forest Products Co., 196 Broadway, Cambridge, Mass. Fahnestock Clips, lead-in wire and rubber base knobs may be obtained from Allied Radio, Dept. 10, 100 N. Western Ave., Chicago, Ill. For aluminum rod, metal supply or products company, see your classified telephone directory.



4 TERMINAL STRIP - 1 REQ. BAKELITE

Completed terminal strip equipped with two Fahnestock clips and terminals for lead-in wire connections (Fig. 2).



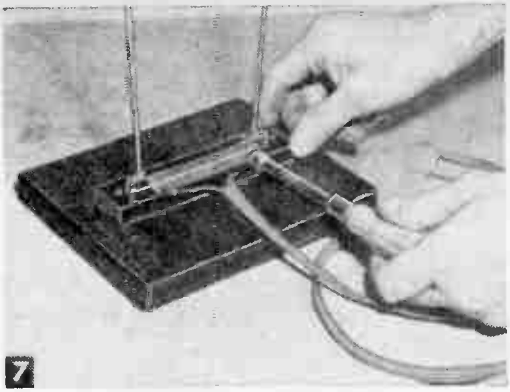
5 Drilling holes for 6-32 screws which attach terminal strip to base piece. Note that ends of antenna arms are put in position to line up the parts.

and the ends of the rods go down in the spring loops of the clips (Fig. 2) to make good contact and also serve to hold the rods in position. You may need to bend the loops out slightly in order to fit the 5/32-inch dia. rods. To make sure clips are placed right on Bakelite so the rods will pass through the loops and enter the holes in the bottom Bakelite piece, use a short piece of rod stock as a guide at each end to insure proper alignment before drilling the holes for the 6-32 screws that secure the clips. The terminal strip attaches to the lower piece with two 6-32 screws (Fig. 5 shows how the holes are spotted for the screws). With the ends of the rods through the loops of the clips and also pressed down in the lower Bakelite piece, use two small C clamps to hold the top piece in position for drilling (Fig. 5). Drill and then tap the holes for 6-32, and then screw terminal strip to base piece. Next screw the assembly to the plywood base with two 1-inch #7 *rh* wood screws (Fig. 2) to accomplish this.

6 Roundhead wood screws fasten the Bakelite base piece to the wood base, through holes bored in the ends of the Bakelite.

Making Antenna Arms

The 5/32-in. dia. aluminum rod stock is of the hard 17ST4 type. You'll need to get two 6-foot pieces from a local dealer in metal and metal products (look under these classifications in the yellow pages of your classified phone directory). Bend the coiled ends around a 6-inch dia. V pulley as shown in Fig. 2. A small hole was bored in the pulley to receive a steel pin, under which the end of the rod is placed to hold it. The pulley is then turned by hand and the rod carefully



7

Connecting a short piece of twin lead-in wire to the terminals. The other end connects to the television set terminals.

wrapped around to form the coil. The stock springs out when released to some extent and you can then apply some hand forming to get the neat coils shown.

Before fitting the finished coiled rods into the base section, slightly round the ends of the rods so that they enter the Fahnestock clips easily when the lever is pressed, and press them down firmly in the slanting holes in the base piece. This construction allows the rods to be turned while the spring clips still hod them firmly in place.

Figure 7 shows how the short length of lead-in wire is attached to the terminals. After connecting the other end of the wire to the set terminals, you are then ready to try out the new antenna. If you wish, you can attach four rubber base knobs or felt to the antenna base to protect the surface of your TV set.

Transistor Set for Code Practice

FOR those interested in mastering the International or Morse codes, an audio-tone oscillator is essential. Prior to transistors, two types of code practice circuits were popular. One was the vacuum tube *feedback* oscillator; the other was the neon-glow *relaxation* oscillator. The relaxation circuit was the simplest, but required a minimum of 60-volt *dc* to fire the neon lamp. The feedback circuit required a minimum of 22½-volt *dc* plate voltage, plus a 1½ to 6-volt filament or heater supply, depending upon the tube employed.

The circuit of this transistorized feedback oscillator has the simplicity of the neon-glow, the signal strength of the vacuum tube, and requires only one or two penlite cells for weeks of service. It may be used for solo practice, or two may send and receive with the same unit.

Following a simple breadboard design, the components are arranged on a 5 x 3½ x ⅝-in. baseboard (Fig. 2). The four Fahnestock clips attached to the base with ½-in. wood screws serve as terminals for attaching key and phones. The 4-lug tie strip secured near the baseboard center serves as a solder tie-point for capacitors, resistor and hookup leads; it also provides a simple mounting for the P-N-P junction transistor.

The feedback inductance is the primary side of most audio output transformers. This is the transformer between the output tube of a radio set and its PM speaker, and you can salvage one from a junked radio, or buy a new one, purchased usually for less than $1. Those advertised as 50L6 types are ideal, but any single plate-type output trans-

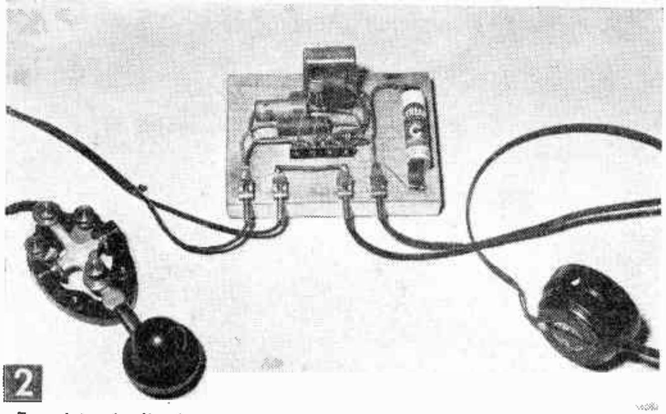
1

This transistor code practice outfit will operate for days on a single penlite battery. It is easily modified for 2-way use.

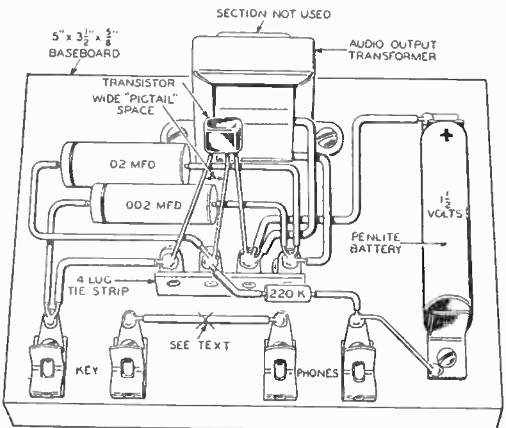
MATERIALS LIST-
CODE PRACTICE SET

- 1 5 x 3½ x ⅝" wood baseboard
- 1 P-N-P junction transistor, CK-722 (Raytheon) or RR-38
- 1 audio output transformer, 2500 to 10,000-ohm tube load
- 1 220K (220,000) ohm, ½-watt composition resistor
- 1 .002 mfd. paper capacitor (working voltage unimportant)
- 1 .02 mfd. paper capacitor (working voltage unimportant)
- 4 Fahnestock clips
- 1 transmitting key
- 1 pair, magnetic headphones, about 2000 ohms (do not use crystal type)
- 1 4-lug tie strip

Miscellaneous, ½-in. rh wood screws, hook-up wire, penlite batteries



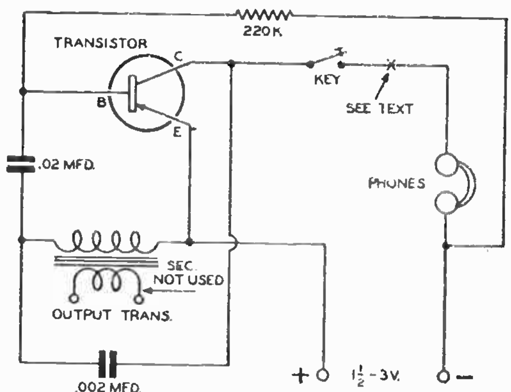
2 Transistor feedback oscillator requires no switch, since penlite cell is simply removed from base clips when unit is idle. Transformer may be eliminated when used for dual practice.



3 PICTORIAL DIAGRAM

Then, with key and magnetic phones connected, the transistor audio oscillator is ready for use. The headphones you use should be rated at about 2000 ohms or so (crystal headphones will not work in this circuit). For a stronger signal, use two penlite cells in series, which will then deliver 3 instead of 1½ volts to the circuit.

If you want to learn the code (Table A) with someone else, connect another key and phone in series, break the lead marked "X" in Fig. 3, and you have a two-way system. Remember, however, that when one person is sending, the other must hold down his key to provide circuit con-



4 SCHEMATIC DIAGRAM

former with a 2500 to 10,000-ohm rating will do.

Disregarding the two plain enameled voice coil secondary leads, connect the insulated primary leads (usually red and blue colored) at the tie-points as shown in Figs. 3 and 4.

Note that two small angle brackets (fashioned from spring brass, copper or tin) are screwed down to the base to secure a single penlite cell.

TABLE A—INTERNATIONAL MORSE CODE

A	.-	J	.---	S	...	2	..---
B	-...	K	-.-	T	-	3	...--
C	-.-.	L	.-..	U	..-	4	....-
D	-..	M	--	V	...-	5	.....
E	.	N	-.	W	.--	6	-....
F	..-.	O	---	X	-..-	7	--...
G	--.	P	.--.	Y	-.--	8	---..
H	....	Q	--.-	Z	--..	9	----.
I	..	R	.-.	1	.----	0	-----

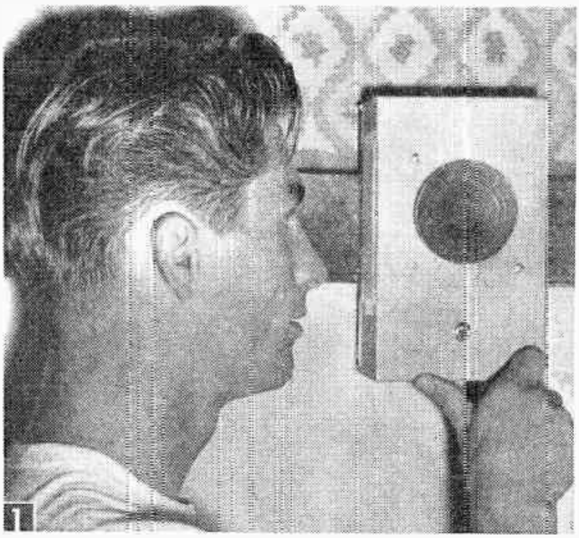
PERIOD .-.-.-
COMMA --..--
? MARK ..--..

tinuity. Some keys have a built-in knife switch for this purpose.

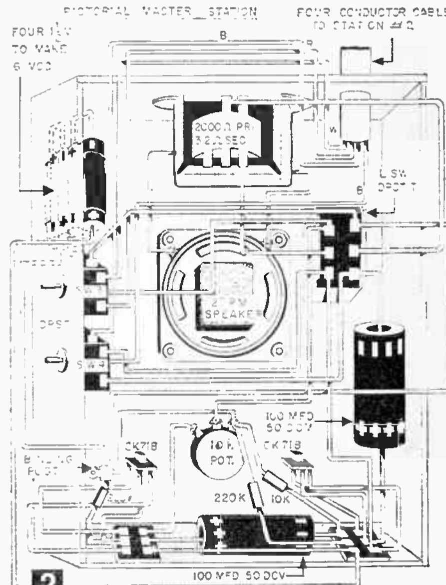
If this transistor oscillator is built expressly for two-way transmission, the audio output transformer can be eliminated by installing clips for the second pair of phones where the primary leads are terminated. Thus the second pair of phones serves both as reproducers and oscillator coil. You then insert the additional key at "X" in Fig. 4.—THOMAS A. BLANCHARD.

Transistorized Intercom

For less than $15 you can build this small but rugged two-station intercom and get surprising clarity and volume from room to room



A few parts—most of them from your scrap box—and a few hours of time and you have your intercom. Here the author is calling to the Master Station.



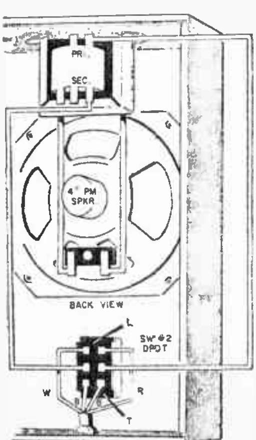
2

By DONALD S. PEARSON

THIS project is based on the Transistor Amplifier project given on p. 34 of the *Radio-TV Experimenter*, Vol. 6 (75¢). By changing a few of the original parts, and using the same circuit and adding a few extra parts and switches, this unit can be made to serve not only as the amplifier, but as an intercom as well.

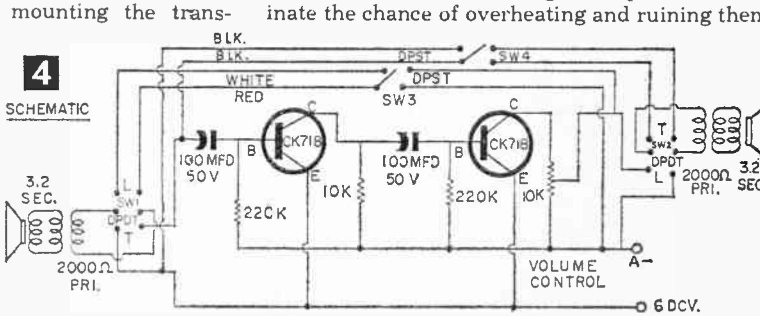
The schematic for the complete unit is given in Fig. 4, pictorial wiring diagrams in Figs. 2 and 3. Use a cigar box as the master station, mounting the transformer and speaker as near the top center as space will allow. The DPDT switch #1 on this station can be mounted to the right of the transformer and there will then be room enough to mount the three penlite batteries to the transformer's left.

You can mount the Cinch-Jones barrier-type terminal strip on the bottom of the box. Note the long leads on the transistor sockets. Leads are soldered to the sockets first; the transistors are inserted when all the wiring is completed to eliminate the chance of overheating and ruining them.



3 PICTORIAL-STATION #2

4 SCHEMATIC



To operate, SW1 must be on L, SW2 must be on T. SW3 and SW4 must be on the closed position. This is the necessary procedure for the Number Two station to call the Number One or Master Station. To call No. 2 station from the Master Station SW1 must be on T, SW2 must be on L. SW3 must be on the open position. SW4 must also be on the open position. Four-conductor cable is used between stations. A buzzer may be added if desired.

MATERIALS LIST—TRANSISTORIZED INTERCOM

No. Req.	Description
1	binding post (see Fig. 2)
2	2" or 4" PM speakers
2	output transformers, 2000-ohm Pri. 3.2-ohm Sec.
2	CK722 or CK718 transistors
2	electrolytic capacitors—100 mfd, 50 v dc
2	220K, ½-watt resistors
1	10K, ½-watt resistors
4	DPDT toggle switches
1	10K potentiometer
1	pointer knob for pot
2	Cinch Jones barrier type terminal, 3 or 6 term
2	transistor sockets (optional)
2	cigar boxes (or equiv. in size)
3-4	Penlite batteries

Long leads permit moving them to a more convenient position, depending upon the space in the box.

I used a 2-in. PM speaker in the Master Station. This was done because it was handy at the time of construction. It also left more room in the box in which to work. A 4-in. speaker will fit, and will probably give better results. Since they both cost about the same, the size speaker to use is optional.

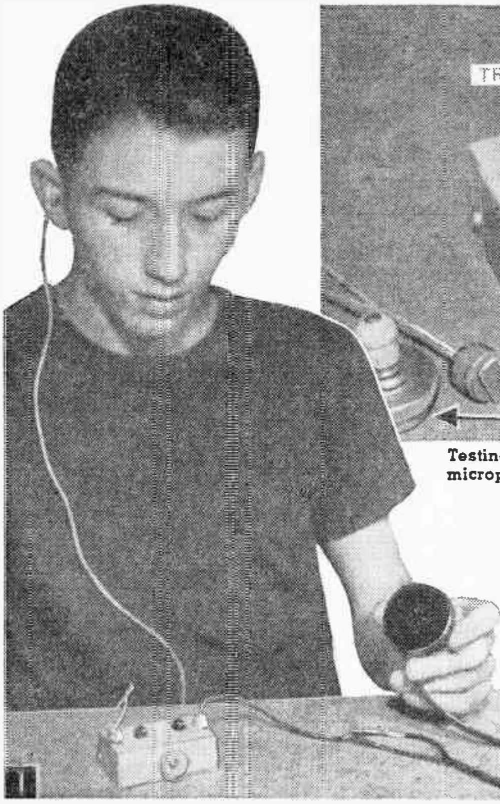
It is possible that a more simple switching arrangement could be devised, but the switches I used were handy at the time. If switches #3 and #4 are not used, an intermittent "bleep" will develop when the intercom is in use. The "T" position on switches #1 and #2, both enter the input side of the amplifier. When the master station is on the "T" position and the #2 station is on the "L" position, part of the signal would go through the amplifier, while the remaining portion of the signal would go out the "T" wires of the #2 station. With switches #3 and #4 at these points, however, the circuit is broken, thus allowing the entire signal to be amplified.

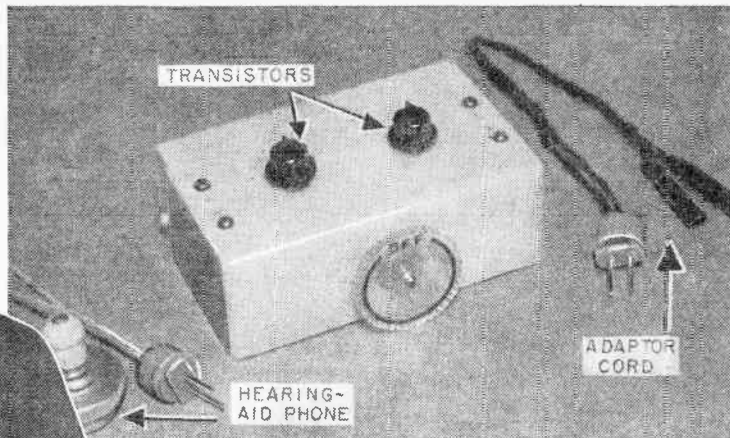
Because of the distance between the two stations (in my case, about 100 ft.), 4½ *v* are used, instead of the 1½ *v* used in the original transistor amplifier. (The batteries will become weak with use and cause a crackle or a mushy sound in the speaker. When this happens, replace the batteries.)

The box for the #2 station is also a cigar box. This can be made smaller if space is your problem. Both stations are mounted on the wall by means of four wood screws through the cover or lid of the box. Contact paper can be used to cover both boxes to give them a neater appearance.

"I said save the short-wave set!"

Vestpocket Transistor Amplifier





Testing an ordinary standard size magnetic earphone for use as a microphone with the transistor amplifier. Photo above shows how transistors are placed on outside top of case.

By THOMAS A. BLANCHARD

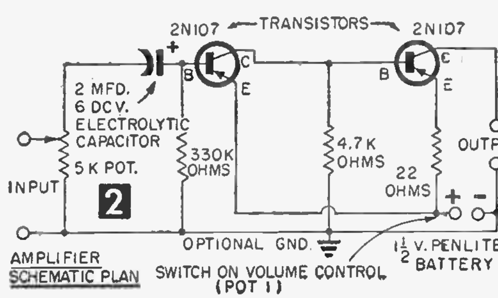
WHILE primarily intended to serve as an electronic novelty, this tiny transistor amplifier certainly is *not* to be classified as a toylike gadget. It may be used to amplify crystal radios, provide private listening with a record player, function as a detectophone, or even as an electronic stethoscope for tracking down vibrations in machinery, motors or engines.

The direct-coupled circuit requires the very minimum of components—all of which are quite inexpensive (see Materials List). A single penlite AA size 1½-volt cell powers the amplifier and the entire unit is housed in a 1 x 2 x 3-in. plastic box.

Make a battery clamp from a strip of 1/32 x 3/8-in. aluminum to fasten the battery to one of the 3-in. box sides as in Fig. 3. Then arrange the amplifier components to fit the remaining space. Because ordinary phone jacks require too much space, the "Input" and "Output" connections terminate at miniature jack strips which match miniature 2-pin plugs designed for hearing-aid size earphones. Drill four 3/32-in. holes spaced 3/16 in. apart at each end of the box for the jack strips. The two outer holes are for mounting the connectors with 2-56 by 3/8-in. *rh* machine screws. Remaining two center holes allow passage of plug pins through the box to the phosphor bronze contacts.

The volume control is the conventional subminiature type and measures just 5/8 in. diameter. A 1/4-in. hole drilled in the front of the box provides for its mounting. The control has a resistance of 5000 ohms and incorporates a power switch for turning battery power on and off as well as controlling the input signal. It has a 1/8-in. dia. shaft, 7/32 in. long and is slotted for either a decorative push-on knob or 5/8-in. dia. knurled set-screw knob for 1/8-in. shafts.

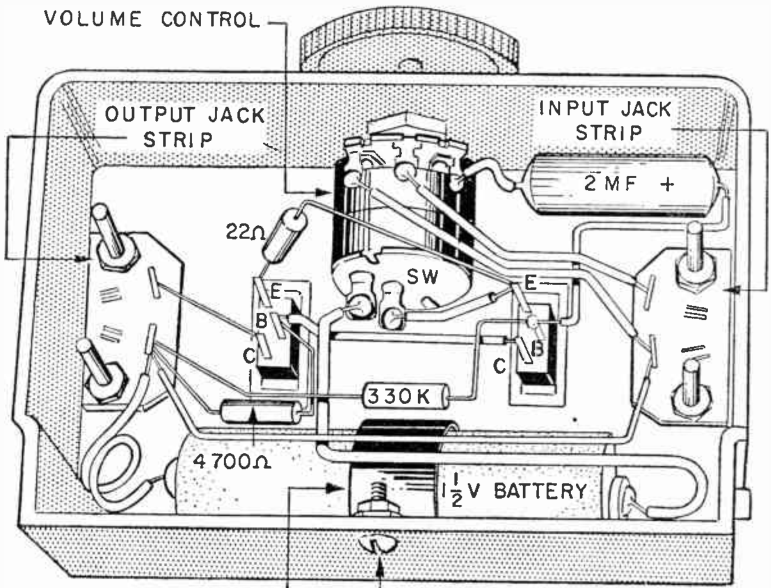
The entire amplifier hook-up will require only a few inches of wire since the pigtail leads on the 1/2-watt resistors and 2 mfd. 6 v. electrolytic capacitor provide their own connecting leads. Because of limited space in practically any transistor circuit, #22 solid tinned hook-up wire is best. Leads that require insulating may be covered with plastic radio "spaghetti." Two short lengths of conventional stranded, plastic insulated wire are used for the leads from amplifier to bat-



AMPLIFIER SCHEMATIC PLAN

tery. Solder these leads directly to the penlite cell (Fig. 3). The battery brass cap is *positive* and zinc case *negative*. Battery life in this circuit is remarkable so that in normal use, replacement will be infrequent.

A word about mounting the transistor sockets: These tiny Bakelite units require a rectangular hole opening of 5/32 x 11/32 in. To avoid making them too large, first drill two 9/64-in. holes side by side. Then use a 1/8-in. sq. modelmakers file to shape the rectangular openings in the plastic. Because plastic files down quite rapidly, check the hole size with a transistor socket after each few file strokes.



3

Using the Amplifier. Since all transistors are low impedance devices, this fact must be kept in mind when using the amplifier. A high impedance crystal microphone or phono pickup *cannot* be connected directly to the input. Nor can a crystal-type earphone be attached directly to the output of a transistor amplifier.

However, any 1- or 2000-ohm, magnetic earphone can be used either as a receiver or mike. While the amplifier was designed for use with a miniature 2000-ohm phone, large phones may be used with the simple adaptor cord shown in Fig. 1. Attach a miniature phone plug to one end of a short cord and to the other end attach two clips salvaged from an old octal wafer tube socket. Cover these clips with plastic spaghetti. Conventional phone tips can then be attached to the clips and the cord plugged into the amplifier. This method may be used for all other applications you may have in mind, such as using a PM speaker as a dynamic microphone.

Any PM speaker may be used. The matching transformer would have its 3 or 4-ohm winding attached to the speaker voice coil lugs. The transformer's 250 to 500-ohm winding would be connected into the input of the amplifier. Now to use the speaker as a speaker, just shift the pin plug to the output jacks and attach the output of a crystal radio, magnetic phono pickup, earphone mike, etc., to the input jacks.

A crystal phono pickup may be used with the amplifier in some instances without a matching transformer, but usually such will be required. An old fashioned magnetic pickup or modern magnetic types require no transformer coupling. Incidentally, a needle soldered to the diaphragm of an old magnetic earphone makes a good phono pickup.

Using the amplifier as a stethoscope, a standard size 1000 or 2000-ohm earphone is connected to the amplifier input, and a hearing-aid phone connected to output jack. Unscrew the large earphone cap and place the receiver on your chest. The exposed diaphragm provides a more effective pickup than with the cap on the receiver. Try placing the rubber eraser end of a lead pencil against the diaphragm, and pointed end in contact with any motor driven device. The result will be similar to that of an industrial stethoscope.

If you own a pair of magnetic phones, the existing tinsel cord may be removed from them and set aside. Each phone may be fitted with new cords and miniature pin plugs. Thus one phone will serve as a mike; the other as a receiver. When finished experimenting with the phones, the original cord may be replaced and phone set will again be as good as new.

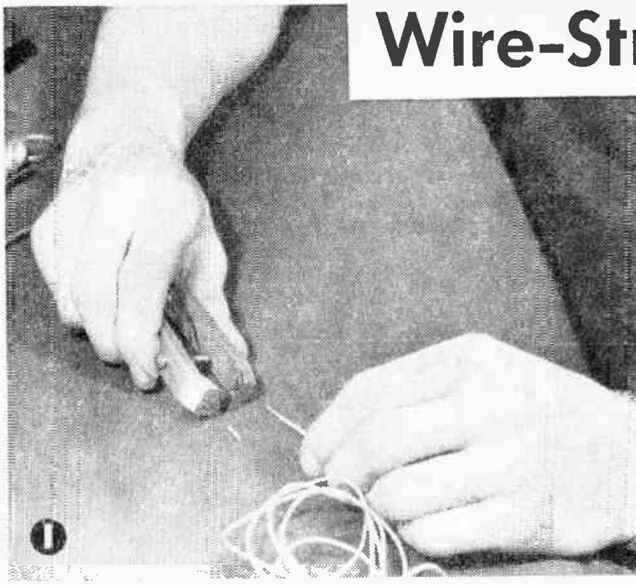
MATERIALS LIST—VESTPOCKET TRANSISTOR AMPLIFIER

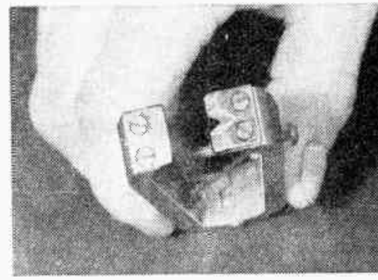
No. Req.	Size and Description
1	small plastic (or metal) box, approx. 1" x 2" x 3"
2	miniature 2-pin phone plugs
2	miniature matching jack strips for above
2	P-N-P transistors, GE 2N107 (or CK-722 types)
2	molded Bakelite transistor sockets for above
1	2 mfd., 6v. miniature electrolytic capacitor
1	sub-miniature 5K volume control/switch
1	knob for control
1	22-ohm. ½-watt composition resistor
1	4.7K, ½-watt composition resistor
1	330K, ½-watt composition resistor
1	type AA penlite battery, 1½v.
4	2-56 by ⅜" *rh* machine screws and nuts
1	4-40 by ¼" *rh* machine screws and nuts

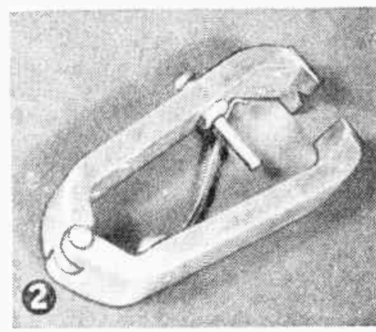
NOTE: To connect a high impedance crystal mike or pickup to amplifier, Lafayette Radio Transformer #AR-100 may be used. To use a PM speaker as such, or as a mike, use #AR-122, or #AR-119. Parts available from Lafayette Radio, 165-SM Liberty Ave., Jamaica 33, N. Y.

Wire-Stripping Tool

By HAROLD P. STRAND







THIS tool quickly strips insulation from all kinds of insulated wire in one twist of the tool and a light pull. End piece is then pulled off with the tool (Fig. 1). First an adjustment screw must be set, using a test piece of wire, to allow cutters to sever insulation without cutting strands of copper. The screw acts as a stop.

Tool accommodates all sizes of wire from about #10 down to the smallest common wire size. One of the hardened tool steel blades has a V cut and the other a straight edge (Fig. 2), both being ground to a sharp cutting edge. When sides of tool are pressed together, straight edge goes under V edge, with a snug but free fit, thus trimming around the wire insulation with one complete turn of the tool. Piano wire spring returns the side pieces to an open position when pressure is released. While the hinge joint shown was made in a small bench milling machine (Fig. 4), it can also be made with hand tools.

Fig. 3 gives a good idea of design and placement of parts. Fig. 2 shows the tool in its normal open position; spring, made from .055 in. piano wire opens side frames about 1⅜ in. at the top, as shown in drawing. Bend 2 pieces of ⅝x¼ in. brass to shape and dimensions given. Start with pieces about 6 in. long to facilitate bending operation. Use a heavy vise with brass jaw protectors and a fairly heavy hammer. To avoid marking stock use a small piece of brass under the hammer blow. After shaping, cut pieces to length; leave hinge ends a little long, until tongue and slot have been cut, after which ends can be dressed down to a good fit.

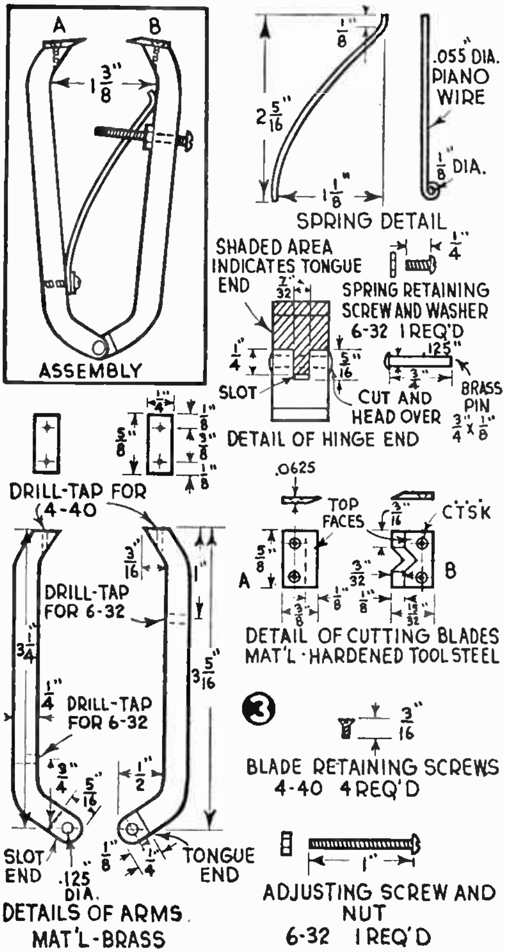
Finish pieces to a smooth surface, with fine abrasive cloth or a power sanding wheel, rounding all edges slightly. Drill and tap two 6-32 holes in the pieces, one for a spring retaining screw, the other for the adjusting screw. At the top ends, drill and tap 2 holes in each piece for 4-40 screws to hold cutting blades in place.

MATERIALS LIST—WIRE-STRIPPING TOOL

2 pcs.	brass bar stock ¼" x ⅝" x 6" (cut to length after bending)
1 pc.	tool steel .0625" x ⅜" x ⅝"
1 pc.	tool steel .0625" x $^{15}/_{32}$" x ⅝"
1	brass low-head rivet or pin ¾" x .125"
1	6-32 rh machine screw 1" long
1	6-32 hex. nut
1	6-32 rh machine screw ¼" long and washer to fit same
1 pc.	.055" dia. piano wire about 3" long
4	4-40 fh machine screws $^{3}/_{16}$" long

After fitting hinge joint with a fine file so it works smoothly without side play, drill hole for hinge pin, using a .125 in. dia. drill. This pin is a low-head brass pin or rivet which fits snugly in the drilled hole without causing joint to bind; use a little oil to get a free-working hinge. In riveting over the pin, don't drive joint together too tightly.

Shape an eye in one end of the .055 piano wire, using a pair of round-nose pliers, then bend to shape. Make blades of tool steel .0625 in. thick. Cut them out on a metal-cutting band saw or by hand with a hacksaw, and file to final shape and size. Make V cut on a power grinding wheel of fine grit. Grind underside of straight edge piece off to a sharp bevel and likewise grind top side of the other blade. Before final grinding of cutting edges, however, drill holes for the screws. Use flathead 4-40 machine screws, coun-



tersunk. With blades in a final finish condition, grind edges to a knife sharpness on a fine grit wheel. Harden blades with a Bunsen burner (Fig. 5) by heating to a cherry red, then plunging in cold water. Clean up one flat surface with

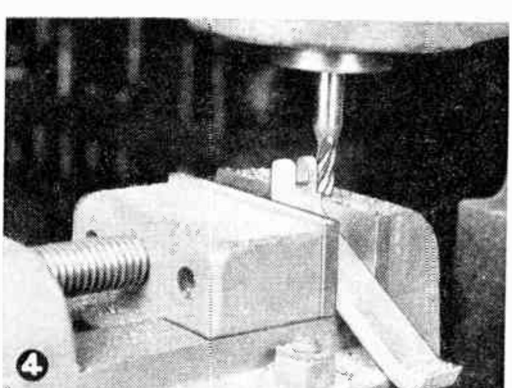


Fig. 4. Making hinge joint in a milling machine.

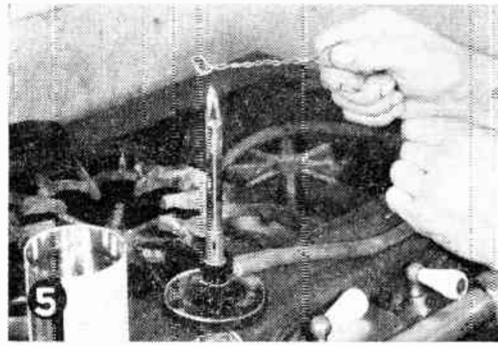


Fig. 5. Hardening cutting blades in a Bunsen burner (see text).

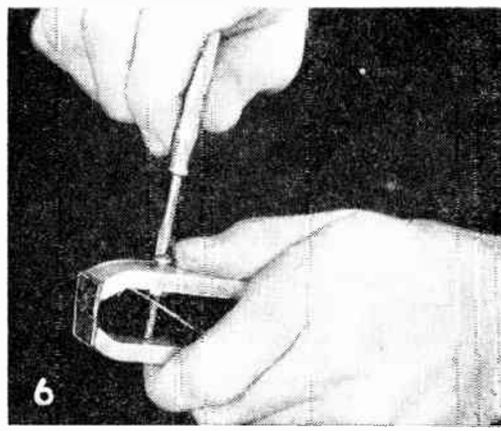


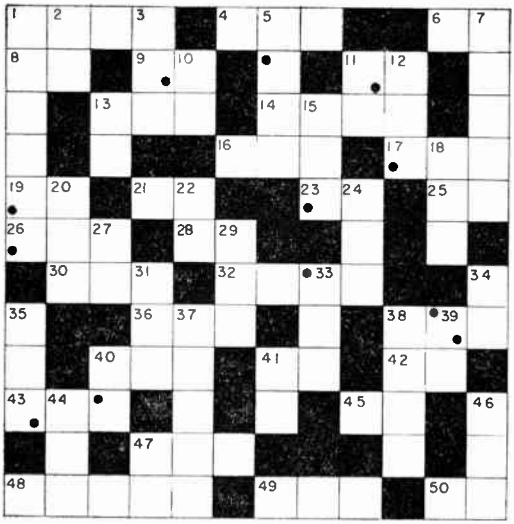
Fig. 6. Adjusting stop position of completed tool.

fine abrasive cloth and then place piece back in flame. When you note a straw color, quickly remove it and again place it in water. This draws the temper a little, so the steel will not be too brittle to work with.

Fig. 6 shows the completed tool with adjusting screw being tested. You may need to file down the end of one of the side frames so straight edge will just fit under the V edge after all blade screws have been tightened. Or a piece of .001 or .002 in. shim stock under one blade may give you the perfect alignment. Here is where accuracy in making hinge joint and in bending side sections counts. If poorly made, the blades will not make contact with each other properly, over their entire length.

You can also use this tool in radio chassis wiring for wire cutting ordinary #24 to #18 hook-up wire. If made properly, it will double for a pair of diagonal wire cutters or pliers. Place wire to be cut out of V groove, but between the cutting edges; wire will snip off just as nicely as with the diagonals; in this way one tool is used in place of two. This tool also trims short wires already attached at opposite ends, such as in re-connecting work or wiring changes. You will find the tool handy for using in very small spaces, where it will do a perfect job.

RADIO-TV CROSS NUMERAL PUZZLE



By JOHN A. COMSTOCK

CLUES

ACROSS

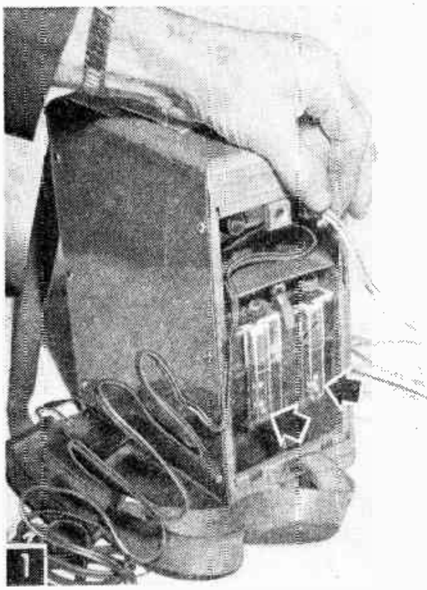
1) The year in which Lee deForest invented the "audion," a triode tube.
4) Mid-frequency of television channel 13.
6) Power consumed by a 175-watt television set operated for 12 hours.
8) Full-wave rectifier tube with electrical characteristics identical to those of the 5Y3.
9) Separation in megacycles between TV picture and sound carrier frequencies.
11) Fast tape recorder speed.
13) Output ripple frequency of full-wave, three-phase rectifier.
14) A current value of 1752 milliamperes converted to amperes.
16) The third harmonic of an 80-kilocycle signal.
17) A 20-cycle signal converted to kilocycles.
19) A capacitance of 2×10^{-2} microfarads expressed in conventional notation.
21) Upper frequency limit of TV channel 6 in megacycles (mid-frequency 85-mc.).
23) Five milliwatts expressed in watts.
25) The power that can be dissipated by two 200-ohm, 25-watt resistors, series connected.
26) Factor by which microhenries must be multiplied to convert to millihenries.
28) Voltage dropped when 2 amperes flows through a 26-ohm impedance.
30) Common AM superheterodyne IF frequency.
32) Oscillator frequency of a superhet having an IF of 456 *kc* tuned to a signal at 1144 kilocycles.
36) Output frequency of a generator having 10 poles and an armature speed of 1200 *rpm*.
38) Resistance of 15 ohms in parallel with 35 ohms.
40) Signal frequency received by a superhet with an IF of 456 *kc* and the local oscillator tuned to 1066 kilocycles.
41) The coefficient of coupling between two coils having values of .2 and .8 henries when mutual inductance is .1 henry.
42) The frequency 5,500 kilocycles converted to megacycles.
43) Total resistance of a 4-ohm, a 7-ohm and a 14-ohm resistance parallel connected.
45) The ripple frequency of a ½-wave single-phase rectifier.
47) Applied voltage across a series circuit of two resistors when voltage dropped across each component is 100 volts.
48) Upper frequency limit in megacycles of the shf band (lower limit 3,000 mc).
49) The wattage dissipated by a circuit drawing 3 amperes at 200 volts.
50) Number of degrees voltage lags current in a purely capacitive *ac* circuit.

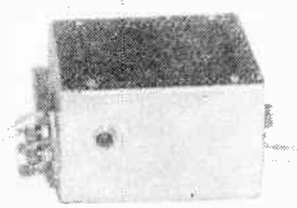
DOWN

1) Velocity in miles per second of a 500 *kc* signal.
2) Total resistance of two resistors of 35 and 55 ohms, series connected.
3) The wattage equivalent of one horsepower.
5) The peak value of a sine wave is found by multiplying the effective value by this factor.
7) Wavelength in meters of the lower limit of the vlf band (upper limit 30,000 meters).
10) Voltage dropped across a series *dc* circuit when the applied potential is 50 volts.
11) The frequency swing in FM transmission that corresponds to 100% AM modulation.
12) The frequency 520,000 cycles per second expressed in kilocycles.
13) Television frame rate.
15) The frequency 7×10^{-2} kilocycles expressed in conventional notation.
18) The unknown of the following voltage ratio: 1 is to 25 as 10 is to ——.
20) Lower frequency limit of television channel 12 in megacycles.
22) Highest approximate amplifier efficiency obtainable with class "C" operation.
24) International distress frequency.
25) Amount of voltage that will send a current of 5 amperes through a 10-ohm resistance.
27) The inductance .015-millihenries converted to microhenries.
29) Difference frequency in kilocycles produced by mixing a 1,000-*kc* signal with a 790-*kc* signal.
31) Impedance of an *ac* circuit when the current drawn is 1 ampere, applied voltage 511 volts.
33) Capacitance in microfarads of a capacitor having a reactance of 531,000 ohms at a frequency of 60 cps.
34) Amount of resistance in which a voltage of 35 volts will maintain a current flow of 1 ampere.
35) Total impedance of an *ac* circuit when reactance is 220 ohms, resistance 250 ohms.
37) Number of zeros represented by green in the resistor color code.
38) Wavelength in meters of a radio wave having a period of .005 second.
39) Current flow in an *ac* circuit when applied voltage is 20 volts, total impedance 400 ohms.
40) Power dissipated by a resistor of 200 ohms in series with a 5-microfarad capacitor across an *ac* voltage of 60 volts, 120 cycles per second.
41) Conductance of a circuit when current flow is 6 amperes, applied voltage 24 volts.
44) Percentage AM modulation that gives the greatest service-area coverage.
46) Amount of power expended when a current of 100 amperes is driven by a potential of 100 volts.
47) Secondary voltage of a transformer which has a primary voltage of 100 volts, primary turns 200, and secondary turns 40.

For answers, see Page 127.

Strobe-Flash Battery Charger





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Plugging the lead wire from the compact battery charger, shown at the right, into a built-in receptacle on the photo-flash unit. The three tiny balls floating in the electrolyte of each cell (identified by arrows above) are near the bottom, indicating the need for recharging. When balls float up to surface of electrolyte, battery is fully charged.

THE air turns blue when some photographer discovers weak batteries in his strobe flash unit have ruined a fine series of shots.

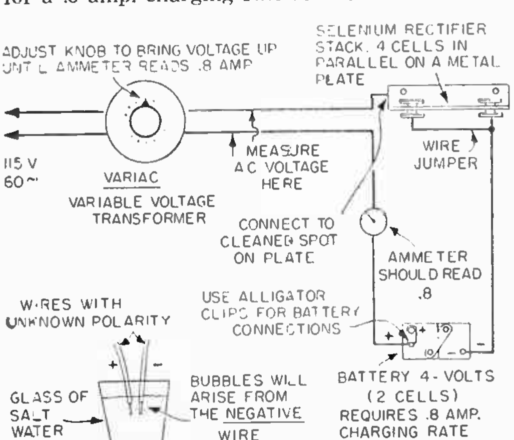
For strobe light flash units will operate even when the batteries are too weak to insure complete synchronization of the flash exposure.

One good way to avoid such wasted shots is to keep your strobe-flash batteries up to snuff with this charger. You can build it for about $10. less than the cost of a comparable commercially-built charger.

Although this charger was designed and built for a .8 amp. charging rate for use with a 4-volt battery in a Dormitzer Synctron flash unit, it could be redesigned for charging batteries of a different size. You can tell at a glance what the voltage of the storage battery in your unit is by counting the number of cells. Each cell is rated at 2 volts and since they are connected in series, merely multiply the cell voltage by the number of cells.

The recharging rate of the battery can be obtained from the manufacturer if it is not noted in the instructions you received with the unit. The value of .8 amperes is the same as 800 milliamperes, which is a more common term in electronics.

To find the correct a-c voltage that the charger transformer must deliver from its secondary in order to provide a .8 *amp.* d-c charging rate, make the test set-up shown in Fig. 2. A variable voltage transformer or Variac, which may be borrowed from a friend in the radio or electrical field, is connected with an ammeter in the test charger circuit. Start with 0 volts and gradually bring the voltage up until the ammeter reads .8 am-



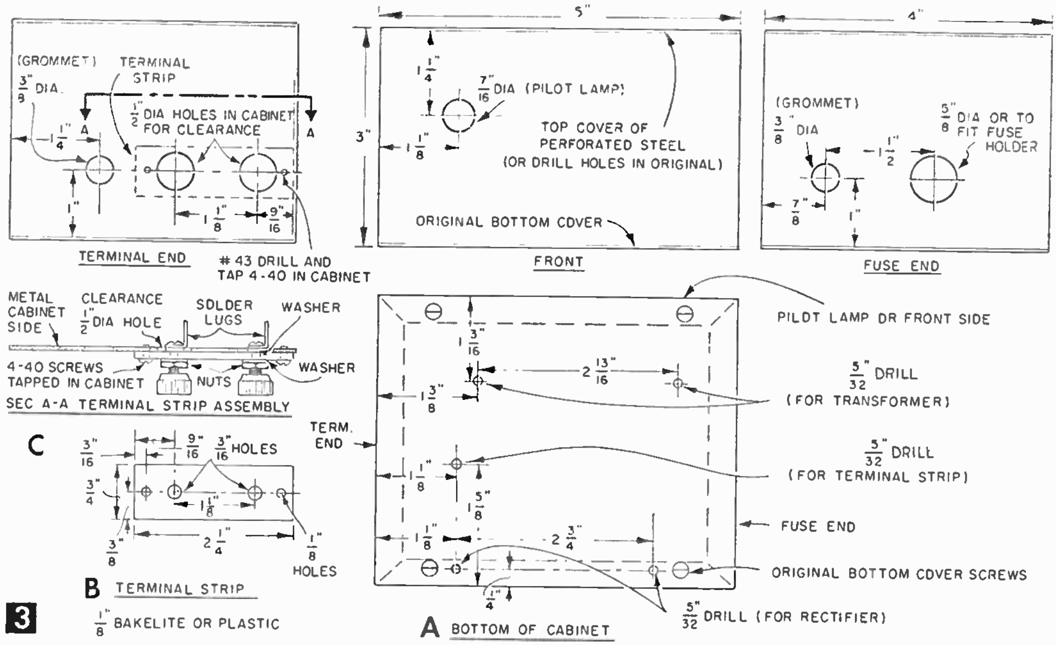
METHOD OF DETERMINING POLARITY OF A D.C. LINE WITH SALT WATER

2 TEST CIRCUIT FOR MEASURING A.C. VOLTAGE REQUIRED FOR A GIVEN D.C. CURRENT TO BATTERY

MATERIALS LIST—STROBE-CHARGER

No. Req.	Size and Description
1	3 x 4 x5" aluminum cabinet, hammertone finish, Type 29811 ICA
1	6.3 volts. 2 amp. filament transformer Merit P 2945
1	selenium rectifier, 1800 ma. D.C. Federal type 1018 (If the above rectifier is not available, purchase 4 International CIH rectifier plates of 250 ma each, Allied catalog #4A825, and assemble as in Fig. 8.)
1	fuse holder, panel type, Littelfuse type 342001 with 1½ amp. fuse
1	pilot light assembly Dialco type 432, Series 510 with 6.3 volt lamp
6 ft	flat rubber lamp cord
1	attachment plug cap
2	rubber or bakelite grommets for ⅜" hole
2	insulated thumb nuts (from old B battery)
1	⅛ x ¾ x 2¼" clear plastic or bakelite
2	8–32 R.H. screws ¾" long
2	8–32 nuts and 4 washers
2	solder lugs for #8 screw (Allied Cat. #44N607)
2	4–40 R.H. screws ¼" long
8 ft	#18 flexible insulated wire
1	special male plug to fit charging receptacle on battery unit (Order from manufacturer of flash equipment.)
2	Mueller test clips type Pee-Wee 45 with rubber insulators
1	2-terminal, Bakelite tie-point terminal strip
1	piece perforated steel 4⅞ x 3⅞" (cut from old television back or other cabinet enclosure)
	Miscellaneous screws, nuts, etc., for mounting parts

Above materials available from any well-stocked electronic supply house, such as Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

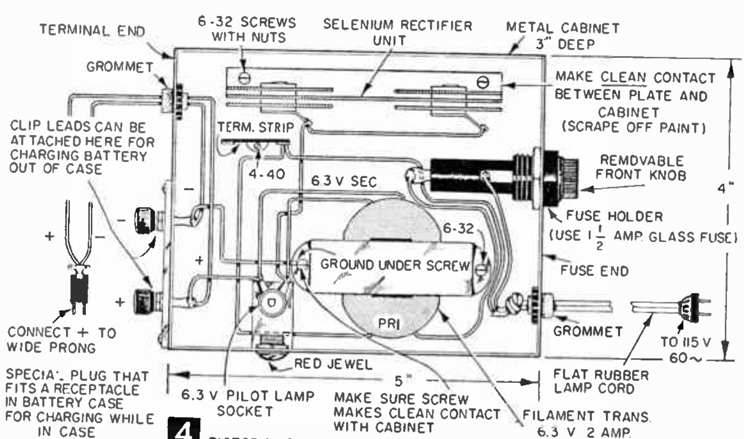


3

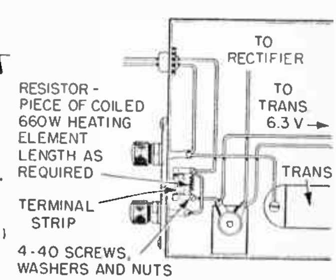
peres. Next, measure the voltage on the load side of the transformer with an a-c voltmeter having a range of to 0-10 volts to find the value required for a permanent transformer. In our case this was found to be 6.2 volts. If your flash outfit has a battery of the type described you will not have to make the above test. However, the method described is useful for determining the necessary voltage for other battery and rectifier combinations. See the Materials List for the components needed to make a 4 volt, .8 *amp.* charger. If the Federal rectifier is not available, use 4 International rectifiers as in Fig. 6.

Fig. 1 shows the new charger being connected to the battery in the carrying case, through a special plug that is attached to the wires coming from the charger, and which fits in a receptacle provided by the manufacturer for the purpose. Note that in this type battery, three small balls are used in each cell to indicate the condition of the battery. When all three are at the top, the battery is fully charged. As it goes down, the balls start to fall and when they are all at the bottom, the battery is discharged. It is well to start a recharge when the first ball has fallen and continue 2-3 hours after it has risen to the top.

Fig. 2 illustrates a set-up of a battery removed from the case and with an ammeter in the circuit to check the charging rate. Connections for this job are made to the two terminal posts and leads with alligator clips are employed. The meter reads about .9 amperes which is close enough to specifications of .8 amperes, since it would not be possible to always maintain exactly the same line voltage and fluctuations in line voltage would cause some variation in charging rate, as an expected fact. The use of these clip leads is conven-



4 PICTORIAL DIAGRAM OF RECTIFIER CIRCUIT SOLDER ALL CONNECTIONS



SEE FIG. 4 FOR CONNECTION WITHOUT RESISTOR

5

IF LINE VOLTAGE IS NORMALLY HIGH (120-125 VOLTS) CHARGING RATE CAN BE DROPPED TO .8-.9 AMPERES WITH A BUILT-IN RESISTOR IN THE CHARGING CIRCUIT. USE AN AMMETER TO DETERMINE THE REQUIRED AMOUNT OF RESISTANCE ient for charging a spare battery, but of course the meter would not be ordinarily used.

Start construction by drilling the required holes in the cabinet sides and bottom as detailed in Fig. 3A. Make the terminal strip as in Fig. 3B and assemble to the cabinet sides as in Fig. 3C sec. A-A with two 4-40 *rh* screws. Remove the bottom from the cabinet sides when fastening the transformer, rectifier and Jones terminal strip in their positions on the bottom of the cabinet with 8-32 screws as in Fig. 4. Scrape off the paint on the transformer and rectifier bases and cabinet and make up the screws tight so these parts will make a good ground connection. Use #18 insulated wire for all hookup connections and be sure to solder at all points of attachment. Assemble the fuse holder and pilot lamp socket to the cabinet sides and continue with the hookup wiring. Two grommets are used where wires leave the cabinet and these can be of rubber or *Bakelite* with screw-on rings.

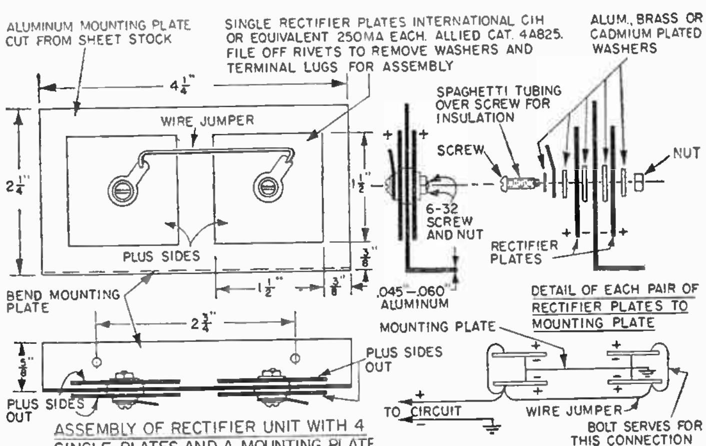
To provide ventilation and an escape for the heat generated in the cabinet, the original cover was substituted with a piece of perforated steel cut from what was formerly the back screen of an old television set. Any other perforated metal could be used instead. If desired, you can use the original cover by drilling six ½-in. holes in it.

If the battery is removed from the flash outfit and the special charging plug cannot be used as in Fig. 1, two leads with battery clips attached can be connected to the binding posts on the terminal strip as in Fig. 7. To replace a fuse, unscrew the front knob of the fuse holder and remove it so the glass fuse holder can be replaced.

As a rule when the battery has lost its charge, an overnight charging will fully restore the charge. However, when the battery has reached a certain age or had considerable use, it may not be possible to recharge it to the proper full condition. One or two of the charge indicating balls (Fig. 1) may rise but no amount of charging will effect the rise of all of them, or in some cases all the balls will rise, but in use the battery will be quickly depleted or fails to hold the charge. In either case it indicates that the battery is reaching the end of its life and may not be dependable.

In some areas where the line voltage is somewhat high (about 120 volts) the charging rate from the rectifier may also be on the high side.

This condition can be quickly determined with an ammeter connected in series with one of the charging leads as in Fig. 2. While a charging current of 1 to 1.5 amperes may not do any harm, and will certainly recharge the battery quicker, it is well to try and keep within the specified charging rate of .8 to .9 amperes if possible. Where the high condition is found, a series resistance can be connected in series between one of the terminal posts inside the cabinet and the wires that connect thereto, as in Fig. 5. A piece of coiled *Nichrome* 660-watt heater element about a half inch long, mounted in chassis terminal strip as shown, can be used for a convenient dropping resistance. With the ammeter in the line, cut this coiled wire to a length that will produce the desired current into the battery. You could also use a 25 w, 3 ohm adjustable resistor, mounted inside the case for a variable resistance.—HAROLD P. STRAND



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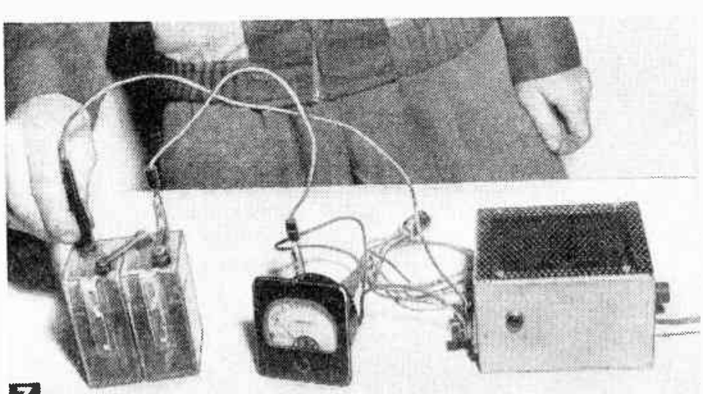

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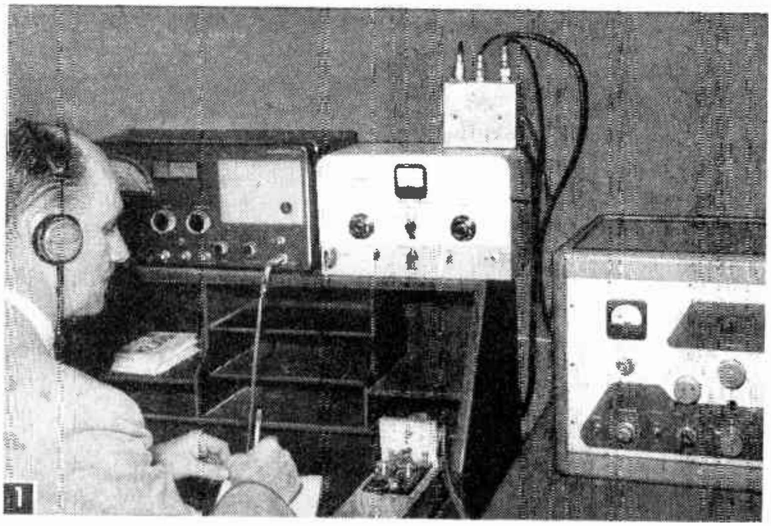
When charging a spare photo-flash battery or one removed from the case, leads with battery clips attached are connected to terminal posts on side of charger case. The ammeter shown is connected in series with one lead to check the charging rate which in this test is indicated as .9 amps. The meter is not ordinarily used.



1

A flick of the switch (on wood block above key) and you go from transmitting to receiving—or vice versa. If switch is located on a microphone, "push-to-talk" operation is possible with any transmitter from ½ watt to 1 kilowatt.

How to Use An Antenna-Changeover Relay

A boon to any amateur, a multipurpose, interchangeable "antenna-changeover relay" can be easily and cheaply constructed

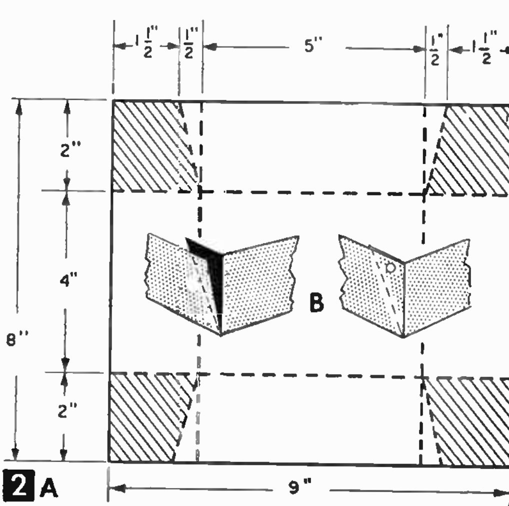
By RALPH E. SCHACHAT (W1GIF) and MARTIN GLICKSMAN

THIS unit automatically switches antenna to receiver or transmitter at the proper time; absorbs excessive received signal while transmitting, so that excess power will not be picked up (and possibly burn out components in the front end of receiver); allows just enough signal to be picked up from the transmitter so that transmission can be easily monitored; works equally well with high-power or low-power transmitters and serves both phone and CW operations. Relay is extremely flexible and interchangeable and can be transferred from one transmitter to another in less than a minute by simply changing two plugs; it minimizes the possibility of TV interference since it is totally enclosed in a grounded case.

Construction. Case for unit is a 2 x 4 x 5-in., #20 gage aluminum box. Take a flat 8 x 9-in. sheet of aluminum and scribe or score it as shown in Fig. 2A. Cut out shaded corner areas with a tin snips or a hack-saw and bend sheet along the scribed lines to form a box, with each flap forming a tight corner (Fig. 2B). Drill a $\frac{9}{64}$-in. hole in each corner, about ¼-in. on-center from the top and side of the box and fasten sides and flaps with 6-32 machine screws and nuts.

The cover of the box-case (Fig. 3) is made simply by cutting corners out square, and bending sides over at right angles to form a lip of about ¼ in. Use the box itself to work out the inside circumference of the cover. Fasten cover on two sides with ordinary sheet metal screws.

Select position for coaxial sockets (S1, S2, S3) so that each socket can be connected to the appropriate relay terminal (R1-A, R1-B, R1-C) with the shortest length of wire (see Fig. 5). Place the relay in the center of the case and mark positions of the sockets on the front panel of the box. Since the relay posts are not equidistant from each other, neither will the coaxial sockets be equally



2A

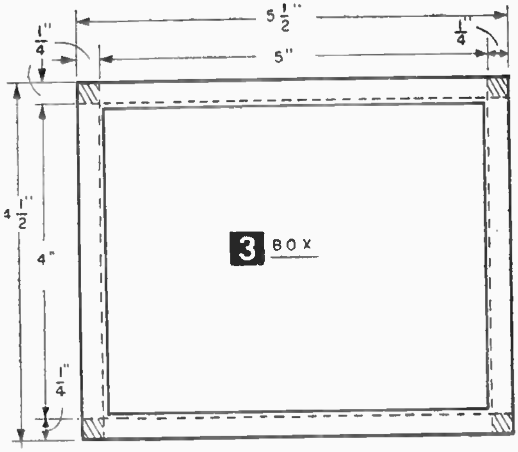
spaced from each other. When positions of the sockets have been selected, place a block of wood behind box wall and drill holes with an ordinary brace-and-bit. Select a bit slightly larger than the sockets, about ⅝ in., so as to allow clearance for their insertion. After sockets are inserted, mark mounting holes and drill and fasten sockets in place with small machine screws, lock washers and nuts. Drill a ⅜-in. hole on the right side of case for a rubber grommet through which power cord is passed.

Assembly of Relay Unit. Next, bolt the relay (R1) to the bottom center of the case with 6-32 machine screws and nuts. The relay is capable of handling up to 1 kilowatt of RF power, and has "wiping action" contacts.

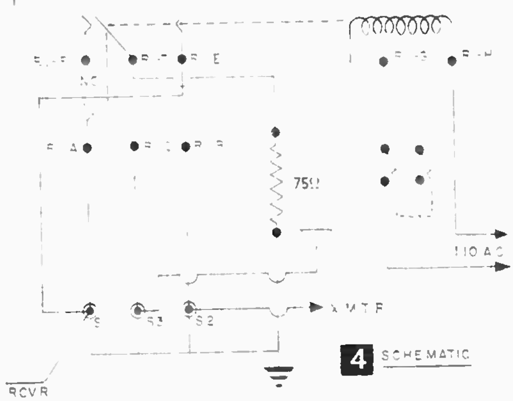
Connect the inner conductor of each socket to the appropriate post on the relay (see Fig. 5). Each socket, the relay (R1-D) and the case are individually grounded by means of a ground "bus" of #12 or #14 wire. A 1-in. screw extending out of the case at one corner is used to connect these components to a good outside ground. The 75-ohm, 1-watt carbon resistor between relay position R1-D and ground matches the characteristic impedance (75 ohms) of the RG-59-U coaxial cable used and gives more uniform quenching of signal pick-up over a wider range of operating frequencies. If a transmission line of another impedance value is used, substitute a corresponding 1-watt carbon resistor of the correct value.

Connect the receiver socket connection (S1) to the relay post (R1-E) with a length of hook-up wire about 6 in. long. This will permit a weak, but adequate, signal to be picked up when transmitting, allowing you to monitor your transmitted signal. If too much pick-up is obtained with this wire as short as possible, use shielded wire, grounding the shield to the case.

If you must conserve cash, eliminate the antenna (S3) or receiver (S1) socket and connect



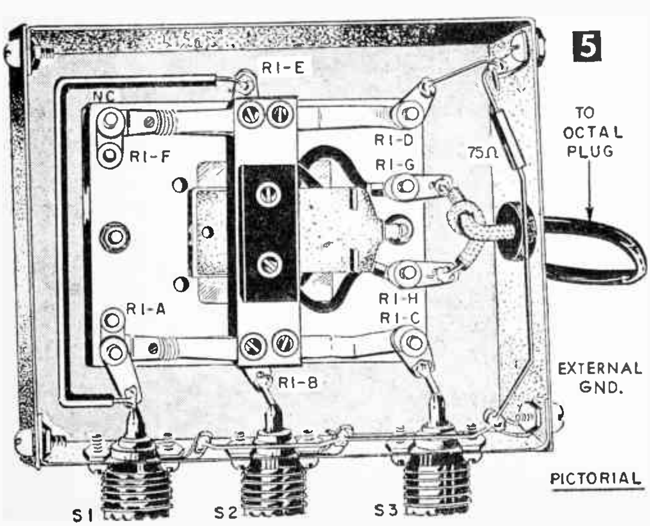
3 BOX



4 SCHEMATIC

the coaxial cable directly to the relay posts (R1-C or R1-A). This will reduce the flexibility of the set-up, however, and should only be considered if absolutely necessary.

An octal plug connects the relay to the transmitter which contains the switch and supplies the power. An octal plug is recommended because some transmitters, such as the Heath DX-100, have an octal socket built into the set so that no alteration is necessary. Any convenient prongs can be used of course, but if the transmitter is a DX-100, then prongs 2 and 4 must be used in order to conform with the existing internal wiring.

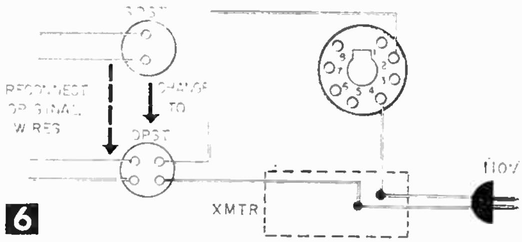


5 PICTORIAL

PLASTIC CORE INSULATES INNER CONDUCTOR FROM OUTER SHELL

MATERIALS LIST—CHANGEOVER RELAY

No. Req.	Description
1 pc	8 x 14", #10 gage aluminum
3	amphenol sockets type SO-239 (S1, S2, S3)
1	relay, type 400, Advance Electric and Relay Co. (R1)
1	DPST switch (to match SPST plate switch in transmitter)
1'	bare #14 wire
1'	standard hook-up wire
1	standard octal socket (Cinch-Jones No. 8EB or No. 8EC)
1	standard octal plug (Cinch-Jones 8-contact plug No. 8PB, with #16F cap)
1	75-ohm, 1-watt carbon resistor (see text)



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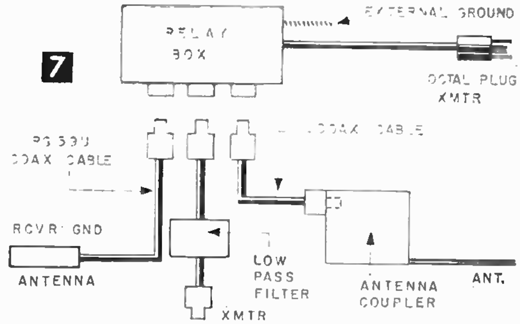


7

Modification of Transmitter. Many transmitters, such as the Heath AT-1, must be altered slightly to use this unit by replacing their SPST plate switch with a DPST switch. Reconnect the wires from the SPST switch within the transmitter to one side of the DPST switch and connect the other side of the DPST switch in series with the 110 *ac* drawn from the power supply plug and two prongs of the octal socket.

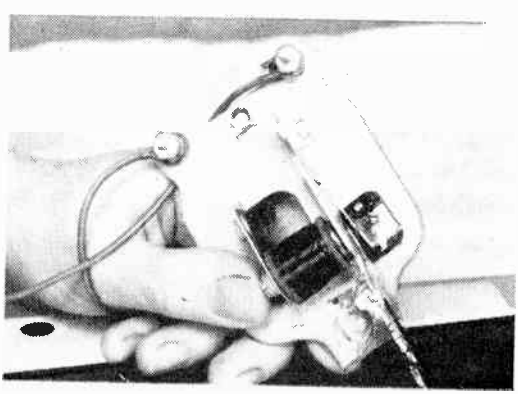
A remote switch can be added to suit the convenience of the operator. This can be attached to the microphone, to a hand-rest with the sending key on the edge of the operating table, or at any other convenient location. Wire such a remote switch in parallel with the regular plate switch so that the transmitter will be turned on by either switch.

To adapt the relay for use with other transmitters, mount an octal socket in any convenient place in the rear of transmitter's chassis and install a DPST switch in place of the SPST switch, reconnecting the original wire to one side of the DPST switch (Fig. 6). The two contacts on the other side of the DPST switch are then connected, with one contact going to terminal 2 of the octal plug, the other going to one side of the 110-*v* line. Connect the other side of the 110-*v* line to terminal 4 of the octal plug. Terminals 2 and 4 were chosen for the sake of convenience. Any others can be used as long as the corresponding plug-socket terminals are used.

Testing and Operation. With all plugs connected as in Fig. 7, turn on the receiver and the filament supply of the transmitter. The receiver should work normally. For the initial test, tune it exactly to the transmitter's operating frequency. Flip the transmitter's plate switch and tune up the transmitter in the usual way. When the plate switch is thrown on, the relay should click over to the antenna position and the receiver should cut out. Now, as the transmitter is operated, the receiver should give out a pleasant, medium-level monitor signal so that you can hear if your CW signal is clear and crisp or whether it has clicks or chirps. Similarly, by allowing someone else to talk into the microphone of a phone rig, you can easily monitor voice.

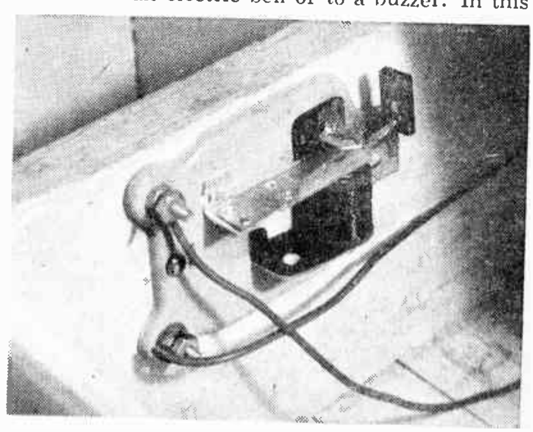
Stippling Machine from Bell

IF THE clapper of a bell is removed and replaced with a nib which may be soldered into position, a very efficient electric stippling machine may be had. After being used 10 or 15 minutes, this machine will be found capable of covering a large area at high speed. It must be held just the right distance from the surface to be inked and just the right amount of ink must be used. A little experience will determine these points.—R. F. Y.



Buzzer Makes Secret Lock

HERE the small bolt of an especially made lock for a drawer is soldered directly to the armature of an electric bell or to a buzzer. In this



case, the current is led directly into the coil and the vibrating system is cut out. When current flows through the coil, the armature will be pulled down and thus release the bolt.—R. F. Y.

The Easiest and the Hardest

Have you picked up Spanish language radio broadcasts and wondered where they originated? Here's how you can find out

By C. M. STANBURY II

IT is fairly easy to tune Latin American stations on the broadcast band. An experienced listener who knows how to identify these stations will tell you that this is the easiest of foreign DX (distant reception). They are not too distant, and it is easy to learn the small amount of Spanish needed for this type of reception. Most stations have frequent commercials which provide easily obtainable program data for your report.

There is no time, during the hours of darkness, when south of the border stations are absent from your dial. During the evening, CMHQ, Santa Clara, Cuba, consistently holds down the 640 kc spot in eastern North America, while in the west such stations as TGJ (880) Guatemala, HJKC (840) Bogota, Colombia, and YSS (655) San Salvador are nightly visitors. Even more powerful are the Mexican border stations. These broadcast in English on relatively clear channels. At least two of them, XEG (1050) and XERF (1570), operate all night.

For best reception the DXer should tune the 2½ hours following sunset. This is especially true during an ionospheric disturbance. (Such disturbances, believed to be associated with sunspots, cause a drop in signal strength. The severity of such blackouts depends upon how near a station is to the pole. Reception from northern stations will be almost impossible, middle latitude stations will be weak, but semi-tropical stations will not be hampered.)

With all this good hunting you will want to know how best to spot your quarry. There is, of course, the obvious and easy matter of language. If while tuning you hear Spanish, chances are pretty good your DX search has paid off. Once your station is zeroed in, you are ready to identify it and obtain enough program data for your report. This is easy. Many well-known American products are advertised south of the border. (Table C will give you help among these lines.) Table B shows the Spanish pronunciation of every letter in the alphabet. With it and a little practice, you should have little trouble interpret-

TABLE A—STATIONS TO START WITH

FREQ.	CALL	LOCATION	SLOGAN AND ADDRESS (*denotes good verifier)
585	TIJC	San Jose, Costa Rica	Radiopolis
590	CMW	Habana, Cuba	Circuito CNC. O No. 216, Vedado*
625	TIDCR	San Jose, Costa Rica	La Voz de la Victor, Apto. 225*
640	CMHQ	Santa Clara, Cuba	Circuito CMQ. Radiocentro, Vedado, Habana*
650	YVQO	Puerto La Cruz Venezuela	Ondas Portenas, Apto. 482*
655	YSS	San Salvador, El Salvador	Radio Nacional, Teatro Nacional
660	CMCU	Habana, Cuba	R. Garcia Serra, Paseo de Marti 260
670	CMHG	Santa Clara, Cuba	Relay of CMBC 690 kc
675	YNDS	Managua, Nicaragua	Union Radio
690	CMBC	Habana, Cuba	Radio Progreso or R. Nacional, Av. Menocal 105
700	YVMH	Maracaibo, Venezuela	R. Popular, Apto. 247*
730	CMCA	Habana, Cuba	Radio Mambi, Paseo de Marti 107
760	CMCD	Habana, Cuba	Radio Voz de la Hora, Calle 25, No. 113
770	CMDC	Holguin, Cuba	R. Oriente, Aguilera 511, Santiago*
770	HJDK	Medellin, Colombia	La Voz de Antioquia, Maracaibo 46-70*
790	CMCH	Habana, Cuba	R. Cadena Habana, San Jose 104
820	HJED	Cali, Colombia	La Voz de Rio Cauca or Ca Ra Col (fair verifier)
830	CMBZ	Habana, Cuba	R. Salas, San Rafael 108, 2°piso (fair verifier)
840	HJKC	Bogota, Colombia	Ca Ra Col, Calle 53, No. 46-80*
880	TGJ	Guatemala, Guatemala	Radio Neuvo Mundo, 6a Av., 10-45, Z1. Strong on Pacific Coast*
910	CMCF	Habana, Cuba	Union Radio, La Rampa, 23 e Emganta
935	YNW	Managua, Nicaragua	Radio Mundial, 5a Calle N.O.
998	YVOB	San Cristobal, Venezuela	La Voz del Tachira, Apto. 37*
1015	HOU44	Panama, Panama	Radio Reloj. Best early AMs*
1020	HJAQ	Cartagena, Colombia	Radio Miramar*
1060	CMCX	Habana, Cuba	La Emisora Amiga, Edif. Odontologico, L y 23, Vedado
1075	YSEB	San Salvador, E. S.	La Voz de Latino-America, Calle Los Planes Km. 4
1120	YVMF	Maracaibo, Venezuela	Ondas del Lago, Apto. 261 (fair verifier)
1160	CMJK	Camaguey, Cuba	La Voz del Camagueyana, Finlay No. 4*
1175	TIQ	Puerto Limon, C. R.	Radio Casino, Apto. 287*
1198	CMDD	Bayamo, Cuba	Relay of CMDC, 770 kc.
1200	CMK	Habana, Cuba	Radio Deportes, manzena de Gomez 508

ing calls. But there is also another way of identifying your catch. Foreign broadcasters tend to use their slogans as often as their call letters. Such slogans are not hard to interpret. Most of the Spanish words used resemble English words, for example, *Radio Nacional* and *Radio Central*. Others make use of place or well known names such as *La Voz de Cali*, and *Radio Bolivar*.

Table A lists 32 stations to start with and includes slogans. White's Radio Log (see page 161 of this handbook) contains all Puerto Rican and the most widely heard Mexican and Cuban stations. These stations announce their call letters as frequently as American stations. Finally, a government publication, *Broadcasting Stations of The World: Part III* (Catalog No.: Pr. 34.659:957/-Pt. 3) lists all foreign stations alphabetically both by call and slogan. It can be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. for $1.25.

Now that you know how to hear it, you will want to verify all this DX. And this is where things get tough because of the language barrier. While many stations have someone on their staff who can read English, many out-of-the-way stations do not. Reporting in Spanish tends to convince the Latin that you are genuinely interested in his station. For those who don't write in Spanish, one solution is a Spanish report form. The National Radio Club, 325 Shirley Ave., Buffalo 15, N. Y., provides its membership with such forms at cost. Dues are $4 a year and include a subscription to DX *News*.

TABLE B
SPANISH PRONUNCIATION OF CALL LETTERS

A	ah
B	bay
C	say or thay
D	day
E	ay
F	ay-fay
G	hay or gay
H	ah-chay
I	ee
J	hoa-tah
K	kah
L	ayl-yay
M	ay-may
N	ay-nay
O	oh
P	pay
Q	koo
R	erray or ay-ray
S	ay-say
T	tay
U	oo (as in tool)
V	vay
W	dahblah-oo or dahblah-vay
X	ay-kees
Y	yay
Z	zay-tah or thay-dah

In writing to Latin stations, try to tell what you heard in Spanish. This is not too difficult. List the time and the item heard. Translations for most of the program data will be found in Table C.

An ordinary radio receiver will not bring in nearly as many stations as a specialized receiver —one with crystal selectivity. The latter is desirable, especially for receiving stations that broadcast between the ordinary frequencies (for example, 725 *kc* instead of 720 or 730).

Different makes of crystals vary slightly in their operation. However, the following procedure generally applies. Set the crystal selectivity control at the first stop and the phasing control in the center position. Carefully tune the dial until you are on the carrier frequency. There are three

TABLE C—SPANISH WORDS AND EXPRESSIONS FOR REPORTING

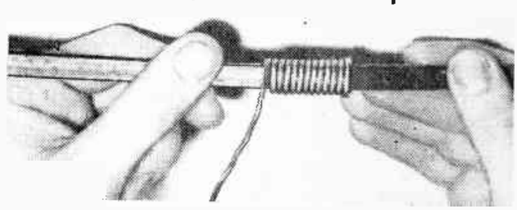
station identification: anuncio de la estación
program: programa
announcement of the correct time: anuncio de la hora correcta
to: a
advertised............: propaganda de............
a march: marcha
classical music: musica clasica
popular music: musica popular
guitar music: musica guitarr
dance music: musica de baile
duet: duo
trio: trio
chimes: ritmo de las campanas
solo vocal by man (woman): solo vocal por hombra (dama)
singing commercials: anuncios comerciales cantados
beer: cerveza
slow: despacio
fast: ligero
cigar: cigarro
mass: misa
political speech: habla politica
and: y

SAMPLE LISTING OF PROGRAM DATA

10.00 a 10.15 pm—programa de musica popular
10.00 y 10.15—anuncio de la estación y ritmo de las companas
10.05—propaganda de Pepsi Cola
10.10—propaganda de Cerveza Crystal.

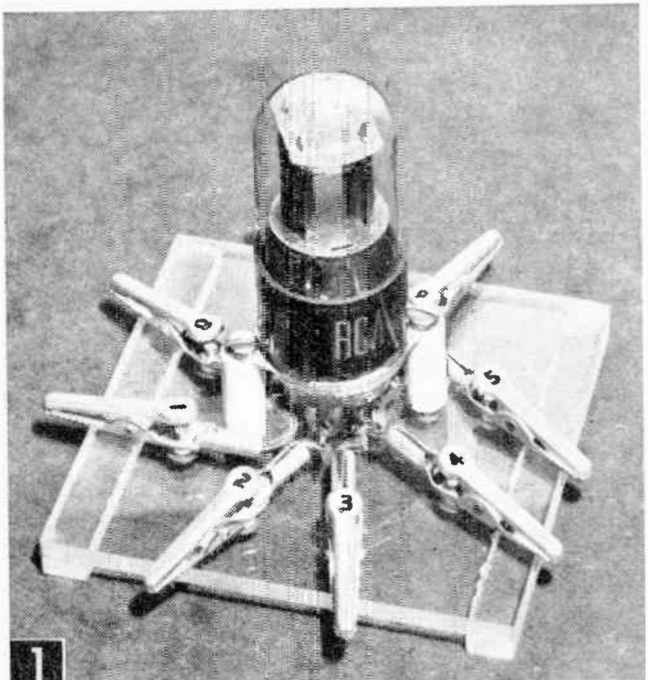
ways of accomplishing the latter: 1) Watch the S-meter; it will peak at the desired frequency; 2) Listen until only a soft swishing sound is audible; or 3) You can turn on the BFO (beat frequency oscillator); after it produces a whistling sound, set the beat frequency control in the center (at 0), and tune back and forth until the BFO's pitch drops to zero. Turn off the BFO. Now adjust the phasing until the heterodyne is least annoying. It is often necessary, when using the crystal, to switch from AVC to manual. A strong station on a nearby frequency tends to block the AVC. Finally some crystals, even in first position, tend to cut the sidebands off too sharply. The effect will be similar to an unmodulated carrier. On occasion it will be necessary to tune slightly away from the carrier frequency in the direction having the least interference. Following this, you will probably have to reset the phasing control.

Solder Improves TV Reception

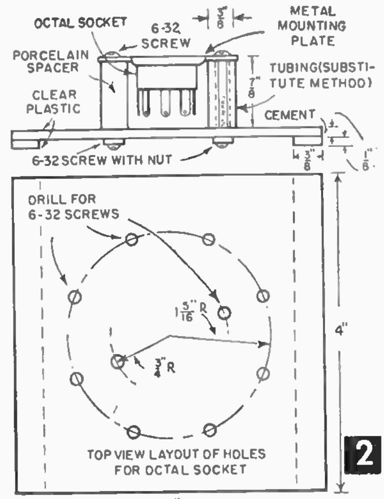


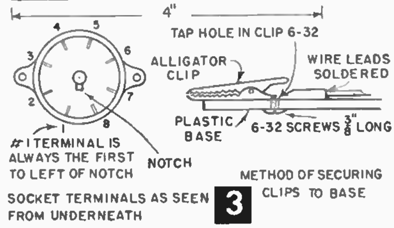
• When a TV ribbon lead-in appears to be unbalanced, don't wrap aluminum foil around the line—after a while it will become torn and crumpled and have to be renewed. Instead, close-wrap wire solder around the line as shown. It will last indefinitely and be easy to slide up and down the line to improve TV reception.—J.A.C.

Alligator Clipette for Experimenters



1 Short wires soldered to clips and to socket terminals complete the project.





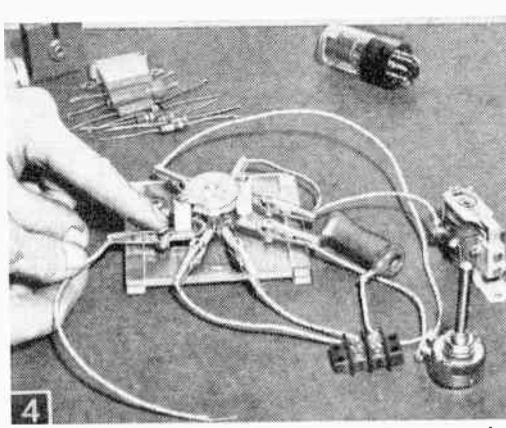
ELIMINATE the slow and tedious job of soldering and unsoldering connections at socket terminals in "breadboard" set-ups by using an alligator clip socket unit for each tube in the circuit (Figs. 1 and 4). Wires and various components can be directly connected to the sockets without the use of solder, and they can be just as quickly disconnected for changes in the circuit. The unit illustrated here is for an 8-pin or octal socket, but similar units can be made up for 7-pin and 9-pin sockets.

First step in making unit is to attach the two bottom strips to the clear plastic base with an acrylic plastic cement (Fig. 2). Apply sufficient cement to the surfaces to be joined to soften the plastic, press the pieces in place and lightly clamp for a few hours. Drill the holes as in Fig. 2. Then remove the original terminal screws in the clips and tap the holes for 6-32 threads. Use screws 3/8-in. long to hold clips in position on base (Fig. 3). Pieces of *Bakelite* or fiber tubing cut to size can be substituted for the porcelain spacers (Fig. 2).

Number clips in counterclockwise fashion so that, when viewed from underneath, numbering corresponds to socket-terminal numbering running clockwise from the first terminal to the left of the center slot (Fig. 3). This is the standard arrangement in all schematic diagrams. Short pieces of #20 insulated wire can be used to connect terminals in consecutive order to the clips.—HAROLD P. STRAND.

MATERIALS LIST—ALLIGATOR CLIPETTE
(For octal socket)

No.	Description
1	clear Lucite or Plexiglas 1/8 x 4 x 4", base
2	clear Lucite or Plexiglas 1/8 x 3/8 x 4", feet
1	octal socket attached to steel mounting plate
2	porcelain spacers 3/8 O.D. x 7/8" with 6-32 threaded holes
8	Mueller alligator clips with screw terminals
6 in.	#20 insulated wire
8	6-32 rh screws 3/8" long
4	6-32 rh screws (for porcelain spacers) or
2	6-32 rh screws 1 1/8" long with nuts (if tubing is used as spacers)

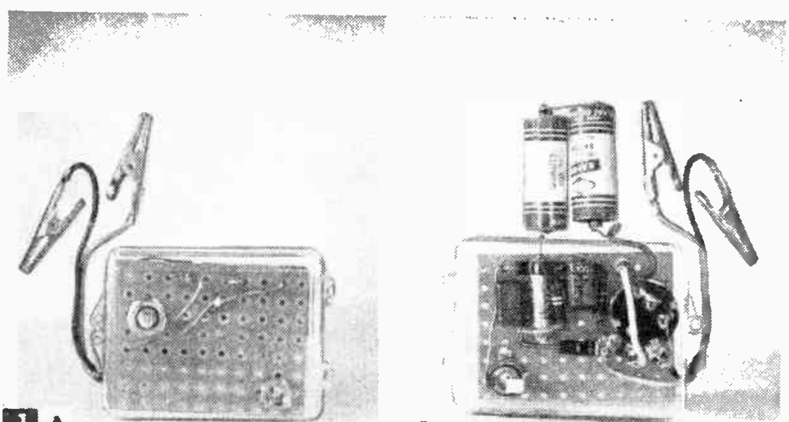


4 Trying out the alligator clip socket unit in an experimental circuit. Radio beginners will find the unit very handy when making various receivers.

The PIGGY-BACK

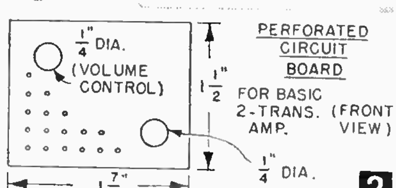
The term piggy-back may recall for you the days when you hitched an occasional ride on your Dad's back, or it may remind you of a practice in the transportation industry. As used here, however, it refers to the units used with a basic piece of miniature, transistorized electronic equipment built so that it may become any one of a number of different electronic devices simply by attaching a different piggy-back

By FORREST H. FRANTZ, SR.



1 A B

The basic two-transistor amplifier with clip-type input leads for general-purpose use (A). Volume control knob has been omitted in this photo to show simplified wiring more clearly. Piggy-back units are built on plastic case halves. In B, the basic amplifier is shown with an inexpensive flashlight battery power supply.



2

THE basic unit used in this project is a two-transistor, high-gain, audio amplifier constructed on one-half of a 1 x 1⅝ x 2⅛-in. plastic box. For general-purpose amplifier applications, this basic unit can be used with a blank piggy-back as the other half of the case. Any of the other piggy-backs described in this article may be used in place of the blank half case.

One of the piggy-backs is a microphone which—with the basic amplifier—may be used as a hearing aid device, as an "eavesdropper," as a very novel but simple vest-pocket musical instrument, as a power amplifier driver and in numerous other practical and novel applications.

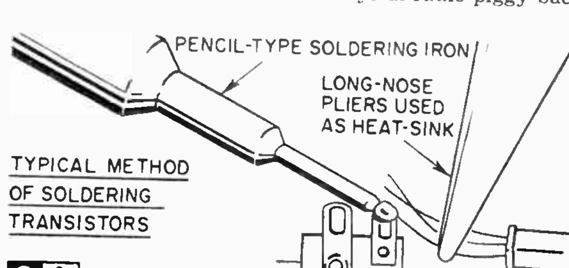
Another is a simple radio tuner-detector. A crystal unit is described in detail and a circuit for a regenerative transistor detector is presented for the hobbyist who wants a hotter radio and enjoys doing his own package designing.

Another piggy-back unit does not attach to the back of the basic amplifier. It is a loudspeaker unit that is the same size as the basic amplifier with a piggy-back (1 x 1⅝ x 2⅛ in.). It may be used attached side-by-side to a basic unit piggy-back combination, or it may be used with a piggy-back combination unattached for remote placement. This speaker unit may be used as a general-purpose speaker for other equipment, too. A second larger speaker unit is also described, and either of these speakers may be used for the variety of applications to be discussed. Additionally, a circuit for an extra amplifier stage that may be built into the basic amplifier to beef up the output will be described.

Finally, a number of circuit ideas for additional piggy-backs and accessories that will extend the application of your piggy-back equipment even further will be presented.

Cost. Is all of this equipment expensive? The answer is no. The piggy-back approach allows you to build circuits in basic easy-to-handle and easy-to-use sections. Components for all of the sections together do not cost as much as the parts for some single-application construction projects, yet you have a multitude of circuits that can be combined in many ways to equal many single-application projects.

To be more specific, the basic amplifier unit costs less than $5; the deluxe microphone piggy-back costs about $7; and two less expensive alternatives about $2. The crystal radio piggy-back



TYPICAL METHOD OF SOLDERING TRANSISTORS

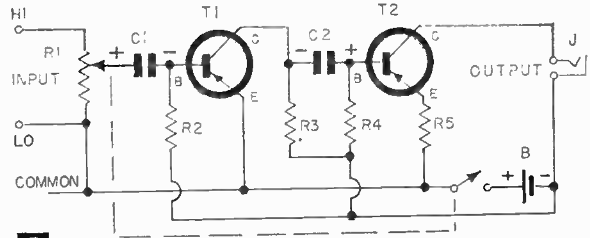
2A

costs less than $3, and the small loudspeaker unit costs a little over $2.

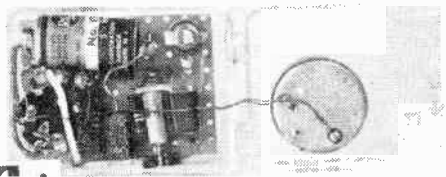
THE BASIC PIGGY-BACK AMPLIFIER UNIT

The basic piggy-back amplifier unit uses two PNP transistors—the inexpensive Raytheon CK722's. Texas Instrument 2N367/300 or General Electric 2N107 transistors may be used in place of the CK722's without any circuit or parts value changes. These transistor types are inexpensive, experimenter-grade transistors. The amplifier has its own volume control and will operate from a self-contained battery supply. You may use any voltage from 3 to 6 *v* for the battery supply. You can obtain 3 *v* from two small penlite cells (type N). This voltage is adequate for headphone operation, but you'll want 4½ to 6 *v* to operate a loudspeaker. The RCA VS310 battery is recommended for use with the amplifier because it provides 5½ *v* (enough for loudspeaker operation), and it's small enough to allow any of the piggy-backs to be attached without crowding. The battery operating cost is higher when this small battery is used, but for some applications, the compactness is worth it.

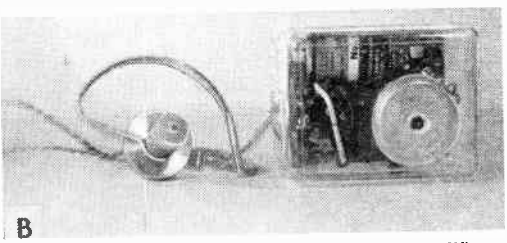
For the technically inclined, it is interesting to note that operating current is about 2 *ma* when a 5½-*v* battery is used with a 2000-ohm earphone in the output jack. The amplifier gain of the original model with a 2000-ohm earphone connected was 51 decibels. In terms of voltage gain, that's 320; the signal into the amplifier is magnified 320 times!



3 2 TRANSISTOR AMPLIFIER SCHEMATIC



4 A



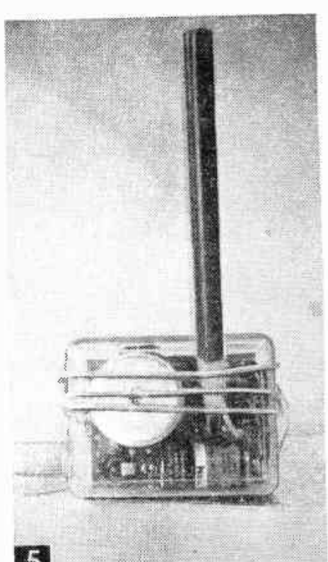
B

Back and front views of basic two-transistor amplifier with deluxe microphone piggy-back using 2000-ohm headphone (B).

To construct the amplifier (Fig. 1), cut and drill a piece of the miniature perforated Bakelite circuit board (see Materials List) as shown in Fig. 2. Make a matching set of holes for the phone jack and volume control in one half of the plastic case by making pilot holes with a heated ice pick and then reaming holes out to size with a taper reamer.

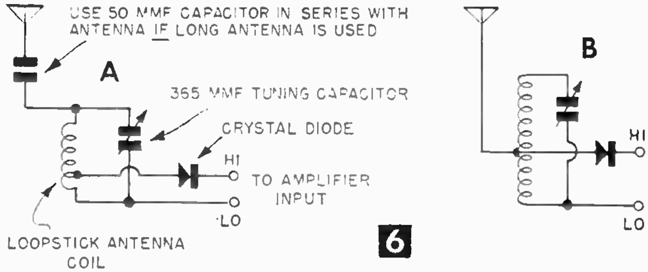
Saw the volume control shaft to a length of ⅜ in. with a hacksaw (clamp the end of the shaft to be discarded in a vise). Fasten the volume control and the phone jack on the perforated circuit board temporarily and wire the circuit (see Figs. 1 and 3 and also Fig 15). Go over each connection on the circuit diagram with a red pencil to avoid wiring mistakes. Connections are made by pushing leads that connect through a common perforation on the wiring board. They're soldered on the side of the board that you see in Fig. 1A, and excess lead lengths are clipped off. The lead from the extreme left center of the board passing close to the volume control hex nut connects to the emitter of transistor T1. The other prominent lead is made up of a number of leads that return to the negative side of the battery. (When you're using PNP transistors, the minus battery terminal is similar to the B-plus terminal in tube circuits.)

I used two type N penlite cells (Ray-O-Vac No. 716) in series in my amplifier for initial testing, since they're so inexpensive. And I brought a pair of input leads terminated with Mueller Mini-Gator clips out through a hole in the side of the plastic case for quick experimental connections and general purpose amplifier use. You'll find these leads particularly handy in trying some of the experiments and applications discussed later. But solder them in the circuit so they can be disconnected easily for the installation of piggy-



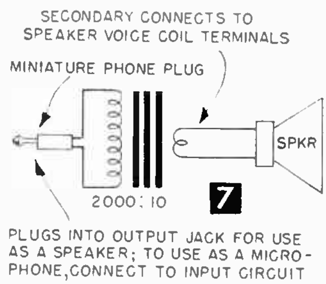
5

The microphone piggy-back and amplifier becomes a musical instrument with the addition of a pencil and rubber bands.



CRYSTAL TUNER PIGGY-BACK

Physically, the Crystal Tuner Piggy-Back shown schematically above in Fig. 6 looks as below in Fig. 8, case open (A), closed (B).



LOUDSPEAKER PIGGY-BACK

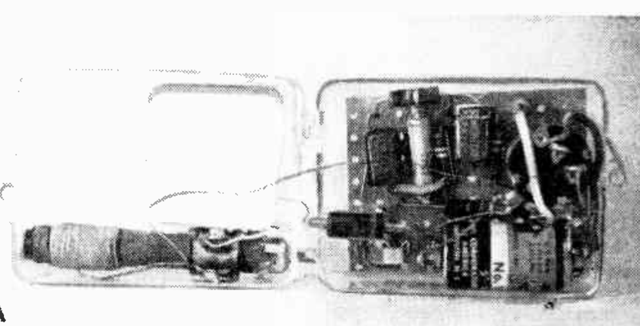
backs. When you've completed the wiring and obtained a satisfactory test of the amplifier, you're ready to remove the volume control and phone jack hex nuts and refasten them with the wiring board in the case. You may have to "dent" the inside of the case with a heated ice pick to accommodate protruding connections before you can fasten the wiring board in place. Fasten the volume control knob to complete the job.

MICROPHONE PIGGY-BACKS

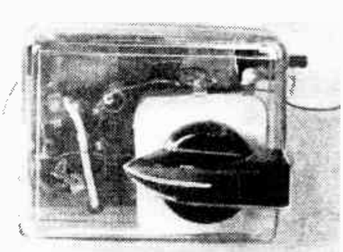
By adding a microphone piggy-back to the basic amplifier unit, you obtain a very compact instrument with many application possibilities. It can be used as a remote communication unit, a microphone and preamplifier for a public address system, a musical instrument pick-up and preamplifier, a gas leak detector, a vibration and rattle locator, and even as a small public address system and complete musical instrument (with the loudspeaker units to be described later). As a toy for children, it may be used as an eavesdropper with a long earphone cord that can be used to listen to birds, animals, and insects as well as human beings. Children will enjoy using the unit as a hearing aid for Blind Man's Bluff and other games. Hams will find the unit extremely useful as a speech amplifier for miniature and mobile transmitters.

The deluxe microphone piggy-back unit uses a Shure MC11 microphone. This microphone is only 1 in. in dia. Drill a 3/16-in. hole in the plastic case half on which you're going to mount it, and fasten the microphone to the plastic case with a small amount of metal-to-plastic cement. Don't allow any of the cement to get into the small sound hole opening on the front of the microphone. In the original unit the hole in the plastic case half is ½ in. from the side and top of the rectangular border formed by the recessed front of the case, but the position isn't critical as long as you mount the microphone so it will not interfere with other components when the case is closed.

Use insulated magnet wire (#28) to connect the microphone to the input circuit of the amplifier. The microphone terminal common to the microphone case connects to the low end terminal of the volume control. Leave the leads long enough to permit the case to be opened without placing a stress on them. Twist them together to minimize the chance of signal feedback from the output circuit (see Fig. 4, in which is also shown the compact 5½-v VS310 battery wired into the circuit as the power supply).



8 A



B

Crystal radio tuner piggy-back attached to basic two-transistor amplifier.

A simple vest-pocket musical instrument can be made from this combination by placing several rubber bands around the assembled amplifier-microphone case. Put different amounts of tension on each of the rubber bands by placing a wedge between the case and the rubber bands. The rubber bands should pass over and near the microphone opening (see Fig. 5). My wedge was a sharpened pencil. In addition to varying the tension on the rubber bands, the wedge spaces them far enough from the case so they can be plucked readily. This vest pocket musical instrument will drive the larger loudspeaker unit (to be described later) directly and with reasonable volume. If the smaller speaker unit is used, equip it with the 3-transistor amplifier described in a later section.

The Shure MC-11 microphone costs about $7. It's a versatile, rugged unit, and in my estimation constitutes a good investment for the experimenter. However, some experimenters do not wish to invest this amount of money in a single component. There are less expensive alternatives, one of which is to use the small loudspeaker unit described later and shown in Fig. 10. This unit is not as compact as the deluxe microphone unit and cannot be mounted as a piggy-back, but you can attach it side-by-side to the amplifier unit equipped with a blank back. Use small machine screws and nuts. Circuit arrangement is shown in Fig. 7.

Another alternative is to use a magnetic earphone as a microphone. The Lafayette MS-367 which costs just a little more than $1 can be used for this purpose. It is small enough to be fitted on a piggy-back just as the MC-11 was, and the leads are connected in the same way.

If you resort to either of these alternatives, you'll get reasonable performance, but not equal to that of the deluxe unit.

TUNER-DETECTOR PIGGY-BACKS

It's quite simple to add a radio piggy-back to your amplifier unit. For those who are undertaking their first project, I'll describe a simple crystal radio piggy-back in some detail. I'll also present a regenerative transistor detector unit which you can build later with a small amount of modification to the original crystal unit. Or, if you wish, you may build the transistor unit immediately. I didn't build the transistor detector as a piggy-back unit, but I've used and tested the circuit in other transistor equipment. The crystal detector, while extremely simple and straightforward, lacks the sensitivity and selectivity of the transistor regenerative type detector. You'll need a moderately good antenna and ground with the crystal detector and amplifier combination, but the requirements will be relaxed considerably if you use the regenerative detector-amplifier combination.

The crystal detector unit circuit is shown in Fig. 6. Two alternatives are shown. Try both of them and use the one you prefer. Figure 8 shows the construction and wiring of the amplifier unit according to the circuit of Fig. 6A. The tuning capacitor shaft hole is a 3/8-in. dia. hole located 1/2 in. from the top and side of the rectangular border formed by the recessed front. Note that the location of this hole is the same as that for the deluxe microphone unit. Place the capacitor in the plastic case. If it doesn't fit tightly into the corner of the case, enlarge the hole with a reamer till it does. Then locate the two mounting screw hole positions for the capacitor by placing the capacitor in the position it will occupy in the plastic case half and marking them off directly.

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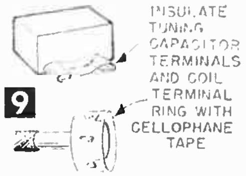
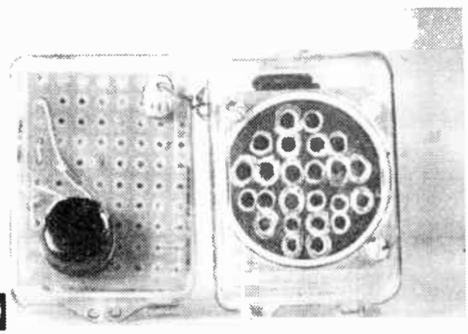


INSULATION PRECAUTIONS FOR CRYSTAL TUNER-DETECTOR PIGGY-BACK

Cut off the antenna loop coil connecting lugs as close to the coil as possible without damaging the coil lead connections. The center for the hole on the side of the plastic case half through which the antenna coil adjusting screw protrudes is located midway between the front and the hinge side of the case along the line formed by the indentation in the plastic between the corner and the hinge. The hole should be between 1/8 in. and 7/32 in. dia., as required, to secure a good fit. Wire the circuit with the components out of the case, checking as you proceed to be sure that you're allowing for proper lead length and fit. Bend the tuning capacitor terminals forward so they'll fit against the front of the plastic case when the capacitor is installed. Insulate these terminals by fastening a piece of cellophane tape to the



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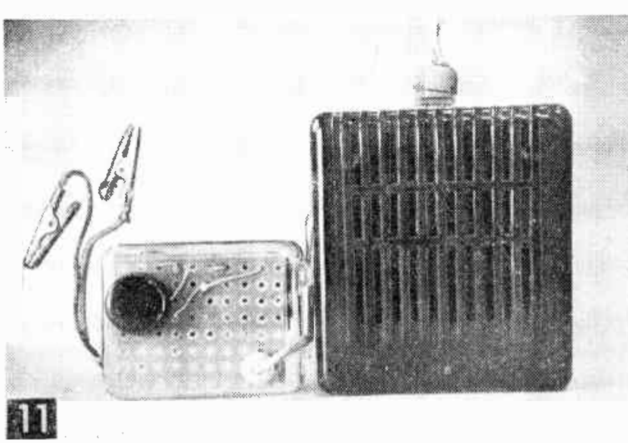
Front view of basic amplifier, with crystal radio piggy-back, attached to small loudspeaker unit.



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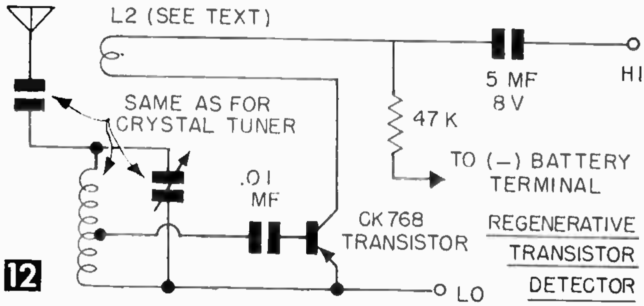
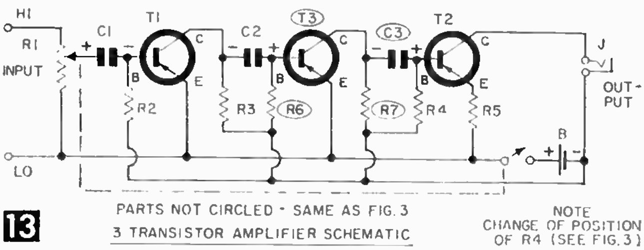
Front view of basic amplifier connected to large loudspeaker unit.





capacitor as shown in Fig. 9. As an added insulating precaution, run a piece of cellophane tape around the coil terminal ring. The assembly may then be mounted in the plastic case half and attached and connected to the amplifier unit. You won't be able to open the case all the way because of the protruding antenna coil adjusting screw. When you close the case, jockey the crystal diode to a position where it can't short-circuit to other components and connections. Use spaghetti insulation on the crystal diode leads.

Tune the antenna slug so you can cover the broadcast frequency range with your antenna and ground connected. On strong local stations you can drive the large loudspeaker unit shown in Fig. 11 directly. Or you can drive the small loudspeaker unit (Fig. 10) with the modified basic amplifier described later. The modified basic amplifier has an extra transistor stage. More distant weak stations can be received if an earphone is used.

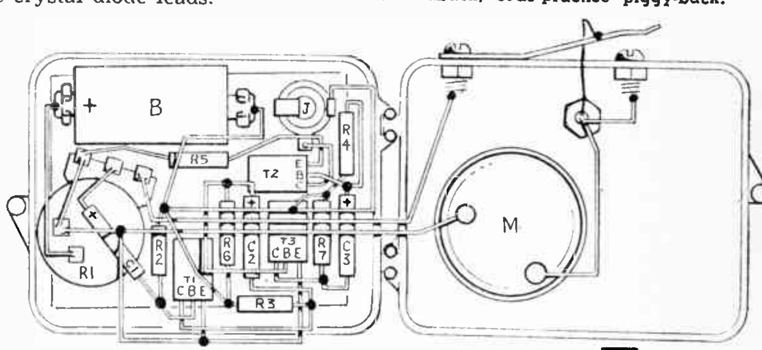
The circuit for conversion to the transistorized regenerative detector is shown in Fig. 12. Simply disconnect the diode from the coil tap terminal and connect the transistor in the circuit. The tickler winding L2 is made by winding 10 to 20 turns of #28 insulated magnet wire at the top of L2. The feedback due to L2 may make the received signal stronger or weaker. Try interchanging the L2 coil connections. Use the set of connections which gives the strongest signal or makes the set squeal. If the set squeals, remove turns from the L2 winding till the squealing stops.

Although the detector can be made more sensitive by providing it with a variable regeneration control so that the set can always be operated just below the oscillation point, the space allowances and the added complexity make it difficult to realize in this set. However, it can be done and the adventuresome experimenter may wish to try it.

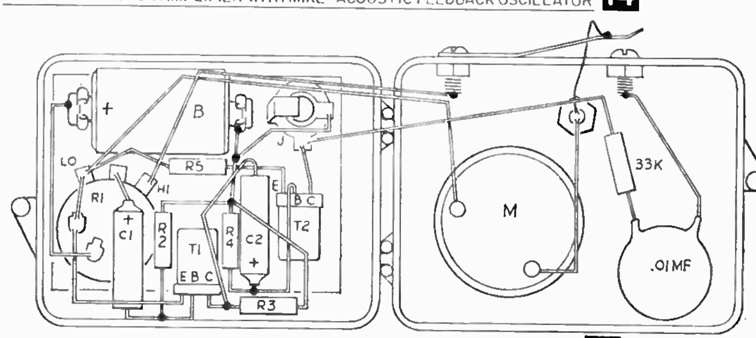
With the regenerative detector-amplifier combination you won't have any difficulty in realizing headphone reception with only a few feet of antenna on local radio stations. You can expect satisfactory loudspeaker reception with a longer antenna.

A higher grade transistor will improve the performance of the regenerative tuner considerably. The RCA 2N412 is a high Beta unit with a high

The basic amplifier converted to a three-transistor amplifier, together with a modified microphone, acoustic feedback, code-practice piggy-back.



THREE TRANSISTOR AMPLIFIER WITH MIKE-ACOUSTIC FEEDBACK OSCILLATOR 14



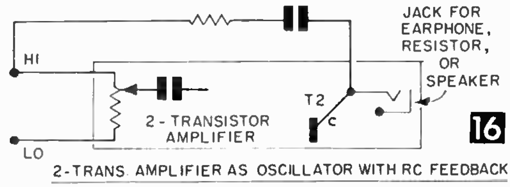
TWO TRANSISTOR AMPLIFIER WITH MIKE-ACOUSTIC FEEDBACK OSCILLATOR 15

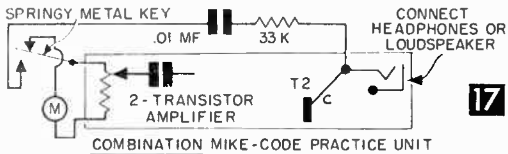
The basic two-transistor amplifier with electronic feedback, code practice and microphone piggy-back.

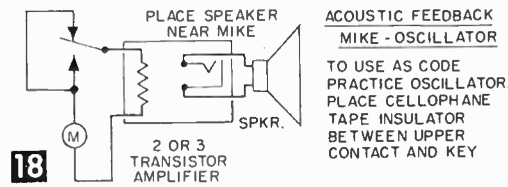
cut-off frequency. This unit may be substituted directly for the CK768 transistor, but this substitution may require a decrease in the number of turns on the regeneration coil.

LOUDSPEAKER UNITS FOR THE PIGGY-BACK AMPLIFIER

The loudspeaker units for the piggy-back amplifier have been referred to frequently in preceding sections because they have a wide variety of uses and because they enhance the value of your piggy-back equipment considerably. One of these units is the extremely small speaker and output transformer combination mounted in a piggy-back size case which is shown with the amplifier unit in Fig. 10. The dia. of this speaker is 1½ in. Because of the small size of this speaker, the change from electrical to sound energy is not accomplished as efficiently as it would be with a larger loudspeaker. The second loudspeaker consists of a larger (2½-in. dia.) loudspeaker—and output transformer—mounted in a ready-made baffle case. This unit (Fig. 11) has a much higher electrical to sound transformation efficiency and can be used connected directly to the basic amplifier unit with good results.







To make the small loudspeaker unit, place the speaker in the case centered relative to the top and bottom of the case (see Fig. 10). Mark the mounting hole locations on the case with an ice pick or scriber, remove the speaker from the case and with a heated ice pick make the mounting and sound opening holes. I didn't measure off the sound opening holes. If you desire a neater appearance, you can measure them off. Otherwise you can guess them in quickly as I did and then use a small cloth grille.

The output transformer fits partially under the loudspeaker magnet frame. It is held in place by pressure between the speaker magnet frame and the transformer on one side and a rubber grommet between the transformer and the plastic case on the other side. Pass a piece of cellophane tape from the magnet over the top of the transformer frame and grommet for additional support. You can increase the tone quality and the volume available from the speaker by cutting out a soft cardboard washer to fit around the front of the speaker rim. This washer will fill the space between the plastic case and the speaker rim which would otherwise exist because the rounded edges of the case prevent the speaker rim from fitting against the front of the case. The secondary (green) leads from the output transformer connect to the loudspeaker voice coil terminals; the primary (red) leads connect to the plug (see Fig. 7).

The loudspeaker unit shown in Fig. 11 utilizes a larger loudspeaker and a ready-made case and can be built with less effort than the small loudspeaker unit. To assemble, remove the four screws that hold the baffle-case back in place and remove the back. Place the speaker in the baffle box and place the output transformer between the speaker magnet frame and the edge of the baffle box. Place a paper or cardboard shim sufficiently thick to hold the transformer in place between the transformer and the speaker.

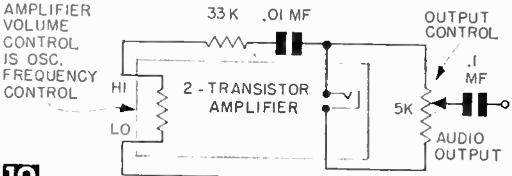
Next, solder the secondary transformer leads (green) to the speaker voice coil terminals and the primary (red) leads to the terminals at the top of the baffle box.

Finally, place the back on the baffle box and fasten the four screws. The speaker fits tight between baffle box and back and the pressure holds it in place.

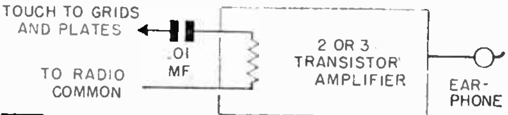
ADDING A THIRD TRANSISTOR TO THE BASIC AMPLIFIER

The amplification of the basic amplifier unit may be increased considerably by adding a third transistor amplifier stage. The extra stage increased the amplification of the original model from 320 to about 10,000. The large increase in amplification makes it possible to drive a loudspeaker with considerably smaller signals at the amplifier input terminals. With the crystal radio piggy-back, for example, the extra transistor amplifier stage will substantially increase the number of radio stations you can receive at reasonable speaker volume. And, with the deluxe microphone piggy-back, the earphone volume is equivalent to that of hearing aids costing from $40 to $100.

The new three-transistor amplifier circuit is shown in Fig. 13. Figure 14 shows parts placement. Compare these Figs. with Figs. 1, 3 and 15. Note that transistors T1 and T2 are still in the output and input stages, and that the new transistor T3 becomes the middle amplifier stage. The only parts required for the modification are transistor T3, resistors R6, R7, and capacitor C3 (see Materials List). They cost less than $2. The physical position of transistor T2 and resistor R4 has been changed in the amplifier. Transistor T3



19 AUDIO TEST OSCILLATOR



20 ARRANGEMENT FOR AUDIO SIGNAL TRACING

occupies approximately the same physical position as T2 occupied before modification. The change can be made in a few minutes if these steps are followed:

1) Remove the volume control knob and the volume control and output jack hex nuts. Remove the amplifier from the case.

2) Remove the 220K resistor R4 from the circuit board and replace it with 270K resistor R6.

3) Disconnect the base of transistor T2 from the junction of C2 and R4. *Don't* disconnect the emitter and collector leads. Bend these leads as required to change T2's position to that shown in Fig. 14.

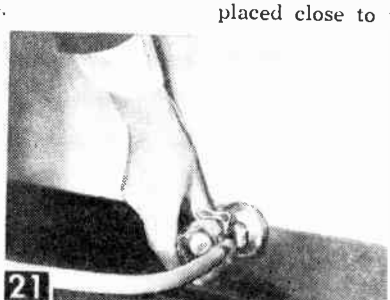
4) Wire transistor T3 into the circuit. Note that the connection end of T3 is toward the upper edge of the circuit board. Run the emitter and base leads through perforations to the front of the board. Connect the emitter to the common (battery plus) bus and the base to the junction of C2 and R6.

5) Mount and connect C3 and R7. The collector of T3 connects to the junction of C3 and R7.

6) Mount and connect R4. Connect the base of T2 to the junction of C3 and R4.

7) Bend component leads as required to minimize the possibility of short circuits. Fasten the amplifier in the case.

The added transistor stage increases the current requirements of the amplifier slightly. If the amplifier is used for prolonged periods, (as a hearing aid, say) you'll find it economical to use two size N penlite batteries in series. The gain will be reduced slightly due to the lower voltage.



21 The three-transistor amplifier with microphone piggy-back and earphone is used here to detect a small gas leak. The hiss of escaping gas is picked up and amplified.

MODIFICATION, ACCESSORY, AND APPLICATION IDEAS

Your piggy-back equipment has many more uses than those described in conjunction with the construction. In some instances, small modifications are required, and in some instances simple accessories are required for these additional applications. All of the applications and circuits that have or will be described have been tried and tested. (You'll probably discover many more.) You can rest assured that they will work provided your wiring is correct, your connections are electrically reliable and your battery and parts are good.

Code Practice Oscillator. The basic two-transistor amplifier can be made to oscillate at audio frequency by connecting the collector of transistor T2 to the high side of the volume control through a capacitor and resistor (as shown in Fig. 17) with an output load connected. This arrangement provides the feedback required to produce oscillation. The output load may be headphones, the small loudspeaker unit, the large loudspeaker unit, or a 3K to 10K resistor.

Figure 15 shows an arrangement for an earphone or loudspeaker code-practice oscillator incorporated piggy-back (schematic is shown in Fig. 16). The resistor is 33K and the capacitor is .01 mfd. Adjust the amplifier volume control for the tone you find most pleasing. The code practice oscillator may be built as a piggy-back with a key made from a small piece of metal, machine screws, and nuts. The microphone is connected through the upper contact as the amplifier input element when the key is up. When the key is depressed, the microphone is disconnected, and contact for the oscillator circuit is established.

A loudspeaker code-practice oscillator can utilize an even simpler scheme, with acoustic feedback from the loudspeaker to the microphone producing oscillation in this case. Circuit is shown in Figs. 14 and 18. A small piece of cellophane tape placed on the key under the upper contact prevents microphone circuit closure when the key is up. This arrangement will work with the two- or the three-transistor basic amplifier and either loudspeaker unit. The only requirement for oscillation is that the microphone be placed close to the loudspeaker.

Model RR Train Whistle and Paging System. The code oscillator-microphone piggy-back combination may be used as a model railroad or toy train whistle and paging system. Either of the code practice oscillator arrangements described above will work acceptably. The two-transistor amplifier with resistor-capacitor feedback is most convenient, although the paging volume of the three-transistor acoustic feedback arrangement is greater. The disadvantage of the acoustic feedback arrangement is that the speaker and microphone must be close together to produce a whistle but then must be separated to be used for paging.

Audio Oscillator. Figure 19 shows the circuit arrangement for a simple audio oscillator that can be used for amplifier testing. It can be built piggy-back. The frequency range is limited to a range of several hundred to several thousand cycles as a sine-wave audio oscillator, but it will operate at lower frequencies as a blocking oscillator. The volume control of the amplifier serves as the frequency control; the added potentiometer is the output level control.

Hum Locator and Telephone Pick-Up. The three-transistor amplifier may be used to pick up telephone conversations and reproduce them at loudspeaker volume with a telephone pick-up coil such as the Lafayette MS-16. Or you can use an unshielded headphone with the diaphragm removed for a telephone pick-up. This arrangement will also enable you to locate *ac* wiring by using the pickup as a 60-cycle hum locator. When the coil gets close to a 60-cycle house wiring circuit, it has a 60-cycle voltage induced in it. You'll get best results using a headphone for listening in the output circuit of the amplifier for the hum location function. The pick-up is connected to the amplifier in the same manner as the microphone.

Audio Signal Tracer. The basic amplifier may be used as a signal tracer for trouble-shooting audio amplifiers and the audio section of radios. The only additional component required is a 0.1 mfd. capacitor to isolate *dc* voltages from the amplifier volume control. The circuit arrangement is shown in Fig. 20.

To use the signal tracer for radio trouble-shooting, connect the input lead from the low side of the volume control to the common ground of the radio receiver. Tune the receiver to a strong local station's frequency and with the volume control all the way up, touch the tube grids and plates with the signal tracer "hi" lead in succession while listening for a signal in the earphone. If you don't hear a signal in the earphone when you contact the grid of the first audio stage, the trouble is in the RF, IF or detector portion of the radio ahead of the audio amplifier. If you do get a signal, the trouble's somewhere in the audio amplifier. It's between the last point in the circuit where you do hear a signal and the first point where you don't hear a signal.

To trace a signal in a phono amplifier or any other amplifier, provide an input signal to the amplifier and proceed with the signal tracer just as you would to signal trace a radio. The input signal can be derived from a phonograph turntable pickup and a record, a radio tuner or an audio oscillator.

MATERIALS LIST—BASIC 2-TRANSISTOR AMPLIFIER

Desig. (see Fig. 3)	Description
C1, C2	5 mfd, 8 v capacitors (PS8-5)*
R1	10K Vol. Control w/sw (VC-28)
R2	270K, ½ watt carbon resistor
R3	10K, ½ watt carbon resistor
R4	220K, ½ watt carbon resistor
R5	27 ohm, ½ watt carbon resistor
T1, T2	CK722 transistors (Raytheon, but see text)
J	miniature phone jack (MS-282)
B	battery (see text)
	plastic case (MS-156)
	perforated circuit board (MS-304)
	pair Mueller Mini-Gator clips

Microphone Piggy-Back

No. Req.	
1	Shure MC-11 microphone
15′	#28 insulated magnet wires (also used in other piggy-backs)

Crystal Tuner Piggy-Back

1	loopstick antenna coil (MS-299)
1	50 mmf capacitor (see Fig. 7)
1	365 mmf tuning capacitor (MS-274)
1	crystal diode (GE 1N64)

Regenerative Transistor Detector

1	5 mfd, 8 v capacitor
1	47K, ½ watt carbon resistor
1	.01 mfd, 75 v capacitor
1	CK768 transistor (Raytheon)

Loudspeaker Piggy-Backs

1	miniature phone plug (MS-281)
1	speaker (SK-62 with MS-156 case for small unit, or an SK-66 with a TR-93 transformer and MS-315 baffle for the large unit; see Fig. 6).

3-Transistor Amplifier

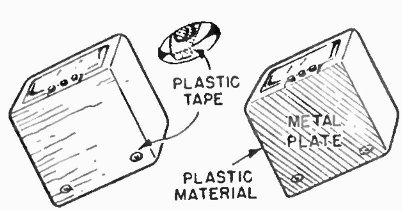
(Components needed in addition to those for 2-Transistor Basic Amplifier)

Desig. (see Fig. 13)	Description
C3	5 mfd, 8 v capacitor (PS8-5)
R6	270K, ½ watt carbon resistor
R7	10K, ½ watt carbon resistor
T3	CK722 transistor (Raytheon)

*All components listed by catalog number may be obtained from Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. Parts numbers, unless otherwise indicated, are Lafayette numbers.

Tape Insulates Radio-TV Screws

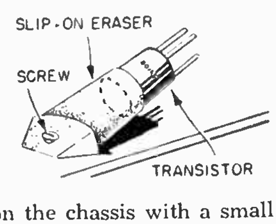
• The chassis of a transformerless *ac-dc* radio or TV can be a very deadly shock hazard, should the set be plugged into the outlet with the incorrect polarity. Often, the mounting screws found on the bottom of the cabinet are in direct contact with the "hot" chassis. Touching one of these screws and ground simultaneously can kill you.



A simple safety precaution is to insulate the heads of the screws by covering them with plastic tape. If your set has a metal plate as a bottom cover, tape clear plastic material (available at hardware stores for a few cents a foot) over entire plate.—John A. Comstock.

Eraser Shock-Mounts Transistor

• A slip-on pencil eraser makes a good mount for some types of round case transistors that are not to be socket-mounted. Drill a small hole through the tip of the eraser, and mount it on the chassis with a small screw and nut. Eraser shock-mounting is especially desirable in portable gear subject to mechanical shocks.—John A. Comstock.



Electronics Picture Quiz

By JOHN A. COMSTOCK

Are you a whiz at picture quizzes? Here's one on electronics. All of the photos are of items commonly found on the electronic hobbyist's bench or in his box of spare parts. See if you can correctly identify and label them in the spaces provided. Study each picture carefully before filling in your answer. You'll find the solution on page 157.

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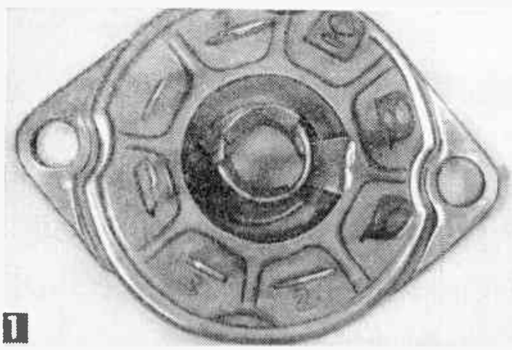

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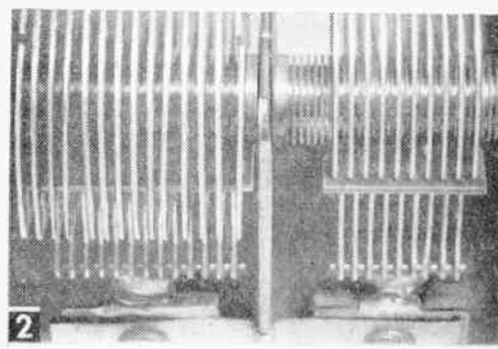

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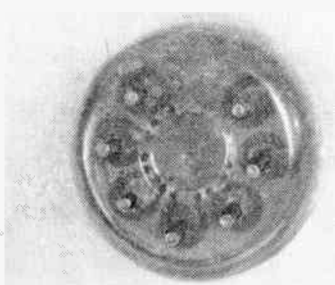

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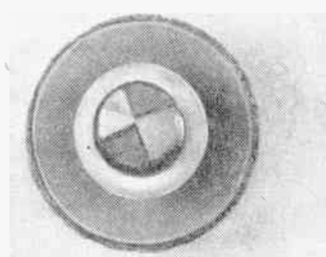

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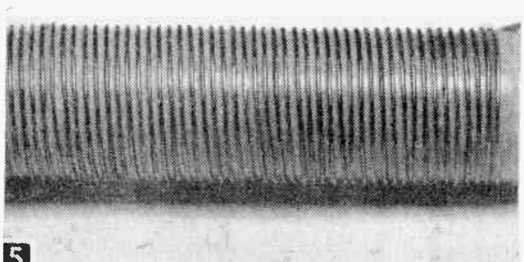

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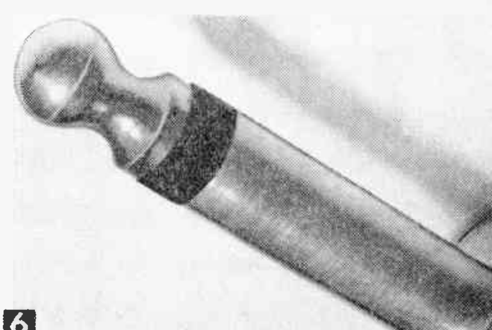


6

Line Voltage Corrector for Your TV Receiver

By HAROLD P. STRAND

LOW line voltage from your electric company can cause all sorts of difficulty in your TV set. Since electric companies can't supply everybody with exactly the same voltage, outlying suburbs are most likely to be troubled with below-normal voltage, particularly during the evening hours when demand for electricity is high. If you're not satisfied with your TV picture, it doesn't fill out the screen or lacks brilliance, try connecting an *a*-c voltmeter to the wall receptacle to determine the line voltage. If I had done that myself, I would have saved considerable time and money.

The picture on my set was not filling the screen, especially at the sides and was not up to its usual brilliance despite any adjustments of the brightness control. The picture kept slipping out of horizontal sync too. Something had to be done!

2 A

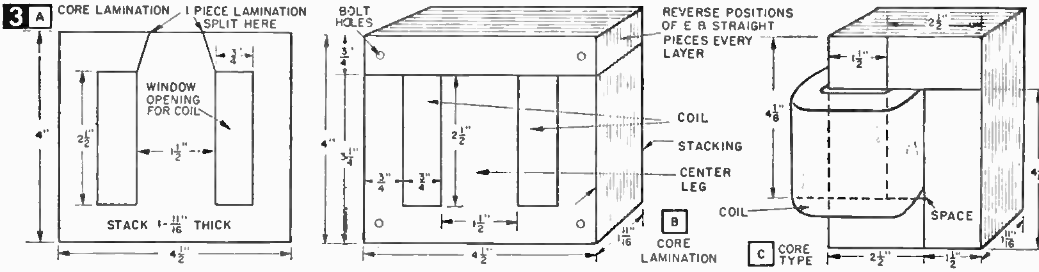
B

Picture wouldn't fill out screen when set was operating on 106 volts (A). Increased brilliance and full screen (B) improve picture after boosting line voltage to 112-115 volts.

First, I replaced all the tubes in the video section, with very little improvement. Next, I removed the chassis and spent two evenings going over the complex circuit using instruments to check the connections and the components against the schematic. Still no luck! Some of the original condensers were bulging with sealing compound at the ends, so all of them were replaced with the latest type. You can imagine my

1

Checking line voltage on meter built into booster. Voltage that's too low causes all sorts of trouble on your TV set.

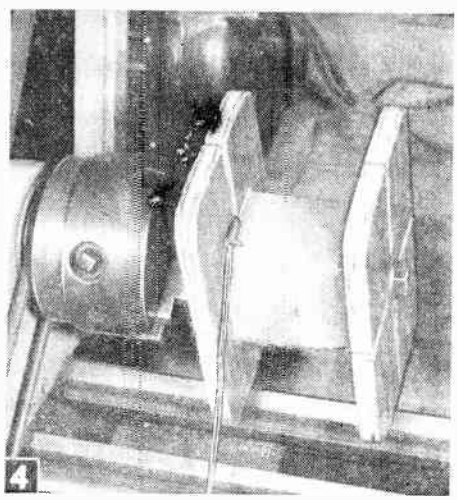


Core laminations (A) 1-piece shell lamination salvaged from used radio power transformer. (B) E-type laminations (C) Core-type lamination made by alternating straight strips of silicon transformer steel. Transformers built on this core will require larger mounting box. (D) Coil winding form.

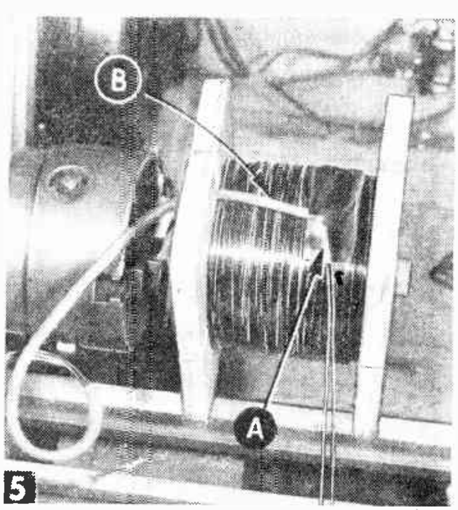
disappointment, when after assembling the set, the improvement was hard to find.

On an impulse, I got my voltmeter from the shop and plugged it into the outlet. I was getting exactly 106 volts! When I connected a *Variac* between the line outlet and the TV set and raised the voltage to 115 volts, the results were amazing. The picture assumed a brilliance it had never had before and it covered the screen with some to spare! You may find the same solution to your television difficulties.

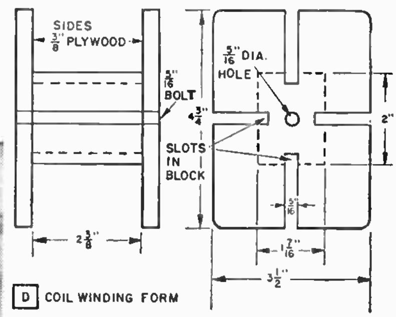
Instead of using the *Variac*, this line voltage booster which you can build yourself will step up line voltage and give you all the reception which your TV set can deliver. Basically it is an autotransformer with a number of taps controlled by a tap switch. The built-in voltmeter tells you at all times the exact voltage being delivered to your TV. I recommend setting the voltage at about 112 volts to allow for any upward line



Start winding through slot in narrow side of form. Turn counter records number of windings.



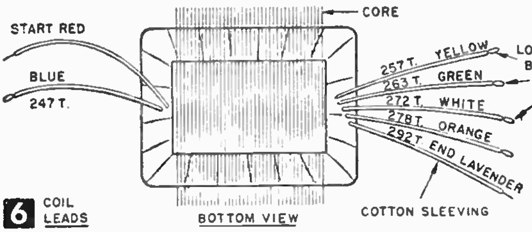
Bringing out loop tap at 247th turn. Slip sleeving over loop and separate lead from rest of windings with electrical tape, top and bottom. Continue winding over tap loops.



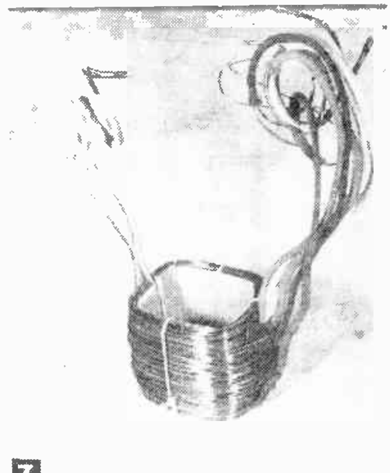
fluctuations. Most electric lines deliver voltage that varies only two to four volts although the general level may be low. No. 1 tap shows direct line voltage on the meter and allows you to check incoming voltage before making any corrections. Each additional tap boosts voltage about two or three volts. Most console TV sets draw about two amperes, well within transformer capacity.

To start building the transformer, you'll need the core taken from an old radio power transformer like an early Silver Marshall or any type close to specified core size (Fig. 4). The stacked E-type laminations measured 4½ x 4 in. outside with coil window openings of ¾x2½-in. with 1½-in. wide center leg and stacked 1¹¹⁄₁₆-in. high. If salvage cores are not available, you can cut 1½-in. wide strips out of regular 26-29-gage silicon transformer steel (Fig. 3C). Alternate stacks of four laminations were used in building the core; this same system for covering the joints should be used in rebuilding the core around the new coil.

The new coil consists of 292 turns of either one #17 *Formex* wire or two #20 wires in parallel. Build a winding form first (Fig. 3D). Leads are brought out on the narrow sides of the form (Fig. 5) to avoid interference when coil is slipped onto the



6 COIL LEADS



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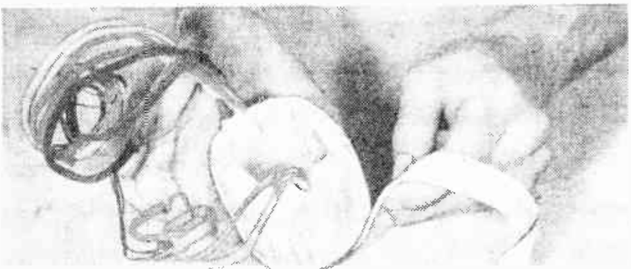
Wound coil ready for taping and varnishing. Start and 247th turn comes out left side and 257 to 292nd turns come out right.



8

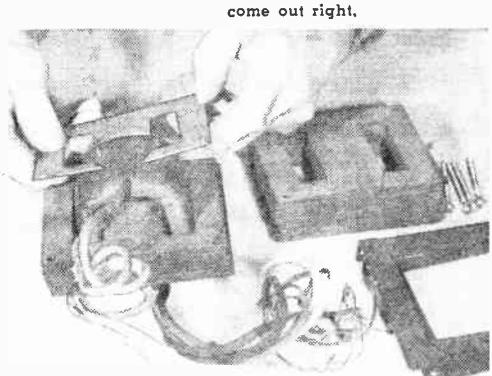
Wind cotton coil tape tightly through center opening, cutting strings that hold coil together as you come to them, and sew end.

core. Slots in the form allow you to pass strings through the coil and tie it tightly after winding. A 5/16-in. bolt holds the form together and is chucked in the lathe for winding. Cover the core with a piece of armature slot insulating paper secured with cellophane tape. The ends of the two #20 wires were passed through an 8 in. piece of cotton sleeving and started in to the form slot at one of the narrow sides. Wrap

MATERIALS LIST—VOLTAGE BOOSTER

- 1 metal cabinet, Insuline Corp., gray hammertone aluminum 9 x 5 x 6" #29801
- 1 panel meter, 3½" round, 0-150 volts A.C.
- 1 core from an old radio power transformer
- 1 power tap switch, Ohmite model #111, 6 taps, 10 amps.
- 1 toggle switch, S.P.S.T. 6 amps at 115 volts
- 1 power receptacle, Amprenol type 61-F1 two pole with plate
- 1 fuse holder, panel mounting, Buss HKP
- 1 fuse, Littelfuse 3 AG 5 amps, #312005
- 1 dial with knob, National HRS-3
- 1 piece cabinet back screen stock, 9 x 6"
- 7 ft. 2-wire #18 line cord
- 1 attachment plug cap
- 1 rubber grommet for 3/8" hole
- 4 rubber base knobs with 8-32 studs, nuts

About ¾ pound #17 Heavy Formex magnet wire, or double #20 wires. Coil tape, cotton sleeving in several colors, screws, nuts



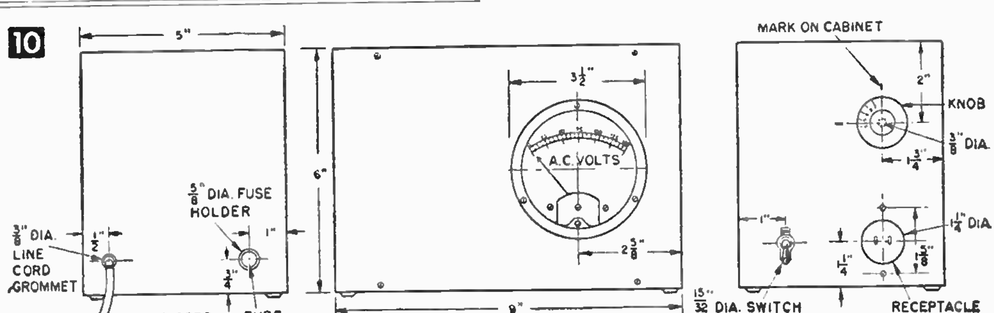
9

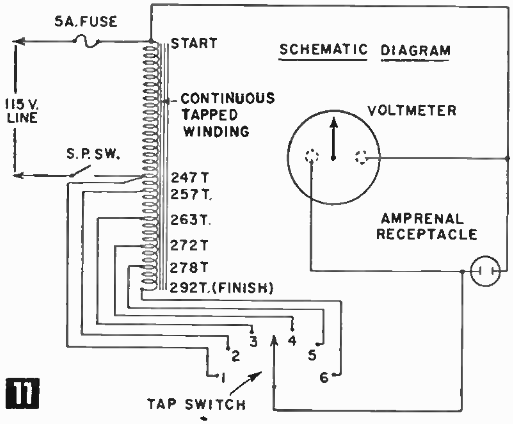
Assembling laminations. Reverse positions of laminations every fourth piece to cover butt joints.

the ends of the wires around the chuck jaws to keep them out of the way. The turn counter fixed to the lathe bed and driven by a rubber vacuum cleaner belt keeps track of the windings. You can, of course, wind the coil onto the form by hand evenly spacing the loops in tight layers.

Wind 247 turns before bringing out an 8 in. loop, also covered with sleeving. To identify the different loop leads, cover each with sleeving of

10





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a different color noting the turns each represents as the winding progresses. At the loops, which will become taps, place a small piece of Scotch #33 insulating tape under the point where the wire is looped off and another piece on top of the spot, to properly insulate the crossing of wires. Also be sure to use a piece of sleeving over the ends brought out. Continue to wind over the previous work to the 257th turn, and bring out another loop. This 257th tap is brought out at the opposite narrow side of the form from the beginning and 247th tap. Continue to wind in the same way, bringing out taps at the 263, 272, 278, 285 and the end or 292 turns, all on the same form side as the 257th tap.

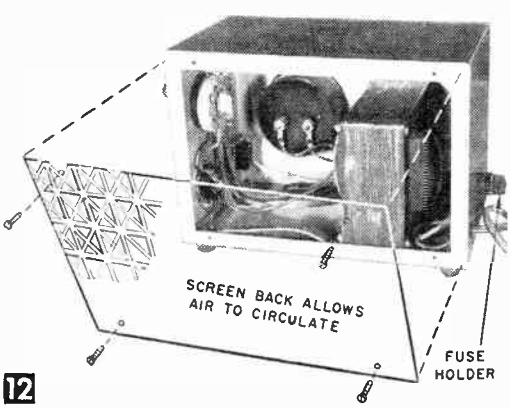
With the last winding on, you're ready to tie the coil with strings through the slots and remove it from the form (Fig. 7). The starting wire and 247th turn are at one of the narrow coil sides and the 257 to 292nd taps are at the other. Tape the entire coil with cotton coil tape as shown in Fig. 8. Sew the end of the tape before dipping the whole coil in air-drying insulation varnish, allowing it to soak for about five minutes. Hang it up to drain and allow it to dry overnight, or bake in an oven at about 150° F for several hours to fully dry the varnish.

Assemble the core to the new coil (Fig. 9). Drive strips of fiber or Bakelite between the coil and center leg at both sides to wedge it tightly in place. Otherwise, an annoying hum may result. Attach the side frames and the transformer is finished. It will be necessary to square up the core with a light hammer, driving butt joints together.

The grey enamelled aluminum cabinet has removable side panels and is laid out for the holes to mount parts according to Fig. 10. Cut the large holes with a Greenlee chassis punch, a hole saw or fly cutter. Instead of one of the panels, cut a piece of mesh screen stock to fit at the back. Mount the voltmeter, the toggle switch, flush receptacle, transformer and tap selector switch in the cabinet.

When all components are installed, you're ready to wire up connections according to the schematic diagram (Fig. 11). Insulation on the *Formex* wire is hard to scrape off, so be sure you get down to the bare copper before hooking it up. Use #18 flexible insulated wire for all hook-up connections aside from the transformer tap connections.

Step #1 on the tap switch shows the line voltage on the booster's meter and tells you if it is high enough (112-115 volts) to use without boosting. Other steps increase voltage and meter records just what these voltages are for top TV reception.

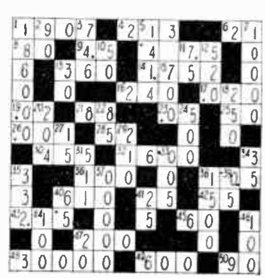


12

Back side of booster assembly. Voltmeter is set off center to clear transformer. Back screen allows air to circulate around transformer. Note fuse holder at right lower corner.

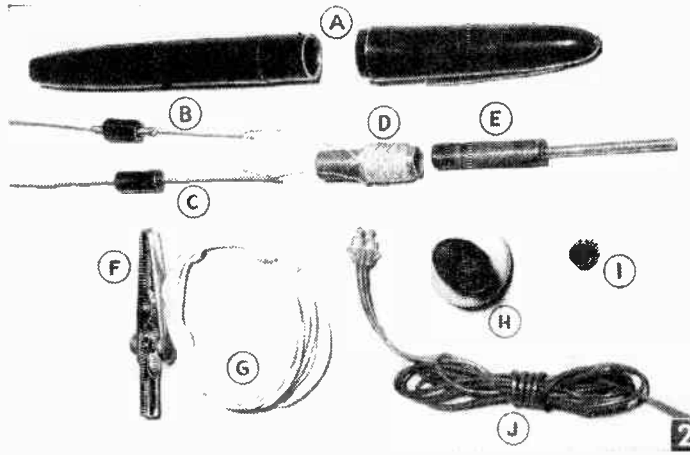
Bottle Plugs as Wire Grommets

• The plugs used in nasal spray plastic squeeze bottles make handy feed-through grommets. Pry out the plug from the bottle's neck with the blade of a sharp knife, then enlarge the opening in the plug with the sharp point of a heat soldering iron or an ice-pick. The inside spray tube makes a good piece of wire insulating spaghetti, too.



Answers to Cross Numeral Puzzle, Page 105.

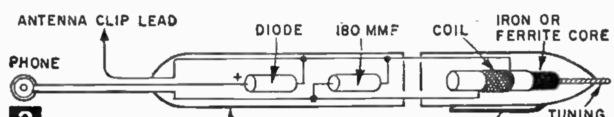
Built into a pen case, this little self-powered radio requires no outside antenna. Stations are received by attaching clip lead to telephone dial screen, or other metal.



Component layout—A. Pen cap and barrel. B. Diode detector. C. Ceramic fixed capacitor. D. Coil. E. Tuning slug and screw. F. Small alligator clip. G. Antenna lead. H. Earphone. I. Tuner knob. J. Earphone Cord.

Fountain Pen Radio

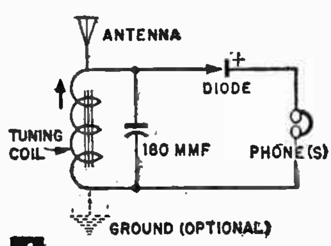
This "air-powered" set built in a pen-case will receive stations up to as far as 50 miles away



3 PICTORIAL PLAN

A DISCARDED ball point pen barrel holds this radio that not only makes a conversation piece, but really works—and works well! A tuning knob in the cap selects various local stations.

A crystal set, it uses a germanium diode detector and requires no operating power. A flexible clip lead attached to a phone dial finger stop, or other handy metallic object becomes an antenna for picking up local stations. X-type antennas may increase the set's range to 50 miles.



4 SCHEMATIC PLAN

The pointed plastic tip of a dime store pen carrying the ball point and capillary ink tube is discarded, leaving an open barrel. Drill ⅛-in. hole in the bottom of the barrel for the phone cord and flexible antenna lead.

Drill a 3/32-in. hole in the top of the pen cap to complete preparation of the pen barrel. The tuning coil is the next job. The coil shown in Fig. 2 consists of 12 ft Litz coil wire lattice-wound on a paper-base *Bakelite* tube ¼ in. I.D. x 1 in. long. Leave coil leads long enough to be connected to the other components.

Duco or similar cement is applied to the outside of the coil before inserting it into the pen cap. The tuning slug is fitted with a #4-40 brass screw. Because the plastic is soft, the screw will cut its own threads when turned into the 3/32-in. hole in the cap. The screw moves the iron or ferrite core with the coil to tune in the stations.

Many inexpensive and surplus radio or TV I.F. transformers will yield a suitable slug and coil form to wind the Litz wire on. Or you can purchase a ferrite-tuned radio antenna coil and strip off its outer cardboard cover and trim the lugs to get it into the pen barrel.

The 180-*mmf* fixed ceramic capacitor and diode detector will fit nicely into the pen barrel when arranged as shown in Fig. 3. Be sure "pigtail" leads are covered with radio spaghetti or plastic *Scotch* tape so that leads do not short when inserted in pen.

The total cost of this novel radio is about $3, less the button type hearing aid receiver. A high resistance magnetic unit of this type costs about

MATERIALS LIST—FOUNTAIN PEN RADIO

- 1 cheapest grade ball point pen, or discarded fountain pen
- 1 tuning coil (available from Electro-Mite, Box 636, Springdale, Conn. for $1, or a complete kit except earphones for $3, postpaid)
- 1 small spool Litz wire (for homemade coil only)
- 1 short length insulated antenna lead wire (plastic stranded)
- 1 alligator clip (small)
- 1 germanium diode detector (CK705, 1N48 or 1N34)
- 1 high resistance hearing aid receiver, or standard size Alnico radio headphone (1000, 1500 or 2000 ohms)
- 1 180 mmf fixed ceramic capacitor for local stations between 1400 and 660 kc. Beyond 660 use 250 mmf, below 1400 kc use 75 mmf.

$8. However, a standard radio type *Alnico* headphone costs a fraction of this figure. Except for its size, it far outperforms a hearing aid receiver in volume. In either case, headphone leads and flexible antenna wire are fished through the 1/8-in. hole and soldered in place, along with the two flexible coil leads. The pen barrel is now slid up the cord to enclose the components and engage the cap.

The cap makes a tight friction fit over the barrel. While there is little danger of the radio pulling apart, a drop of cement may be applied inside the cap to permanently secure it to barrel.

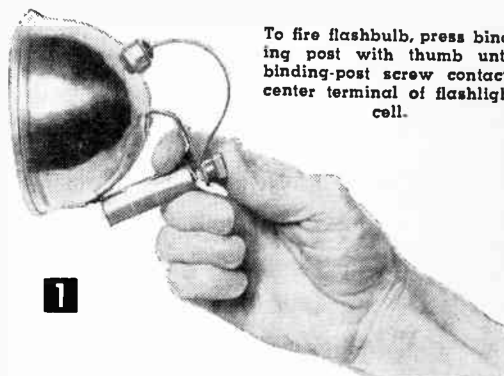
Turning the #4-40 screw on the tuning core proved a little rough on the fingertips, so I squirted a generous amount of *Duco* cement into the plastic cap salvaged from a discarded lighter fluid can and attached it to the screw, allowing screw and knob to dry overnight.

Camera Flashgun From Toy Teakettle

BATTERY powered and hand held, this economical little flashgun can be used anywhere with any camera having a time, bulb or slow shutter speed. Exposure is made by the open lens-flash-shut lens method.

Obtain the parts given in the list of materials first. Then, cut out the bottom of the toy teakettle with a pocket knife and, with a pair of pliers, pull the remaining bottom metal out of the seam. Bend the teakettle handle to the shape shown in Fig. 2 and carefully remove the kettle spout. Force the automobile lamp socket into the spout hole and, with a midget flashbulb in the socket, adjust the socket in the hole so that the bulb is centered in the reflector. If the spout hole must be enlarged to do this, use a tapered wooden dowel to expand the hole just large enough for a snug fit with the lamp socket. Coat the inside and outside edges around the socket where it joins the kettle with household cement.

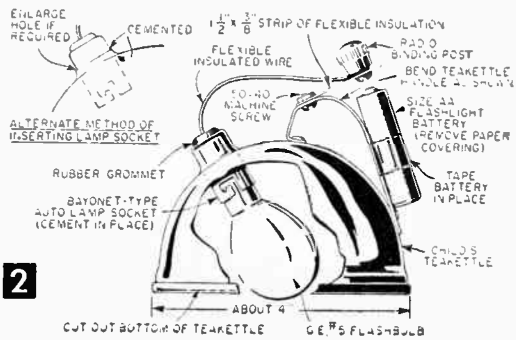
Now, remove the paper cover from an AA-size flashlight dry cell battery and tape to the teakettle handle as in Fig. 2. For the on-off switch, drill one end of a strip of flexible insulating material (see materials list) to take a radio binding post and the other end for a 5-40 machine screw. Because different makes of toy kettles will vary somewhat in size, determine the distance between the drilled holes by holding the insulating strip on the kettle handle so that the rd binding-post screw will make contact with the battery center terminal when the binding post is pressed. Then cement and bolt the insulating strip to the kettle handle. Connect the wire from the lamp socket to the radio binding post and you're all set to take indoor, flashbulb-lighted pictures.—ARTHUR TRAUFFER.



To fire flashbulb, press binding post with thumb until binding-post screw contacts center terminal of flashlight cell.

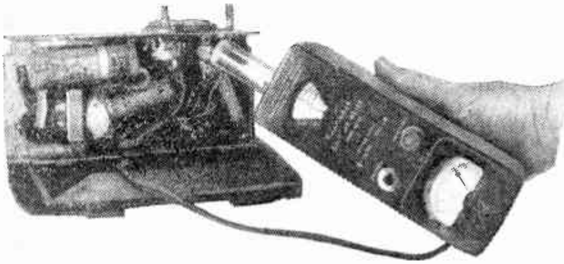
MATERIALS LIST— CAMERA FLASHGUN FROM TOY TEAKETTLE

No.	Description	Use
1	4" toy whistling teakettle (aluminum)	reflector
1	1/16 x 3/8 x 1½" flexible insulating material (Plexiglas, Bakelite, Micarta or Fiber)	switch
1	8-32 Bakelite knob radio binding post	switch
1	size AA flashlight dry cell	battery
1	3/8 x 5-40 machine screw	switch
1 box	Midget flashbulbs (General Electric #5)	
1	single-point, bayonet-type automobile lamp socket to fit above bulbs	bulb socket
1 tube	household cement	

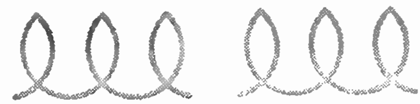


• When a rat-tail file breaks, don't throw it away—break it up into a number of 2-in. lengths and use them in your power drill to enlarge radio chassis holes. They cut very rapidly and are ideal for enlarging tube socket holes and for similar radio work.—J.A.C.

How to Use a Grid Dip Meter



A highly versatile piece of test equipment, the Heathkit model GD-1B, is shown here checking the tuning of a receiver.



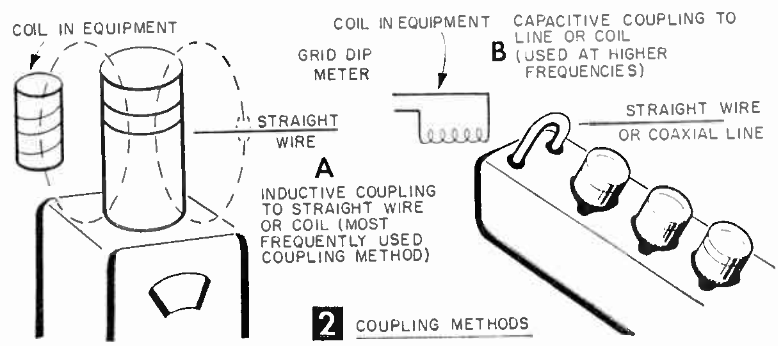
Versatile? Grid dip meters will measure resonant frequency, capacitance, inductance and Q, and will pinch-hit as RF signal generators, oscillation detectors, frequency meters and relative power meters—a total of eight different jobs

By FORREST H. FRANTZ, SR.

BASICALLY, a grid dip meter is an RF oscillator—but it has several unique features. For one, the oscillator coil is physically located on the instrument so that it can be placed near other coils in circuits under measurement or test. Plug-in type coils are most practical for this instrument.

For another, a grid dip meter has a meter which indicates relative oscillator output. When the oscillator is in an unloaded condition (when it isn't coupled to a circuit tuned to the frequency of oscillation), oscillation level is high and meter reading is high. But when the oscillator is loaded (when its coil is near a circuit tuned to the oscillation frequency), the oscillation level drops and the meter reading is low. Thus, in use, the grid dip meter coil is placed near the coil of a tuned circuit and the tuning dial of the grid dip meter is rotated through the frequency range. A noticeable "dip" of the meter needle will occur when the grid dip meter is tuned to the resonant frequency of the circuit under test and since the frequency dial of the grid dip meter is calibrated, the resonant frequency may be read from it.

The grid dip meter shown in Fig. 1 (Heathkit Grid Dip Meter GD-1B), has two additional features which all grid dip meters do not have. These are: a phone jack and a diode switch. The switch (on the underside of the instrument) permits the tuned circuit and tube to be used as an absorption wave meter by turning off B-plus and permitting the tube to function as a diode. The headphone jack permits the use of the grid dip meter as an oscillating detector with the diode switch in the "Osc" position. In this mode of operation, a beat note is heard in the headphones when the grid dip meter frequency is the same as that of an oscillator under test.



2 COUPLING METHODS

Coupling between a grid dip meter and the circuit under test may be either inductive or capacitive (see Fig. 2). If a lumped constant tuning arrangement (coil and capacitor) at frequencies below 100 *mc* is involved, inductive coupling is usually preferable. However, where distributed constant tuning and higher than 100 *mc* frequencies are involved, capacitive coupling is usually employed.

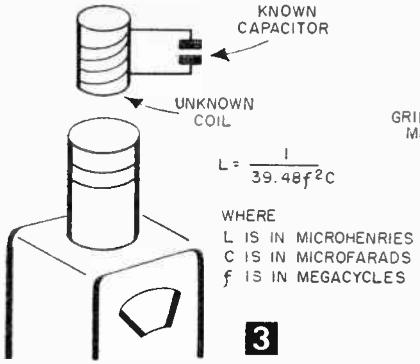
The extent of the coupling is determined by the proximity of the tuned circuits of the meter and the unit being tested. The largest separation possible which still allows dips to be detected represents minimum loading and therefore gives the most accurate resonant frequency if the dial is correctly calibrated.

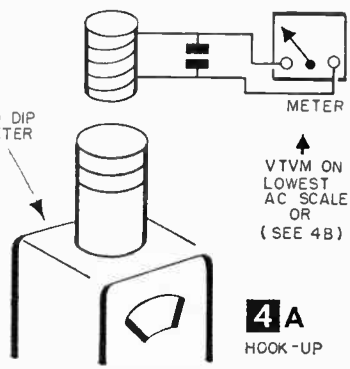
Measuring L, C and Q. To measure for *inductance*, connect a known capacitance in parallel with the unknown inductance. Then, with the unknown coil inductively coupled to the grid dip meter coil, locate the dip frequency by rotating the grid dip meter tuning dial (see Fig. 3). The unknown inductance can then be found with the help of a reactance chart from a reference book, or it can be calculated by using the relationship:

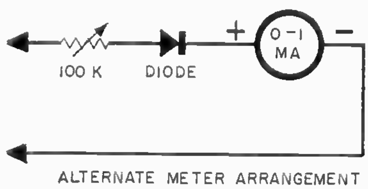
$$L=\frac{1}{39.48f^2C}$$

where L is expressed in microhenries, C in microfarads, and f in megacycles.

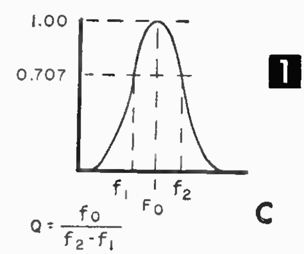
Capacitance can be measured—with the Model GD-1B—by connecting the unknown capacitor in parallel with the C band coil (14-37 *mc*), and finding the dip frequency of the combination with coil A (2-5 *mc*) or coil B (5-14 *mc*) in the grid dip meter. This arrangement is suitable for finding unknown capacitance between 70 and 2,000 *mmf* directly from a graph furnished with the GD-1B. With other grid dip meters, assuming you know the inductance of the coil,







MEASURING Q



$$C=\frac{1}{39.48f^2L}$$

where C is in microfarads, L is in microhenries, and f is in megacycles.

If you want to measure a capacitance smaller than 70 *mmf*, connect it in parallel with a capacitor of approximately 100 *mmf*. Since capacitance in parallel is like resistance in series and adds, the capacitance of the unknown capacitor will be the capacitance of the combination minus the capacitance of the known capacitor.

If you want to measure the capacitance of a capacitor greater than 2,000 but, less than 10,000 *mmf* (.01 *mfd*), connect a known capacitor of about 1500 *mmf* in series with the unknown capacitor and find the dip frequency. The unknown capacitance is given by

$$C_x=\frac{1}{1/C_t-1/C_k}$$

where the subscripts x, t, and k represent the unknown, the total of series, and the known capacitance, respectively.

To measure the Q (quality factor) of a coil, connect the coil as shown in Fig. 4A. The meter can be a general purpose VTVM set on the lowest *ac* range, or it can be made up with a O-1 *ma* meter as shown in Fig. 4B. Find the dip frequency f_o; note the external meter reading; multiply it by .707. Now adjust the grid dip meter frequency till the external meter reading falls to this computed value. There'll be points at a lower frequency (f_1) and a higher frequency (f_2) at which this will occur. The Q of the coil is given by:

$$Q=\frac{f_o}{f_2-f_1}$$

The functions which a grid dip meter can perform enable you to use it to calibrate variable capacitor dial scales, prealign tuned circuits without applying power, neutralize transmitters, wind your own coils to specified frequencies, locate parasitic oscillations, and numerous other specific jobs you'll discover as you use it.

Nailpolish Is "Liquid" Insulation

• Nailpolish makes a high-quality liquid insulation for coating bare electric wire connections and is especially easy to apply to radio-TV connections that are difficult to reach with tape. After the connection has been soldered and allowed to cool, apply the polish with the handy applicator brush provided in the bottle. If the connection has to be unsoldered later, just the touch of a hot soldering iron will burn away such insulation with a puff of smoke.—John A. Comstock.

Four-way Table Radio Conversion

This youngster is going to listen to his favorite record without disturbing other members of the household because he is using a small radio with earphone attachment to amplify record player.

Convert Your Radio to a

1) Telephone-pickup speaker
2) Public address unit
3) Record-player speaker
4) Electronic Amplifier for musical instruments

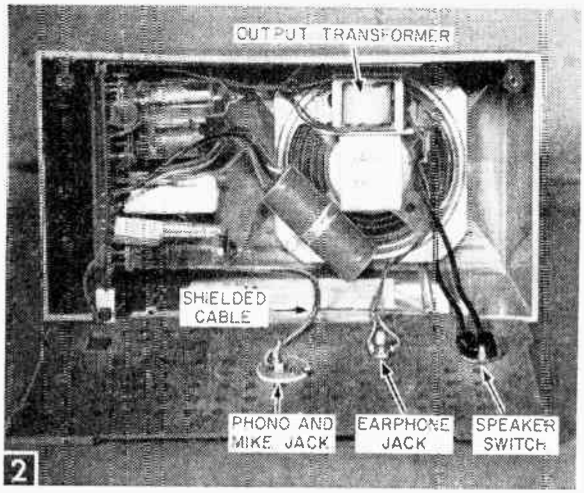
By THOMAS A. BLANCHARD

YOU can, without having previous radio circuitry knowledge, convert your small inexpensive radio into a multi-purpose unit that will (1) amplify telephone conversations so the whole family can listen to calls from distant friends or relatives; (2) perform as a small public address unit, or "home broadcaster" for party stunts or act as a one-way intercom between house and garage, or basement; (3) accept any manual or automatic record player with reserve amplification, thus allowing teenagers to play their favorite discs without disturbing others; (4) amplify stringed musical instruments so they can be heard when played with other louder instruments. Radio may be operated with speaker silent, or speaker and earphone both on at the same time.

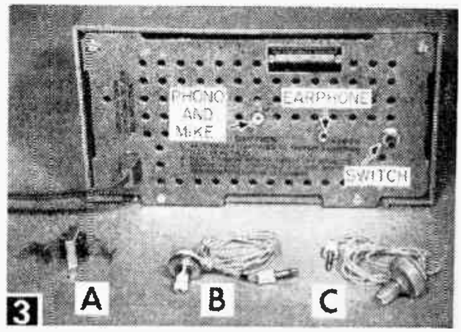
Converting your radio set for the above features involves an outlay of less than $1 for the necessary components which consist of 1 ft. of single conductor shielded phono or mike cable, a phono jack, a rotary lamp switch, a .005 *mfd.* capacitor, and a miniature earphone plug, and jack. Record player, phone pickup coil, crystal mike, etc., will also be needed depending upon the use you intend to put your converted radio to.

First remove the chassis from the radio cabinet, and drill three holes in the pressed-wood back for mounting the two jacks and switch as in Figs. 2 and 3. Since the radio cabinet back is most likely perforated, it will only be necessary to enlarge the holes in order to install the components. Earphone jack and switch require a plain hole for mounting, while the phono jack will require two additional mounting holes to clear a pair of #3-48 x 3/8-in. machine screws which secure the component to the panel.

Note in Fig. 4 that there are two methods for installing the earphone attachment. The first method is the most versatile because it allows either an inexpensive crystal earphone or the superior high resistance magnetic-type phone to be used. In this hookup, a lead is attached to the primary side of the set's audio output transformer, then terminated to one of the earphone jack lugs. A second lead is connected to the remaining transformer primary lead through a .0047 or .005 *mfd.* paper capacitor. This lead is now terminated on the remaining jack lug. Now, in order to silence the speaker, we open one side of the output transformer's secondary and install the rotary switch to the voice coil lug on the speaker, and



Earphone, phono jacks and switch are mounted on back cover of radio. Alterations do not affect set's normal use.



(A) Miniature output transformer as used in alternate earphone hookup. (B) High impedance magnetic earphone. (C) Inexpensive crystal earphone will also work as a "mike."

the disconnected transformer wire.

In most small radios, the output transformer is mounted on the speaker frame as in Fig. 2. However, in some sets, this transformer may be on the chassis and gaining access to the primary side may be difficult unless you're familiar with radio circuitry. In such instances, the earphone attachment can be connected through a miniature radio output transformer directly to the speaker voice coil lugs. The 3.2 ohm secondary is connected to the speaker while the 2000 ohm primary is connected to the earphone jack.

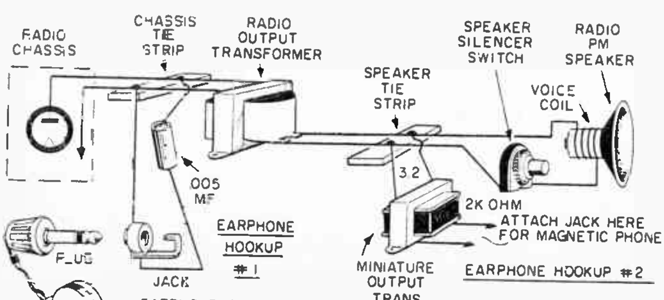
It should be noted that with this arrangement, only magnetic earphones will work. The speaker silencer switch connections are the same for either hookup. The miniature earphone jacks are 2-circuit types. Therefore, connections are made only to the two outside lugs, the center lug not being connected. While this jack can be wired so that the speaker (in the Fig. 3, #1 hookup only) is automatically silenced when a magnetic (only) earphone is plugged in, this arrangement will not allow both speaker and phone to function together. It is for this reason that a separate switch has been employed. Moreover, the #1 hookup allows use of a crystal earphone or magnetic type.

MATERIALS LIST—CONVERT YOUR RADIO

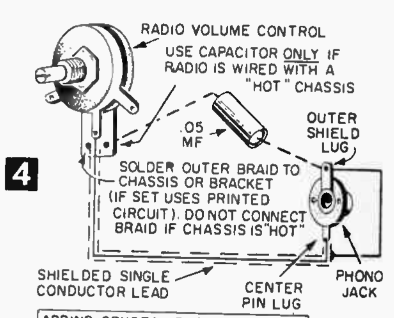
No. Req.	Size and Description
1	1 ft. length shielded, insulated single conductor phono cable
1	phonograph jack
1	miniature phone plug
1	miniature phone jack
1	rotary lamp switch (dime store) or Radio Toggle Switch, S.P.S.T.
1	.005 or .0047 mfd. paper capacitor 400 d.c.w.v.
1	miniature output transformer, 3.2 ohm Pri./2000 ohm sec. Lafayette #AR-96 (Optional)
1	.05 mfd. paper capacitor, 400 d.c.w.v. (Optional)
	Contact mikes, telephone coil and miniature earphones mentioned in text available from Lafayette Radio, 165 Liberty Ave., Jamaica 33, N. Y. or Allied Radio, 100 N. Western Ave., Chicago 80, Ill.

Record player-mike attachment. Whether the set you are working with contains 4, 5 or 6 tubes, you will in nearly every instance, get just as much amplification from the 4-tube set as you will from the 5 or 6. Nearly all table sets made within the last 5 years employ a miniature 12AV6 detector-AVC-voltage amplifier and a 50C5 miniature power pentode output tube. All other tubes in the set are for R.F., I.F. and voltage rectification. This applies equally well to sets using large tubes.

Start by carefully removing about ¾ in. of the outer plastic insulation from the shielded cord. This will expose a loose-woven wire braid. With a needle, carefully unravel the braid. This will expose a second layer of insulation under which is the "grid" lead. Twist the braid wires together and use them as any other wire. But be careful



ADDING EARPHONE TO ANY TYPE OF RADIO RECEIVER



ADDING CRYSTAL PHONO AND MIKE INPUT TO ANY TYPE OF RADIO that the inner wire and braid lead do not contact each other.

Note that the receiver volume control contains three soldering lugs. It may have two additional lugs on the back, but disregard these as they are line switch connections. Without disturbing any wires now on the volume control, solder the inner wire of the shielded cable to the *center* lug of the volume control. Now solder the outer braid to the set chassis if a conventional radio, or to the volume control bracket if set employs a printed circuit board.

There is no further work to do on the set. Simply connect the remaining end of the shielded cable to the outer shield lug of the phono jack and the inner wire to the center pin lug of the jack. Any radio built according to Retma standards employs a "floating" ground system. There is no chance of dangerous shock when connections are made as described above.

On the other hand, if your set is wired with the chassis "hot," you can eliminate shock hazard by adding an .05 *mfd.* capacitor in series with the ground return. Fig. 4 indicates the alternate connections along with the conventional hookup for RETMA sets which automatically provides capacitor isolation on both the grid and ground sides of the phono jack input. You can now reassemble the radio and replace the back.

For public address system or one-way intercom use any good crystal mike can be plugged into the phonograph jack. The cord on the mike must be sufficiently long, however, so that radio and mike are not in the same room, otherwise feedback (howl) will result. This hookup, incidentally, has sufficient output for store window demonstrators (pitchmen) to reach large sidewalk gatherings.

To pick up and amplify telephone conversations you need only an inexpensive induction coil. Plug the cable into the phono jack, and place the coil under the phone near the rear of the base. If phone has a wall ringer box, place the coil on top of the box. These induction coils are plastic encased and measure only 1½ x 4½ x ¼. A strip of scotch masking tape will secure them to the telephone apparatus.

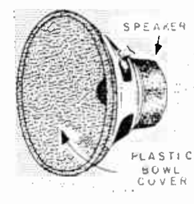
If feedback results with the telephone hookup it can be corrected by cupping your hand over the phone transmitter, or merely being sure that you are a modest distance behind the radio and not in front of it. This also applies when using a mike. By careful positioning of yourself behind the radio, it is possible to use a mike without creating a feedback effect.

Phono players and contact mikes for stringed instruments usually come with 6-ft. cords; an extension cord of single conductor shielded wire up to 25 ft. may be employed. Contact mikes are available for amplifying harmonicas and accordions, too. These units are all inexpensive and work very well. We have used a contact mike attached to the baffle of our electronic organ to feed music to the basement.

When using the radio in any of the amplifier applications, always turn the radio dial to the 550KC end. This simple circuit employs no system to defeat the R.F., I.F. sections, thus the radio should be tuned to the less sensitive end of the band. Our youngsters have used this condition to advantage by knowing the top tunes and the order in which they are played by disc jockeys.

With the record player plugged in, and the set tuned to the record show, they'll "kick" the player mechanism at the moment the disc jockey starts the same tune. There is always a small lag as record player and radio feed the same signals through the amplifier. The effect is often novel with the lag creating anything from a true echo effect to something that sounds like a hound dog trapped in a barrel.

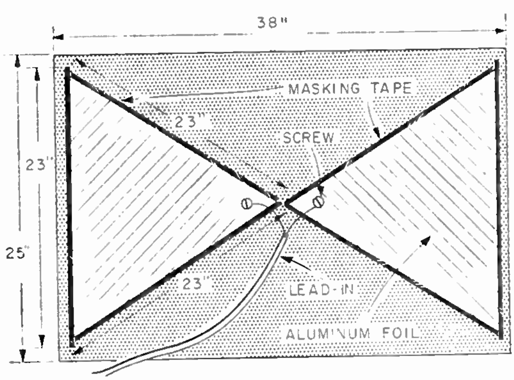
Bowl Cover Protects Speaker



• To eliminate the possibility of puncturing a loudspeaker's cone while working on the speaker or carrying it from one place to another, slip an inexpensive plastic bowl cover over the face of the speaker.—JOHN A. COMSTOCK.

Experimental Foil TV Antenna

• Need an all-channel TV antenna for experiments to see how many stations you can pull in? Here's one that is easy to make, inexpensive and



very efficient. Cut a 25 x 38-in. piece of cardboard from a large cardboard box and outline two equilateral triangles measuring 23 x 23 x 23 in. each on the cardboard in a fan shape. Cut two pieces of household aluminum foil to the outline of the triangles and secure them to the cardboard with masking tape. Connect a piece of twin-lead to the apex of each fan with small screws and nuts through a hole punched through both foil and cardboard. Fasten the lead-in to your set and try the antenna in various positions for best reception. If the antenna is to be used permanently, mount it to the rafters in the attic, with 25-in. dimension in vertical position.—JOHN A. COMSTOCK.

Useful Tables and Formulas

Compiled by Thomas A. Blanchard

STANDARD RESISTOR VALUES

• Table A, below, lists all *carbon type* resistors manufactured in the United States according to RETMA (Radio-Electronics-Television Manufacturers Assoc.) and JAN (Joint Army-Navy) Standards. The bold figures show the 10% accuracy values that are becoming the preferred electronic standard. For example, a circuit may call for a resistor of 50,000 ohms. However, noting chart, the nearest standard 10% value today is 47,000 ohms.

Except in cases where a very low ohms value is called for, any resistance under 500 ohms, it is usually safe to use the nearest value shown in bold face type in Table A.

TABLE A—STANDARD RESISTANCE VALUES

All values in OHMS						(Identical) MEGOHMS		
1.0	**10**	**100**	**1,000**	**10,000**	**100,000**	**0.1**	**1.0**	**10.0**
1.1	11	110	1,100	11,000	110,000	0.11	1.1	11.0
1.2	**12**	**120**	**1,200**	**12,000**	**120,000**	**0.12**	**1.2**	**12.0**
1.3	13	130	1,300	13,000	130,000	0.13	1.3	13.0
1.5	**15**	**150**	**1,500**	**15,000**	**150,000**	**0.15**	**1.5**	**15.0**
1.6	16	160	1,600	16,000	160,000	0.16	1.6	16.0
1.8	**18**	**180**	**1,800**	**18,000**	**180,000**	**0.18**	**1.8**	**18.0**
2.0	20	200	2,000	20,000	200,000	0.2	2.0	20.0
2.2	**22**	**220**	**2,200**	**22,000**	**220,000**	**0.22**	**2.2**	**22.0**
2.4	24	240	2,400	24,000	240,000	0.24	2.4	
2.7	**27**	**270**	**2,700**	**27,000**	**270,000**	**0.27**	**2.7**	
3.0	30	300	3,000	30,000	300,000	0.3	3.0	
3.3	**33**	**330**	**3,300**	**33,000**	**330,000**	**0.33**	**3.3**	
3.6	36	360	3,600	36,000	360,000	0.36	3.6	
3.9	**39**	**390**	**3,900**	**39,000**	**390,000**	**0.39**	**3.9**	
4.3	43	430	4,300	43,000	430,000	0.43	4.3	
4.7	**47**	**470**	**4,700**	**47,000**	**470,000**	**0.47**	**4.7**	
5.1	51	510	5,100	51,000	510,000	0.51	5.1	
5.6	**56**	**560**	**5,600**	**56,000**	**560,000**	**0.56**	**5.6**	
6.2	62	620	6,200	62,000	620,000	0.62	6.2	
6.8	**68**	**680**	**6,800**	**68,000**	**680,000**	**0.68**	**6.8**	
7.5	75	750	7,500	75,000	750,000	0.75	7.5	
8.2	**82**	**820**	**8,200**	**82,000**	**820,000**	**0.82**	**8.2**	
9.1	91	910	9,100	91,000	910,000	0.91	9.1	

Note: Values below one ohm are available for precise instrument or laboratory work. They are not ordinarily needed by the radio or TV experimenter.

10% accuracy resistors are less costly and can be used for most applications. All values may not be available from all manufacturers or radio supply houses.

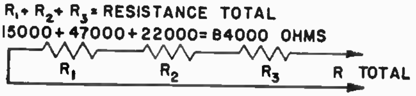
It will be noted that resistors are standardized in *units, tens, hundreds, thousands* . . . reading across table. This simplifies reading of color codes. While standard values stop at 22 megohms, IRC and certain other resistor makers supply values up to 200 megohms for laboratory use. Special resistors may cost 100 times a standard value due to technically skilled labor required in calibration as against production-line labor.

RESISTORS IN MULTIPLE

• *Series.* Any number of resistors of identical wattage may be connected in series to obtain a desired resistance value. If wattage ratings are mixed, the total resistance will handle as much as the lowest wattage resistor in the "string."

FORMULA: $R_1 + R_2 + R_3$ = RESISTANCE TOTAL

EXAMPLE: 15000 + 47000 + 22000 = 84000 OHMS



Parallel. Identical resistors in parallel increase the wattage rating of the total resistance. At the same time the total number of resistors becomes the divisor for the unit combination.

(Using three 4700-ohm, 1-watt units.)

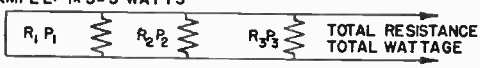
$R = R_1 = R_2 = R_3$ $P = P_1 = P_2 = P_3$

FORMULA: $\frac{R}{\text{NO. OF RESISTANCES}}$ = TOTAL RESISTANCE

EXAMPLE: $\frac{4700}{3}$ = 1567 OHMS

FORMULA: P x NO. OF RESISTANCES = TOTAL WATTAGE (POWER)

EXAMPLE: 1 x 3 = 3 WATTS



Mixed value resistors connected in parallel employ this formula for multiples of two resistors only: (Using a 4700 and 3300 ohm 1-watt resistor.)

FORMULA: $\frac{R_1 \times R_2}{R_1 + R_2}$ = TOTAL RESISTANCE

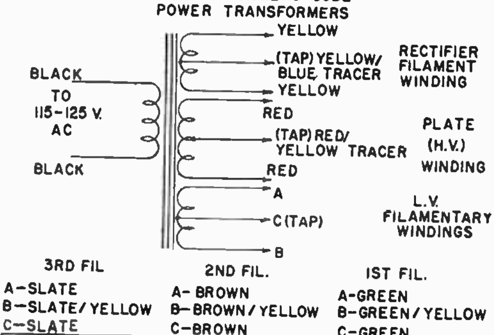
EXAMPLE: $\frac{4700 \times 3300}{4700 + 3300} = \frac{155100}{8000}$ = 1940 OHMS (APPROX)

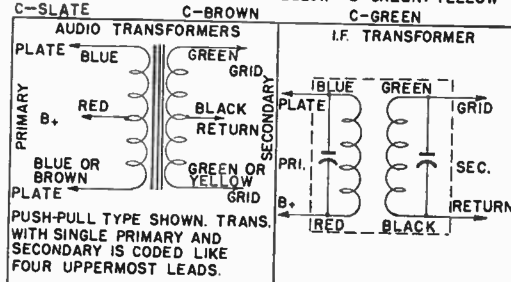
Mixed resistances in parallel do not (theoretically) double in current carrying capacity (wattage). However, if above 4700 and 3300-ohm resistors were each rated 1-watt, the combination would handle almost two watts. If a large difference exists between two values, total wattage through circuit should not greatly exceed rating of lowest wattage single unit.

For multiple mixed parallel combinations, reduce resistors in pairs with above formula until arriving at final resistance. There are formulas

STANDARD RTMA TRANSFORMERS CODE

POWER TRANSFORMERS





for multiple mixed resistor combinations, but they are much more complicated than simple reduction.

COLOR CODE CHART—FOR RESISTORS AND CAPACITORS

Color Dot A (mmf.) Color Band A (ohms)	Color Dot B (mmf.) Color Band B (ohms)	Color Dot C (mmf.) Color Band C (ohms)
Black........0	Black........0	....
Brown.......1	Brown.......1	Brown.....Add 1 zero
Red.........2	Red.........2	Red.......Add 2 zeros
Orange......3	Orange......3	Orange.....Add 3 zeros
Yellow.......4	Yellow.......4	Yellow.....Add 4 zeros
Green........5	Green........5	Green......Add 5 zeros
Blue.........6	Blue.........6	Blue.......Add 6 zeros
Violet........7	Violet........7	Violet......Add 7 zeros
Gray.........8	Gray.........8	Gray.......Add 8 zeros
White........9	White........9	White......Add 9 zeros

Example:
Band A is Yellow
Band B is Violet
Band C is Orange
Resistor will be 47,000 ohms.

Example:
Dot A is Red
Dot B is Green
Dot C is Brown
Capacitor is 250 mmf.

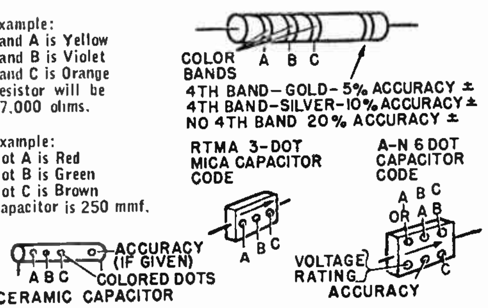


TABLE B—DECIMAL EQUIVALENTS

1/64	.0156	1/4	.2500	1/2	.5000	3/4	.7500
1/32	.0312	17/64	.2656	33/64	.5156	49/64	.7656
3/64	.0469	9/32	.2812	17/32	.5312	25/32	.7812
		19/64	.2969	35/64	.5469	51/64	.7969
1/16	.0625	5/16	.3125	9/16	.5625	13/16	.8125
5/64	.0781	21/64	.3281	37/64	.5781	53/64	.8281
3/32	.0938	11/32	.3438	19/32	.5938	27/32	.8437
7/64	.1094	23/64	.3594	39/64	.6094	55/64	.8594
1/8	.1250	3/8	.3750	5/8	.6250	7/8	.8750
9/64	.1406	25/64	.3906	41/64	.6406	57/64	.8906
5/32	.1562	13/32	.4062	21/32	.6562	29/32	.9062
11/64	.1719	27/64	.4219	43/64	.6719	59/64	.9219
3/16	.1875	7/16	.4375	11/16	.6875	15/16	.9375
13/64	.2031	29/64	.4531	45/64	.7031	61/64	.9531
7/32	.2188	15/32	.4688	23/32	.7183	31/32	.9688
15/64	.2344	31/64	.4844	47/64	.7344	63/64	.9844

TABLE C—METRIC LENGTHS TO INCHES

2.54 Centimeters = 1 inch

1 Millimeter (unit) mm		= .03937	inch
10 Millimeters	= 1 Centimeter (cm)	= .3937	inch
10 Centimeters	= 1 Decimeter	= 3.937	inches
10 Decimeters	= 1 Meter (m)	= 39.37	inches

COMPUTING VOLTAGE-DROPPING RESISTOR FOR SERIES WIRED TUBES

• Small *ac-dc* radios are operated without use of a step-down filament transformer by wiring all tube filaments (heaters) in series. Tubes in a modern 5-tube set have individual filaments which total 121 volts, requiring no voltage-drop.

Sets with 4 or less tubes may require a resistor to make up the difference between their total and line voltage. Most miniature tubes and GT types draw .3 *amp.* if 6-volt filament type; or .150 *amp.* if 12-volt filament type.

To calculate voltage drop, add up total voltage of tubes in string (all must have same current rating as determined by checking in a tube manual). Subtract the resulting figure from your power line voltage. Now divide the tube current into the voltage difference. The answer will be the value of the voltage dropping resistor in ohms. For example:

	Line voltage 120 volts	R = Resistance in ohms
Three 12 v., .150 amp. tubes total	36 volts	E = voltage in volts
	Voltage drop 84	I = current in amperes

$R = \frac{E}{I}$ $R = \frac{84}{.150}$ = 560-ohm resistor required

To determine wattage rating use formula $W = I^2 R$ or .150 x .150 x 560 = 12.60 watts.

Since a 560-ohm, 12.60-watt resistor is not available, select next size; in this case 600 ohms rated at 20 watts.

FINDING THE UNKNOWN

Volts —E—	Milliamperes (Ma.) —I—	Ohms —R—	Watts —W—
Known	Known	$\frac{1000 \times \text{volts}}{\text{milliamperes}}$	$\frac{\text{Volts} \times \text{milliamps}}{1000}$
Known	$\frac{1000 \times \text{volts}}{\text{Ohms}}$	Known	$\frac{\text{Volts} \times \text{volts}}{\text{Ohms}}$
Known	$\frac{1000 \times \text{watts}}{\text{volts}}$	$\frac{\text{volts} \times \text{volts}}{\text{watts}}$	Known
$\frac{\text{MA.} \times \text{Ohms}}{1000}$	Known	Known	$\frac{\text{MA.} \times \text{MA.} \times \text{Ohms}}{1,000,000}$
$\frac{1000 \times \text{watts}}{\text{MA.}}$	Known	$\frac{1,000,000 \times \text{watts}}{\text{MA.} \times \text{MA.}}$	Known
$\sqrt{\text{ohms} \times \text{watts}}$	$1000\sqrt{\frac{\text{watts}}{\text{Ohms}}}$	Known	Known

Circuit component requirements are quickly established with this table so long as any two items in columns are known. Then simply read across the proper row for formulas that will provide the unknown information.

OHM'S LAW AND DIRECT CURRENT RELATIONS

(E = IR or Volts = Amperes x Ohms)

(E) VOLTS = IR or $\frac{W}{I}$ or $\sqrt{RW}$ (I) AMPS. = $\frac{E}{R}$ or $\frac{W}{E}$ or $\sqrt{\frac{W}{R}}$

(R) OHMS = $\frac{E}{I}$ or $\frac{W}{I^2}$ or $\frac{E^2}{W}$ (W) WATTS = EI or I^2R or $\frac{E^2}{R}$

TABLE D—CONVERTING ELECTRONIC UNITS OF MEASURE

Amperes	× 1,000,000	=	Microamperes
Amperes	× 1,000	=	Milliamperes
Cycles	× .000,001	=	Megacycles
Cycles	× .001	=	Kilocycles
Farads	× 1,000,000,000,000	=	Micro-microfarads
Farads	× 1,000,000	=	Microfarads
Henries	× 1,000,000	=	Microhenries
Henries	× 1,000	=	Millihenries
Kilocycles	× 1,000	=	Cycles
Kilovolts	× 1,000	=	Volts
Kilowatts	× 1,000	=	Watts
Megacycles	× 1,000,000	=	Cycles
Microfarads	× .000,001	=	Farads
Microfarads	× 1,000,000	=	Micro-microfarads
Microhenries	× .000,001	=	Henries
Microvolts	× .000,001	=	Volts
Micro-microfarads	× .000,000,000,001	=	Farads
Milliamperes	× .001	=	Amperes
Millihenries	× .001	=	Henries
Millivolts	× .001	=	Volts
Ohms	× .000,001	=	Megohms
Ohms	× 1,000	=	Milliohms
Volts	× 1,000,000	=	Microvolts
Volts	× 1,000	=	Millivolts
Watts	× 1,000	=	Milliwatts
Watts	× .001	=	Kilowatts

This table is extremely versatile in that it may be used forward and backward. For Example: amperes x 1,000,000=microamperes. Or 0.25

TABLE E—ELECTRONIC & ELECTRICAL ABBREVIATIONS

A.C., *a-c*	Alternating Current
A.F.	Audio Frequency
AM	Amplitude Modulation. Method of transmission used by standard long and short-wave stations; also for sending TV pictures
A.V.C.	Automatic Volume Control
C (cp.)	Capacitance in farads; microfarads, or micro-microfarads
c.p.s.	Cycles per second
db	Decibel. A unit of sound measurement
D.C., *d-c*	Direct Current
FM	Frequency Modulation. Method of sound transmission used by high-frequency broadcasters (including TV sound)
E, *e*	Symbol denoting voltage
	Frequency—kilocycles or megacycles
emf, e	Electromotive force
H.F.	High-frequency as used for standard shortwave, FM and TV sound and picture transmission.
H.V.	High-voltage (usually with regard to TV circuits)
Hy, *h*	Henry, unit for measuring coil inductance
I	Electrical symbol for current (amperes, milliamperes, micro-amperes)
I.F., i.f.	Intermediate Frequency (or transformers as employed in superheterodyne circuits)
K (M)	Kilo from the Greek meaning one thousand. M also a prefix for one thousand, but becoming obsolete
L	Electrical symbol for inductance
L.V.	Low-voltage (tube filaments and TV voltages under 360v
ma	Milliamperes; 1/1000th of an ampere
Meg, MΩ	One megohm (1-megohm = one million ohms)
mfd, µfd	Microfarad
mmf, mmfd.	Micro-microfarad
Mil	One-thousandth part. Used as prefix in voltage and current: Also a measurement of wire diameters
mu	Amplification factor of vacuum tubes
R	Symbol for electrical resistance (ohms)
R.F.	Radio Frequency
RMS, *r.m.s.*	*Root means square* as employed in alternating current calculation
SG (g₂)	The high potential valve element in a vacuum tube; often called the *screen grid*
SW (sw)	Switch or shortwave
TRF, t.r.f.	Tuned Radio Frequency. Often with reference to a low sensitivity-high fidelity type radio circuit
UHF	Ultra-High Frequency
VHF	Very-High Frequency
wl, λ	Wavelength
X	Electrical symbol for reactance (Opposing force to *a-c*)
Z	Electrical symbol for impedance (Total *a-c* opposition)

GREEK SYMBOLS

Ω	Ohms (from *omega*) "O"
λ	Wavelength (from *lambda*) "L"
µ	Mu or micro- (Greek letter M)
π	Pi or 3.14 (Greek letter P)

Greek *Alpha* (A); *Beta* (B), *Gamma* (C) denote types of radio-active waves.

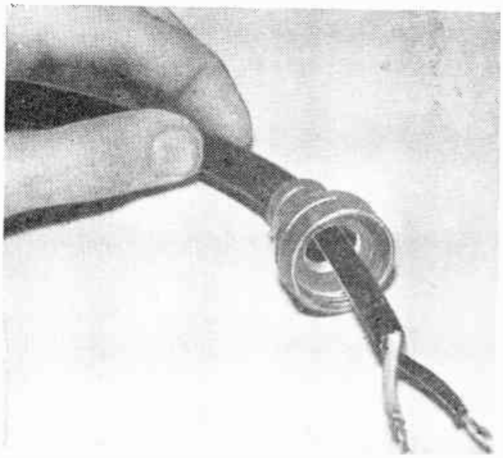
amp. x 1,000,000=250,000 microamperes. Reading the table from right to left, note that a microampere is a millionth part of an ampere; a milliampere is a thousandth part of an ampere.

The center "multiplier" column is expressed both in whole numbers and decimals. This is done for mathematical simplicity.

When reading a decimal "multiplier" from right to left, it is read as a whole number. For example: Watts x .001=Kilowatts. Or 10 watts x .001=.01 (1/100th part of a kilowatt.) Now reading right to left, Kilowatt equals 1000 watts. The decimal .001 (1/1000th) is read as a whole number, or *one thousand.*

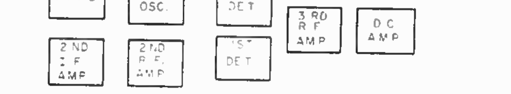
Plastic Hose Protects Underground Cable

• If you need some UF (underground feeder) cable and there's none to be had, or the price is too high, ordinary wire (providing a small enough size wire is permissible) can be housed



inside lengths of plastic garden hose. Bury the wire and hose, then caulk the open ends shut to prevent moisture from entering.—JOHN A. COMSTOCK.

RADIO HOOKUP PUZZLE

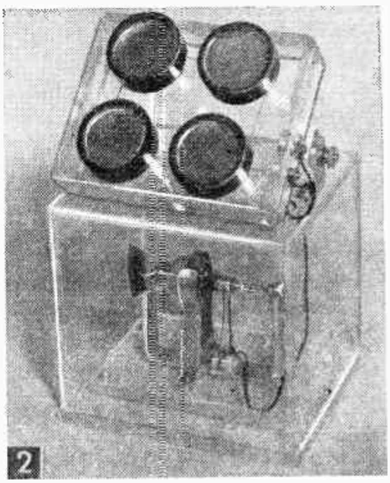


IF you like to work puzzles, here's one that's rather unusual. Using the appropriate circuits in the block diagram above, hook up a tuned-radio-frequency radio receiver by drawing in a connecting wire between the various stages. Also, indicate (with arrows) the path the signal takes through the circuit. There's no power supply so just assume that one already exists and that all stages are receiving power. It doesn't matter what route you take in making connections, just so you find and couple together all six stages in their correct order.

Solution to Radio Hookup Puzzle, Page 152.

Silicon-Cell Sun Battery Powers Motor

By HAROLD P. STRAND



Four black discs on top of case (Fig. 2) are silicon solar cells that convert sunlight into electricity to operate motor enclosed in plastic case. Note whirling fan blades in Fig. 1 that indicate motor is running from electricity generated by solar cells.

OF THE two types of cells available for converting sun power to electricity, *silicon* cells are theoretically more efficient. They convert 11% of solar energy they receive into electrical power, while selenium cells convert only 1-2% of the available energy.

Up until recently, however, the cost of the more efficient *silicon* cells was so high that relatively few experimenters could afford to use them to power small radios or motors.

Now, however, there are silicon cells available at a price many experimenters can afford. So we have developed a new solar battery using them, and will show you how to use it to run a small electric motor.

The motor is encased in a clear plastic case to protect it from dust and dirt and so its operation can be observed. The battery case, mounted on top of the motor case (Fig. 2) can be tilted to catch the direct rays of the sun. The motor will operate at a speed of about 800-1000 *rpm* in bright sunlight during winter months when the light intensity is probably less than 5000 footcandles. During the summer, when sunlight approaches 10,000 footcandles, the motor will speed up to 2000 *rpm* or more.

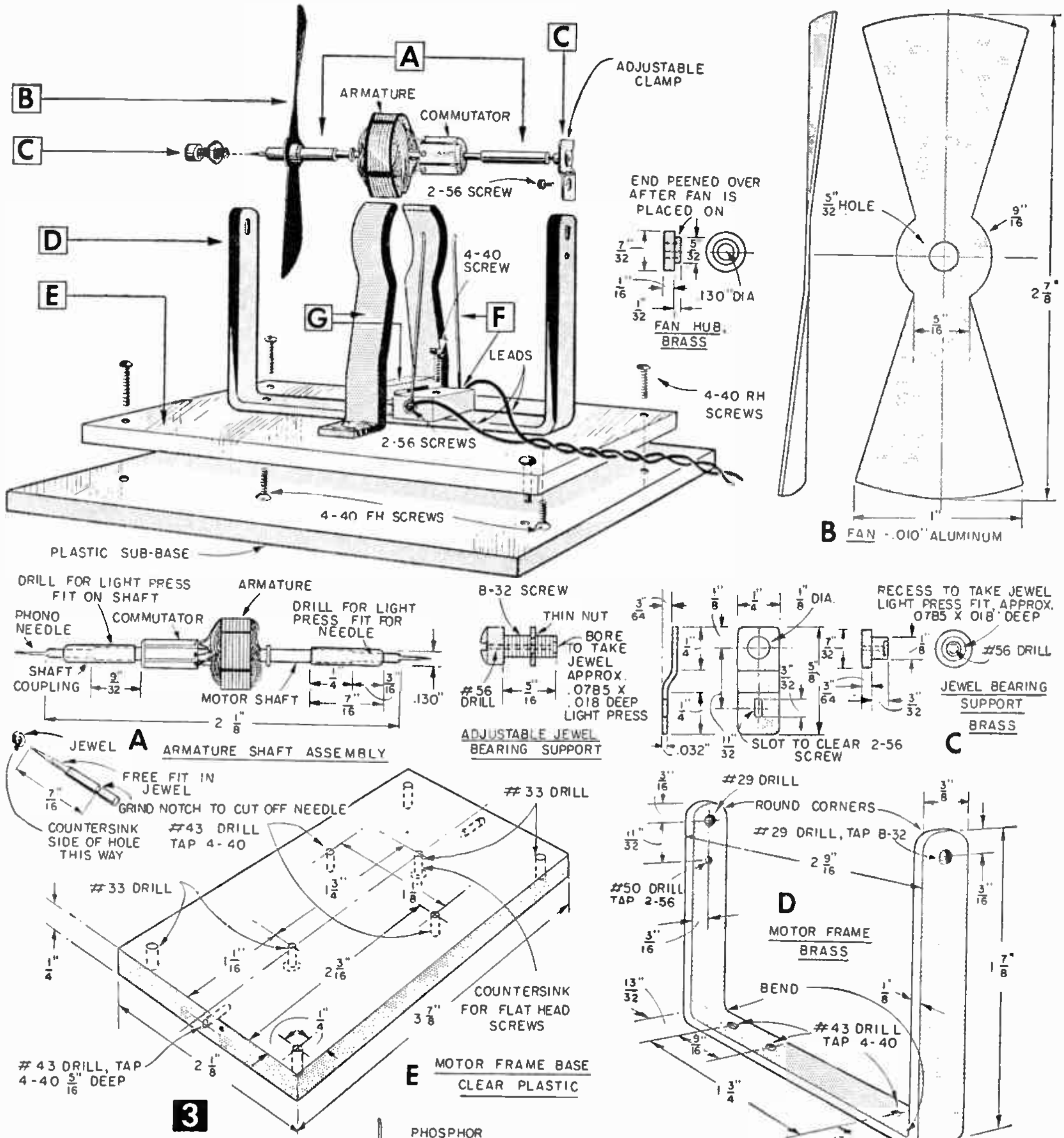
The motor armature shaft is equipped with phonograph needles running in sapphire jewel bearings to minimize friction. Brushes are of fine phosphor bronze wire to further reduce friction. A permanent magnet field having a single magnet and two pole pieces is used. The motor will operate on a minimum of about .5 volts and draws about 40-50 milliamperes at that voltage. With higher intensity sunlight, the voltage at the motor terminals will be about .6 to .9 volts.

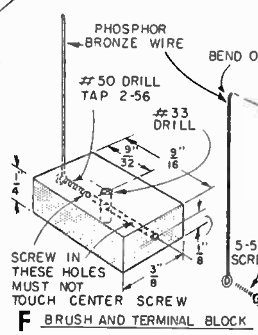
Making the Motor. After purchasing the parts called for in the Materials List, cut off both ends of the armature shafts $\frac{9}{32}$ in. from the commutator on one end and the same distance from the bushing on the other end. Round-off the cut ends of the shaft with a file. The phonograph needles, used for armature shaft extentions (Fig. 3A), must also be cut off to a total length of $\frac{7}{16}$ in. from the pointed end. Grip the blunt end with pliers and, holding the needle against the corner of an abrasive wheel, grind a notch around the needle and break off the end. Dress the cut end square and round-off the corner. Take care not to injure the pointed end.

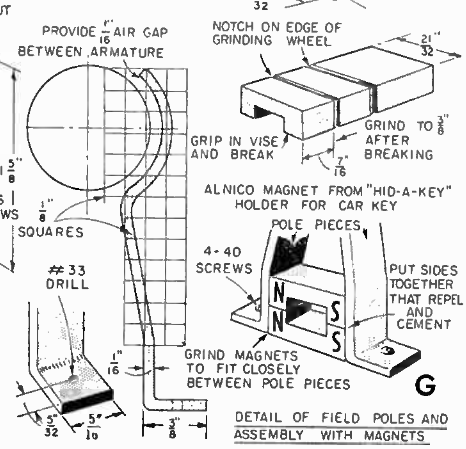
To mount the needles to the armature shaft ends, make two shaft couplings (Fig. 3A). These should be accurately bored with a modelmaker's lathe so the holes are concentric and press fit with the needles and armature shaft. If you do not have a metal-turning lathe to do this work, have these and other turned parts made at a local model or machine shop. Assemble the couplings by pressing them on the armature shaft and then press the needles into the coupling holes as in Fig. 3A.

Make the fan and fan hub (Fig. 3B) next. Fasten fan to hub by peening end of hub after assembly. Mount the fan on the armature by pressing it on the coupling as in Fig. 3.

Set the assembled armature aside for the moment and work on the jeweled bearing supports. For







the adjustable bearing support, mount an 8-32 filister-head screw in the lathe, and drill and counterbore for a light press fit with one of the sapphire bearings as in Fig. 3C. Make the bearing support and bracket for the other sapphire bearing as detailed in Fig. 3C. Apply just a trace of thinned shellac to the sides of the holes the jewels are to be mounted in before pressing them in place. Avoid getting shellac on the faces or into the holes of the jeweled bearings and be sure to assemble the bearings with the countersunk side of the holes facing outward.

Make the motor frame by bending a strip of ⅛x⅜ in.

brass as in Fig. 3D. Then drill and tap the holes. To hold motor frame upright during assembly, make a plastic base for it as shown in Fig. 3E.

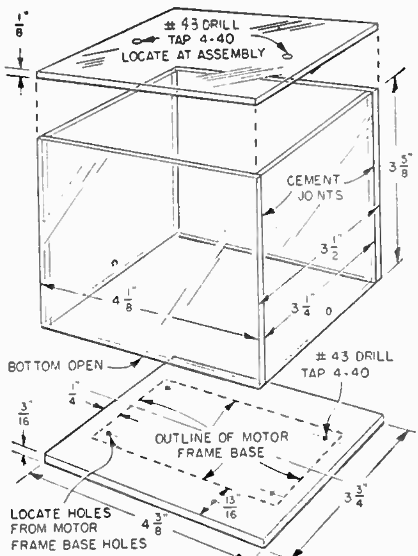
Before assembling the parts you have made thus far, polish the brass parts by rubbing with very fine steel wool. First assemble the motor frame to the plastic base with two 4-40 *fh* screws. Clean the jeweled bearings with carbontetrachloride and fasten the bearing support bracket to the motor frame with one 2-56 *rd* screw. Then, insert the commutator end of the armature in the bracket bearing and other end of shaft into the bearing in the filister-head screw. Adjust the screw as in Fig. 5 so there is just a slight amount of end play and fasten screw in place with a locknut. Apply a drop of clock oil to the bearings and spin the armature with your fingers—it should continue rotating for about 15 seconds. If the bearings bind, loosen the bearing at the commutator end and raise or lower, or move to one side.

Continuing with the construction of the motor, make the brush and terminal block (Fig. 3F). Use .011-.012 in. dia. phosphor bronze wire bent as in Fig. 3F for the brushes. Fasten the brushes to the terminal block with short 2-56 screws and connect two 8 in. length of #28 plastic insulated wire under the screws. Be sure these screws do not touch the 4-40 center mounting screw. Twist the two #28 gage wires together to form a neat cable. These are the leads that will go to the solar battery. Now fasten the terminal block to the motor frame with one 4-40 *rh* screw.

Field pole pieces are next. Bend these from strips of soft steel to the shape shown in Fig. 3G. The 1/16 in. air gap is not too critical except that if the poles are too close to the armature core, there will be too much magnetic attraction for the armature which may prevent the armature from starting on the very low power available from the solar cells. In general, about a 1/16 in. gap or a bit less will be best. Drill #33 holes through the bottoms of the pole pieces and mount them with 4-40 *rd* screws on each side of the armature as in Fig. 3.

The permanent magnets for the field poles are made from a *Hide-a-Key* unit sold in auto parts stores for holding the spare car keys in a hidden place in the car. Remove the Alnico magnet from the unit and grind notches 7/16 in. apart as in Fig. 3G. Then grip the magnet in a vise with the jaws at the edge of the notches and break the magnet with a sharp blow from a hammer. Break off two pieces and grind the broken edges smooth. Since heat may remove some of the magnetism, dip the pieces in water frequently during grinding. Also grind the ends of the magnets so they will fit snugly between the pole pieces.

Place the two magnets together so that they *repel* one another as in Fig. 3G (like poles repel) resulting in a combined north and south pole. To keep the two repelling sections together, apply *Pliobond* cement to each piece and, after a few minutes,



4 PLASTIC CASE BASE, 3/16" CLEAR PLASTIC

MATERIALS LIST—SILICON CELL BATTERY AND MOTOR

1 "Tiny Atom" armature with 120 turns #35 wire per coil and with 5-section commutator. Wilson's of Cleveland, 425 Lakeside Avenue, N.W., Cleveland 13, Ohio. $1.50 P.P. in U.S., remittance with order, no C.O.D.'s.
2 sapphire clock jewels measuring 2.0 mm O.D. and with .50-.51 mm hole. 2-jewels as above with fitted phono needles and piece of phosphor bronze wire for the brushes can be supplied by Howard R. Hawkins, 88 E. Foster St., Melrose, Mass. for $2.00 P.P. in U.S. Send M.O.
1 filister-head 8-32 brass screw 5/16" long for adjustable jewel bearing support
1 8-32 brass nut, file to 1/16" thickness
1 piece brass rod stock about 1/4" dia., 3/4" long for jewel support and fan hub
1 piece brass stock about .032" x 1/4" x 3/4". Jewel support bracket
1 piece brass stock 1/8" x 3/8" x 6 3/4". Main motor frame
1 piece brass rod stock about 3/16" dia. x 1 1/4" for armature-shaft sleeves
1 piece sheet aluminum .010" x 1" x 3" for fan. Can also use brass stock about .008" thick
2 pieces soft iron or steel 1/16" x 5/16" x 2 5/8" for motor-pole pieces
1 Alnico permanent magnet from a "Hide-A-Key" container for car keys (auto parts stores)
1 piece clear plastic 1/4" x 3/8" x 9/16" for brush block
1 piece clear plastic 1/4" x 2 1/8" x 3 7/8" for motor base
1 piece clear plastic 3/16" x 3 3/4" x 4 3/8" for piece under base
2 pieces clear plastic 1/8" x 3 5/8" x 4 1/8" for sides of motor case
2 pieces clear plastic 1/8" x 3 1/4" x 3 5/8" for sides of motor case
1 piece clear plastic 1/8" x 3 1/2" x 4 1/8" for top of motor case
1 piece clear plastic 1/8" x 3" x 3 3/4" for top of solar battery case
1 piece clear plastic 1/8" x 3" x 3 3/4" for back of solar battery case
2 pieces clear plastic 3/16" x 1/2" x 3 3/4" for sides of battery case
2 pieces clear plastic 3/16" x 1/2" x 2 5/8" for sides of battery case
1 piece aluminum about .035" x 5/16" x 4" for adjustable battery brackets
2 pieces phosphor bronze wire .011"-.012" dia., 2" long for motor brushes
4 solar cells, International Rectifier SA5-M (standard) at $7.00 each or SA5A-M (selected cells) at $8.00 each. Order from electronic parts dealers
2 pieces plastic covered stranded wire about #28 gage and about 8" long for motor leads

Misc. screws, nuts, bare hook-up wire for battery, etc.

The plastic parts can be supplied cut to measure from Forest Products Co., Inc., 131 Portland Street, Cambridge, Mass. They can also supply a small bottle of plastic cement. Total cost $4. P.P. in U.S. Send M.O. No C.O.D.'s.

press them together. After magnets are placed between poles apply a little shellac at the top edges where magnets join pole pieces to keep them in place.

Your motor is now ready for a test run. Connect a 1½ volt penlight cell to the leads. The motor should run smoothly and at high speed. However, since the solar battery will supply only .5-.9 volts instead of the 1½ volts from the dry cell, a more accurate test can be made by connecting a small rheostat in series with one lead from the dry cell and, with a vacuum tube volt-meter across the motor terminals, the voltage adjusted to about .6 volts, this will then be about the average voltage the motor will be operating on from the solar battery. If the motor does not run on this reduced voltage, adjust the pressure of the brushes on the commutator by bending them as required and also check for friction in the bearings.

Plastic Case. If you purchase the plastic for the case (Fig. 4) from the supplier listed at the bottom of the Materials List, you will receive all of the pieces for the motor and battery case cut to size, so all you need do is assemble them. Pour a small quantity of plastic cement on a piece of glass and draw the edge of one plastic side piece in the cement, allowing it to remain for a few seconds. Then, placing it against the piece to which it is to be joined, slide it back and forth a few times lengthwise and press tightly together.

Keep an even pressure on the joint several minutes, with the parts held square, until the softened plastic sets up. Continue cementing other side joints, cementing top in place last. Use a weighted cigar box to maintain pressure on the top until cement sets up.

A properly cemented joint will come out as clear as the plastic after drying. Cloudy joints indicate either lack of enough cement to soften the plastic or inadequate pressure. Drill and tap the 3/16 in. plastic base piece (Fig. 4), and fasten motor-frame base to it with four 4-40 *rh* screws. Then place the plastic case over the motor and drill a hole at bottom of each 3½ in. side to line up with the 4-40 tapped holes in motor frame base. Fasten with 4-40 *rh* screws.

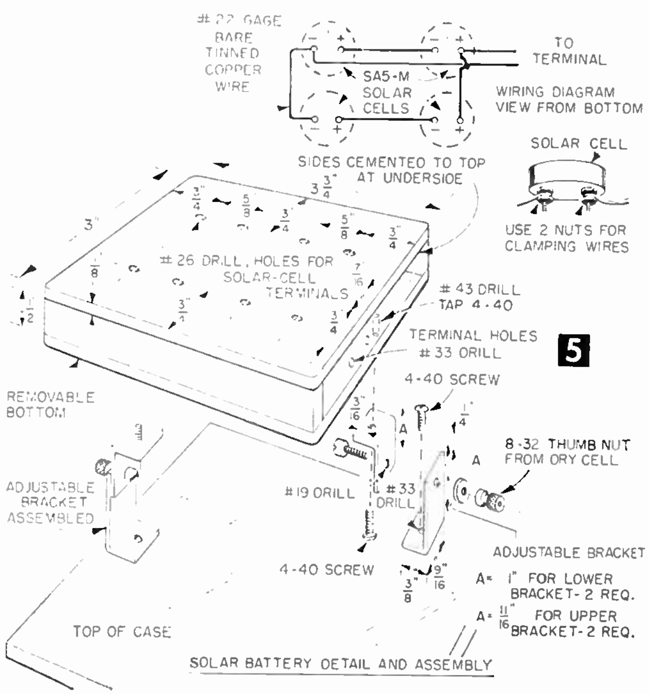
Assembling the Solar Batteries. The four solar cells are arranged on top of the case so they can be tilted as in Fig. 1 to the direct rays of the sun. Make the battery case of clear plastic as detailed in Fig. 5, following the same cementing procedure you used for the motor case. Note that the bottom of the battery case is removable and held in place with two 4-40 *rh* screws. Mount the solar cells in the top of the case with their terminal studs. Avoid tightening the terminal nuts too much because this may cause the studs to turn in their plastic cases and thus break off internal connections.

Use #22 gage tinned copper solid wire to hook up the cells to the two terminal screws in the case side as in Fig. 5. Two groups of two cells each are connected in series (plus to minus). Polarity markings are on the backs of the cells. The two groups of series-connected cells are then connected in parallel (plus to plus and minus to minus).

To support the battery case, make up two sets of the adjustable brackets as detailed in Fig. 5. Mount the lower brackets to the top of the motor case with 4-40 *rh* screws and the upper brackets to the bottom of the battery case with the screws that hold the bottom in place. Bring the leads from the motor up through a hole drilled in the top of the motor case and connect them to the battery terminals.

Place the unit in the sunlight and tilt the solar batteries to catch the direct rays of the sun. The little motor should immediately start running. If, for demonstration purposes, you care to operate the motor in a room where there is no sunlight or at night, you can use a 150-watt clear electric light bulb in a reflector or a 150-watt reflectortype flood lamp. Hold the bulb about 10 in. from the batteries. Prolonged use of the batteries under the heat of a light bulb will reduce the voltage output, but will have relatively little effect on the current.

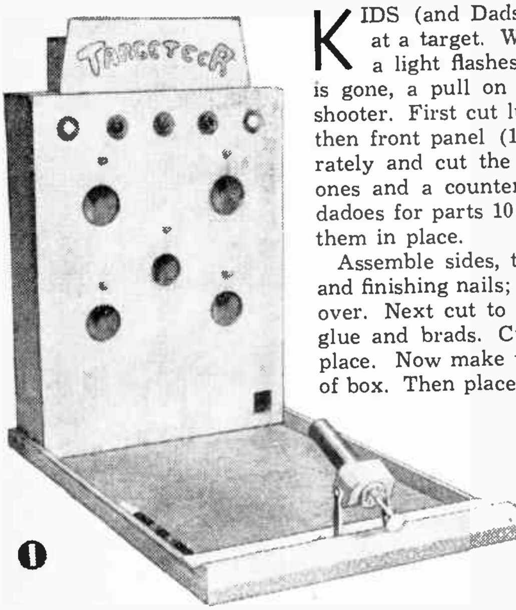
If you are interested in building a silicon-solar-cell, transistorized radio, get a copy of the RADIO-TV EXPERIMENTER (75¢), No. 559, from SCIENCE AND MECHANICS.



SOLAR BATTERY DETAIL AND ASSEMBLY

Light up the Target

KIDS (and Dads too) like to see things happen when they shoot at a target. When a hit is made with this marble game (Fig. 1) a light flashes—red, green or white, and when the ammunition is gone, a pull on the handles lets the marbles return to the next shooter. First cut lumber to sizes shown in Fig. 2. Cut parts 2 and 3, then front panel (1) and back panel (4). Lay out front panel accurately and cut the holes, using a fly cutter or jigsaw on the larger ones and a counterbore on the ½ in. holes. Before assembling, cut dadoes for parts 10 and 11 (Fig. 2A) and then fit (but do not fasten) them in place.

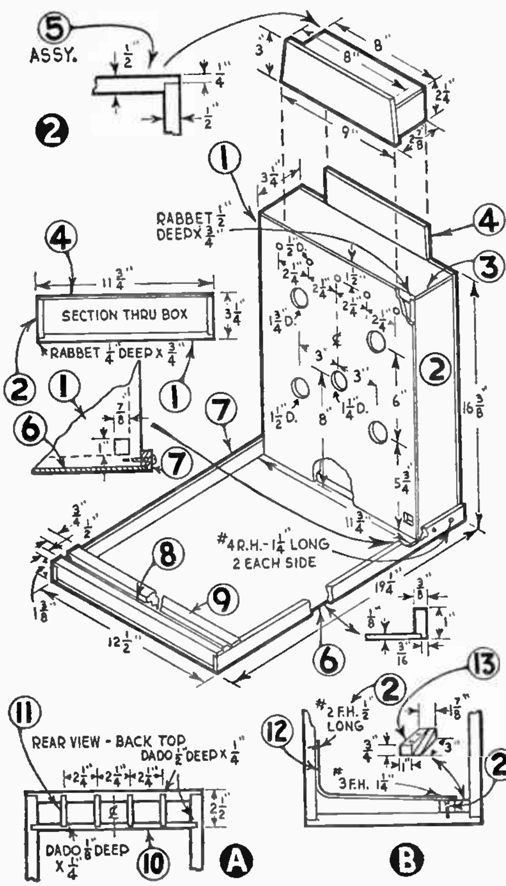


1

Assemble sides, top and front panel and fasten together with glue and finishing nails; set these beneath the wood surface and putty them over. Next cut to size and assemble parts 6, 7, and 8 with plenty of glue and brads. Cut part 9 to size and fit (but do not fasten) it in place. Now make the number 5 assembly and fit it in position on top of box. Then place and fit the back (4). Make and fit parts 12 and 13 (Fig. 2B), making sure metal marble return has just enough slant to roll marble down and out through exit hole in front panel.

For the *Cannon* (Figs. 4 and 5), first make slide (19). After making sure it works smoothly with the slide rail (9), put it in place and fasten slide rail down.

Make tube holder (20) and bore a hole through it that will be a good tight fit for the tube (21). Seal back end of tube with the plug (23) and then drill a 3/16 in. hole through it for the plunger (22). The pusher (24), should be a nice fit in the tube but loose enough so that it will slide easily. Drill a 3/16 in. center hole through it and then counterbore so that the bolt head will sit tight and flush with the surface. Use a spring



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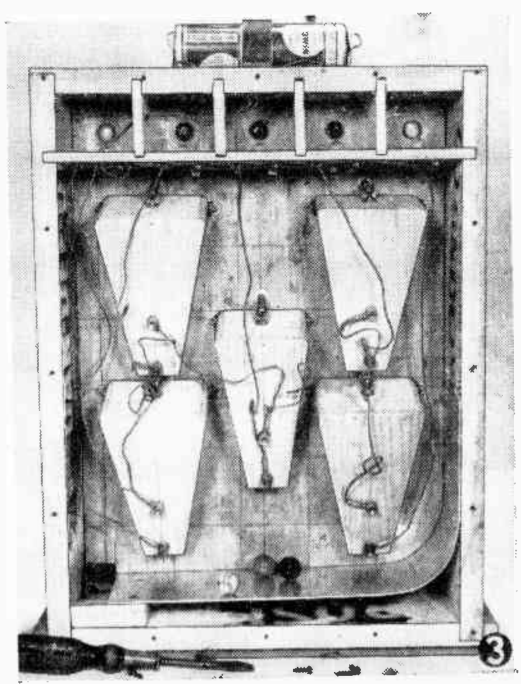

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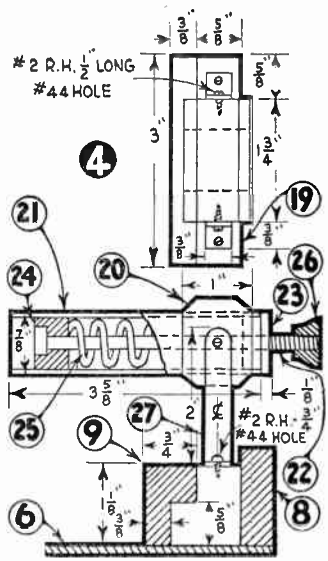
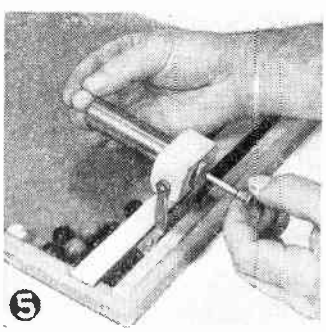




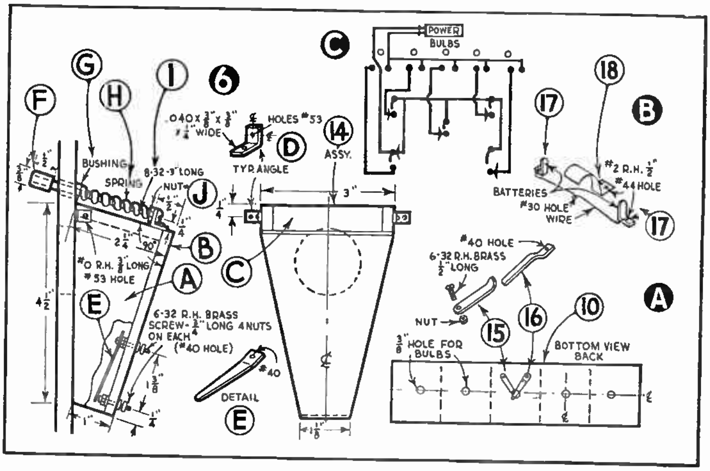
MATERIALS LIST—TARGET GAME

No.	No. pcs.	Name	Size	Materials
1	1	front panel	3/8" x 11 3/4" x 16 1/4"	plywood
2	2	sides	3/4" x 3" x 15 3/4"	pine
3	2	top-bottom	3/4" x 3" x 11 3/4"	pine
4	1	back panel	1/8" x 11 3/4" x 18 1/2"	Masonite
5 assy.	1	top	1/2" x 2 3/4" x 8"	pine
	2	sides	1/2" x 2 3/4" x 2"	pine
	1	front	1/4" x 3" x 9"	pine
6	1	base	1/8" x 12 1/8" x 19 1/4"	Masonite
7	2	side rails	3/8" x 1" x 19 1/4"	plywood
8	1	front rail	1/2" x 1 3/8" x 12 1/2"	pine
9	1	slide rail	3/4" x 1 1/8" x 12 1/2"	pine
10	1	bulb shelf	1/4" x 2 3/4" x 11 1/4"	pine
11	4	bulb partitions	1/4" x 2 1/8" x 2 3/4"	pine
12	1	marble return	.032 x 2 3/4" x 15"	aluminum
13	1	marble return	3/4" x 1 7/8" x 2 3/4"	pine
14 assy.	(amounts listed are for 5 units)			
a	10	sides	1/4" x 2 1/4" x 4 1/2"	plywood
b	5	backs	1/4" x 3" x 4 1/2"	plywood
c	5	tops	1/4" x 2 1/4" x 3"	plywood
d	15	angles	.040 x 1/4" x 3/8" legs	bend from sheet brass
e	5	contacts	.016 x 1/4" x 2"	brass shim stock
f	5	handles	3/8" D. x 1/2"	brass rod
g	5	bushings	3/8" O.D. x 1/2"	brass rod
h	5	springs	see text	
i	5	screws	8-32 roundhead, 3" long	
j	5	nuts	for 8-32 screw	
15	5	contacts	.016 x 1/4" x 2"	brass shim stock
16	5	contacts	.016 x 1/4" x 2"	brass shim stock
17	2	contacts	.016 x 1/4" x 2"	brass shim stock
18	1	battery clamp	.040 x 3/4" x 3"	brass sheet
19	1	slide	1" x 1 1/8" x 3"	maple
20	1	tube holder	1" x 1 1/4" x 1 3/4"	maple
21	1	tube	7/8" O.D. x 3 5/8"	copper tube
22	1	plunger	3/16" bolt—4" long	
23	1	plug	3/8" x 1" x 1"	turned maple
24	1	pusher	1/2" x 1" x 1"	turned maple
25	1	spring	see text	
26	1	knob	purchased part	
27	2	supports	.040 x 3/8" x 2 3/8"	brass sheet

hardware, etc.

4	#4 rh, 1 1/4"	6-32 rh, 3/4" brass	10 screws—40 nuts
2	#2 fh, 1/2"	8-32 rh, 3"	5 screws— 5 nuts
2	#3 fh, 1 1/4"	6-32 rh, 1/2"	10 screws—10 nuts
25	#0 rh, 3/8"	#2 rh, 1/2"	6
2	#2 rh, 3/4"		

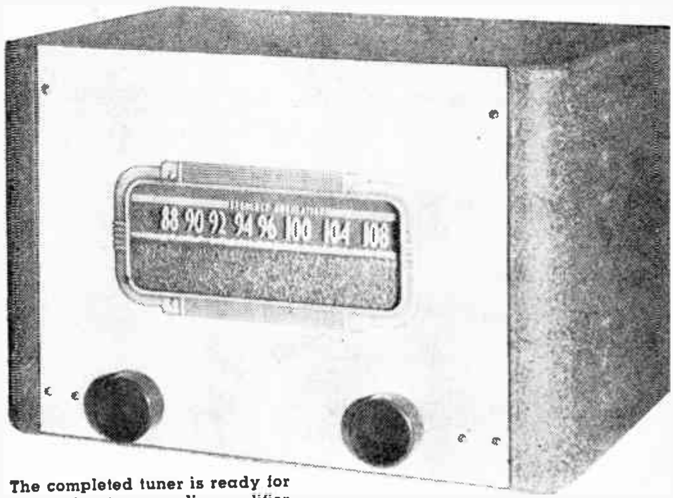
about 12 #2 rh, 5/8" long for attaching back panel; small roll of bell wire, 5 flashlight bulbs, 2 flashlight dry cells, about ten glass marbles (5/8" D.), glue, brads, 1" finishing nails. Also 5 pilot light jewels—1 green, 2 red, 2 white (Allied Radio Co., 100 N. Western Ave., Chicago 80, Ill.) to fit 1/2" hole.



that's strong enough to throw marble against front panel but not so strong that marble will bounce off with considerable force when a miss is made. Next make the 2 metal angles (27) and assemble the unit together and to the slide.

To make the 5 assemblies (14) shown in Fig. 6, first make one complete unit and then check it on the project. If it's satisfactory use it as a pattern to make the remaining four. Make and assemble wood parts first and attach them in place on back of front panel, so they swing freely on the angles; if necessary, dress the top edge for clearance. Then attach top angle in place and, using it as a guide, drill a pilot hole through front panel. Enlarge this hole for bushing (Part G). Make bushing and angle holes a very loose fit for the 8-32 screws and use a spring here strong enough to hold assembly tight against front panel. When this is working correctly, remove the boxes and fit the contacts in place (Part E). Check these before mounting to see that they close under the weight of a single marble. Turn the handles (Part F in Fig. 6) from brass rod which has been cut to length, drilled and tapped for the 8-32 screw.

For the bulb shelf (Part 10 and Fig. 6A), drill bulb holes to center in each enclosure and mount contacts so the bulb will complete the circuit when it is put in place. Tape the 2 batteries together and place in position on the box. Using them as a guide, locate the 2 contacts and screw them in place. Then form a clamp from sheet metal (18) to fit snugly around batteries and screw them down. Wire is fed from each contact down through a #30 hole into the center compartment and down and out through the bulb shelf (Fig. 6B). Be sure to keep the wires long enough so that they won't interfere with the movement of the boxes (Fig. 6C). Press fit the jewels in place and record the scoring in colors or paint numbers above each jewel. Before attaching back panel permanently, coat insides of bulb enclosures with silver paint.



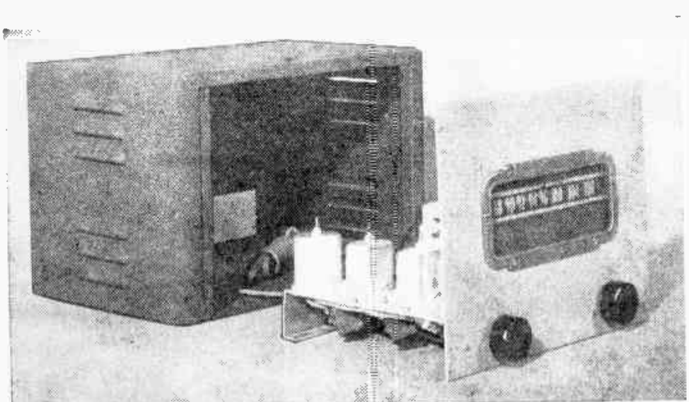
The completed tuner is ready for connection to an audio amplifier or phono jack on console radio.

FM TUNER

By ROBERT H. HAWKINS

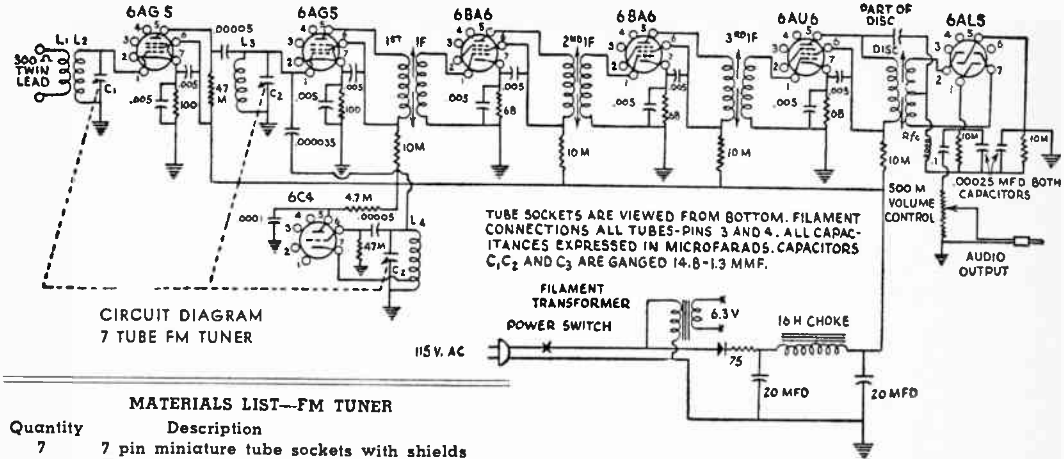
THIS sensitive FM Tuner regularly receives stations 90 airline miles distant, and can easily be connected to the audio system of nearly all AM radios. Miniature tubes, a selenium rectifier, slide-rule tuning dial, and a handsome cabinet are outstanding features of this tuner. Brand names and model numbers used on original unit are shown in materials list where certain parts must meet space requirements.

Start construction by laying out on paper a full-size chassis drawing. Fasten this template to the metal chassis with Scotch tape and use it as a guide when drilling all holes. Mark hole centers lightly with a center punch and then drill holes according to sizes shown on the chassis drawing. No holes are shown for mounting screws on tube sockets and IF transformers because these vary slightly with different shipments of the same brand. Drill mounting holes to fit the components you purchase. These holes are usually drilled with a #28 drill, which takes a 6-32 machine screw. After drilling all holes and making two cut-outs on the chassis (with a scroll saw and metal-cutting blades), remove any burrs around holes with a file. Next lay out 8 x 10 in. front panel (see drawing), marking hole centers as before. File off any rough edges.



Chassis is removed from cabinet to show means of mounting front panel and hole in back of cabinet through which power cord and antenna connections pass.

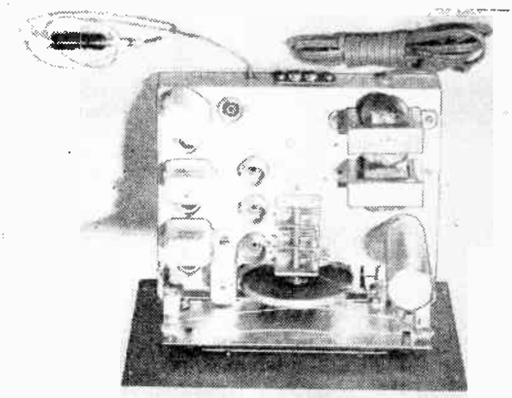
To mount parts on chassis, first make two *dial plate brackets* to support slide-rule dial and two *condenser mountings* for the 3-gang tuning condenser. Then mount filament transformer, filter choke, electrolytic capacitor, tuning condenser, selenium rectifier, tube sockets, IF transformers, discriminator transformer, antenna binding post, volume control and switch, and finally, slide-rule dial, in that order. With parts mounted, check photos again for correct place-



CIRCUIT DIAGRAM
7 TUBE FM TUNER

MATERIALS LIST—FM TUNER

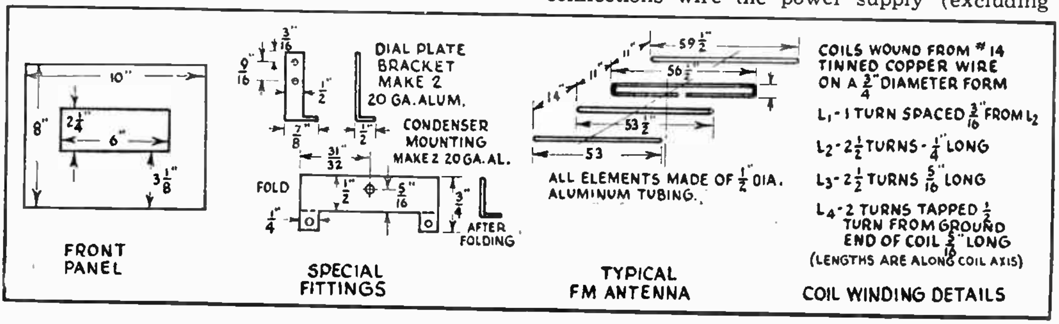
Quantity	Description
7	7 pin miniature tube sockets with shields
1	Croname tuner assembly, Type 233
1	Alternate scale for above tuner, 88-108 megacycles
1	7⅜" x 9" x 1½" chassis
1	Selenium rectifier, 100 milliampere rating
1	6.3v filament transformer, Thordarson T-21F10
1	16 henry, 50 milliampere filter choke, Stancor C1003
1	3 gang FM tuning capacitor, 15 mmf./sec.
1	20-20 mfd electrolytic capacitor, 150 WVDC
1	0.1 mfd paper capacitor, 400 WVDC
13	0.005 mfd mica capacitor, 300 WVDC
2	250 mmfd mica capacitor, 300 WVDC
1	100 mmfd mica capacitor, 300 WVDC
1	50 mmfd mica capacitor, 300 WVDC
1	35 mmfd mica capacitor, 300 WVDC
1	500,000 ohm volume control with switch
2	47,000 ohm resistor, ½ watt
4	10,000 ohm resistors ½ watt
1	4700 ohm resistor, ½ watt
2	100 ohm resistors, ½ watt
3	68 ohm resistors, ½ watt
3	10.7 mc. IF trans., Meissner type 16-6665
1	10.7 mc. Discriminator trans., Meissner type 17-3484
1	2½ millihenry RF choke
1	ICA steel cabinet, Type 3925 8" x 12" x 8", with 8" x 10" panel, Allied Radio #86-310
2	Round plastic knobs
1	3 foot length shielded wire
1	6" length Twin Lead antenna wire
1	10' length #20 solid hook up wire
1	Belden replacement lamp cord
1	Standard phone plug
2	6AG5 miniature tubes
2	6BA6 miniature tubes
1	6C4 miniature tube
1	6A46 miniature tube
1	6AL5 miniature tube
2	6-8v dial bulbs (#40 Min. screw base)

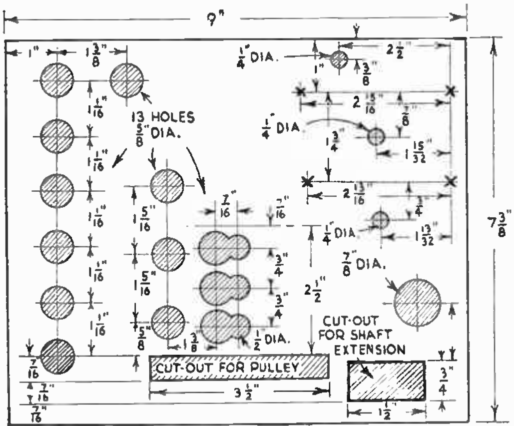


Top view shows placement of component parts. Tubes and shields have been removed to permit view of mounting details of sockets and tuning condenser.

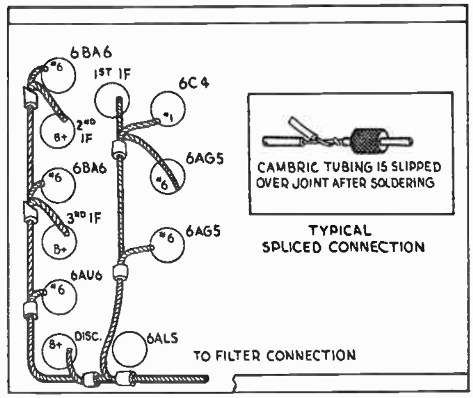
ment and study proposed system of wiring. Proper placing of tube socket pins can make wiring more convenient and the leads short. Note that a tube socket pin arrangement has a front and back; try to duplicate positions shown in drawing of bottom view of chassis. Approximate location of either pin 6 or pin 1 can be determined from this drawing. Mount IF and discriminator transformers with terminals marked PLATE—B plus, toward front of chassis.

When starting to wire tuner, first make a B plus cable (see drawing). Then with short, neat connections wire the power supply (excluding





CHASSIS
7 TUBE FM TUNER

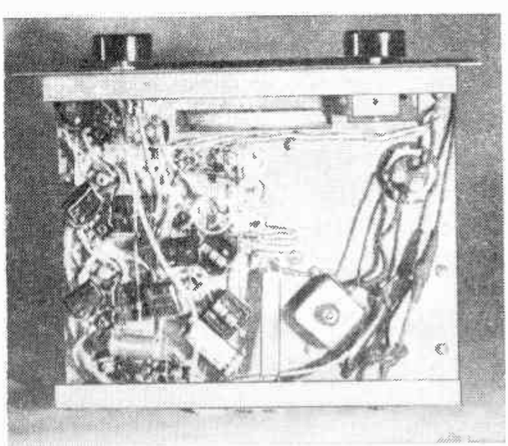


BOTTOM VIEW OF CHASSIS SHOWING PLACEMENT OF B+ CABLE

line cord), filament leads, B plus cable, ground connection bus (tinned #14 copper wire), RF coils (as shown in photo), and then the various resistors and capacitors, in that order. Make RF coils as shown in coil winding drawing; you may find that a very slight stretching or squeezing of the coils is necessary to obtain good alignment and tracking.

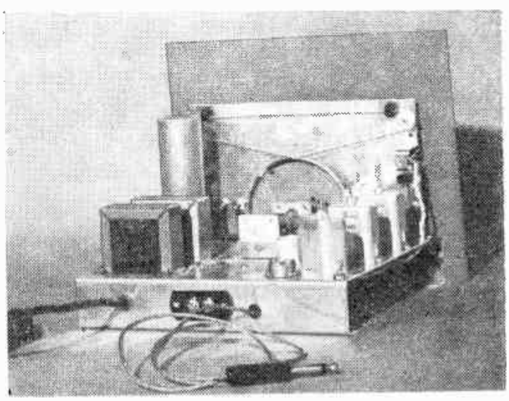
After wiring is complete and *carefully checked*, mount line cord. If line cord is wired last, it will not dangle in front of some connection to be soldered. Note that one side of line is grounded to chassis as is common on the *ac-dc* sets of today. This unit will *not* operate on *dc*. Remember, *don't put a ground connection of any kind on the tuner*. A two-terminal antenna binding post is used and *both* of them are connected to the 300 ohm twin-lead coming from the antenna. This unit can, however, be connected by the audio plug to any set having a ground connection because the shielded lead is connected to the chassis through a 0.003 mfd. capacitor. Using this type of circuit involves a danger of shock,

Bottom view showing wiring of power supply, position of RF coils and Twin-Lead connection from antenna binding post.



which can be avoided if you do not set tuner on a metal table or against water pipes, and use a crackle finish on cabinet, which acts as a good insulator. A metal cabinet shields tuner from any hum that might be picked up.

The original unit was aligned using a frequency-modulated signal generator and a cathode ray oscilloscope. You probably will not have these available, but almost all reputable radio service shops are equipped to complete the alignment for you. Of course, a nominal charge is made



Rear view showing relative positions of power cord, antenna binding post and audio output line. Note wires connecting dial lamp on right edge of panel.

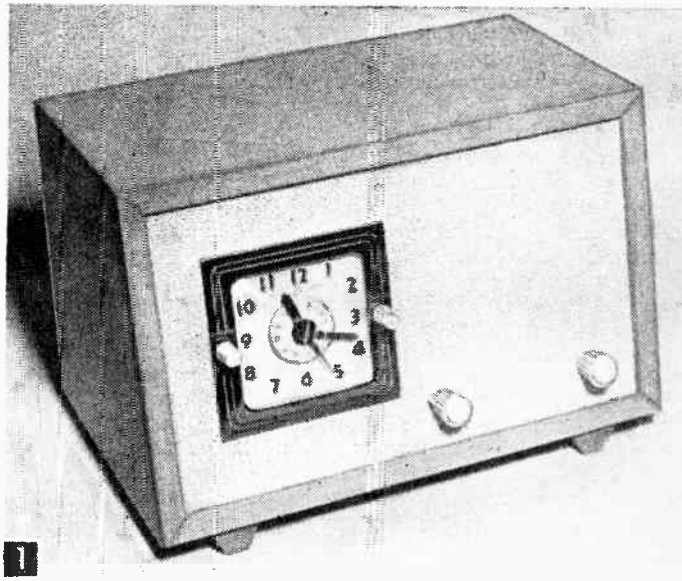
for this service with prices varying in different localities. A good job of alignment and tracking will make this tuner a unit of which the constructor can well be proud.

The type antenna suggested for the tuner is highly directional and capable of receiving weak signals (see drawings). Any commercial FM antenna will produce good results with this tuner when properly oriented and connected with twin-lead lead-in wire. When entirely finished, connect this unit to a good audio amplifier or the *phono* connection on most console radios and you can enjoy fine FM reception.

New Cabinets for Old

Drop a plastic-case radio from any height and usually the radio will survive. But you'll need a new cabinet. Here's how to make it

By HAROLD P. STRAND

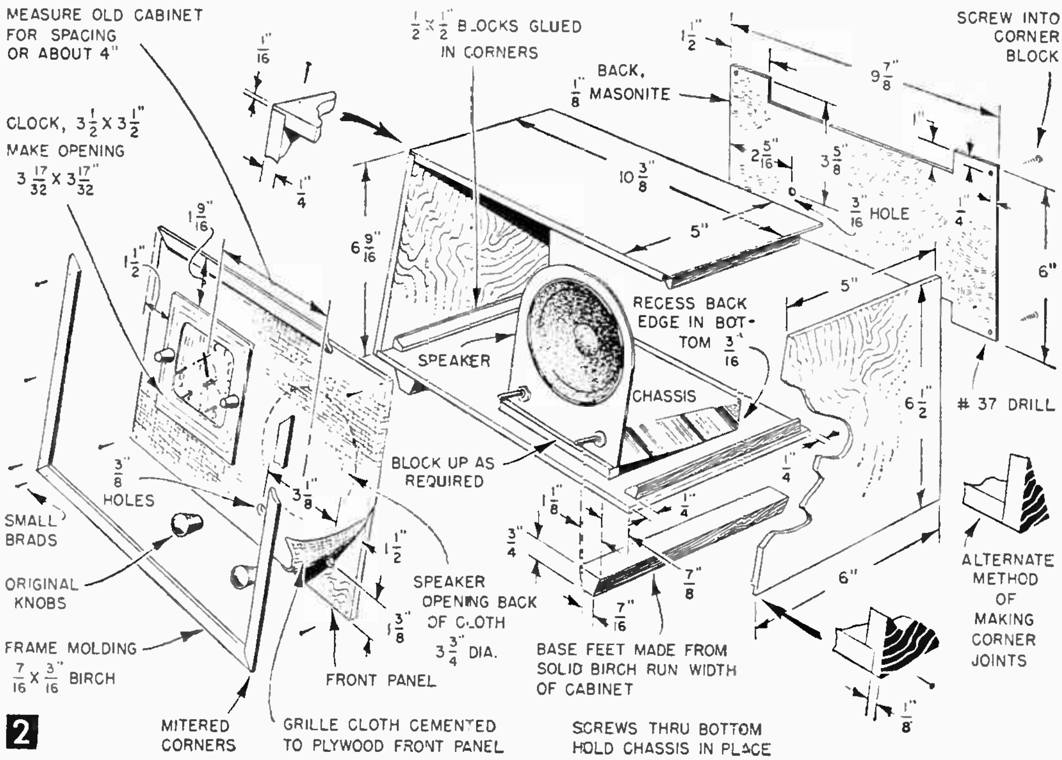


1

A new cabinet gives an old clock-radio a modern look. Finished in blonde, it has the modern appearance of a new radio.

WHILE principally for table model radios that have had their plastic cases damaged beyond repair, these plans can be modified to suit other makes and types of radios which—while not having been dropped—could well be modernized in appearance. Figure 1 shows a completed new cabinet of modern design, equipped with the original cabinet's receiver and clock. The cabinet is made of 1/4-in. birch plywood finished in modern blonde. Total cost of materials is about $2.

The first step in replacing any damaged or outmoded cabinet is to remove from it the receiver chassis and clock. Figure 3 shows how the clock is



2

removed. The two wires connecting the radio to the clock line and the control switch are cut close to the terminals with diagonal pliers. To remove the receiver chassis, first pull off the knobs at the front and then remove the bottom screws.

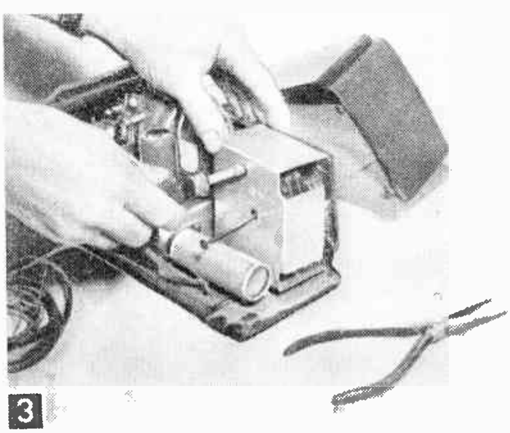
Dimensions in Fig. 2 are given for use with a typical clock-radio unit. They can be modified as required to fit other makes and types of radios or radio-clock combinations. Begin cabinet construction by cutting the birch plywood to size for the ends and the top and bottom pieces, using a sharp, fine-tooth circular saw to avoid splintering. Make cuts outside the marked line, leaving something for dressing on a sanding disc, to provide smooth, straight edges.

The cabinet's top is fitted with half-lap joints to the end pieces; the bottom is simply let in between the ends. The step or rabbet can best be made on a circular saw, but if hand methods are employed, use a small back saw with a guide block. The cut should be made 3/16-in. deep; use a chisel to remove the stock at the rabbet.

The frame is assembled with glue and a few small brads. If suitable clamps are available, use them and eliminate the brads for better appearance. The frame should be checked with a square while being assembled and, if necessary, pulled square with a temporary diagonal brace until glue has set. Cut corner blocks from any dry stock and glue them in corners for additional support as detailed in Fig. 2. Their length should be such that their ends will provide a stop to which the front and back panels can be secured, with the front panel being let in its thickness, or 1/4 in. A brad at each corner secures the front panel; small wood screws into the ends of the corner blocks are used at the back panel or cover.

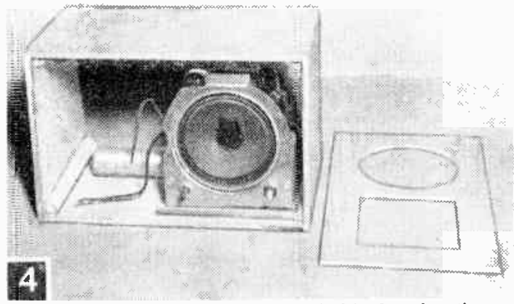
If brads were used, set them and apply plastic wood to fill the depressions. After this is dry, use fine sandpaper (about 0000) to smooth all surfaces and slightly round the corners.

Cut the front cover from a piece of the 1/4-in. birch plywood to fit in the front opening about 1/32 in. undersize all around to allow space for the grille cloth which will be carried over the edges. Grille cloth will also be carried over the edges of the clock opening, so allow 1/32-in. for its thickness also. The round opening for the speaker and the spacing between it and the clock opening is obtained from the original cabinet (on our set this was about 4 in. on centers).



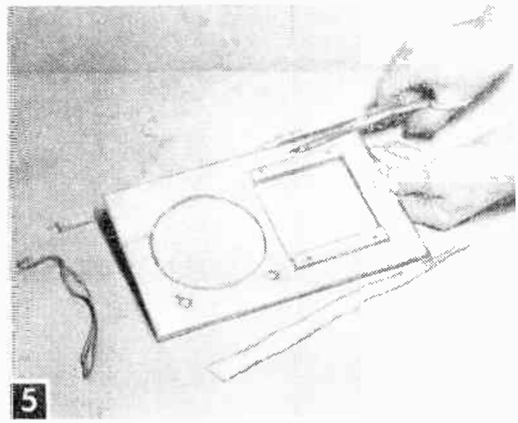
3

To remove the clock from its old case, remove two screws at the back cover.



4

Try the chassis in the cabinet to find its best locations. Note strip of wood used to raise the front edge so that the speaker lines up with slanting front panel.



5

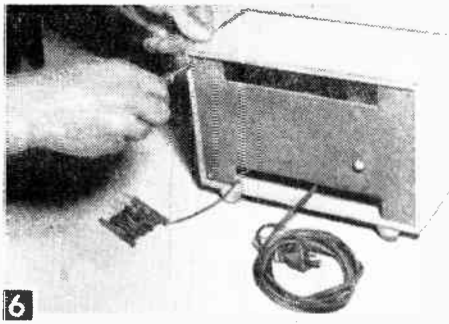
Cement plain coarse-woven monk's cloth to the face of the panel and trim the excess off at the back.

Cut these openings on a jig saw and after completion of this work, true up and smooth the edges of the square opening to proper size, using a rasp or a piece of coarse sandpaper on a stick. The exact size or uniformity of the round opening is not important since it will be back of the grille cloth and will not show.

Now drill two 3/8-in. dia. holes in the panel below the speaker opening to clear the shafts of the two receiver controls. Find their location by measuring on the old cabinet with respect to the position of the speaker opening.

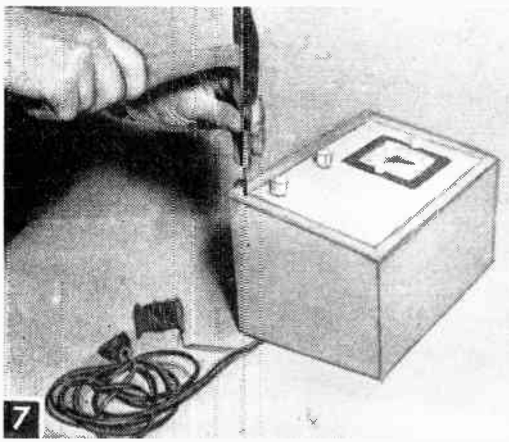
Since the front panel is designed on a slant, block up the front edge of the radio chassis about 1/4 in. and recess the back edge about 3/16 in. on the cabinet bottom to make the speaker fit properly in line with the panel (see Figs. 2 and 4). With the chassis position determined by check, locate and drill base screw holes.

Now apply an adhesive such as Pliobond or Duco cement to the surface of the front panel of the cabinet in two even coats. When the cement



6

Installing back cover. Time-setting knob has been brought through the cover, which required an extension on the original shaft.



7

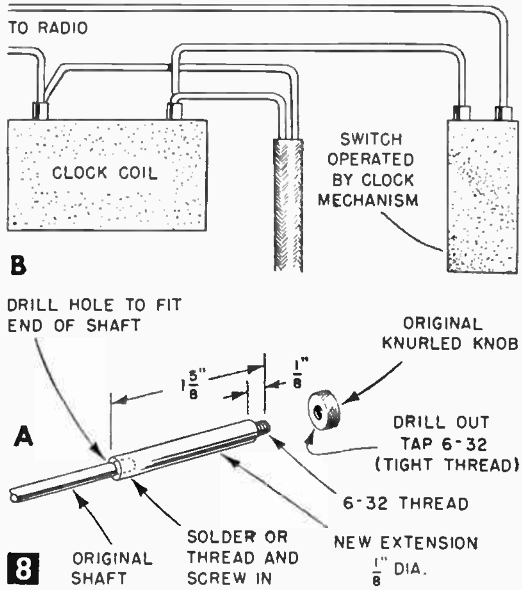
Fit birch frame molding to front to cover joints, set the brads and fill the holes. The pieces should be completely finished before fastening.

has dried to a tacky state, tightly stretch the grille cloth over it. Apply cement to the edges and carry the material over them, cutting off the excess at the back side as shown in Fig. 5. Use a tapered punch to smooth the material into the round shaft holes.

Base feet run the full width of the cabinet ends and are cut from some solid birch stock to the dimensions given in Fig. 2. They are attached with glue and brads through the bottom.

For a blonde finish on the cabinet, first apply a coat of light gray flat paint, brushing it on generously. This color can be mixed by adding a little flat black to some flat white, using just enough of the black to provide a light pearl gray color. Dry 20 minutes, then wipe off with a cloth to bring the grain back to the wood. Traces of gray will be left in the pores as a filler and as coloring. Dry thoroughly and wipe again.

After a thin coat of white shellac has been brushed on, apply a coat of flat varnish. Thin the shellac with denatured alcohol or shellac solvent about 20% and be sure that it is perfectly hard before applying the varnish. An alternate method is to continue with the shellac, applying about 4 thin coats, rubbing each down when dry with very fine steel wool. Finally, apply paste wax



8

MATERIALS LIST—NEW CABINET

No. Req'd	Description
2 pcs	birch plywood 1/4 x 6 x 6 1/2" (cabinet ends)
1 pc	birch plywood 1/4 x 5 x 10 3/8" (cabinet top)
1 pc	birch plywood 1/4 x 6 x 10 1/8" (cabinet bottom)
1 pc	birch plywood 1/4 x 6 1/8 x 9 7/8" (front panel)
2 pcs	solid birch 1 1/8 x 3/4 x 6" (base feet)
4 pcs	pine or other stock 1/2 x 1/2" length as required for making four corner blocks. (See Fig. 3)
1 pc	birch or other stock 1/4 x 1/2 x 4" (block for front end of chassis)
2 pcs	birch plywood 1/4 x 1/2 x 4" (attach at inside edges of clock opening)
2 pcs	solid birch 3/16 x 7/16 x 10 1/2" (front frame molding)
2 pcs	solid birch 3/16 x 7/16 x 7" (front frame molding)
1 pc	brass rod 1/8". dia. 1 5/8" long (extension for clock shaft)
1 pc	plain monk's cloth, gray or light buff about 7 x 11" (grille cloth)
1 pc	Masonite hardboard 1/8 x 6 x 9 7/8" (back cover)
	brads, screws, flat grey enamel, shellac, glue

and polish briskly with a soft cloth.

Install clock and receiver chassis in the finished cabinet (see Fig. 8) and attach the back cover (see Fig. 6) with four small wood screws. The shaft coming from the back of the clock on our remodeled set was too short to reach through the new cover and make the knob accessible so we made an extension for it (Fig. 8A) and attached it to the end of the original shaft. It can be made to screw on the shaft or it can be quite easily soldered to it. The knob was drilled out to take 6-32 threads and then a nut was tightly screwed on the extension on the outside by holding the shaft with long-nosed pliers.

A neat frame for the front of the cabinet is made from strips of birch cut 3/16 in. thick and 7/16 in. wide. This is used as a molding with mitered corners as shown in Fig. 7. These pieces are finished with the gray paint and shellac before installation. Use three 1/2-in. wire brads to a side for fastening and set them below the surface. Fill the holes and touch up with paint as required to render them invisible.

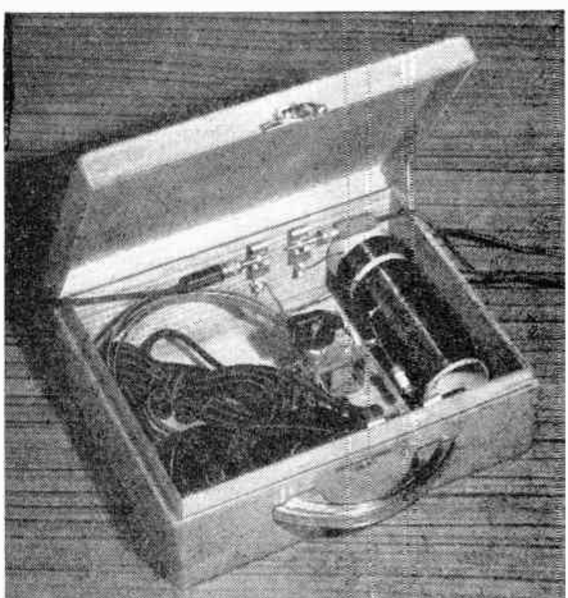
Tapped Coil Crystal Set

Want to try a receiver with fixed crystal detectors? Here is a selective circuit with few components

By MILO ADLER

THIS easily constructed crystal receiver which uses few parts, needs no power supply, has a minimum of adjustments, and will give clear reception over a limited area. It is designed to give maximum selectivity in metropolitan areas where several high-powered radio stations may be found. Where *selectivity* is not necessary, you can adjust this set to provide maximum *sensitivity* by placing extra taps on the secondary winding while constructing the coil, as we will explain later.

The receiver may be mounted on a board 4½ by 6 in. or it may be placed with the earphones in a cigar box for easy carrying. Before beginning construction, carefully examine both schematic and pictorial diagrams. It's wise for beginners to work with the pictorial diagram while doing the actual construction, as it shows positions and identities of each part, wire and connection. Then, as construction progresses, they should check

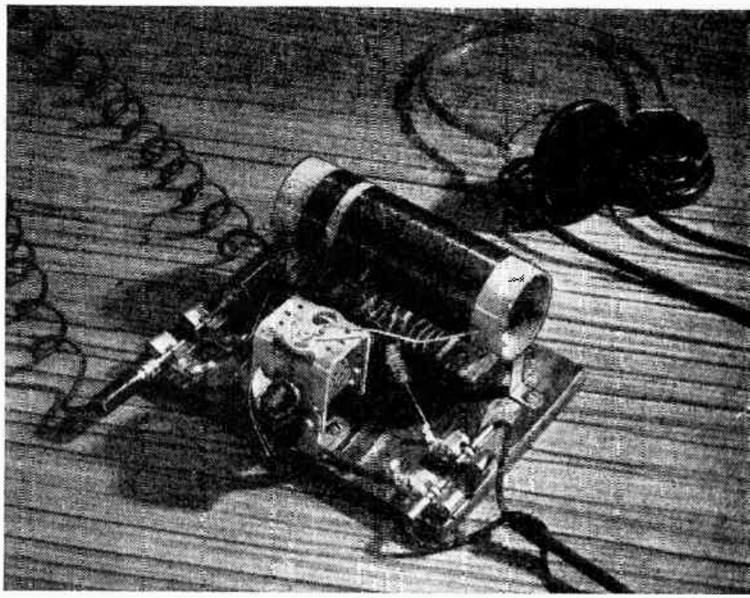


The crystal set is shown above mounted in the cigar box with headphones in place beside it.

with the schematic in order to become familiar with the symbols used and to better understand the actual workings of the circuit and its operating principles. When you can follow more complex circuits, and the symbols, part functions, and wiring procedure are completely familiar, you only need the schematic as a guide.

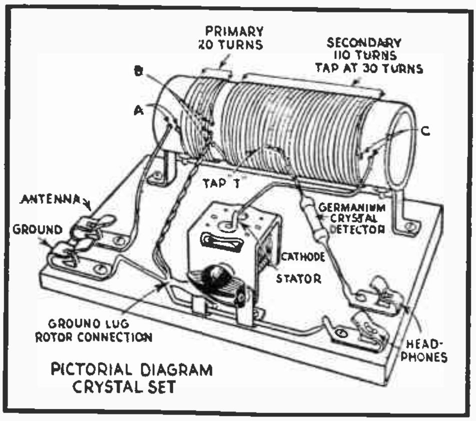
First drill two holes for mounting the coil ⅜ in. from each end of the coil form and just large enough to pass the 5/16 in. machine screws used for mounting the coil. Next drill two holes shown at A in the pictorial diagram in the coil form, locating the first hole ⅜ in. from end of coil form as mentioned above and the second hole ⅛ in. from the first one. Then carefully unwind 5 to 10 ft. of No. 22 enameled wire, being sure not to kink it as a kink may cause it to break while coil is being wound.

Pass about 5 in. of wire through the second of the two small holes in the coil form from the outside of the coil form towards the inside. Next pass the same wire through the first of the holes from the inside of the coil form. and pull small loop on inside of form taut. Fasten coil of wire to a stationary object or have someone hold it, being careful not to cause any sharp bend in the wire. Pull the wire taut and slowly rotate the coil form, thus winding the wire on the form. Wind 20 turns on the form for the primary winding. Stop every few turns and press the turns of wire together so that coil form cannot be seen between turns of wire. After 20 turns are wound on the coil, leave approximately 5 in. of excess wire and cut off the remaining portion.



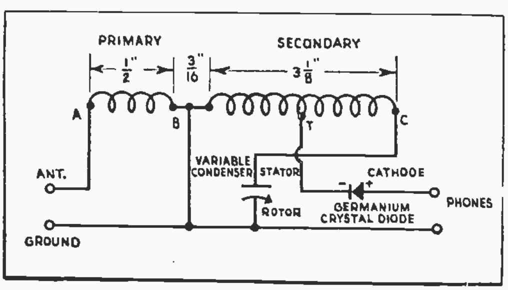
Completed "breadboard" version of crystal set with headphones connected.

Drill three small holes at point B (see pictorial diagram) and fasten end of primary winding through two of these holes in the same manner as the beginning of the coil winding, using two of the holes. Use the center and remaining hole at B to fasten beginning of secondary winding. Start the secondary winding as you did the primary, with a 5 in. lead coming from the coil, and place 30 turns on the coil form. Place the tap (T in diagram), at 30 turns from point B on the coil; this tap or loop is made by scraping the black enamel coating from the wire, twisting to form a small loop, and soldering the wire together.



PICTORIAL DIAGRAM
CRYSTAL SET

Now place the remaining 80 turns of the 110-turn secondary on the coil form and fasten end of winding through two small holes (at C in diagram). If you want to be able to adjust the sensitivity and selectivity of this crystal set, place taps every 10 to 15 turns while winding the secondary winding. But don't place any taps on the secondary before the first 30 turns.



Receiver construction will vary depending upon whether a "breadboard" or cigar-box model is to be constructed. The wiring of the receiver will be the same regardless of which model is constructed, so instructions for constructing the "breadboard" model will be given first, followed by instructions for mounting parts in a cigar box.

For the "breadboard" model, first mount the coil mounting feet on the coil form, taking care not to damage the coil. Then mount coil as shown on the pictorial diagram. Next mount the variable (tuning) condenser with angle brackets; be sure to place a solder lug under condenser mounting screw, as shown in the pictorial diagram. Fasten clips to baseboard with wood or self-tapping metal screws.

If receiver is being constructed in a cigar box, after coil is completed cement coil in location shown in photo, using a quick drying radio or model builders' cement. Let cement dry thoroughly before doing any further work on the set. Then mount the variable condenser in the box with cement and two No. 6 by 1/4 in. wood or self-tapping sheet metal screws. Mount the four clips for headphone, antenna and ground connections in the box with the same size screws that were used to mount the tuning condenser. Be sure to mount a soldering lug on the frame of the tuning condenser with a No. 6 by 1/8 in. machine screw.

Solder all connections, using rosin core solder only (acid-core solder and acid flux may cause corrosion). Pre-heat parts for easier, better work by holding soldering iron tip against wire and terminal to be joined for a few seconds. Then apply just enough solder to cover connection and fill crevices between wires. Remove iron, but do not move wires until solder has set—this takes only a few seconds. When more than one wire is to be connected at a particular point, don't solder and resolder. Install all wires to that point before soldering. Work slowly, checking each connection as it is made. Mark the diagram with a colored pencil as each connection is completed. Be sure enamel coating on wire is scraped off before connecting ends of coil into set.

MATERIALS LIST—CRYSTAL SET

Receiver Parts:
- 1 1½" x 5" coil form
- 55 feet No. 22 enamel wire
- 1 381.4 mmfd. midget single gang condenser (Allied 61-009)
- 1 Germanium crystal diode (Sylvania type 1N34; (Allied 7-219) or General Electric type 1N48 (Allied 7-250)
- 1 1¼" pointer knob
- 4 Fahnestock clips
- 1 4½" x 6" x 3/8" plywood base or wood cigar box, depending upon model being made
- 8 No. 6 x ¼" woodscrews
- 2 6-32 x 5/16" or longer machine screws
- 2 coil mounting brackets
- 2 condenser mounting brackets
- 1 solder lug

Accessories:
- 1 2000 ohm headset
- 1 outdoor antenna

Cure for Weak Stations

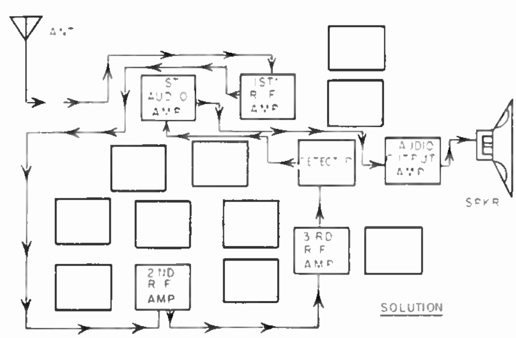
To get the best results, use a good antenna, good ground, and a pair of high-resistance headphones (1000 ohms or higher). In most cases a long antenna is unnecessary. However, if stations are weak, or if nearest one is a great distance from you, you may need to secure an antenna at least 50 ft. long and as high as possible, and adjust set for maximum sensitivity by moving connection at point T over to point C (see diagram). Use glass or porcelain insulators at the antenna ends and rubber-covered wire for a lead-in to prevent contact with grounded objects.

If taps are made on secondary winding when coil is constructed, move connection to crystal diode up and down coil until a tap is found which gives the best performance for the station being received. For a ground, drive a few feet of metal rod or pipe into moist earth or make a connection to a cold water pipe or radiator.

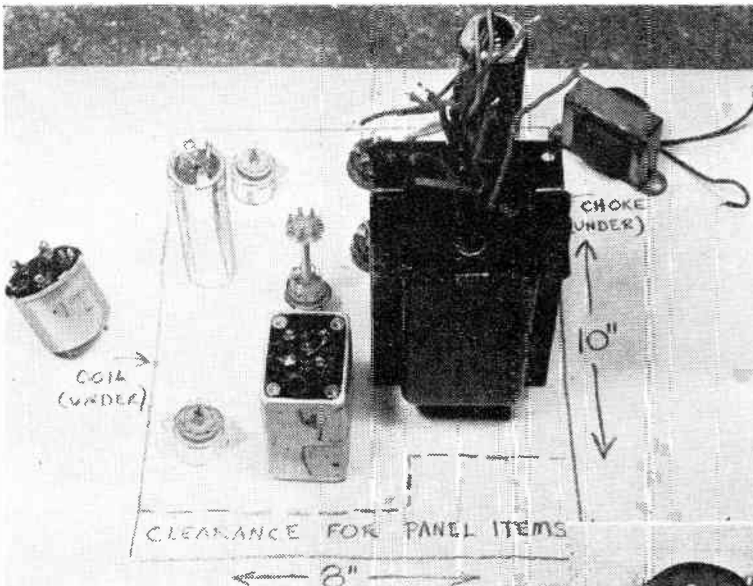
The broadcasting station microphone converts sound to an audio frequency (AF) current which fluctuates as the sound changes in pitch and volume. This AF current is an electrical pattern of sounds picked up by the microphone. Since it cannot be transmitted alone it is combined with a strong, steady radio frequency (RF) current. The combination is sent out through an antenna, becoming radio waves. The RF signal is called the "carrier" because it "carries" the AF signal. Some of these waves will strike your receiver antenna, setting up a current which travels to the set. The crystal detector "demodulates" the signal—that is, it takes out the RF signal, but allows the AF to continue to the headphones where it is converted to sound. The coil and tuning condenser select a particular signal from the many constantly striking your antenna. Hence you adjust the condenser to "pick up" the station you want.

The cigar box was sanded to remove the printing and then given two coats of shellac. The handle shown may be purchased from your local hardware store.

Solution to the Radio Hookup Puzzle on Page 137.



George, there's something I think I should tell you about your invention.



After securing all necessary components, lay out large parts on paper on flat surface and plan chassis layout. Photo below shows back of panel of completed unit.

By
W. F. GEPHART

1

Electronic Equipment Design and Layout

The how and why of it, incorporating plans for a custom-built tape recording amplifier with recording level meter and bias-erase oscillator circuit

WITH complete details—schematics, chassis and panel layouts, pictorial diagrams —furnished, building a neat, efficient piece of electronic equipment is fairly easy. But when only a schematic is available, considerable thought and planning is required for best results in the finished unit.

Parts placement on a chassis is important not only from the standpoint of performance, but also from the standpoint of efficient, neat and simple wiring. Panel layouts can be neat and well-organized, or they can be sloppy looking and inefficient. And without advance planning, it sometimes becomes necessary to drill additional chassis holes after wiring has started, which is not only difficult, but also endangers mounted components and completed wiring.

If you are going to build a unit of electronic equipment, and only a schematic is available, take the following steps:

1) Secure all necessary parts so that they will be available for measurements.

2) Plan chassis layout.

3) Plan panel layout.

4) Mark tie-point requirements on schematic and include mounting holes for them on chassis layout.

5) Drill chassis and panel.

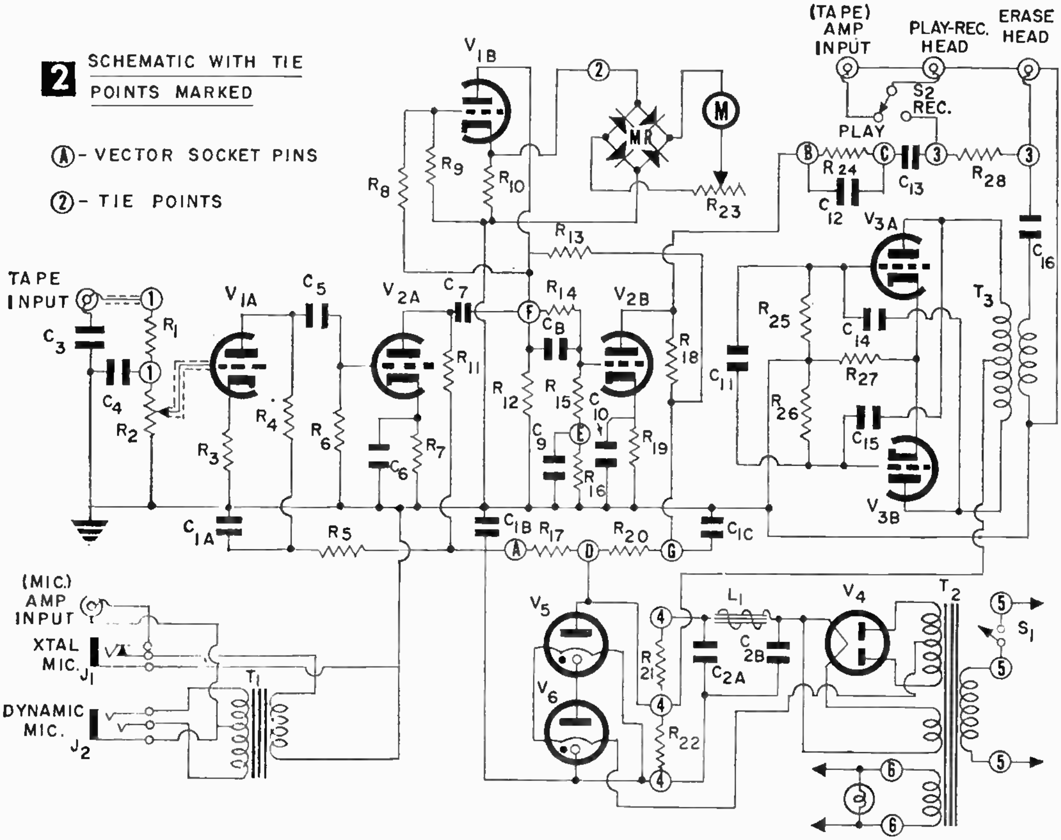
6) Place labels or decals on panel and chassis.

7) Wire sub-assemblies where possible.

8) Mount components and attach panel.

9) Complete wiring.

The chassis and panel layouts *must* be coordinated. Holes for grommets to carry wires from panel-mounted components to points under the chassis must be marked, and the placement of parts on the panel and chassis should be related



2 SCHEMATIC WITH TIE POINTS MARKED

to each other as closely as possible. The panel layout must be considered from the standpoint of operating efficiency, relation to chassis-mounted parts, and symmetry. Chassis layouts must consider shielding problems, circuit paths, and relation to panel-mounted items.

Unless the unit is to fit in a specified space, chassis size will depend solely on the number and size of the components to be used. When a specific space is involved, however, it is often necessary to double-deck a chassis, or use extremely small components in order to get everything in the desired space.

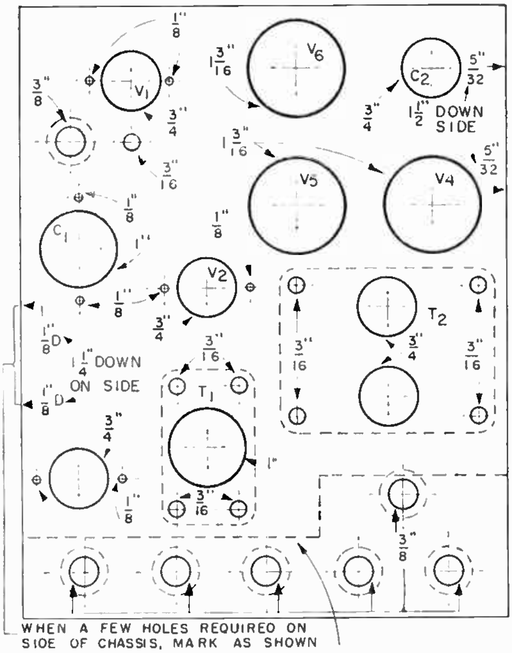
Usually, chassis size can be determined by laying out the chassis-mounted components (transformers, tube sockets, etc.) on a flat surface in various arrangements until you have the most practical layout. Power supply sections are usually put at the back or to one side of the chassis; other tubes should be in path-of-signal order. The input end of the tube line-up should be near the input jack and, where possible, the output near the output jack. (Sometimes this may mean a U-shaped layout if both jacks are on the same surface.)

Input or other sensitive stages should be mounted as far away as possible from the power transformer and other *ac* lines such as power switch, etc. Also, sufficient under-chassis space must be allowed between stages to provide room for small components and associated wiring.

Figure 1 shows how components might be placed on a flat surface to determine chassis size and layout; the final layout is shown in Fig. 3. For this tape recording amplifier, one input jack was on the back of the chassis with the output, and another (microphone) was on the front panel. Since the amplifier input was more important, the input tube was located at the back of the chassis. To prevent looping grid leads of this tube to the front panel and back again for the panel-controlled volume control, this control was mounted on a bracket near the input tube and controlled from the front with an extension shaft.

After the preliminary chassis layout has been made (as in Fig. 1), check to see that the chassis size required is standard and will fit into a standard size cabinet, if one is to be used. Preliminary panel layouts are made in the same way as preliminary chassis layouts, by placing the components on a flat surface. If a cabinet is to be used, the size and shape of the panel is often governed by the cabinet and sometimes a cabinet larger than necessary to hold all parts has to be used, simply to get sufficient panel space.

Mount panel items in logical order (input controls, jacks, etc., to the left, output to the right), with the controls to be used most frequently the most accessible. Allow space around each control for manipulation without disturbing the other



3 TYPICAL CHASSIS LAYOUT (SEE FIG.1)

controls, and for the dial markings required. Finally, a symmetrical arrangement of panel-mounted items will add to the appearance of the completed unit.

When the panel is tentatively laid out, compare it with the tentative chassis layout to see that panel-mounted items are near related chassis-mounted items, and that there is enough room behind the panel for chassis-mounted items. After comparison, make any minor changes that have to be made.

When the rough chassis and panel layouts have been made, draw up both layouts full-size on heavy paper. Mark centers carefully and show the size of the hole beside each centerpoint. Then these papers can be taped to the chassis and panel and holes center-punched accurately. Figures 3 and 4 show finished chassis and panel layouts. Dotted lines showing components and the explanatory notes are not needed for actual layouts, of course.

Now review the schematic carefully to determine where tie-points will be required. Whenever two minor components (such as a resistor and capacitor) join at other than a component terminal (such as a tube socket pin), a firm connection point is required. This is usually provided by tie points or vector-type tube sockets. It is best to plan on definite points for all such connections, leaving any vacant tube socket pins for unforeseen needs. If tie points are used, mark the schematic with the location of the point planned, so that the chassis layout can be marked for drilling mounting holes. In some cases, tie points can be mounted on transformer or other mounting screws.

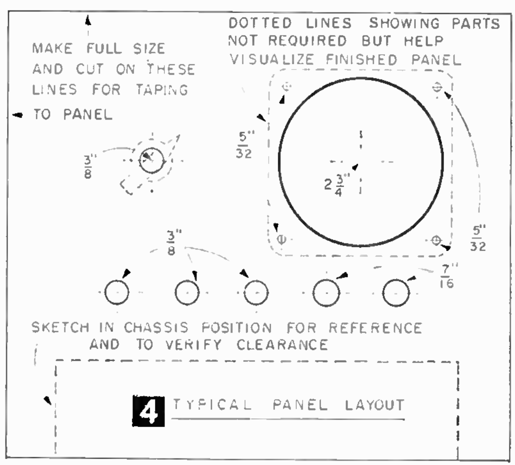
Vector sockets are more expensive than conventional sockets, but they do save the space and mounting hole required for tie points, and minimize wiring. Figure 2 shows a schematic where one vector socket is used (on V_2). The connection points on the vector socket and the tie points required are marked on the schematic to aid in wiring and to permit mounting holes to be drilled for the tie points.

After marking tie-point mounting holes on the chassis layout, tape it to the chassis, center-punch the holes, and drill holes, using a block under the surface being drilled. Do the same with the panel, taking care to remove the burrs on the inner sides of the holes. Lay the panel face down on a soft cloth when clipping the burrs off the back side, shaking the cloth carefully each time the panel is raised to prevent scratching the front surface.

It is easier to label a panel, either with hand lettering or decals, when it is lying flat on a bench. When labeling controls, lay a knob over the mounting hole to determine the clearance for lettering. To keep a series of letters or words in line, tape a piece of paper (or thread) to the edge of the panel, with one edge running along the desired line. If you are using decals, cut the letters for this line at the bottom of the letters and rest them against the paper or thread when applying them.

Often, a set of decals does not contain the exact desired word, and though words can be made up of individual letters, it is easier to cut them out of words where groups of lettering fall in proper sequence.

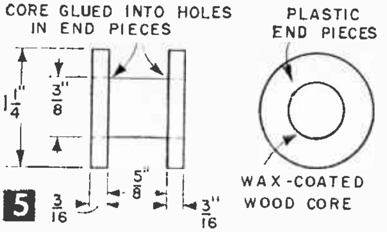
After the panel has been labeled, protect the letters with a coat of varnish. If you are using decals or lacquer paint, do not use lacquer or various spray-type coatings that have an acetone



4 TYPICAL PANEL LAYOUT

or acetate base, since they will dissolve decals if a good, heavy coat is applied. Clear varnish is available in spray-type cans and provides safe, long-lasting protection.

Wherever possible, simplify wiring by wiring sub-assemblies, such as rotary switches, vector sockets, etc., before mounting. Use color-coded wire on leads coming from pre-wired sub-assemblies to assist in wiring them in after they have been mounted, noting the color code on the schematic.



5 BIAS-ERASE OSCILLATOR COIL FORM (T3)

Prior to actual wiring, mount all components and attach the panel to the chassis. Sometimes the panel can be attached to the chassis by the components themselves, instead of mounting screws. After all components are mounted, you may want to protect the panel by covering it with pliofilm or cellophane during wiring.

Wiring must be done from the bottom up. All *ac* lines, twisted where possible, should lie close to the chassis, so they are wired first. Usually the power supply is wired next, so it can be tested before further wiring. The remaining wiring can be done in path-of-signal order or in any convenient manner. Sometimes the situation must be studied as wiring progresses, to be sure that the more inaccessible places are wired first.

Small components, such as resistors and capacitors, which may later have to be replaced, should be mounted so that they are readily accessible, and "spaghetti" tubing should be used to cover bare leads. Sometimes several connections have to be made to a single tube socket pin or terminal. Study the schematic when wiring to anticipate this so that you will not solder until all wires to the point are in place. This provides better connections and saves having to try to "squeeze" another wire into a soldered joint.

In many circuits a bus wire ground is required to prevent stray *ac* currents and fields between ground points. It doesn't hurt in any circuit and it makes wiring simpler and easier, so include such a bus wherever possible. Plan it to run near, but out of the way of, all tube sockets and major components, and fasten it to the chassis at a single point. Such a bus should be of stiff wire and well-supported, usually on tie points.

Even if you have only a schematic to work from, with care and planning you can have a piece of equipment not only designed to suit your needs, but one that will appear and operate like a professionally built unit.

Tape Recording Amp. The unit used as an example in this article is a custom-built tape recording amplifier with a recording level meter and a bias-erase oscillator circuit. It mounts in a custom-made mahogany cabinet, with mahogany front panel and with gold decal letters.

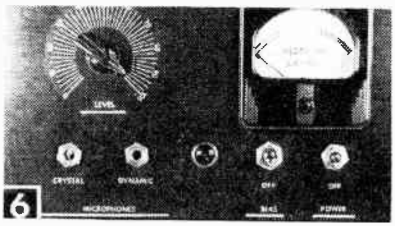
Values for the components used in this piece of equipment are given in the Materials List. As can be seen from the schematic (Fig. 2), the microphone portion of the circuit involves only matching a special dynamic microphone, and provides microphone jacks at the front of the panel for connection to rear amplifier connections.

The tape bias-oscillator section has excellent waveform, and oscillates at around 70 *kc*. The coil is wound on a form as shown in Fig. 5. It consists of 800 turns on the primary, centertapped, with 275 turns on the secondary. Both windings are scramble-wound with No. 28 enameled wire. The output to the play-record and erase heads are adjusted to the head specifications by the size of R28 and C16.

Switch S2 switches the play-record head to a preamplifier input for playing, and to the amplifier and bias circuits for recording. The unit is turned on only when recording.

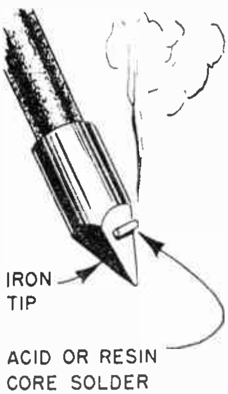
MATERIALS LIST—
TAPE RECORDING AMPLIFIER
(All resistors are 1/2 watt unless specified)

Desig.	Description
R1, R8	.12 meg.
R2	.25 meg. potentiometer
R3	5600 ohm
R4	.22 meg.
R5, R11, R15, R18	.1 meg
R6, R14	2.2 meg.
R7, R19	2200 ohm
R9	4.7 meg.
R10, R25, R26	27K ohms
R12	.27 meg.
R13, R24	51K ohms
R16	.2 meg.
R17	33K ohms, 1 watt
R20	2200 ohms, 1 watt
R21	2500 ohms, 10 watts
R22	.1 meg, 2 watts
R23	25K potentiometer
R27	560 ohms
R28	see text
C1	10-10-10 mf. 350 volt
C2	8-8 mf. 450 volt
C3	50 mmf ceramic
C4	100 mmf ceramic
C5	.022 mf. 200 volt
C6	50 mf. 25 volt
C7	.1 mf. 400 volt
C8	25 mmf. ceramic
C9	.05 mf. 200 volt
C10	.01 mf. 200 volt
C11	500 mmf mica
C12, C14, C15	.002 mf. 400 volt
C13	.2 mf. 200 volt
C16	see text
T1	special mic. transformer
T2	power transformer Sec—350-0-350 v. @ 110 ma. 6.3 volts @ 3 amps. 5 volts @ 2 amps. (Thordarson 22R32)
T3	oscillator bias transformer (see text)
L1	8 hy. 100 ma. (Merit C-2995)
S1	SPST toggle
S2	SPDT toggle
J1	closed circuit jack
J2	special mic. jack
M	0-1 milliammeter
MR	meter rectifier
V1	12AX7 (Conant type M)
V2	12AU7
V3	12AU7
V4	5Y3
V5, V6	0D3



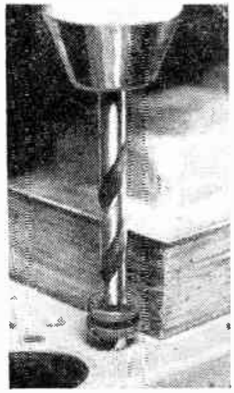
Front panel of unit.

Iron Sends Smoke Signals



• Want to know when your soldering iron has reached solder-melting temperature? Clip off a small piece of acid or resin-core solder and rest it on the tip of the iron just before you plug it in. When the solder melts, a puff of smoke will rise from the tip and the sight or smell of the smoke will tip you off that the iron's ready to go to work.—JOHN A. COMSTOCK.

Grommet Arrests Drill's Travel

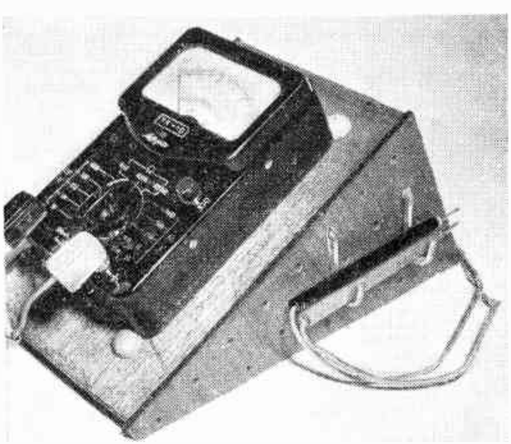


• When drilling a hole through a radio or TV chassis, keep the drill from extending down through far enough to damage valuable components mounted underneath by arresting the drill's travel with a rubber grommet slipped over the bit (see photo). There are different sized rubber grommets available that will tight-fit most twist drill sizes.—JOHN A. COMSTOCK.

Building Breadboard Circuits

• When building breadboard circuits, loose dangling wires may touch together, cause a short circuit, and ruin a transistor or other valuable component. To prevent this from happening, tape the wire leads to the chassis with masking or plastic tape. This will also improve the appearance of the layout and permit easier tracing of the wires.—JOHN A. COMSTOCK.

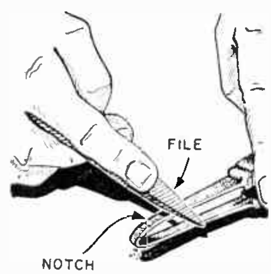
Build Yourself a Multimeter Stand



• Do you have to stretch your neck to read the scale of your VTVM or VOM when it is lying flat on its back on the bench? You won't have to if you build the simple stand shown in the photo.

Cut the front and back pieces from ¼-in. plywood and the two side pieces from pre-finished Marlite peg-board. Nail all pieces together and pound four rubber headed tacks into the front piece as shown to keep your meter positioned. Then add two hook-type tool hangers to one peg-board side to hold your test leads. If your leads are exceptionally long, you can nail a small spool to the back piece and keep the leads wrapped neatly around it when they aren't in use.—J.A.C.

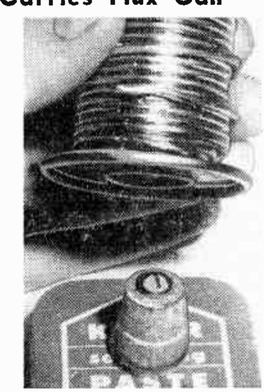
Shaky Soldering Hand?



• A small notch filed into the bottom of a soldering gun's tip near the end makes it easier to hold the gun steady when soldering wires. The notch hooks over the wire connection and is especially handy for electronic builders and hobbyists with shaky soldering hands. The notch won't harm the tip in any way (if you don't file it too deep) but it will make soldering a lot easier.—J.A.C.

Solder Spool Carries Flux Can

• Attach a cork to the lid of your can of soldering paste and set your spool of solder down over the plug as a means for keeping the can of flux handy. It will always go wherever the spool of solder goes and will also serve as a base to keep the spool from tipping over and rolling off the bench.—J. A. C.



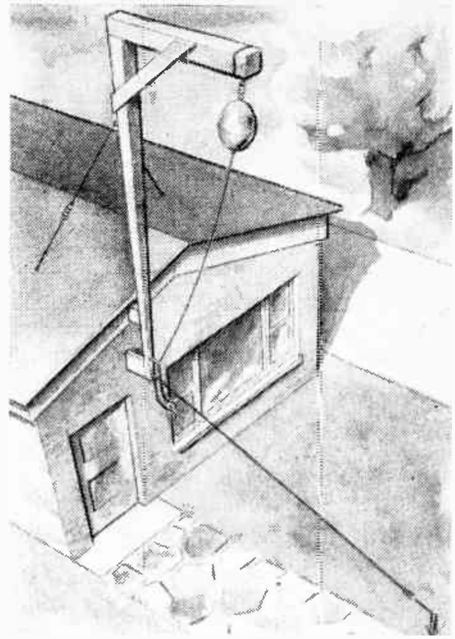
Answers to Electronics Picture Quiz, Page 123

1) Eight-pin octal tube socket (bottom view).
2) Two-gang variable tuning capacitor.
3) Miniature tube (a socket's eye view, pins pointing out of the page).
4) Pencil-type soldering iron (wire connection's eye view with iron's tip pointing out of the page).
5) Close-up of coil winding.
6) Standard phone plug.

I. C. R. A.*

*(Intercontinental Radio Antenna)

By C. F. ROCKEY, W9SCH



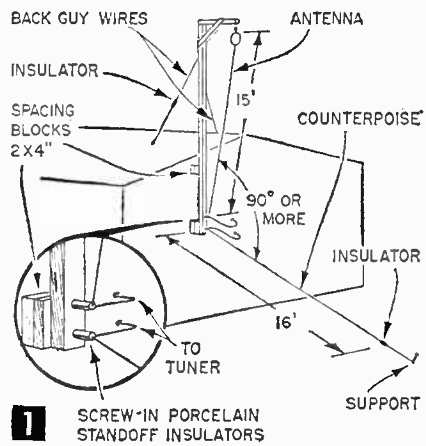
EVERYONE in amateur radio today agrees that a multi-element "rotary beam" is the best DX antenna for effective communication of 5000 miles and beyond. But rotary beams are expensive, costing well over $100 for a suitably durable one. This puts them beyond the reach of many amateurs, particularly the younger fellows.

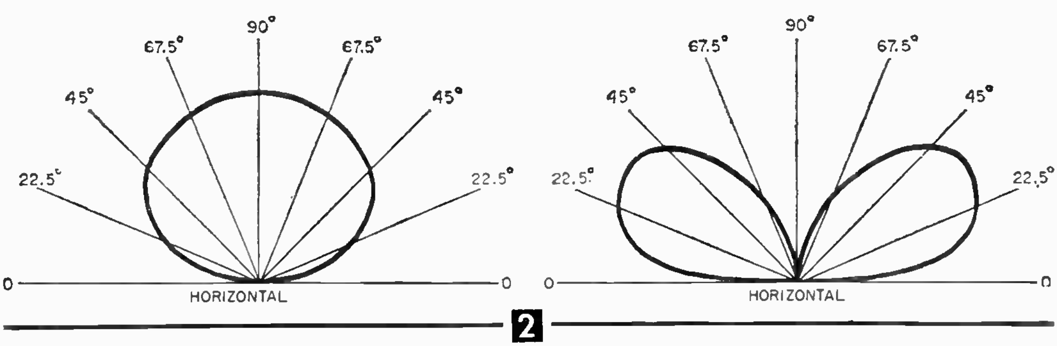
While we do not claim that our "closet-tank float special" will equal a good beam antenna, we do know that it has produced effective long-range contacts for us, and for a very modest cash investment, too. Actual tests made on the air tend to indicate that the ball increases the signal reports in Europe by at least one "s" unit. Also the percentage of calls answered by DX seems to increase noticeably when the ball is used.

Good results with this antenna require that it be erected in a reasonably clear location, about 30 ft. or more from large conducting objects. Aside from this, it is remarkably non-critical. In the author's case it was erected along the end wall of a redwood frame cottage (Fig. 1), the presence of the dry wood having little apparent effect upon its radiation. Brick or stone, particularly when wet, might not be too good, however.

This antenna performs most spectacularly in the fifteen meter (21 MC) and twenty meter (14 MC) bands, but it continues to radiate reasonably well at forty meters (7 MC) and on ten meters (28 MC) too.

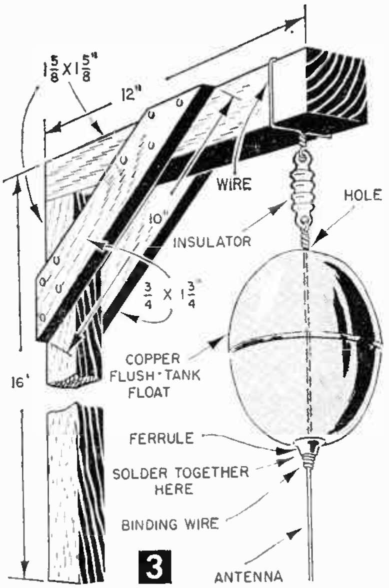
What has this antenna got that the ordinary vertical doesn't? simply this: a ball-shaped copper closet-tank float at the upper end that contributes "*top* capacity," causing significantly more RF current to flow in the uppermost end of the wire, where it increases the power radiated along the horizontal (Fig. 2). This is





VERTICAL RADIATION PATTERN SIMILAR TO THAT OF TYPICAL HORIZONTAL DIPOLE. NOTE THAT MOST OF ENERGY IS RADIATED UPWARDS WHERE IT IS USELESS FOR LONG-RANGE COMMUNICATION. RADIAL DISTANCE IS PROPORTIONAL TO RADIATED FIELD STRENGTH.

VERTICAL RADIATION PATTERN SIMILAR TO THAT OF PROPERLY INSTALLED "CLOSET-TANK FLOAT SPECIAL" ANTENNA. NOTICE THAT CONSIDERABLY MORE ENERGY IS RADIATED AT ANGLES BELOW 45° WHICH ARE THOSE MOST SIGNIFICANT FOR LONG RANGE COMMUNICATION.



3

the radiation that skips out to the long distances. (This is an old principle, known to Marconi. However, few of the present-day gang seem aware of it.)

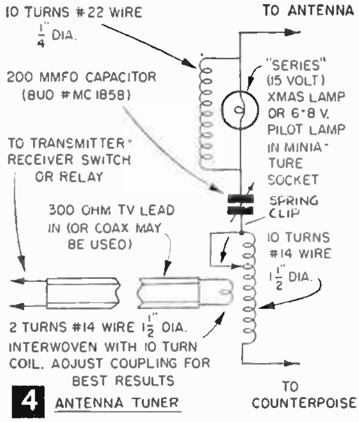
The antenna itself is vertical, about 20 ft. long. It is supported upon a "gallows" made as in Fig. 3. Prepare a standard copper flush-tank valve float by drilling a ⅛-in. hole through the ferrule where the ball normally screws to the float rod. Drill another similar hole through the ball diametrically opposite to the ferrule.

Use a 20-ft. length of stranded or solid, insulated or bare #12 or #14 copper wire for the antenna. Pass the wire completely thru the float, so the float ferrule is at the bottom and fasten the wire to an insulator in the usual manner (Fig. 3). Scrape the insulation, if any, from the wire just below the ferrule and wind several turns of copper wire around the antenna to keep the float in place. With a torch, solder the wire, float and antenna firmly together. Make sure the solder flows into and all around the joint and makes good contact with the ball.

Now erect the antenna "gallows," vertically and firmly in a clear location as in Fig. 1. Fasten the lower-end of the antenna to a porcelain screw standoff insulator. The nearly vertical portion of the wire, with ball at top, should be about 16 ft. long. Allow about four feet of wire for lead-in to the tuner.

In addition to the antenna, you will also need a counterpoise. This is a 16-ft. length of antenna wire, which should project as near horizontally as possible from the base (Fig. 1) and be insulated at each end. Connect near end to tuner as in Fig. 4.

A suitable tuner, as used by the writer, is diagrammed in Fig. 4. It is possible that your antenna may require a slightly different sized coil,



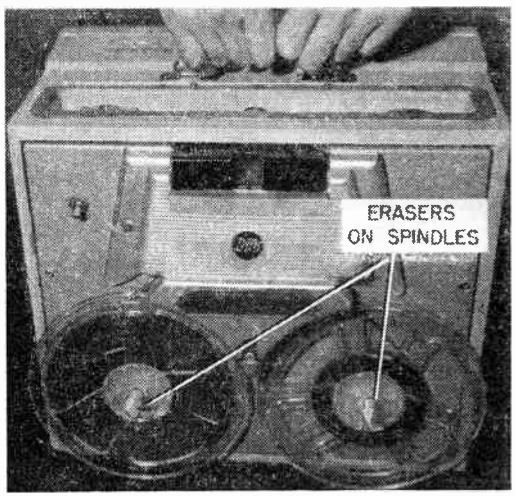
4 ANTENNA TUNER

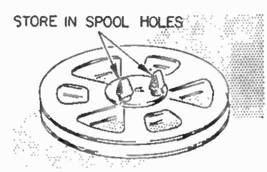
but the figures given will serve as a start. Adjust the tuner capacitor (along with proper adjustment of the transmitter tank circuit) until maximum brilliance of the lamp is obtained for each transmitting frequency. (The transmitter power input should be correct, too.) This will also prove best for receiving within the same frequency band. Mount the tuner parts on a ¾-in. thick board.

MATERIALS LIST—INTERCONTINENTAL RADIO ANTENNA

No. Req.	Size and Description
1	1⅝ x 1⅝" x 18' clear pine or hemlock
1	¾ x 1¾ x 12" clear pine or hemlock
1	antenna tension insulators, porcelain
1	closet flush-tank, copper valve float (the plastic type will NOT work)
2	screw-in standoff porcelain insulators
35 ft	#12 or #14 copper wire (insulated or bare)
FOR TUNER:	
1	miniature screw-base lamp socket
1	"series" Christmas-tree lamp, or Blue-bead, screw base 6-8 volt pilot bulb
1	variable capacitor, 200 mmfd., such as Bud type MC 1858
3 ft	#14 wire for coils (#12 will do), suitable length of 300 ohm TV lead-in to reach from tuner to operating position (coax. cable may also be used)
1	copper spring clip

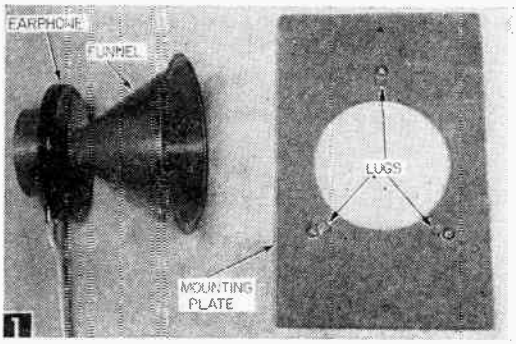
Erasers Help Carry Recorder





• If you ever need to carry your tape recorder in a vertical position with the tape spools still on the spindles, place a slip-on pencil eraser over each spindle. This will keep the spools from falling off the spindles and spilling the tape. Store the erasers in the holes of an empty spool when not in use.—John A. Comstock.

Old Earphone Makes High-Frequency "Tweeter" Speaker



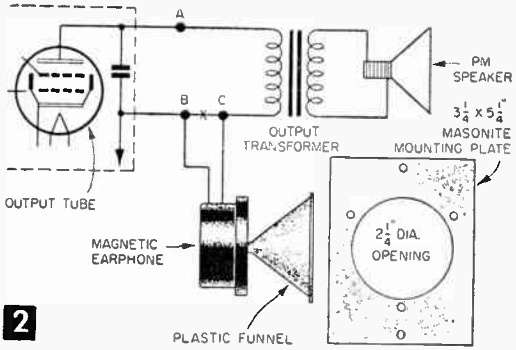
1

To reproduce the higher frequencies, expensive record players and combination sets have a miniature "tweeter" speaker in addition to the regular speaker. If you have a regular-size magnetic or crystal headset on hand, one of the phones of the set can be used for making such a tweeter speaker.

Any 1000 or 2000-ohm magnetic phone may be used. If a crystal phone is used, its hookup requires only connection across the primary side of the audio output transformer (A to B in Fig. 2). For best results, wire a magnetic earphone in series with one of the transformer primary leads. In this case the solid lead is cut and connections are made to B and C in Fig. 2.

Make the speaker horn from a plastic funnel 2¾ in. o.d. or larger by cutting off all but about ⅛ in. of the spout end of the funnel. Unscrew the Bakelite phone cap and enlarge the center hole with a burring reamer so the funnel spout stub fits the hole snugly. Be sure the funnel stub is flush inside the cap so that it will not interfere with the free movement of the diaphragm. Fasten the funnel to the cap with household cement. Attach the miniature horn speaker to a mounting plate made from a piece of hardboard. Use three soldering lugs clipped short and bent as in Fig. 1 to hold the flange of the funnel to the hardboard.

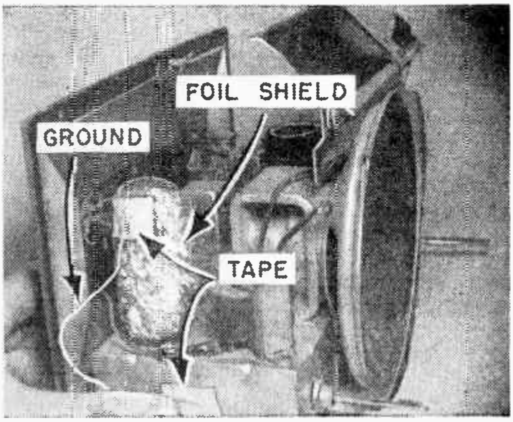
Since the original earphone cord is a series tinsel type and therefore would not be suitable, use a length of ordinary plastic fixture cord for connecting the tweeter speaker to your set or amplifier.—T.A.B.



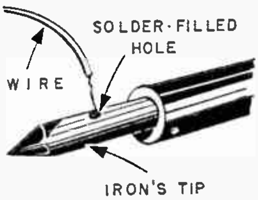
2

Foil Shield for Tube

• A piece of household aluminum foil will serve as a temporary shield for a tube, or for wires causing hum pickup due to stray coupling. Tape wire ground to shield and chassis. Leave an opening in top of shield to allow heat from bulb to escape.—John A. Comstock.

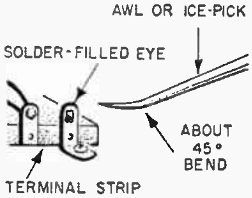


Wire Dip in Iron's Tip



• Drill a small hole (about ⅛ in. dia. and ¼ in. deep) in your iron's tip, to use for tinning the tips of wires. Simply heat the iron and fill the hole with solder into which to dip tips.

Awl Opens "Eye"



• An awl or ice-pick with the tip bent at a 45° angle makes a handy tool for poking open the solder-clogged eye of a soldering lug or terminal. Heat the terminal with an iron and poke the awl's tip through the eye. When the solder cools, pull out the awl and thread the wire through the open eye.—John A. Comstock.

WHITE'S RADIO LOG

An up-to-date broadcasting directory
AM, FM, TV and Short-Wave Stations

Vol. 36 **No. 2**

QUICK REFERENCE INDEX

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
WDVM Pocomoke City, Md.	500d
WCNG Canonsburg, Pa.	250d
WDXN Clarksville, Tenn.	250d
WRIC Richlands, Va.	1000d
550—545.1	
CFNB Fredericton, N.B.	5000
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
WGGA Gainesville, Ga.	5000
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.	500
WPAB Ponce, P.R.	5000
WPAW Pawtucket, R.I.	1000d
KMVI Wailuku, T.H.	1000
KCRS Midland, Tex.	5000
KISA San Antonio, Tex.	5000
WDEV Waterbury, Vt.	5000
WSVA Harrisonburg, Va.	5000
WSAU Wausau, Wis.	5000
560—535.4	
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
WMIC 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
CJEM Edmundston, N.B.	1000
WCAS Gadsden, Ala.	5000d
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.	1000d
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.	250
580—516.9	
CFCL Timmins, Ont.	1000
CJFX Antigonish, N.S.	5000
CKEY Toronto, Ont.	5000
CKPR Ft. William, Ont.	5000
CKUA Edmonton, Alta.	1000
CKY Winnipeg, Man.	5000
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
WHP Harrisburg, Pa.	5000
WKAQ San Juan, P.R.	5000
WRKH Rockwood, Tenn.	1000d
KDAV Lubbock, Tex.	500d
WCHS Charleston, W.Va.	5000
WKTY LaCrosse, Wis.	1000
590—508.2	
CFAR FlinFlon, 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
WAGA 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.	1000
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
WYFE 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

Kc. Wave Length W.P.

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
WCEH Hawkinsville, Ga. 500d
KUAM Agana, Guam 1000
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

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. 5000
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
WISK So. St. Paul, Minn. 5000
KXOK St. Louis, Mo. 5000
KOH Reno, Nev. 5000
KLEA Lovington, N.Mex. 500
WIRC Hickory, N.C. 1000d
WMFD Wilmington, N.C. 1000
WEJL Scranton, Pa. 500d
WPRO Providence, R.I. 5000
KGFX Pierre, S.Dak. 250
KPOA Honolulu, T.H. 5000
KMAC San Antonio Tex. 5000
KGDN Edmunds, Wash. 1000d
KZUN Opportunity, Wash. 500d

640—468.5

CBN St. John's, N.F. 10000
KFI Los Angeles, Calif. 50000
WOI Ames, Iowa 5000d
WHKK Akron, Ohio 1000
WNAD Norman, Okla. 1000d

650—461.3

WSM Nashville, Tenn. 50000
KRCT Baytown, Texas 250d

660—454.3

KFAR Fairbanks, Alaska 10000
KOWH Omaha, Nebr. 500d
WRCA New York, N.Y. 50000
WESC Greenville, S.C. 5000d
KSKY Dallas, Tex. 1000

Kc. Wave Length W.P.

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. 5000
KNBC San Fran., Calif. 50000
WPIN St. Petersburg, Fla. 1000d
WCTT Corbin, Ky. 1000
WCBM Baltimore, Md. 10000
WNAC Lawrence, Mass. 50000
WDBC Escanaba, Mich. 1000
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

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
WADS Ansonia, Conn. 500d
WAPE Jacksonville, Fla. 25000d
KBLI Blackfoot, Idaho 1000d
KGGF Coffeyville, Kans. 10000
WTIX New Orleans, La. 5000
KSTL St. Louis, Mo. 1000d
KRCO Prineville, Oreg. 1000d
KUSD Vermillion, S.Dak. 1000d
KULA Honolulu, T.H. 10000
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. 250d
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. 1000
CKLG No. Vancouver, B.C. 10000
KFQD Anchorage, Alaska 10000
WJMW Athens, Ala. 1000d
KNBY Newport, Ark. 1000d
WKTG Thomasville, Ga. 1000d
KBLR Goodland, Kans. 1000d
WFMW Madisonville, Ky. 250d
WMTC Vancleve, 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
WDOS Oneonta, N.Y. 500d
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
KKOG Ogden, Utah 1000d
WPIK Alexandria, Va. 1000d
WMNA Gretna, Va. 1000d
KULE Ephrata, Wash. 1000d

740—405.2

CBXA Edmonton, Alta. 250
CBL Toronto, Ont. 50000
WBAM Montgomery, Ala. 50000d

Kc. Wave Length W.P.

KUEQ Phoenix, Ariz. 1000d
KBIG Avalon, Calif. 10000d
KCBS San Francisco, Calif. 50000
KSSS Colo. Springs, Colo. 250d
KVFC Cortez, Colo. 1000d
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
WIBS Santurce, P.Rico 10000d
WBAW Barnwell, S.C. 500d
WIRJ Humboldt, Tenn. 250d
WJIG Tullahoma, Tenn. 250d
KTRH Houston, Tex. 50000

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. 10000
WPDX Clarksburg, W.Va. 1000d

760—394.5

KGU Honolulu, Hawaii 10000
WJR Detroit, Mich. 50000
WCPS Tarboro, N.C. 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

CBY Corner Brook, N.F. 1000
CKMR Newcastle, N.B. 1000
CKSO Sudbury, Ont. 5000
WTUG Tuscaloosa, Ala. 500d
KCEE Tucson, Ariz. 1000d
KOSY Texarkana, Ark. 1000
KDAN Eureka, Calif. 5000d
KABC Los Angeles, Calif. 5000
WLBE Leesburg, Fla. 1000
WPFA Pensacola, Fla. 1000d
WQXI Atlanta, Ga. 5000
WGRA Cairo, Ga. 1000d
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. 500d
WTNC Thomasville, N.C. 1000d
WKLM Wilmington, N.C. 500d
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
WSIG Mount Jackson, Va. 1000d
WTAR Norfolk, Va. 5000
KVOS Bellingham, Wash. 1000
KNEW Spokane, Wash. 5000
WEAU Washington, Wis. 5000

800—374.8

CHAB Moose Jaw, Sask. 10000
CKOK Penticton, B.C. 10000
CFOB Ft. Frances, Ont. 1000
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
KIKK Bakersfield, Calif. 250d
KHIL Brighton, Colo. 500d
WLAD Danbury, Conn. 250d
WMBM Miami Beach, Fla. 1000d
WSUZ Palatka, Fla. 1000d
WJAT Swainsboro, Ga. 1000d
KXIC Iowa City, Iowa 1000d
WRUS Russellville, Ky. 1000d

Kc. Wave Length W.P.

WBOK New Orleans, La. 1000d
WCCM Lawrence, Mass. 1000d
KREI Farmington, Mo. 1000d
KDBM Dillon, Mont. 1000d
WKDN Camden, N.J. 1000d
KTOW Okla. City, Okla. 250d
KPDQ Portland, Oreg. 1000d
WCHA Chambersburg, Pa. 1000d
DZPI Manila, P.I. 10000
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
WHTN Huntington, W.Va. 1000d
WDUX Waupaca, Wis. 1000d

810—370.2

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
WCBD 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
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
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 Homestead, Pa. 250d
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. 5000d
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 Kaimuki, Hawaii 1000
WWL New Orleans, La. 50000
WKAR E. Lansing, Mich. 5000d
WHCU Ithaca, N.Y. 1000d
WGTL Kannapolis, N.C. 1000d
KJIM Ft. Worth, Tex. 250d
WFLO Farmville, Va. 1000d

880—340.7

WCBS New York, N.Y. 50000

Kc.	Wave Length	W.P.
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
CJGX	Yorkton, 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
KSIR	Wichita, Kan.	250
WKYW	Louisville, Ky.	1000d
WLSI	Pikeville, Ky.	1000d
KREH	Oakdale, La.	250d
WCME	Brunswick, Maine	500d
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
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
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
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.	500
WAVL	Apollo, Pa.	1000d
WGBI	Scranton, Pa.	1000
WSBA	York, Pa.	1000
WPRP	Ponce, P.R.	5000
WORD	Spartanburg, S.C.	1000
WJHL	Johnson City, Tenn.	5000
WEPG	S. Pittsburgh, Tenn.	500d
KRIO	McAllen, Tex.	1000
KRRV	Sherman, Tex.	1000
KALL	Salt Lake City, Utah	1000
WRNL	Richmond, Va.	5000
WHYE	Roanoke, Va.	1000d
KORD	Pasco, Wash.	1000d
KQDE	Renton, Wash.	1000
KISN	Vancouver, Wash.	1000
WHSM	Hayward, Wis.	1000d
WDOR	Sturgeon Bay, Wis.	500d

920—325.9

CJCH	Halifax, N.S.	10000
CKNX	Wingham, Ont.	2500
WCTA	Adalusia, Ala.	5000
WWWR	Russellville, Ala.	1000d
KARK	Little Rock, Ark.	5000
KDES	Palm Springs, Calif.	1000d
KVEC	San Luis Obispo, Cal.	1000
KIUP	Durango, Colo.	5000
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
WPIX	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
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

CFBC	Saint John, N.B.	5000
CJCA	Edmonton, Alta.	5000
CJON	St. John's, N.F.	10000
WETO	Gadsden, Ala.	1000d
KTKN	Ketchikan, Alaska	1000
KAPR	Douglas, Ariz.	1000d
KHJ	Los Angeles, Calif.	5000
KIUP	Durango, Colo.	5000
WKSB	Milford, Del.	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
WIST	Charlotte, N.C.	5000
WRRF	Washington, N.C.	5000
WEOL	Elyria, Ohio	1000
WKY	Oklahoma City, Okla.	5000
WCNR	Bloomsburg, Pa.	1000d
KSDN	Aberdeen, S.D.	1000
WSEV	Sevierville, Tenn.	5000d
KDET	Center, Tex.	1000d
KITE	San Antonio, Tex.	5000d
KENY	Bellingham-Ferndale Wash.	1000d
WSAZ	Huntington, W.Va.	5000
WLBL	Auburndale, Wis.	5000d

940—319.0

CBM	Montreal, Que.	50000
CJGX	Yorkton, Sask.	10000
CJIB	Vernon, B.C.	1000
KFRE	Fresno, Calif.	50000
WINZ	Miami, Fla.	50000
WMAZ	Macon, Ga.	10000
WMIX	Mt. Vernon, Ill.	1000
KIOA	Des Moines, Iowa	10000
WYLD	New Orleans, La.	1000
WESA	Charleroi, Pa.	250
WIPR	San Juan, P.R.	10000
KIXZ	Amarillo, Tex.	1000

950—315.6

CKNB	Campbellton, N.B.	1000
CKBB	Barrie, Ont.	5000
WRMA	Montgomery, Ala.	1000d
KXJK	Forrest City, Ark.	5000d
KFSA	Ft. Smith, Ark.	1000
KAHI	Auburn, Calif.	500d
KIMN	Denver, Colo.	5000
WFBS	Ft. Walton Bch., 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
WORL	Boston, Mass.	5000d
WWJ	Detroit, Mich.	5000
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
KDSX	Denison, Tex.	500
KPRC	Houston, Tex.	5000
KSEL	Lubbock, Tex.	1000
WXGI	Richmond, Va.	1000d
KJR	Seattle, Wash.	5000
WKAZ	Charleston, W.Va.	5000
WSHE	Sheboygan, Wis.	500d

960—312.3

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
WRFC	Athens, Ga.	5000
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
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

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
WKHM	Jackson, Mich.	1000
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
WICA	Ashtabula, Ohio	5000
WATH	Athens, Ohio	1000d
KAKC	Tulsa, Okla.	1000
KOIN	Portland, Oreg.	5000
WWSW	Pittsburgh, Pa.	5000
WJMX	Florence, S.C.	5000
KNOK	Ft. Worth, Tex.	1000d
KREM	Spokane, Wash.	5000
WWYO	Pineville, W.Va.	1000d
WHA	Madison, Wis.	5000d

980—305.9

CKNW	New Westminster, Brit. Columbia	5000
CFPL	London, Ont.	5000
CBV	Quebec, Que.	5000
CHEX	Peterboro, Ont.	5000
CKRM	Regina, Sask.	5000
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.	500d
WKLY	Hartwell, Ga.	1000d
WBBN	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
KICA	Clovis, N.Mex.	1000
KMIN	Grants, N.Mex.	1000d
WTRY	Troy, N.Y.	5000
WKLM	Wilmington, N.C.	5000d
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.	1000d
WCUB	Manitowoc, Wis.	1000d
WPRE	Prairie du Chien, Wis.	500d

990—302.8

CBW	Winnipeg, Man.	50000
CBT	Grand Falls, N.F.	1000
WWWF	Fayette, Ala.	1000d
WTCB	Flomaton, Ala.	500d
KTKT	Tucson, Ariz.	10000d
KKIS	Pittsburg, Calif.	5000
KLIR	Denver, Colo.	1000d
WBZY	Torrington, Conn.	1000d
WHOO	Orlando, Fla.	10000
WDWD	Dawson, Ga.	1000d
WCAZ	Carthage, Ill.	1000d
WITZ	Jasper, Ind.	1000d
KAYL	Storm Lake, Iowa	250d
KRSL	Russell, Kans.	250d
WJMR	New Orleans, La.	250d
KCLP	Rayville, La.	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.	10000
WVSC	Somerset, Pa.	250d
WPRA	Mayaguez, P.R.	10000
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
KTUT	Tooele, Utah	1000d
WNRV	Narrows, Va.	1000d
WANT	Richmond, Va.	1000d
WKLJ	Sparta, Wis.	250

1000—299.8

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

CBX	Edmonton, Alta.	50000
CFRB	Toronto, Ont.	50000
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
WEAS	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
KJCF	Festus, Mo.	250d
KRVN	Lexington, Nebr.	25000d
WINS	New York, N.Y.	50000
WABZ	Albermarle, N.C.	1000d
WELS	Kinston, N.C.	1000d
WITT	Lewisburg, Pa.	250d
WHIN	Gallatin, Tenn.	1000d
WORM	Savannah, Tenn.	250d
KAMQ	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

KPOP	Los Angeles, Calif.	5000
WCIL	Carbondale, Ill.	1000d
WPEO	Peoria, Ill.	1000d
KDKA	Pittsburgh, Pa.	50000

Kc. Wave Length W.P.

1030—291.1

WBZ Boston, Mass. 50000
WBZA Springfield, Mass. 1000
KATR Corpus Christi, Tex. 50000d

1040—288.3

KHVH Honolulu, Hawaii 5000
WHO Des Moines, Iowa 50000
KIXL Dallas, Tex. 1000d
WIVI Christiansted, V.I. 250

1050—285.5

CFGP Grand Prairie, Alta. 10000
CKSB St. Boniface, Man. 10000
CJIC Sault Ste. Marie, Ont. 250
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
WJSB Crestview, Fla. 1000d
WIVY Jacksonville, Fla. 1000d
WHBO Tampa, Fla. 250d
WRMF Titusville, Fla. 500d
WJAZ Albany, Ga. 1000d
WAUG Augusta, Ga. 1000d
WBIE Marietta, Ga. 500d
KZIN Coeur D'Alene, Idaho 250d
WDZ Decatur, Ill. 1000d
KNCO Garden City, Kans. 1000d
WZIP Covington, Ky. 250d
WKTM Mayfield, Ky. 1000d
KLPL Lake Providence, La. 250d
KCIJ Shreveport, La. 250d
WGAY Silver Sprg., Md. 1000d
WPAG Ann Arbor, Mich. 1000d
KLOH Pipestone, Minn. 1000d
WACR Columbus, Miss. 1000d
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
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
WSMT Sparta, Tenn. 1000d
KLEN Killeen, Tex. 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

1060—282.8

CFCN Calgary, Alta. 10000
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. 10000
KNX Los Angeles, Calif. 50000
WVCG Coral Gables, Fla. 1000d
WIBC Indianapolis, Ind. 50000
KFBI Wichita, Kans. 10000
KHMO Hannibal, Mo. 5000
WHPE High Point, N.C. 1000d
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
WINE Kenmore, N.Y. 1000d
WEWO Laurinburg, N.C. 1000d
KWJJ Portland, Oreg. 10000
WEEP Pittsburgh, Pa. 1000d
KRLD Dallas, Tex. 50000

1090—275.1

CFJB 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

KJBS San Francisco, Calif. 1000d
WLBB Carrollton, Ga. 250d
WHLI Hempstead, N.Y. 10000d
KYW Cleveland, Ohio 50000
WGPA Bethlehem, Pa. 250d

1110—270.1

CFTJ Galt, Ont. 250
KXLA Pasadena, Calif. 10000
WALT Tampa, Fla. 10000d
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
KIPA Hilo, T.Hawaii 1000

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

CKXL Calgary, Alta. 1000
KRAK Stockton, 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. 5000
CKOC Hamilton, Ont. 5000
CKX Brandon, Man. 5000
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. 1000d
WFPM Fort Valley, Ga. 1000d
WJEM Valdosta, Ga. 1000d
KANI Oahu, Hawaii 1000
WGGH Marion, Ill. 5000d
KWDM 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 1000d
WCOP Boston, Mass. 5000
WCEN Mt. Pleasant, Mich. 1000
KASM Albany, Minn. 500d
KRMS Osage Beach, Mo. 1000d
KSEN Shelby, Mont. 1000
KDEF Albuquerque, N.Mex. 1000d
WRUN Utica, N.Y. 5000
WFNS Burlington, N.C. 1000d
WGBR Goldsboro, N.C. 5000
WCUE Akron, Ohio 1000d
WIMA Lima, Ohio 1000
KNED McAlester, Okla. 1000
KFJI Klamath Falls, Oreg. 5000
WHUN Huntingdon, Pa. 1000d
WKPA New Kensington, Pa. 1000d
WORA Mayaguez, P.R. 1000
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
KOYE El Paso, Tex. 1000d
KJBC Midland, Tex. 1000d
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. 5000
KLOK San Jose, Calif. 10000
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

KNBA Vallejo, Calif. 250d
WOWO Ft. Wayne, Ind. 50000
WANN Annapolis, Md. 1000d
WKOX Fram'gham, Mass. 1000d
WLIB New York, N.Y. 1000d
KEX Portland, Oreg. 50000
KLIF Dallas, Tex. 50000
WDTV St. John, V.I. 1000

1200—249.9

WOAI San Antonio, Tex. 50000

1210—247.8

WCNT Centralia, Ill. 1000d
WKNX Saginaw, Mich. 1000d
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
CKEC New Glasgow, N.S. 250
CKCW Moncton, N.B. 10000
CKSF Cornwall, Ont. 1000
CKSM Shawinigan Falls, Quebec 1000
WEDR Birmingham, Ala. 1000d
KVSA McGehee, Ark. 1000d
KIBE Palo Alto, Calif. 1000d
KFSC Denver, Colo. 1000d
WTTT Arlington, Fla. 250d
WRWB Kissimmee, Fla. 250d
WFEC Miami, Fla. 250d
WCLB Camilla, Ga. 1000d
WSFT Thomaston, Ga. 250d
WLPO LaSalle, Ill. 1000d
WKRS Waukegan, Ill. 1000d
WSLM Salem, Ind. 1000d
KJAN Atlantic, Iowa 250d
KOFO Ottawa, Kans. 250d
WFKN Franklin, Ky. 250d
KBCL Bossier City, 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. 250d
WGNY Newburgh, N.Y. 1000d
WKMT Kings Mtn., N.C. 1000d
WREV Reidsville, N.C. 250d
WENC Whiteville, N.C. 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
KLBS Livingston, Tex. 250d
KZEE Weatherford, Tex. 250d
WLSD Big Stone Gap, Va. 1000d
WFAX Falls Church, Va. 1000d
KASY Auburn, Wash. 250d

1230—243.8

CFCW Camrose, Alta. 1000
CFKL Schefferville, Que. 250
CFGR Gravelbourg, Sask. 250
CFYT Dawson City, Yukon T. 100
CJBQ Belleville, Ont. 250
CFPA Port Arthur, Ont. 1000
CKEC New Glasgow, N.S. 250
CKLD Thetford Mines, Que. 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
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
WGUY Bangor, 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. 250
WIKB Iron River, Mich. 250
WMPC Lapeer, Mich. 250
WSOO Slt. Ste. Marie, Mich. 250
WSTR Sturgis, Mich. 250
WKLK Cloquet, Minn. 250
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
KOLL 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
WKCB Berlin, N.H. 250
WTSV Claremont, N.H. 250
WCMC Wildwood, N.J. 100
KALG Alamogordo, N.Mex. 250
KOTS Deming, N.Mex. 250
KFUN Las Vegas, N.Mex. 250
KSWS Roswell, N.Mex. 250
WNIA Cheektowaga, N.Y. 250
WENY Elmira, N.Y. 250
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
KADA N. of Ada, Okla. 250
WBBZ Ponca City, Okla. 250
KVAS Astoria, Oreg. 250
KRNS Burns, Oreg. 250
KOOS Coos Bay, Oreg. 250
KGRO Gresham, Oreg. 250
KYJC Medford, Oreg. 250
KQIK Lakeview, 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

Kc.	Wave Length	W.P.
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.	250
KLYK	Spokane, Wash.	250
KREW	Sunnyside, Wash.	250
WLOG	Logan, W.Va.	250
WCOM	Parkersburg, W.Va.	250
WHBY	Appleton, Wis.	250
WCLO	Janesville, Wis.	250
WHVF	Wausau, Wis.	250
KVOC	Casper, Wyo.	250

1240—241.8

Kc.	Wave Length	W.P.
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
CKLS	LaSarre, Que.	250
WEBJ	Brewton, Ala.	250
WULA	Eufaula, Ala.	250
WOWL	Florence, Ala.	250
WARF	Jasper, Ala.	250
KWJB	So. of Globe, Ariz.	250
KOFA	Yuma, Ariz.	250
KVRC	Arkadelphia, Ark.	250
KAGH	Crossett, Ark.	250
KHOZ	Harrison, Ark.	250
KWAK	Stuttgart, Ark.	250
KCRE	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.	250
WLAG	LaGrange, Ga.	250
WBML	Macon, Ga.	250
WWNS	Statesboro, Ga.	250
WPAX	Thomasville, Ga.	250
WTWA	Thomson, Ga.	250
KANI	Kailua, Hawaii	250
KVNI	Coeur d'Alene, Idaho	250
KWIK	Pocatello, Idaho	250
WCRW	Chicago, Ill.	100
WEDC	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.	250
WKBR	Manchester, N.H.	250
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
WSOC	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
KASA	Elk City, Okla.	250
KBEL	Idabel, Okla.	250
KHBG	Okmulgee, Okla.	250
KFLY	Corvallis, Oreg.	1000d
KKID	Pendleton, Oreg.	250
KPRB	Redmond, Oreg.	250
KRXL	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
WBEJ	Elizabethton, Tenn.	250
WEKR	Fayetteville, Tenn.	250
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.	250
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.	250
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

Kc.	Wave Length	W.P.
CHWO	Oakville, Ont.	1000
CKBL	Matane, Que.	5000
CKRB	Ville St. Georges, Que.	5000
CKSB	St. Boniface, Man.	1000
WZOB	Ft. Payne, Ala.	1000d
WETU	Wetumpka, Ala.	5000d
KFAY	Fayetteville, Ark.	500d
KGHI	Little Rock, Ark.	1000
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
KFKU	Lawrence, Kans.	5000
WREN	Topeka, Kans.	5000
WLCK	Scottsville, Ky.	500d
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
WMTR	Morristown, N.J.	1000d
WIPS	Ticonderoga, N.Y.	1000d
WBRM	Marion, N.C.	1000d
WCHO	Washington Court House, Ohio	500d
WPEL	Montrose, Pa.	1000d
WCAE	Pittsburgh, Pa.	5000
WNOW	York, Pa.	1000d
WTMA	Charleston, S.C.	5000
WKBL	Covington, Tenn.	1000d
KFTV	Paris, Tex.	500d
KPAC	Port Arthur, Tex.	5000
KARS	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

Kc.	Wave Length	W.P.
CFRN	Edmonton, Alta.	5000
DYBU	Cebu, P.I.	1000
WCRT	Birmingham, Ala.	5000d
KPIN	Casa Grande, Ariz.	1000d
KGIL	San Fernando, Calif.	1000
KYA	San Francisco, Calif.	5000
WWDC	Washington, D.C.	5000
WFTW	Fort Walton Beach, Florida	1000d
WMMA	Miami, Fla.	5000d
WWPF	Palatka, Fla.	1000
WHAB	Baxley, Ga.	5000d
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.	1000d
WJBL	Holland, Mich.	500d
KROX	Crookston, Minn.	1000
KDUZ	Hutchinson, Minn.	1000d
WGVM	Greenville, Miss.	1000d
WNSL	Laurel, Miss.	1000d
KGBX	Springfield, Mo.	5000
KIMB	Kimball, Nebr.	1000d
WBUD	Trenton, N.J.	5000
KVSF	Santa Fe, N.Mex.	1000
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
WMFS	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

Kc.	Wave Length	W.P.
CHAT	Medicine Hat, Alta.	1000
CHWK	Chilliwack, B.C.	1000
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
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
KTFI	Twin Falls, Idaho	5000
WEIC	Charleston, Ill.	1000d
WHBF	Rock Island, Ill.	5000
WCMR	Elkhart, Ind.	500
WWCA	Gary, Ind.	1000
WORX	Madison, Ind.	1000d
KSCB	Liberal, Kans.	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
WLSM	Louisville, Miss.	1000d
KUSN	St. Joseph, Mo.	1000d
WTSN	Dover, N.H.	5000
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.	1000d
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
KIDX	Bay City, Tex.	1000
KHEM	Big Spring, Tex.	1000d
KEPS	Eagle Pass, Tex.	1000d
KFJZ	Fort Worth, Tex.	5000
WYUO	Newport News, Va.	1000d
KCVL	Colville, Wash.	1000d
KBAM	Longview, Wash.	1000d
WKYR	Keyser, W.Va.	5000d

1280—234.2

Kc.	Wave Length	W.P.
CJMS	Montreal, Que.	5000
CKCV	Quebec, Que.	5000
WPID	Piedmont, Ala.	1000d
WNPT	Tuscaloosa, Ala.	5000
KHEP	Phoenix, Ariz.	1000d
KFOX	Long Beach, Calif.	1000
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
WIBB	Macon, Ga.	1000d
WMRO	Aurora, Ill.	250d
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
KHOB	Hobbs, N.Mex.	1000d
WOV	New York, N.Y.	5000
WVET	Rochester, N.Y.	5000d
WRSA	Saratoga Sprgs., N.Y.	1000
WSAT	Salisbury, N.C.	1000
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
WJGD	Columbia, Tenn.	1000d
WDNT	Dayton, Tenn.	1000d
KNIT	Abilene, Tex.	500d
KWHI	Brenham, Tex.	1000d
KLTI	Longview, Tex.	1000d
KNAK	Salt Lake City, Utah	5000
WYVE	Wytheville, Va.	1000d
KIT	Yakima, Wash.	5000
WMNF	Richwood, W.Va.	1000d
WNAM	Neenah, Wis.	1000

1290—232.4

Kc.	Wave Length	W.P.
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.	500d
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, Michigan	5000d
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

Kc. Wave Length W.P.

KLIQ Portland, Oreg. 1000d
WTRN Tyrone, Pa. 1000d
WICE Providence, R.I. 500d
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
WVOW Logan, W.Va. 5000
WMIL Milwaukee, Wis. 1000d
WCOW Sparta, Wis. 1000d

1300—230.6

CBAF Moncton, N.B. 5000
WTLS Tallassee, Ala. 1000d
KWCB Searcy, Ark. 1000d
KROP Brawley, Calif. 1000
KYNO Fresno, Calif. 1000
KWKW Pasadena, Calif. 1000
KVOR Colo. Sprgs., Colo. 1000
WAVZ New Haven, Conn. 1000
WSOL Tampa, Fla. 1000d
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
KLUE 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
WTNJ 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
KACI The Dalles, Oreg. 1000d
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
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
KWBR 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 1000
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
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
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. 1000
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
KZIP Amarillo, Tex. 1000d
WRR Dallas, Tex. 5000
KOYL Odessa, Tex. 500d
WEEL Fairfax, Va. 500d
WGH Newport News, Va. 5000
KARY Prosser, Wash. 1000d
WIBA Madison, Wis. 5000

1320—227.1

CJSO Sorel, P.Q. 1000
WAGF Dothan, Ala. 1000
WEZB Homewood, Ala. 1000d
KWHN Fort Smith, Ark. 5000
KRLW Walnut Ridge, Ark. 1000d
KUDE Oceanside, Calif. 500
KCRA Sacramento, Calif. 5000
KAVI Rocky Ford, Colo. 1000d
WATR Waterbury, Conn. 1000
WGMA Hollywood, Fla. 1000d
WJHP Jacksonville, Fla. 5000
WHIE Griffin, Ga. 1000d
WNEG Toccoa, Ga. 1000d
WKAN Kankakee, Ill. 1000d
KMAQ Maquoketa, Iowa 500d
KLWN Lawrence, Kans. 500d
WBRT Bardstown, Ky. 1000d
WNGO Mayfield, Ky. 1000d
KVHL Homer, La. 1000d
WICO Salisbury, Md. 500d
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
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
KDYL Salt Lake City, Utah 5000
WLLY Richmond, Va. 1000d
KXRO Aberdeen, Wash. 1000
KHIT Walla Walla, Wash. 1000d

1330—225.4

CBH Halifax, N.S. 100
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. 1000d
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 Havre deGrace, Md. 1000d
WCRB Waltham, Mass. 5000
WBBC Flint, Mich. 1000
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 Oswego, 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. 1000d
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
KDOK Tyler, Tex. 1000d
WBTM Danville, Va. 5000
WESR Tasley, Va. 1000d
KFKF Bellevue, Wash. 1000d
WETZ New Martinsville, West Virginia 1000d
WHBL Sheboygan, Wis. 1000
KOVE Lander, Wyo. 1000

1340—223.7

CFGB Goose Bay, Nfld. 250
CFSL Weyburn, Sask. 250
CFYK Yellow Knife, N.W.T. 150
CHAD Amos, Que. 250
CJLS Yarmouth, N.S. 250
CHRD Drummondville, Que. 250
CJQC Quebec, Que. 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
KZOK Prescott, Ariz. 250
KBTA Batesville, Ark. 250
KBRS Springdale, Ark. 250
KENL Arcata, Calif. 250
KMAK Fresno, 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
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
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
WNBS Murray, Ky. 250
WEKY Richmond, Ky. 250
KGAN Bastrop, La. 250
KRMD Shreveport, La. 250
WFAU Augusta, Maine 250
WABM 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. 250
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
KBTK 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
KSIL Silver City, N.Mex. 250
WMBO Auburn, N.Y. 250
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 Washington, 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, Ore. 250
KAGI Grants Pass, Oreg. 250
KIHR Hood River, Oreg. 250
KFIR North Bend, Oreg. 250
WFBG Altoona, Pa. 250
WCVI Connellsville, Pa. 250
WSAJ Grove City, Pa. 100
WKRZ Oil City, Pa. 250
WHAT Philadelphia, Pa. 250
WRAW Reading, 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 Greenville, 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
KNAF Fredericksburg, Tex. 250
KDUB Lubbock, Tex. 250
KRBA Lufkin, Tex. 250
KVKM Monahans, 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
WSTA Charlotte Amalie, V.I. 250
WKEY Covington, Va. 250
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. 250
WRIT Milwaukee, Wis. 250
WFHR Wis. Rapids, Wis. 250
KOWB Laramie, Wyo. 250
KWOR Worland, Wyo. 250

1350—222.1

CHOV Pembroke, Ont. 1000
CJDC Dawson Creek, B.C. 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
WPCT Putnam, Conn. 1000d
WDCF Dade City, Fla. 1000d
WRPB Warner Robins, Ga. 1000d
KRLC Lewiston, Idaho 5000
WEEK 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
WHIP Mooresville, N.C. 1000d
KQDI Bismarck, N.D. 500d
WADC Akron, Ohio 5000
WCHI Chillicothe, Ohio 500d
KRHD Duncan, Okla. 250
KTLQ Tahlequah, Okla. 500d
WORK York, Pa. 5000
WDAR Darlington, S.C. 500d
WGSW Greenwood, S.C. 1000d
KTXJ Jasper, Tex. 1000d
KCOR San Antonio, Tex. 5000
WBLT Bedford, Va. 1000d
WNVA Norton, Va. 5000d
WAVY Portsmouth, Va. 5000
WPDR Portage, Wis. 1000d

1360—220.4

WWWB Jasper, Ala. 1000d
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. 1000
WDRC Hartford, Conn. 5000
WOBS Jacksonville, Fla. 5000d
WKAT Miami Beach, Fla. 5000
WIOD Sanford, Fla. 500d
WINT Winter Haven, Fla. 1000d
WAZA Bainbridge, Ga. 1000d
WLAW Lawrenceville, Ga. 1000d
WLBK DeKalb, Ill. 500d
WVMC Mt. Carmel, Ill. 500d
KXGI Ft. Madison, Iowa 1000d
KSCJ Sioux City, Iowa 5000
KBTO El Dorado, Kans. 500d
WFLW Monticello, Ky. 1000d
KDBC 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. 500d

Kc.	Wave Length	W.P.
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
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
KREL	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
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
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.	1000d
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
KUKD	Post, Tex.	500d
KSOP	Salt Lake City, Utah	1000d
WBTN	Bennington, Vt.	500d
WHEE	Martinsville, Va.	1000d
WJWS	South Hill, Va.	1000d
KPOR	Quincy, Wash.	1000d
WMOD	Moundsville, W.Va.	1000d
WCCN	Neillsville, Wis.	1000d
KVWO	Cheyenne, Wyo.	1000

1380—217.3

CFDA	Victoriaville, Que.	1000
CKPC	Brantford, Ont.	10000
CKLC	Kingston, Ont.	5000
WGYV	Greenville, Ala.	1000d
KNLR	N. Little Rock, Ark.	1000d
KBVM	Lancaster, Calif.	1000d
KGMS	Sacramento, Calif.	1000
KSBW	Salinas, Calif.	1000
KFLJ	Walsenburg, Colo.	1000d
WAMS	Wilmington, Del.	1000
WQXQ	Ormond Bch., Fla.	1000d
WTSP	St. Petersburg, Fla.	5000
WAOK	Atlanta, Ga.	5000
WRWH	Cleveland, Ga.	500d
KPOI	Honolulu, Hawaii	5000
WKJG	Ft. Wayne, Ind.	5000
KCIM	Carroll, Iowa	1000
WMTA	Central City, Ky.	500d
WWKY	Winchester, Ky.	1000d
WEND	Baton Rouge, La.	500d
WTTH	Port Huron, Mich.	1000
KLIZ	Brainerd, Minn.	1000d
KAGE	Winona, Minn.	1000d
WDLT	Indianola, Miss.	500d
WTUP	Tupelo, Miss.	1000d
KUDL	Kansas City, Mo.	1000d
KWK	St. Louis, Mo.	5000
KUVR	Holdredge, Nebr.	500d
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.	1000
WACB	Kittanning, Pa.	1000d
WAYZ	Waynesboro, Pa.	1000d
WNRI	Woonsocket, R.I.	1000d
WAGS	Bishopville, S.C.	1000d
KOTA	Rapid City, S.Dak.	5000
KJET	Beaumont, Tex.	1000d
KBWD	Brownwood, Tex.	1000
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
KNOE	Monroe, La.	5000
WCAT	Orange, Mass.	1000d
WPLM	Plymouth, Mass.	1000d
WCER	Charlotte, Mich.	1000d
KRFO	Owatonna, Minn.	500d
WROA	Gulfport, Miss.	1000d
WQIC	Meridian, Miss.	5000d
KENN	Farmington, N.Mex.	5000
WEOK	Poughkeepsie, N.Y.	1000d
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
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
WTJS	Jackson, Tenn.	5000
KULP	El Campo, Tex.	500d
KBEC	Waxahachie, Tex.	500d
KLGN	Logan, Utah	1000d
WEAM	Arlington, Va.	5000
WWOD	Lynchburg, Va.	5000
KLOQ	Yakima, Wash.	1000

1400—214.2

CKBC	Bathurst, N.B.	250
CKCY	Sault Ste. Marie, Ont.	250
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
KONI	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
KCOY	Santa Maria, Calif.	250
KSPA	Santa Paula, Calif.	250
KUKI	Ukiah, Calif.	250
KONG	Visalia, Calif.	250
KRLN	Canon City, Colo.	250
KDTA	Delta, Colo.	250
KFTM	Ft. Morgan, Colo.	250
KBNZ	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
WCOS	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
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
KXLK	Great Falls, Mont.	250
KCOW	Alliance, Nebr.	250
KLIN	Lincoln, Nebr.	250
KPTL	Carson City, Nev.	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.	250
WBNY	Buffalo, N.Y.	250
WELM	Elmira, N.Y.	250
WSLB	Ogdensburg, N.Y.	250
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
KEYJ	Jamestown, N.Dak.	250
WPAY	Portsmouth, Ohio	250
KWON	Bartlesville, Okla.	250
KTMC	McAlester, Okla.	250
KNOR	Norman, Okla.	250
KWIN	Ashland, Oreg.	250
KOMB	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
WHOA	San Juan, P.R.	250
WPCC	Clinton, S.C.	500
WCOS	Columbia, S.C.	250
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
KDWT	Stamford, 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.	250
WINC	Winchester, Va.	250
KWLK	Longview, Wash.	250
KTNT	Tacoma, Wash.	250
WBOY	Clarksburg, W.Va.	250
WRDN	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
KDDI	Cody, Wyo.	250

1410—212.6

CFUN	Vancouver, B.C.	1000
WALA	Mobile, Ala.	5000
KTCS	Fort Smith, Ark.	500d
KERN	Bakersfield, Calif.	500
KTEE	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
WDAX	McRae, Ga.	1000d
WLAQ	Rome, Ga.	1000
WRMN	Elgin, Ill.	500d
WTIM	Taylorville, Ill.	1000d
KGRN	Grinnell, Iowa	500d
KLEM	LeMars, Iowa	1000d
KCLO	Leavenworth, Kans.	500d
KWBB	Wichita, Kans.	1000
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
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.	250d
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

CJMT	Chicoutimi, Que.	1000
CKOM	Saskatoon, Sask.	5000
WACT	Tuscaloosa, Ala.	5000d
KHFH	Sierra Vista, Ariz.	1000d
KPOC	Pocahontas, Ark.	1000d
KSTN	Stockton, Calif.	1000
WLIS	Old Saybrook, Conn.	500d
WBRD	Bradenton, Fla.	1000
WDBF	Delray Beach, Fla.	500d
WSTN	St. Augustine, Fla.	1000d
WAVO	Avondale Estates, Ga.	500d
WRBL	Columbus, Ga.	5000
WLET	Toccoa, Ga.	5000d
WINI	Murphysboro, Ill.	500d
WIMS	Michigan City, Ind.	1000
WOC	Davenport, Iowa	5000
KJCK	Junction City, Kans.	1000d
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.	500
KTOE	Mankato, Minn.	5000
WSUH	Oxford, Miss.	1000d
WQBC	Vicksburg, Miss.	1000
KBTN	Neosho, Mo.	500d
KOOO	Omaha, Nebr.	500d
WALY	Herkimer, N.Y.	1000d
WACK	Newark, N.Y.	500
WLNA	Peekskill, N.Y.	1000d
WMYN	Mayodan, N.C.	500
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	Abredeen, S.D.	1000d
WEMB	Erwin, Tenn.	1000d
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
WKTF	Warrenton, Va.	5000d
KITI	Chehalis, Wash.	1000d
KUJ	Walla Walla, Wash.	5000
WPLY	Plymouth, Wis.	500d

1430—209.7

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

Kc.	Wave Length	W.P.
WPCF	Panama City, Fla.	5000
WGFS	Covington, Ga.	1000d
WRCD	Dalton, Ga.	1000d
WWGS	Tifton, Ga.	5000d
WCMY	Ottawa, Ill.	500d
WIRE	Indianapolis, Ind.	5000
KASI	Ames, Iowa	1000d
KMRC	Morgan City, La.	500d
WNAV	Annapolis, Md.	1000
WHIL	Medford, Mass.	5000d
WION	Ionia, Mich.	500d
WBRB	Mt. Clemens, Mich.	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.	500d
WENO	Madison, Tenn.	5000d
WHER	Memphis, Tenn.	1000
KSTB	Breckenridge, Tex.	1000d
KSIJ	Gladewater, Tex.	1000d
KCOH	Houston, Tex.	1000d
KLO	Ogden, Utah	5000
KBRC	Mt. Vernon, Wash.	5000
WEIR	Weirton, W.Va.	1000
WBEV	Beaver Dam, Wis.	1000d

1440—208.2

WHHY	Montgomery, Ala.	5000
KPOK	Scottsdale, Ariz.	5000d
KOKY	Little Rock, Ark.	5000d
KVON	Napa, Calif.	500
KPRO	Riverside, Calif.	1000
WBIS	Bristol, Conn.	500d
WABR	Winter Park, Fla.	5000
WWCC	Bremen, Ga.	500d
WGIG	Brunswick, Ga.	5000
WXLI	Dublin, Ga.	1000d
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
KMLB	Monroe, La.	5000
WAAB	Worcester, Mass.	5000
WBCM	Bay City, Mich.	1000
WCHB	Inkster, Mich.	1000d
KEVE	Minneapolis, Minn.	5000d
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
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.	1000
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

CBG	Gander, Nfld.	250
CFAB	Windsor, N.S.	250
CFJR	Brockville, Ont.	250
CHEF	Granby, P.Q.	250
CJOY	Guelph, Ont.	250
WDNG	Anniston, Ala.	250
WENN	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
KHOG	Fayetteville, Ark.	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.	250
WCCP	Savannah, 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
WTCO	Campbellsville, Ky.	250
WWXL	Manchester, Ky.	250
WPAD	Paducah, Ky.	250
KSIG	Crowley, La.	250
KNOC	Natchitoches, La.	250
WNPS	New Orleans, La.	250
WAGM	Presque Isle, Maine	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.	250
KDMA	Montevideo, Minn.	100
KFAM	St. Cloud, Minn.	250
WROX	Clarksdale, Miss.	250
WCJU	Columbia, Miss.	250
WJXN	Jackson, Miss.	250
WOKK	Meridian, Miss.	250
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.	250
KUDI	Great Falls, Mont.	250
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
WHDL	Allegany, N.Y.	250
WCLI	Corning, N.Y.	250
WWSC	Glen Falls, N.Y.	250
WHDL	Olean, N.Y.	250
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
KWRO	Coquille, Oreg.	250
KORE	Eugene, Oreg.	250
KFLW	Klamath Falls, Oreg.	250
KLBM	La Grande, Oreg.	250
KBPS	Portland, Oreg.	250
WLEU	Erie, Pa.	250
WGET	Gettysburg, 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
KYNT	Yankton, S.Dak.	250
WLAR	Athens, Tenn.	250
WAGC	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
WTSA	Brattleboro, Vt.	250
WFTR	Front Royal, Va.	250
WREL	Lexington, Va.	250
WMVA	Martinsville, Va.	250
WLPM	Suffolk, Va.	250
KBKW	Aberdeen, Wash.	250
KCLX	Colfax, Wash.	250
KRSC	Othello, Wash.	100
KONP	Port Angeles, Wash.	250
KAYE	Puyallup, Wash.	250
WPAR	Parkersburg, W.Va.	250
WHAW	Weston, 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

CJNB	N. Battleford, Sask.	10000
WFMH	Cullman, Ala.	5000d
WPNX	Phenix City, Ala.	5000
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
WDMF	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
WBET	Brockton, Mass.	1000
WBRN	Big Rapids, Mich.	1000d
WPON	Pontiac, Mich.	500
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.	500d
WMBA	Ambridge, Pa.	500d
WCMB	Harrisburg, Pa.	5000
WBCU	Union, S.C.	1000
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
KIMA	Yakima, Wash.	5000
WRAC	Racine, Wis.	500d

1470—204.0

CHOW	Welland, Ontario	500d
WBLO	Evergreen, Ala.	1000d
KBLO	Hot Springs, Ark.	1000d
KBMX	Coalinga, Calif.	500d
KUTY	Palmdale, Calif.	1000d
KXOA	Sacramento, Calif.	1000
WMMW	Meriden, Conn.	1000d
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
WCBC	Anderson, Ind.	1000d
KTRI	Sioux City, Iowa	5000
KWVY	Waverly, Iowa	1000d
KARE	Atchison, Kans.	1000
WSAC	Radcliff, Ky.	1000d
KPLC	Lake Charles, La.	5000
WLAM	Lewiston, Maine	5000
WJDY	Salisbury, Md.	5000d
WTTR	Westminster, Md.	1000d
WSRO	Marlborough, Mass.	1000d
WNBP	Newburyport, Mass.	500d
WKMF	Flint, Mich.	1000
WKLZ	Kalamazoo, Mich.	500d
KANO	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
WSAN	Allentown, Pa.	5000
WFAR	Farrell, Pa.	1000d
WOIC	Columbia, S.C.	5000d
WEAG	Alcoa, Tenn.	1000d
WHER	Memphis, Tenn.	1000d
WVOL	Nashville, Tenn.	1000d
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
KSPR	Casper, Wyo.	5000

1480—202.6

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
WAPG	Arcadia, Fla.	1000d
WEZY	Cocoa, Fla.	1000d
WTHR	Panama Beach, Fla.	500d
WYZE	Atlanta, Ga.	5000d
WRDW	Augusta, Ga.	5000
WTHI	Terre Haute, Ind.	1000
WRSW	Warsaw, Ind.	500
KLEE	Ottumwa, Iowa	500d
KBKC	Mission, Kans.	500d
KLEO	Wichita, Kans.	5000
WKOA	Hopkinsville, Ky.	1000d
WNKY	Neon, Ky.	1000d
WTLO	Somerset, Ky.	1000d
KANV	Jonesville, La.	500d
KJOE	Shreveport, La.	1000d
WSAR	Fall River, Mass.	5000
WMAX	Grand Rapids, Michigan	1000d
KAUS	Austin, Minn.	1000
KGCX	Sidney, Mont.	5000
KLMS	Lincoln, Nebr.	1000
KWEW	Hobbs, N.Mex.	1000
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
WAGR	Lumberton, N.C.	1000
WMSJ	Sylva, N.C.	5000d
WHBC	Canton, Ohio	5000
WCIN	Cincinnati, Ohio	1000d
WTRA	Latrobe, Pa.	500d
WDAS	Philadelphia, Pa.	1000
WISL	Shamokin, Pa.	1000
WLOK	Memphis, Tenn.	5000d
KBOX	Dallas, Tex.	5000
KLVL	Pasadena, Tex.	1000
WCFR	Springfield, Vt.	1000d
WBBL	Richmond, Va.	5000
WLEE	Richmond, Va.	5000
WBLU	Salem, Va.	5000d
KPVA	Camas, Wash.	1000d
WISC	Madison, Wis.	1000

1490—201.2

CFRC	Kingston, Ont.	100
CKCR	Kitchener, Ont.	250
CKBM	Montaquy, Que.	250
WANA	Anniston, Ala.	250
WAJF	Decatur, Ala.	250
WRLD	Lanett, Ala.	250
WHBB	Selma, Ala.	250
KYCA	Prescott, Ariz.	250
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
KCMS	Manitou Sprgs., Colo.	100
KOLO	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
WDAN	Danville, Ill.	250
WAMV	East St. Louis, Ill.	250
WOPA	Oak Park, Ill.	250
WKBV	Richmond, Ind.	250
WNDU	South Bend, Ind.	250

Kc. Wave Length W.P.

KBUR	Burlington, Iowa	250
WDBQ	Dubuque, Iowa	250
KRIB	Mason City, Iowa	250
KTOP	Topeka, Kans.	250
WFKY	Frankfort, Ky.	250
WKAY	Glasgow, Ky.	250
WOMI	Owensboro, Ky.	250
WSIP	Paintsville, Ky.	250
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.	100
WTXL	W. Springfield, Mass.	250
WABJ	Adrian, Mich.	250
WBFC	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
WELO	Tupelo, Miss.	250
WVIM	Vicksburg, Miss.	250
KDMO	Carthage, Mo.	250
KTTR	Rolla, Mo.	250
KDRO	Sedalia, Mo.	250
KBOW	Butte, Mont.	250
KBON	Omaha, Nebr.	250
WLDB	Atlantic City, N.J.	250
KRSN	Los Alamos, N.Mex.	250
KRTN	Raton, N.Mex.	250
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
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
KVOW	Littlefield, Tex.	250
KPLT	Paris, Tex.	250
KGKB	Tyler, Tex.	250
KVWC	Vernon, Tex.	250
KVOG	Ogden, Utah	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
WJBK	Detroit, Mich.	10000
KSTP	St. Paul, Minn.	50000
KTXO	Sherman, Tex.	250

1510—199.1

CKOT	Tillsonburg, Ont.	1000d
KASK	Ontario, Calif.	250d
KTIM	San Rafael, Calif.	1000d
KUDY	Littleton, Colo.	1000
WKAI	Macomb, Ill.	250d
WMEX	Boston, Mass.	5000
KANS	Independence, Mo.	1000d
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.	250d
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

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.	1000d
WPTS	Pittston, Pa.	1000d
WPME	Punxsutawney, Pa.	1000d
WADK	Newport, R.I.	1000d
KCUL	Ft. Worth, Tex.	10000
KGBC	Galveston, Tex.	1000
KUBO	San Antonio, Tex.	250d
WTKM	Hartford, Wis.	500d

1550—193.5

CBE	Windsor, Ont.	10000
WAAY	Huntsville, Ala.	5000
KOBY	San Fran., Calif.	10000
KENT	Shreveport, La.	1000
KRES	St. Joseph, Mo.	5000
WLOA	Braddock, Pa.	1000d
WBSC	Bennetsville, S.C.	10000

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

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
KRKC	King City, Calif.	250d
KCVR	Lodi, Calif.	1000d
KACE	Riverside, Calif.	1000d
KLOV	Loveland, Colo.	250d
WTWB	Auburndale, Fla.	1000d
WFBF	Fernandina Beach, Florida	1000d
WJOE	Ward Ridge, Fla.	250d
WCPK	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
WLRP	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
WNCA	Siler City, N.C.	1000d
WHOT	Campbell, Ohio	250d
WCLW	Mansfield, Ohio	250d
WPTW	Piqua, Ohio	250d
KTAT	Frederick, Okla.	250d
KOLS	Pryor, Okla.	1000d
KRWC	Forest Grove, Oreg.	1000d
KOHU	Hermiston, Oreg.	1000d
WBUX	Doylestown, Pa.	1000d
WAKU	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.	250d
KZOL	Muleshoe, Tex.	250d
KTER	Terrell, Tex.	250d
WKIC	Salt Lake City, Utah	500d
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
KPCA	Marked Tree, Ark.	250d
KFDF	Van Buren, Ark.	1000d
KWIP	Merced, Calif.	500d
KDAY	Santa Monica, Calif.	10000d
KPIK	Colorado Sprgs., Colo.	5000d
WWIL	Ft. Lauderdale, Fla.	1000
WIOK	Mount Dora, Fla.	1000d
WCLS	Columbus, Ga.	1000d
WLBA	Gainesville, Ga.	5000d
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
WFMA	Davenport, Iowa	500d
KDSN	Denison, Iowa	500d
WGOR	Georgetown, Ky.	250d
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
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.	5000d
KZKY	Albemarle, N.C.	250d
WTYN	Tryon, 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
WTUC	Union City, Tenn.	250d
KGAF	Gainesville, Tex.	250d
KIRT	Mission, Tex.	1000d
KTLU	Rusk, Tex.	500d
KWED	Seguin, Tex.	1000d
KEVA	Shamrock, Tex.	250d
WILA	Danville, Va.	1000d
WPUV	Pulaski, Va.	5000d
WTTN	Watertown, Wis.	250d

1590—188.7

WATM	Atmore, Ala.	5000d
WVNA	Tuscumbia, Ala.	5000d
KPBA	Pine Bluff, Ark.	1000d
KSJO	San Jose, Calif.	1000
KUDU	Ventura, Calif.	1000
WBRY	Waterbury, Conn.	5000
WILZ	St. Petersburg Beach, Florida	1000d
WDAT	S. Daytona Bch., Fla.	1000d
WALB	Albany, Ga.	1000
WLFA	Lafayette, Ga.	5000d
WNMP	Evanston, Ill.	1000d
WQUB	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
WTVB	Coldwater, Mich.	5000
WDOG	Marine City, Mich.	1000d
WOKJ	Jackson, Miss.	5000d
KDEX	Dexter, Mo.	1000d
KPRS	Kansas City, Mo.	1000d
KMAM	Tularosa, N.Mex.	1000d
WEHH	Elmira Heights-Horseheads, N.Y.	500d
WNYS	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
WXRF	Guayama, P.R.	1000
WCBG	Chambersburg, Pa.	5000d
WDRF	Chester, Pa.	1000
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
KYOK	Houston, Tex.	5000
KCBD	Lubbock, Tex.	1000
KBUS	Mexia, Tex.	500d
KANN	Sinton, Tex.	1000d
WEZL	Richmond, Va.	5000d
KTIX	Seattle, Wash.	5000d
WSWW	Platteville, Wis.	1000d
WTRW	Two Rivers, Wis.	1000d

1600—187.5

CHVC	Niagara Falls, Ont.	5000
WEUP	Huntsville, Ala.	1000d
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
WOKB	Winter Garden, Fla.	1000d
WGKA	Atlanta, Ga.	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
WNES	Central City, Ky.	500d
WSTL	Eminence, Ky.	500d
KFNV	Ferriday, La.	1000d
KLFT	Golden Meadow, La.	1000d
KLVI	Vivian, La.	500d
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
WLAU	Laurel, Miss.	5000d
KATZ	St. Louis, Mo.	5000
KTTN	Trenton, Mo.	500d
WONG	Oneida, N.Y.	1000d
WWRL	Woodside, N.Y.	5000
WGIV	Charlotte, N.C.	1000d
WIDU	Fayetteville, N.C.	1000d
WFRC	Reidsville, N.C.	1000
WBLY	Springfield, Ohio	1000d
KUSH	Cushing, Okla.	1000d
KASH	Eugene, Oreg.	1000
WHOL	Allentown, Pa.	500d
WEZN	Elizabethtown, Pa.	500d
WFIS	Fountain Inn, S.C.	1000d
WGUS	N. Augusta, S.C.	500
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
WBOF	Virginia Bch., Va.	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	1220	
	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
Agana, Guam	KUAM	610	N
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	
	WHKK	640	M
Alamogordo, N.M.	KALG	1230	M
	KRAC	1270	
Alamosa,Colo.	KGIW	1450	M
Albany, Ga.	WALB	1590	A
	WGPC	1450	C
	WJAZ	1050	
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	1030	N
	KQEO	920	M
	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.	WCOS	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	1340	N
	WRTA	1240	A
	WVAM	1430	C
Alturas, Calif.	KCNO	570	
Altus, Okla.	KWHW	1450	
Alva, Okla.	KALV	1430	
Amarillo, Tex.	KAMQ	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	
Anchorage, Alaska	KBYR	1270	
	KFQD	730	C-A
	KENI	550	A-M-N
Andalusia, Ala.	WCTA	920	
Anderson, Ind.	WCBC	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	
Artesia, N.M.	KSVP	990	M
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.	WTTT	1220	
Arlington, Va.	WARL	780	
	WEAM	1390	
Artesia, N.M.	KSVP	990	M
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, Wis.	WATW	1400	
Ashtabula, Ohio	WICA	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.	WAGA	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
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	
Austin, Minn.	KAUS	1480	M
Austin, Tex.	KNOW	1490	A
	KTBC	590	C
	KOKE	1370	
	KVET	1300	M
Avalon, Calif.	KBIG	740	
Avon Park, Fla.	WAVP	1390	
Avondale Estates, Ga.	WAVO	1420	
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	
	KIKK	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	1230	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	
Barrie, Ont.	CKBB	950	
Barstow, Calif.	KWTC	1230	A
Bartlesville, Okla.	KWON	1400	M
Bartow, Fla.	WBAR	1460	
Bastrop, La.	KTRY	730	
	KGAN	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
	WEND	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	
	KREL	1360	
Beatrice, Nebr.	KWBE	1450	
Beaufort, N.C.	WBMA	1400	
Beaufort, S.C.	WBEU	960	
Beaumont, Tex.	KFDM	560	A
	KJET	1380	
	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	
Bellaire, Ohio	WOMP	1290	M
Bellefontaine, Ohio	WOHP	1390	
Bellefonte, Pa.	WBLF	1330	
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
Bellingham-Ferndale, Wash.	KENY	930	
Belmont, N.C.	WCGC	1270	M-A
Beloit, Wis.	WBEL	1380	
	WGEZ	1490	M
Belton, S.C.	WHPB	1390	
Bemidji, Minn.	KBUN	1450	M
Bend, Oreg.	KBND	1110	A
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	
Berkeley, Calif.	KRE	1400	
Berkeley Springs, W.Va.	WCST	1010	
Berlin, N.H.	WKCB	1230	
Berryville, Ark.	KTCN	1480	
Berwick, Pa.	WBRX	1280	
Bessemer, Ala.	WENN	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	
Bijou, Calif.	KOWL	1490	
Biloxi, Miss.	WLOX	1490	M
	WVMI	570	
Billings, Mont.	KBMY	1240	M
	KGHL	790	N
	KOOK	970	C
	KOYN	910	
Binghamton, N.Y.	WINR	680	N
	WKOP	1360	M
	WNBF	1290	C
Birmingham, Ala.	WAPI	1070	N
	WBRC	960	C
	WCRT	1260	A
	WEDR	1220	
	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	
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.	KYOR	1450	A
Blytheville, Ark.	KLCN	910	
Bogalusa, La.	WIKC	1490	N
	WBOX	920	
Boise, Idaho	KBOI	950	C
	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	
Bossier City, La.	KBCL	1220	
Boston, Mass.	WBZ	1030	
	WCOP	1150	
	WILD	1090	
	WNAC	680	M-N
	WEZE	1260	N
	WEEI	590	C
	WHDH	850	
	WMEX	1510	
	WORL	950	
Boulder, Colo.	KBOL	1490	
Bowling Green, Ky.	WKCT	930	A
	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.	CFJB	1090	
Brandon, Man.	CKX	1150	
Branson, Mo.	KBHM	1220	
Brantford, Ont.	CKPC	1380	
Brattleboro, Vt.	WTSA	1450	
Brawley, Calif.	KROP	1300	A
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
Bridgeton, N.J.	WSNJ	1240	
Bridgewater, N.S.	CKBW	1000	
Brigham City, Utah	KBUH	800	
Brighton, Colo.	KHIL	800	
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	
Brooklyn, N.Y.	WPOW	1330	
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	
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

Location	C.L.	Kc.	N.A.
Burlington, Iowa	KBUR	1490	A
Burlington, N.C.	WBBB	920	M
	WFNS	1150	
Burlington, Vt.	WCAX	620	C
	WDOT	1400	
	WJOY	1230	A
Burns, Oreg.	KRNS	1230	
Butler, Pa.	WBUT	1050	
	WISR	680	
Butte, Mont.	KBOW	1490	C
	KOPR	550	M
	KXLF	1370	N
Cadillac, Mich.	WATT	1240	M
Caguas, P.R.	WNEL	1450	
	WRDL	1450	
	WVJP	1110	
Cairo, Ga.	WGRA	790	
Cairo, Ill.	WKRO	1490	
Caldwell, Idaho	KCID	1490	
Calera, Ala.	WBYE	1370	
Calexico, Calif.	KICO	1490	
Calgary, Alta.	CFAC	960	
	CFCN	1060	
	CKXL	1140	
Calhoun, Ga.	WCGA	900	
Camas, Wash.	KPVA	1480	
Cambridge, Md.	WCEM	1240	
Cambridge, Mass.	WTAO	740	A
Cambridge, Ohio	WILE	1270	
Camden, Ark.	KAMD	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.	KTEE	1410	
Carmi, Ill.	WROY	1460	
Carrizo Springs, Tex.	KBEN	1450	
Carroll, Iowa	KCIM	1380	
Carrollton, Ala.	WRAG	590	
Carrollton, Ga.	WLBB	1100	
Carson City, Nev.	KPTL	1400	
Cartersville, Ga.	WBHF	1450	M
Carthage, Ill.	WCAZ	990	
Carthage, Mo.	KDMO	1490	
Carthage, Tex.	KGAS	1590	
Caruthersville, Mo.	KCRV	1370	
Casa Grande, Ariz.	KPIN	1260	
Casper, Wyo.	KSPR	1470	C
	KATI	1400	
	KVOC	1230	A-M
Cayce, S.C.	WCAY	620	
Cedar City, Utah	KSUB	590	C
Cedar Rapids, Iowa	KCRG	1600	M
	KPIG	1450	
	WMT	600	C
Cedartown, Ga.	WGAA	1340	
Center, Tex.	KDET	930	
Centerville, Iowa	KCOG	1400	
Centerville, Tenn.	WHLP	1570	
Centerville, Utah	KBBC	1600	
Central City, Ky.	WNES	1600	
	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	1400	
	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	
	WIST	930	M
	WSOC	1240	N
	WWOK	1480	
Charlotte Amalie, V.I.	WSTA	1340	
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.	WAGC	1450	M
	WAPO	1150	A
	WDEF	1370	N
	WDOD	1310	C
	WDXB	1490	
	WMFS	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.	WDRF	1590	
	WVCH	740	
Chester, S.C.	WGOD	1490	
Cheyenne, Wyo.	KFBC	1240	A
	KVWO	1370	M
Chicago, Ill.	WAAF	950	
	WAIT	820	
	WBBM	780	C
	WCBD	820	
	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	
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	1040	
Church Hill, Tenn.	WMCH	1260	
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	
Claremore, Okla.	KWPR	1270	
Claremont, N.H.	WTSV	1230	
Clarksburg, W.Va.	WBOY	1400	N
	WHAR	1340	M
	WPDX	750	
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, Mo.	KXLW	1320	
	KFUO	850	
Clayton, N.Mex.	KLMX	1450	
Clearfield, Pa.	WCPA	900	
Clearwater, Fla.	WTAN	1340	
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
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	
	KICA	980	
Coachella, Calif.	KCHV	970	
Coalinga, Calif.	KBMX	1470	
Coatesville, Pa.	WCOJ	1420	
Cocoa, Fla.	WKKO	860	
	WEZY	1480	
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.	WCPK	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.	WJGO	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	
	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
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	1450	
Coral Gables, Fla.	WVCG	1070	
Corbin, Ky.	WCTT	680	M
Cordele, Ga.	WMJM	1490	M
Cordova, Alaska	KLAM	1450	
Corinth, Miss.	WCMA	1230	
	WCRR	1330	
Cornelia, Ga.	WCON	1450	
Corner Brook, Nfld.	CBY	790	
Corning, N.Y.	WCBA	1350	
	WCLI	1450	A
Cornwall, Ont.	CKSF	1220	
Corona, Calif.	KBUC	1370	
Corpus Christi, Tex.	KATR	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, Oreg.	KOMB	1400	
Coudersport, Pa.	WFRM	600	
Council Bluffs, Iowa	KSWI	1560	M-A
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	
Crescent City, Calif.	KCRE	1240	
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, 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
	WDVA	1250	M
	WILA	1580	
Darlington, S.C.	WDAR	1350	
Dauphin, Man.	CKDM	1050	
Davenport, Iowa	WOC	1420	N
	KFMA	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.	WEAS	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	
	WOOO	1310	
Delano, Calif.	KCHJ	1010	
Delray Bch., Fla.	WDBF	1420	
Del Rio, Tex.	KDLK	1230	
Delta, Colo.	KDTA	1400	
Deming, N.Mex.	KOTS	1230	
Demopolis, Ala.	WXAL	1400	M
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	
	KWDM	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
	WOOF	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, Ohio	WJER	1450	
Doylestown, Pa.	WBUX	1570	
Drumheller, Alta.	CJDV	910	
Drummondville, Que.	CHRD	1340	
Dublin, Ga.	WMLT	1330	
	WXLI	1440	

Location	C.L.	Kc.	N.A.
Ou Bois, Pa.	WCED	1420	C
Dubuque, Iowa	KOTH	1370	A
	WDBQ	1490	M
Duluth, Minn.	KDAL	610	C
	WEBC	560	
	WREX	1080	
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	
Ourant, 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	
Easley, S.C.	WELP	1360	
Eastland, Tex.	KERC	1590	
E. Lansing, Mich.	WKAR	870	
E. Liverpool, Ohio	WOHI	1490	A
East Longmeadow, Mass.	WTYM	1600	
E. Point, Ga.	WTJH	1260	
E. St. Louis, Ill.	WAMV	1490	A
Easton, Pa.	WEEX	1230	
	WEST	1400	N
Eatontown, N.J.	WHTG	1410	
Eau Claire, Wis.	WEAU	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	1450	M
Elizabethtown, Pa.	WEZN	1600	
Elk City, Okla.	KASA	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	1400	A-C
	WENY	1230	N
Elmira Heights-Horseheads, N.Y.	WEHH	1590	M
El Paso, Tex.	KROO	600	C
	KELP	920	
	KHEY	690	
	KOYE	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	1250	
Endicott, N.Y.	WENE	1430	A
Englewood, Colo.	KGMC	1150	
Enid, Okla.	KCRC	1390	A
	KGWA	960	M
Enterprise, Ala.	WIRB	600	
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.	WEDA	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.	WFMD	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	
	KXGO	790	A
Faribault, Minn.	KDHL	920	
Farmington, Mo.	KREI	800	
Farmington, N.M.	KENN	1390	
	KWYK	960	
	KZUM	1280	
Farmville, Va.	WFLO	870	
Farrell, Pa.	WFAR	1470	
Fayette, Ala.	WWWF	990	
Fayetteville, Ark.	KHOG	1450	
	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.	WFBF	1570	
Ferriday, La.	KFNV	1600	
Festus, Mo.	KJCF	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.	KFMO	1240	M
Flin Flon, Man.	CFAR	590	
Flint, Mich.	WFOF	910	N
	WBBC	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	
Floydada, Tex.	KFLD	900	
Foley, Ala.	WHEP	1310	
Fond du Lac, Wis.	KFIZ	1450	M
Forest, Miss.	WMAG	860	
Forest City, N.C.	WBBO	780	
	WAGY	1320	
Forest Grove, Oreg.	KRWC	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. Lauderdale, Fla.	WFTL	1400	
	WWIL	1580	
Ft. Lupton, Colo.	KHIL	800	
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, Idaho	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.	WFBS	950	
	WFTW	1260	
Ft. Wayne, Ind.	WGL	1250	A
	WDWO	1190	
	WANE	1450	C
	WKJG	1380	N
Ft. William, Ont.	CKPR	580	
Ft. Worth, Tex.	KJIM	870	
	KCUL	1540	
	KFJZ	1270	
	KNOK	970	
	WBAP	570	A
	WBAP	820	N
	KXOL	1360	
Fostoria, Ohio	WFOB	1430	
Fountain Inn, S.C.	WFIS	1600	
Framingham, Mass.	WKOX	1190	
Frankfort, Ind.	WILD	1570	
Frankfort, Ky.	WFKY	1490	M
Franklin, Ky.	WFKN	1220	
Franklin, N.C.	WFSC	1050	
Franklin, Pa.	WFRA	500	
Franklin, Tenn.	WAGG	950	
Franklin, Va.	WYSR	1250	
Frederick, Md.	WFMD	930	C
Frederick, Okla.	KTAT	1570	
Fredericksburg, Tex.	KNAF	1340	M
Fredericksburg, Va.	WFVA	1230	A
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.	WBFC	1490	
Fremont, Nebr.	KHUB	1340	
Fremont, Ohio	WFRO	900	
Fresno, Calif.	KARM	1430	A
	KBIF	900	
	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.	WGAO	1350	A
	WETO	930	M
	WCAS	570	
Gaffney, S.C.	WFGN	1570	
Gainesville, Fla.	WOVH	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	
	WQUB	1590	
Gallatin, Tenn.	WHIN	1010	
Gallipolis, Ohio	WJEH	990	
Gallup, N. Mex.	KGAK	1330	A
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	
Gaylord, Mich.	WATC	900	
Geneva, Ala.	WGEA	1150	
Geneva, N.Y.	WGVA	1240	A
Georgetown, Del.	WJWL	900	
Georgetown, Ky.	WGOR	1580	
Georgetown, S.C.	WGTN	1400	M
Gettysburg, Pa.	WGET	1450	
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.	WWSC	1450	A
Glenwood Sprgs., Colo.	KGLN	980	M
Globe, Ariz.	KWJB	1240	A
Gloucester, Va.	WDDY	1420	
Gloversville-Johnston, N.Y.	WENT	1340	C
Golden, Colo.	KXXI	1250	
Golden Meadow, La.	KLFT	1600	
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 Falls, Nfld.	CBT	990	
Grand Forks, N.Dak.			
Grand Coulee, Wash.	KFDR	1360	
	KFJM	1370	
	KILO	1440	C
	KNDX	1310	M
Grand Haven, Mich.	WGHN	1370	
Grand Island, Nebr.	KMMJ	750	A
	KRGI	1430	
Grand Junction, Colo.	KREX	920	M
	KEXD	1230	
	KSTR	620	
Grande Prairie, Alta.	CFGP	1050	
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	1340	M
	KAJO	1270	
Gravelbourg, Sask.	CFGR	1230	
	CFRG	710	
Gt. Barrington, Mass.	WSBS	860	
Gt. Bend, Kans.	KVGB	1590	N
Gt. Falls, Mont.	KFBB	1310	C
	KUDI	1450	
	KMON	560	M
	KXLK	1400	N
Greeley, Colo.	KFKA	1310	
	KYOU	1450	
Green Bay, Wis.	WBAY	1360	C
	WJPG	1440	
	WDUZ	1400	A
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, Miss.	WJPR	1330	
	WDDT	900	
	WGVM	1260	
Greenville, N.C.	WGTC	1590	M
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.	KGRO	1230	
Gretna, Va.	WMNA	730	
Griffin, Ga.	WKEU	1450	M
	WHIE	1320	
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	1450	
Gulfport, Miss.	WROA	1390	
	WGCM	1240	A
Guntersville, Ala.	WGSV	1270	
Guthrie, Okla.	KWRW	1490	
Guymon, Okla.	KGYN	1220	
Hagerstown, Md.	WARK	1490	C
	WJEJ	1240	A-M
Haleyville, Ala.	WJBB	1230	M
Halifax, N.S.	CBH	1330	
	CHNS	960	
	CJCH	920	
Hamilton, Ala.	WERH	970	
Hamilton, Ohio	WMOH	1450	
Hamilton, Ont.	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	

Location	C.L.	Kc.	N.A.
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
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.	KNOC	1490	
Hibbing, Minn.	WMFG	1240	N
Hickory, N.C.	WHKY	1290	A
	WIRC	630	
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	1280	
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	
Homestead, Pa.	WAMO	860	
Homewood, Ala.	WEZB	1320	M
	WJLD	1400	
Honolulu, Hawaii	KGMB	590	C
	KPOI	1380	
	KIKI	830	
	KGU	760	N
	KHVH	1040	
	KPOA	630	M
	KULA	690	A
Hood River, Oreg.	KIHR	1340	
Hope, Ark.	KXAR	1490	
Hopewell, Va.	WHAP	1340	
Hopkinsville, Ky.	WHOP	1230	C
	WKOA	1480	
Hornell, N.Y.	WWHG	1320	
	WLEA	1480	M
Hot Springs, Ark.	KAAB	1350	A
	KBHS	590	
	KBLO	1470	M
Houghton, Mich.	WHDF	1400	
Houghton Lake, Mich.	WHGR	1290	
Houlton, Maine	WABM	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
	WHTN	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, Kan.	KWBW	1450	N
	KWHK	1260	
Hutchinson, Minn.	KOUZ	1260	
Idabel, Okla.	KBEL	1240	
Idaho Falls, Idaho	KID	590	C
	KIFI	1260	A-M
	KUPI	930	
Independence, Kans.	KINO	1010	M
Independence, Mo.	KANS	1510	
Indiana, Pa.	WOAO	1450	C
Indianapolis, Ind.	WFBM	1260	A-M
	WGEE	1590	
	WIBC	1070	
	WIRE	1430	N
	WISH	1310	C
	WXLW	950	
Indianola, Miss.	WOLT	1380	
Indio, Calif.	KREO	1400	A
Inglewood, Calif.	KTYM	1460	
Inkster, Mich.	WCHB	1440	
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
Ishpeming, Mich.	WJPO	1240	
Ithaca, N.Y.	WHCU	870	C
	WTKO	1470	A
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.	WOXI	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.	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	
Jesup, Ga.	WBGR	1370	
Johnson City, Tenn.	WIHL	910	C
	WETB	790	M
Johnstown, Pa.	WJAC	1400	N
	WARO	1490	C
	WCRO	1230	M
Joliet, Ill.	WJOL	1340	
Jonesboro, Ark.	KBTM	1230	M
	KNEA	970	
Jonesboro, La.	KTOC	920	
Jonesboro, Tenn.	WJSO	1590	
Jonesville, La.	KANV	1480	
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	KANI	1240	
Kaimuki, Hawaii	KAIM	870	
Kalamazoo, Mich.	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	
	KUOL	1380	
	WDAF	610	N
	WHB	710	
Kearney, Nebr.	KGFW	1340	M
	KRNY	1460	
Keene, N.H.	WKNE	1290	N
Kelowna, B.C.	CKOV	630	
Kelso, Wash.	KLOG	1490	
Kendallville, Ind.	WAWK	1570	
Kenedy, Tex.	KAML	990	
Kenmore, N.Y.	WINE	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
Kilgore, Tex.	KOCA	1240	
Killeen, Tex.	KLEN	1050	M
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.	WKNY	1490	M
Kingston, Ont.	CFRC	1490	
	CKLC	1380	
	CKWS	960	
Kingstree, S.C.	WDKO	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
Kitchener, Ont.	CKCR	1490	
Kissimmee, Fla.	WRWB	1220	
Kittanning, Pa.	WACB	1380	
Klamath Falls, Oreg.	KFJI	1150	M
	KFLW	1450	A-C
	KLAD	960	
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	
LaCrosse, Wis.	WKBH	1410	N
	WLCX	1490	
	WKTY	580	A
Ladysmith, Wis.	WLDY	1340	
Lafayette, Ga.	WLFA	1590	
Lafayette, Ind.	WASK	1450	M
	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	
LaJunta, Colo.	KBNZ	1400	M
Lake Charles, La.	KLOU	1580	
	KPLC	1470	N
	KAOK	1400	M
Lake City, Fla.	WOSR	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	
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
Lansford, Pa.	WLSH	1410	
Lansing, Mich.	WILS	1320	
	WJIM	1240	A-N
Lapeer, Mich.	WMPC	1230	
LaPorte, Ind.	WLOI	1540	
Laramie, Wyo.	KOWB	1340	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.	WAKU	1570	M
	WTRA	1480	
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	
Lawrenceburg, Tenn.	WDXE	1370	
Lawrenceville, Ga.	WLAW	1360	
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	
Leitchfield, Ky.	WMTL	1580	
Leland, Miss.	WESY	1580	
LeMars, Iowa	KLEM	1410	
Lenoir, N.C.	WJRI	1340	M
Lenoir, Tenn.	WLIL	730	
Leonardtown, Md.	WKIK	1370	
Lethbridge, Alta.	CJOC	1220	
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	
	WMRF	1490	N
Lexington, Ky.	WLAP	630	
	WBLG	1300	A
	WVLK	590	M
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.	KOLL	1230	M
Liberal, Kans.	KSCB	1270	
Liberty, N.Y.	WVOS	1240	
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.	KLFO	1410	
Little Falls, Minn.	KLTF	960	
Little Falls, N.Y.	WLFH	1230	
Littlefield, Tex.	KVOW	1490	
Little Rock, Ark.	KARK	920	N
	KGHI	1250	M
	KLRA	1010	A
	KOKY	1440	
	KTHS	1090	C
	KVLC	1050	
Littleton, Colo.	KUDY	1510	
Live Oak, Fla.	WNER	1250	
Livingston, Mont.	KPRK	1340	M
Livingston, Tenn.	WLIV	920	
Livingston, Tex.	KETX	1440	
	KLBS	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	
Longview, Tex.	KFRO	1370	A
	KLTI	1280	
Longview, Wash.	KEOO	1400	A
	KBAM	1270	
Lorain, Ohio	WWIZ	1380	
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	
	KPOP	1020	
	KRKO	1150	
Louisburg, N.C.	WYRN	1480	
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	

Location	C.L.	Kc.	N.A.
Lovington, N.Mex.	KLEA	630	
Lowell, Mass.	WCAP	980	
	WLLH	1400	M
Lubbock, Tex.	KCBO	1590	M-N
	KDAV	580	
	KDUB	1340	
	KFYO	790	C
	KLLL	1460	M
	KSEL	950	A
Ludington, Mich.	WKLA	1450	A
Lufkin, Tex.	KRBA	1340	A
	KTRE	1420	M
Lumberton, N.C.	WAGR	1480	
	WTSB	1340	M
Lynchburg, Va.	WLVA	590	A
	WWOD	1390	M-N
	WBRG	1050	
Lynn, Mass.	WLYN	1360	
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, Wis.	WHA	970	
	WIBA	1310	N
	WISC	1480	A-M
	WKOW	1070	C
Madison, Tenn.	WENO	1430	
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	
Manchester, Conn.	WINF	1230	
Manchester, Ga.	WFDR	1370	
Manchester, Ky.	WWXL	1450	
Manchester, N.H.	WFEA	1370	
	WGIR	610	C
	WKBR	1240	
Manchester, Tenn.	WMSR	1320	
Manhattan, Kans.	KSAC	580	
	KMAN	1350	
Manila, P.I.	DZPI	1800	M-C
	DZRH	710	N
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	
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	C
	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	1150	
	WPRA	990	
	WTIL	1300	
Mayfield, Ky.	WKTM	1050	
	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	N
	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
	WOIA	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
	WDAL	1330	
	WMOX	1240	
	WOKK	1450	A
	WQIC	1390	
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
	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
	WMBM	800	
Michigan City, Ind.	WIMS	1420	
Middlesboro, Ky.	WMIK	560	
Middletown, Conn.	WCNX	1150	
Middletown, N.Y.	WALL	1340	
Middletown, Ohio	WPFB	910	
Midland, Mich.	WMDN	1490	
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	
Millington, Tenn.	WHEY	1220	
Millville, N.J.	WMVB	1440	
Milton, Fla.	WEBY	1330	M
	WSRA	1490	
Milton, Pa.	WMLP	1570	
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.	KEVE	1440	M
	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
	KBTK	1340	M
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
	WMOZ	960	
Mobridge, S.Dak.	KOLY	1300	
Modesto, Calif.	KTRB	860	
	KBEE	970	
	KFIV	1360	A
Moline, Ill.	WQUA	1230	A
Monahans, Tex.	KVKM	1340	M
Moncton, N.B.	CBAF	1300	
	CKCW	1220	
Monett, Mo.	KRMO	990	
Monmouth, Ill.	WRAM	1330	
Monroe, Ga.	WMRE	1490	
Monroe, La.	KMLB	1440	A-N
	KLIC	1230	M
	KNOE	1390	
Monroe, Mich.	WMIC	560	
Monroe, N.C.	WMAP	1060	
Monroe, Wis.	WEKZ	1260	
Monroeville, Ala.	WMFC	1360	
Monterey, Calif.	KIDD	630	
	KMBY	1240	C
Montevideo, Minn.	KDMA	1450	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
	CJAD	800	
	CJMS	1280	
	CKAC	730	C
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.	WIOK	1580	
Mt. Jackson, Va.	WSIG	790	
Mt. Kisco, N.Y.	WVIP	1310	
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	
	KZOL	1570	
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, Tenn.	WKDA	1240	
	WLAC	1510	C
	WMAK	1300	
	WNAH	1360	M
	WSIX	980	A
	WSM	650	N
	WVOL	1470	
Natchez, Miss.	WMIS	1240	N
	WNAT	1450	M
Natchitoches, La.	KNOC	1450	M
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.	WLRP	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 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	
Newcastle, N.B.	CKMR	790	
New Castle, Pa.	WKST	1280	M
Newcastle, Wyo.	KASL	1240	
New Glasgow, N.S.	CKEC	1230	
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
	WYFE	600	
	WYLD	940	M
Newport, Ark.	KNBY	1280	
Newport, Ky.	WNOP	740	
Newport, Oreg.	KNPT	1310	
Newport, R.I.	WADK	1540	
Newport, Tenn.	WLIK	1270	
Newport, Vt.	WIKE	1490	
Newport News, Va.	WGH	1310	A
	WYUO	1270	
New Rochelle, N.Y.	WVOX	1460	
New Smyrna Beach, Fla.	WSBB	1230	M
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
	WOV	1280	
	WPOW	1330	
	WQXR	1560	
	WRCA	660	N
Niagara Falls, N.Y.	WHLD	1270	
	WJJL	1440	
Niagara Falls, Ont.	CHVC	1600	
Niles, Mich.	WNIL	1290	
Nogales, Ariz.	KNOG	1340	A
Norfolk, Nebr.	WJAG	780	
Norfolk, Va.	WTAR	790	C
	WCMS	1050	
	WNOR	1230	
	WRAP	850	
Norman, Okla.	WNAD	640	
	KNOR	1400	
Norristown, Pa.	WNAR	1110	
N. Adams, Mass.	WMNB	1230	
N. Augusta, S.C.	WGUS	1600	
N. Battleford, Sask.	CJNB	1460	
North Bay, Ont.	CFCH	600	
North Bend, Oreg.	KFIR	1340	C
Northfield, Minn.	WCAL	770	
Northampton, Mass.	WHMP	1400	M

Location	C.L.	Kc.	N.A.
N. Little Rock, Ark.	KNLR	1380	
	KXLR	1150	
	KVLC	1050	
North Platte, Nebr.	KJLT	970	
	KODY	1240	N
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	
Oak Grove, La.	KWCL	1280	
Oak Hill, W.Va.	WOAY	860	
Oakland, Calif.	KEWB	910	
	KABL	960	
	KWBR	1310	
Oak Park, Ill.	WOPA	1490	
Oak Ridge, Tenn.	WATO	1290	
Oakville, Ont.	CHWO	1250	
Ocala, Fla.	WMOP	900	
	WTMC	1290	N
	WHYS	1370	
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
	KKOG	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	N
	KTOK	1000	C
	KTOW	800	
	WKY	930	
Okmulgee, Okla.	KHBG	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	
	KOWH	660	
	KSWI	1560	M-A
	WOW	590	C
Omak, Wash.	KOMW	680	
Oneida, N.Y.	WONG	1600	
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	
Oregon City, Oreg.	KGON	1520	N
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	1450	
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
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	
Paragould, Ark.	KDRS	1490	
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
	WCOM	1230	A
Park Falls, Wis.	WPFP	1450	
Parsons, Kans.	KLKC	1540	
Pasadena, Calif.	KALI	1430	
	KPPC	1240	
	KXLA	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
Pensacola, Fla.	WBOP	980	
	WBSR	1450	C
	WNVY	1230	A
	WCOA	1370	N
	WPFA	790	
Penticton, B.C.	CKOK	800	
Peoria, Ill.	WEEK	1350	N
	WMBD	1470	C
	WIRL	1290	M
	WPEO	1020	
Perry, Fla.	WPRY	1400	
Perry, Ga.	WBBN	980	
Perryton, Tex.	KEYE	1400	M
Peru, Ind.	WARU	1600	
Petaluma, Calif.	KAFP	1490	
Peterborough, Ont.	CHEX	980	
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	M
	WJMJ	1540	
	WPEN	950	
	WRCV	1060	N
	WTEL	860	
Philipsburg, Pa.	WPHB	1260	
Phoenix, Ariz.	KIFN	860	
	KONI	1400	
	KHAT	1480	
	KHEP	1280	
	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	
	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	
	WAMP	1320	N
	WPIT	730	
	WWSW	970	
Pittsfield, Ill.	WBBA	1580	
Pittsfield, Mass.	WBEC	1420	A
	WBRK	1340	M
Pittston, Pa.	WPTS	1540	
Plainview, Tex.	KVOP	1400	M
Plant City, Fla.	WPLA	910	
Platteville, Wis.	WSWW	1590	
Plattsburg, N.Y.	WEAV	960	A
	WIRY	1340	M
Pleasanton, Tex.	KBOP	1380	
Pleasantville, N.J.	WOND	1400	
Plymouth, Mass.	WPLM	1390	
Plymouth, Wis.	WPLY	1420	
Pocahontas, Ark.	KPOC	1420	
Pocatello, Idaho	KSEI	930	N
	KWIK	1240	M
	KYTE	1290	
Pocomoke City, Md.	WDVM	540	
Pomona, Calif.	KWOW	1600	
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, Wis.	WPDR	1350	
Portage la Prairie, Man.	CFRY	1570	
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	
	KLIQ	1290	
	KEX	1190	
	KGW	620	
	KOIN	970	C
	KPAM	1410	
	KPDQ	800	
	KPOJ	1330	M
	KWJJ	1080	A
	KXL	750	
Portsmouth, N.H.	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
	KZOK	1340	
Presque Isle, Me.	WAGM	1450	
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	M
	WHIM	1110	
	WICE	1290	
	WJAR	920	N
	WPRO	630	C
	WRIB	1220	
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	
Pulaski, Tenn.	WKSR	1420	A
Pulaski, Va.	WPUV	1580	
Pullman, Wash.	KWSC	1250	
	KOFE	1150	
Punxsutawney, Pa.	WPME	1540	
Putnam, Conn.	WPCT	1350	
Puyallup, Wash.	KAYE	1450	
Quanah, Tex.	KOLJ	1150	
Quebec, Que.	CBV	980	
	CHRC	800	
	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
Radcliff, Ky.	WSAC	1470	
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	
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.	KCLP	990	
Reading, Pa.	WEEU	850	A
	WHUM	1240	C
	WRAW	1340	N
Redding, Calif.	KRDG	1230	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	
Regina, Sask.	CBK	540	
	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	
	KDDT	1230	
Renton, Wash.	KQDE	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
	WLLY	1320	
	WMBG	1380	A
	WRNL	910	M
	WRVA	1140	C
	WXGI	950	
Richmond Hill, Ont.	CJRH	1310	
Richwood, W.Va.	WMNF	1280	
Ridgecrest, Calif.	KRCK	1360	
	KRKS	1240	
Rimouski, Que.	CJBR	900	
Rio Piedras, P.R.	WRIO	1320	
	WWWW	1520	
Ripley, Tenn.	WTRB	1570	
Ripon, Wis.	WCWC	1600	
Riverhead, N.Y.	WRIV	1390	
Riverside, Calif.	KPRO	1440	
	KACE	1570	
Riverton, Wyo.	KWRL	1450	M
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
	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
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	
Rocky Mount, Va.	WYTI	1570	

Location	C.L.	Kc.	N.A.
Rogers, Ark.	KAMO	1390	
Rogers City, Mich.	WHAK	960	
Rogersville, Tenn.	WRGS	1370	
Rolla, Mo.	KTTR	1490	
Rome, Ga.	WLAQ	1410	A
	WRGA	1470	M
	WROM	710	
Rome, N.Y.	WKAL	1450	A
Ronceverte, W.Va.	WRON	1400	
Roseburg, Oreg.	KRNR	1490	C
	KRXL	1240	A
Rosenberg, Tex.	KFRO	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	
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
	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	
Ste. Anne de la Pocatiere, Que.	CHGB	1350	
St. Augustine, Fla.	WFOY	1240	C
	WSTN	1420	
St. Boniface, Man.	CKSB	1050	
St. Catharine, Ont.	CKTB	610	
St. Charles, Mo.	KADY	1460	
St. Cloud, Minn.	KFAM	1450	N
	WJON	1240	
St. George, Utah	KDXU	1450	
St. Helen, Mich.	WCBQ	1590	
St. Jean, Que.	CHRS	1090	
St. Jerome, Que.	CKJL	900	
Saint John, N.B.	CFBC	930	
	CHSJ	1150	
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. Mary's, Pa.	WKBI	1400	
St. Paul, Minn.	KSTP	1500	N
	WISK	1590	M
St. Peter, Minn.	KRBI	1310	
St. Petersburg, Fla.	WPIN	680	
	WSUN	620	A
	WTSP	1380	M
St. Petersburg Beach, Fla.	WILZ	1590	
St. Thomas, Ont.	CHLO	680	
Ste. Genevieve, Mo.	KSGM	980	
Salamanca, N.Y.	WNYS	1590	
Salem, Ill.	WJBD	1350	
Salem, Ind.	WSLM	1220	
Salem, Mass.	WESX	1230	
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	
	WJDY	1470	
Salisbury, N.C.	WSTP	1490	M
	WSAT	1280	A
Salt Lake City, Utah	KALL	910	M
	KDYL	1320	N
	KLUB	570	A
	KNAK	1280	
	KSL	1160	C
	KSOP	1370	
	KWHO	860	
	KWIC	1570	
San Angelo, Tex.	KTXL	1340	
	KGKL	960	A
	KPEP	1420	
	KWFR	1260	
San Antonio, Tex.	KCOR	1350	
	KENS	680	C
	KARS	1250	
	KITE	930	
	KUBO	1540	
	KMAC	630	A
	KONO	860	
	KTSA	550	
	WOAI	1200	
San Bernardino, Calif.	KCKC	1350	
	KFXM	590	M
	KRNO	1240	
	KITO	1290	A
Sandersville, Ga.	WSNT	1490	
San Diego, Calif.	KCBQ	1170	
	KFMB	540	C
	KFSO	600	N
	KGB	1360	A
	KSON	1240	
	KSOO	1130	
Sandpoint, Idaho	KSPT	1400	
Sandusky, Ohio	WLEC	1450	M
San Fernando, Calif.	KGIL	1260	
Sanford, Fla.	WTRR	1400	
	WIOD	1360	
Sanford, Me.	WSME	1220	
Sanford, N.C.	WEYE	1290	
	WWGP	1050	
San Francisco, Cal.	KFRC	610	M
	KCBS	740	C
	KJBS	1100	
	KNBC	680	N
	KOBY	1550	
	KSAY	1010	
	KSAN	1450	
	KSFO	560	
	KYA	1260	
San Jose, Calif.	KLOK	1170	
	KSJO	1590	
	KEEN	1370	
	KXRX	1500	
San Juan, P.R.	WAPA	680	M
	WHOA	1400	
	WIPR	940	
	WKAQ	580	C
	WKVM	1230	
	WITA	1140	
San Luis Obispo, Calif.	KATY	1340	
	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	
	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	
Santurce, P.R.	WIAC	740	
	WKAQ	580	C
Saranac Lake, N.Y.	WNBZ	1240	A
Sarasota, Fla.	WKXY	930	
	WSPB	1450	C
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	
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
Seaford, Del.	WSUX	1280	
Seattle, Wash.	KAYO	1150	
	KING	1090	A
	KIRO	710	C
	KJR	950	
	KOL	1300	
	KOMO	1000	N
	KTIX	1590	
	KTW	1250	
	KXA	770	
Searcy, Ark.	KWCB	1300	
Sebring, Fla.	WJCM	960	
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.	KEVA	1580	
Sharon, Pa.	WPIC	790	
Shawano, Wis.	WTCH	960	
Shawinigan Falls, 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	
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	
	KCIJ	1050	
	KEEL	710	
	KENT	1550	M
	KJOE	1480	
	KOKA	980	
	KRMO	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
Silver City, N.Mex.	KSIL	1340	C
Silver Sprgs., Md.	WGAY	1050	
Simcoe, Ont.	CFRS	1560	
Sinton, Tex.	KANN	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
South Daytona Beach, Florida	WDAT	1590	
So. Paris, Me.	WKTQ	1450	
So. Pittsburg, Tenn.	WEPG	910	
So. St. Paul, Minn.	WISK	630	M
So. Williamsport, Pa.	WMPT	1450	
Sparta, Ill.	WHCO	1230	
Sparta, Tenn.	WSMT	1050	
Sparta, Wis.	WCOW	1290	
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	
	KXLY	920	C
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	1400	
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	
	KRAK	1140	
	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
Sturgeon Bay, Wis.	WDOR	910	
Sturgis, Mich.	WSTR	1230	
Stuttgart, Ark.	KWAK	1240	M
Sudbury, Ont.	CKSO	790	
	CFBR	550	
	CHNO	900	
Suffolk, Va.	WLPM	1450	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
	WSSC	1340	A
Sunbury, Pa.	WKOK	1240	C
Sunnyside, Wash.	KREW	1230	
Superior, Wis.	WDSM	710	N
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	A
	WNDR	1260	M
	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	
Tallassee, Ala.	WTLS	1300	
	WTAL	1270	
	WTNT	1450	A-M-C
Tallulah, La.	KTLD	1360	
Tampa, Fla.	WALT	1110	
	WDAE	1250	C
	WFLA	970	N
	WHBO	1050	
	WTMP	1150	
	WSOL	1300	
Tarboro, N.C.	WCPS	760	
Tarpon Sprgs., Fla.	WDCL	1470	
Tasley, Va.	WESR	1330	
Taunton, Mass.	WPEP	1570	
Taylor, Tex.	KTAE	1260	
Taylorville, Ill.	WTIM	1410	
Tell City, Ind.	WTCJ	1230	
Temple, Tex.	KTEM	1400	
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	

Location	C.L.	Kc.	N.A.
Tifton, Ga.	WTIF	1340	
	WWGS	1430	
Tillamook, Oreg.	KTIL	1590	
Tillsonburg, Ont.	CKOT	1510	
Timmins, Ont.	CFCL	580	
	CKGB	680	
Titusville, Fla.	WRMF	1050	
Toccoa, Ga.	WLET	1420	M
	WNEG	1320	
Toledo, Ohio	WOHO	1470	M
	WSPD	1370	N
	WTOD	1560	C
	WTOL	1230	A
Tooele, Utah	KTUT	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	
Towson, Md.	WAQE	1570	
Trail, B.C.	CJAT	610	
Traverse City, Mich.	WTCM	1400	
Trenton, Mo.	KTTN	1600	
Trenton, N.J.	WTNJ	1300	
	WBUD	1260	
	WTTM	920	N
Trinidad, Colo.	KCRT	1240	M
Troy, Ala.	WTBF	970	M
Troy, N.Y.	WHAZ	1330	
	WTRY	980	
Truro, N.S.	CKCL	600	
Truth or Consequences, New Mexico	KCHS	1400	
Tryon, N.C.	WTYN	1580	
Tucson, Ariz.	KTUC	1400	A
	KAIR	1490	
	KCEE	790	
	KTAN	580	A
	KCUB	1290	N
	KEVT	690	
	KMOP	1330	
	KTKT	990	
	KOLD	1450	C
Tucumcari, N.Mex.	KTNM	1400	M
Tulare, Calif.	KCOK	1270	M
	KGEN	1370	
Tularosa, N.M.	KMAM	1590	
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	1490	M
	WTUP	1380	A
Turlock, Calif.	KTUR	1390	
Tuscaloosa, Ala.	WJRD	1150	
	WACT	1420	
	WNPT	1280	A
	WTUG	790	
	WTBC	1230	M
Tuscumbia, Ala.	WVNA	1590	
Tuskegee, Ala.	WABT	580	
Twin Falls, Idaho	KTFI	1270	N
	KLIX	1310	M
	KEEP	1450	
Two Rivers, Wis.	WTRW	1590	
Tyler, Tex.	KDOK	1330	
	KGJB	1490	M
	KTBB	600	A
	KZEY	690	
Tyrone, Pa.	WTRN	1290	
Ukiah, Calif.	KUKI	1400	
Union, Mo.	KLPW	1220	
Union, S.C.	WBCU	1460	
Union City, Tenn.	WENK	1240	
	WTUC	1580	
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	
Vallejo, Calif.	KNBA	1190	
Valley City, N.Dak.	KOVC	1490	M
Valparaiso-Niceville, Fla.	WNSM	1340	
Van Buren, Ark.	KFDF	1580	
Van Wert, Ohio	WERT	1220	
Vanceburg, Ky.	WKKS	1570	
Vancleve, Ky.	WMTC	730	
Vancouver, B.C.	CBU	690	
	CFUN	1410	
	CJOR	600	
	CKWX	1130	M
Vancouver, Wash.	KKEY	1150	
	KISN	910	
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	
	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	1250	
Vincennes, Ind.	WAOV	1450	M
Vineland, N.J.	WWBZ	1360	
Vinita, Okla.	KVIN	1470	
Virginia, Minn.	WHLB	1400	N
Virginia Bch., Va.	WBOF	1600	
Virouqua, Wis.	WISV	1360	
Visalia, Calif.	KONG	1400	
Vivian, La.	KLVI	1600	
Waco, Tex.	WACO	1460	A
	KWTX	1230	M
Wadena, Minn.	KWAO	920	M
Wadesboro, N.C.	WADE	1210	
Wailuku, Hawaii	KMVI	550	N
Waipahu, Hawaii	KAHU	920	
	KAHU	920	
Wallace, Idaho	KWAL	620	M
Wallace, N.C.	WLSE	1400	
Walla Walla, Wash.	KHIT	1320	
	KUJ	1420	M
	KTEL	1490	A
Walnut Ridge, Ark.	KRLW	1320	
Walsenburg, Colo.	KFLJ	1380	
Walterboro, S.C.	WALD	1220	M
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	
	WKTF	1420	
Warsaw, Ind.	WRSW	1480	
Warsaw, Va.	WNNT	690	
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	
Washington, N.C.	WOOW	1340	
	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	
	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	
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	
Weirton, W.Va.	WEIR	1430	
Weiser, Idaho	KWEI	1260	
Welch, W.Va.	WELC	1150	
	WOVE	1340	M
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
Weslaco, Tex.	KRGV	1290	N
W. Bend, Wis.	WBKV	1470	
W. Frankfort, Ill.	WFRX	1300	
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
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	1450	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	
Whitehorse, Y.T.	CFWH	1240	
Whitesburg, Ky.	WTCW	920	
Whiteville, N.C.	WENC	1220	
Wichita, Kans.	KAKE	1240	M
	KLEO	1480	N
	KFBI	1070	
	KFH	1330	C
	KSIR	900	
	KWBB	1410	
Wichita Falls, Tex.	KSYD	990	M
	KTRN	1290	
	KWFT	620	C
Wildwood, N.J.	WCMC	1230	
Wilkes-Barre, Pa.	WBAX	1240	M
	WBRE	1340	N
	WILK	980	A
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
	WVOT	1420	M
Winchester, Ky.	WWKY	1380	
Winchester, Tenn.	WCDT	1340	
Winchester, Va.	WINC	1400	A
Winder, Ga.	WIMO	1300	
Windom, Minn.	KDOM	1580	
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	
Wisconsin Rapids, Wis.	WFHR	1340	M
Wolf Pt., Mont.	KVCK	1450	M
Woodside, N.Y.	WWRL	1600	
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.	KWDA	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	
	KVOY	1400	A
	KYUM	560	N
Zanesville, Ohio	WHIZ	1240	N
Zarephath, N.J.	WAWZ	1380	

U. S. and Canadian AM Stations by Call Letters

Canadian stations follow U.S. list, on p. 185

C.L., call letters; Kc., frequency in kilocycles

U. S.

C.L.	Location	Kc.
KAAA	Kingman, Ariz.	1230
KAAB	Hot Springs, Ark.	1350
KABC	Los Angeles, Calif.	790
KABL	Oakland, Calif.	960
KABQ	Albuquerque, N.M.	1350
KABR	Aberdeen, S. Dak.	1220
KABY	Albany, Oreg.	990
KACE	Riverside, Calif.	1570
KACI	The Dalles, Oreg.	1300
KACT	Andrews, Tex.	1360
KACY	Port Hueneme, Calif.	1520
KADA	Ada, Okla.	1230
KADO	Marshall, Tex.	1410
KADY	St. Charles, Mo.	1460
KAFP	Petaluma, Calif.	1490
KAFY	Bakersfield, Calif.	550
KAGE	Winona, Minn.	1380
KAGH	Crossett, Ark.	800
KAGI	Grants Pass, Oreg.	1340
KAGT	Anacortes, Wash.	1340
KAGR	Yuba City, Calif.	1450
KAHI	Auburn, Calif.	950
KAHU	Waipahu, Hawaii	920
KAIM	Kaimuki, Hawaii	870
KAIR	Tucson, Ariz.	1490
KAJO	Grants Pass, Oreg.	1270
KAKC	Tulsa, Okla.	970
KAKE	Wichita, Kan.	1240
KALB	Alexandria, La.	580
KALE	Richland, Wash.	960
KALG	Alamogordo, N.Mex.	1230
KALI	Pasadena, Calif.	1430
KALL	Salt Lake City, Utah	910
KALM	Thayer, Mo.	1290
KALT	Atlanta, Tex.	900
KALV	Alva, Okla.	1430
KAMD	Camden, Ark.	910
KAML	Kenedy, Tex.	990
KAMO	Rogers, Ark.	1390
KAMP	El Centro, Calif.	1430
KAMQ	Amarillo, Tex.	1010
KANA	Anaconda, Mont.	1230
KANB	Shreveport, La.	1300
KAND	Corsicana, Tex.	1340
KANE	New Iberia, La.	1240
KANI	Kailua, Oahu, Hawaii	1240
KANN	Sinton, Tex.	1590
KANO	Anoka, Minn.	1470
KANS	Independence, Mo.	1510
KANV	Jonesville, La.	1480
KAOK	Lake Charles, La.	1400
KAPA	Raymond, Wash.	1340
KAPB	Marksville, La.	1370
KAPI	Pueblo, Colo.	690

C.L.	Location	Kc.
KAPR	Douglas, Ariz.	930
KARE	Atchison, Kan.	1470
KARK	Little Rock, Ark.	920
KARM	Fresno, Calif.	1430
KARS	San Antonio, Tex.	1250
KART	Jerome, Idaho	1400
KARY	Prosser, Wash.	1310
KASA	Elk City, Okla.	1240
KASH	Eugene, Ore.	1600
KASI	Ames, Iowa	1430
KASK	Ontario, Calif.	1510
KASL	Newcastle, Wyo.	1240
KASM	Albany, Minn.	1150
KASO	Minden, La.	1240
KAST	Astoria, Ore.	1370
KASY	Auburn, Wash.	1220
KATE	Albert Lea, Minn.	1450
KATI	Casper, Wyo.	1400
KATL	Miles City, Mont.	1340
KATR	Corpus Christi, Tex.	1030
KATY	San Luis Obispo, Cal.	1340
KATZ	St. Louis, Mo.	1600
KAUS	Austin, Minn.	1480
KAVE	Carlsbad, N.Mex.	1240
KAVI	Rocky Ford, Colo.	1320
KAVL	Lancaster, Calif.	610
KAVR	Apple Valley, Calif.	960
KAWL	York, Neb.	1370
KAWT	Douglas, Ariz.	1450
KAYE	Puyallup, Wash.	1450
KAYL	Storm Lake, Iowa	990
KAYO	Seattle, Wash.	1150
KAYS	Hays, Kans.	1400
KAYT	Rupert, Idaho	970
KBAL	San Saba, Tex.	1410
KBAM	Longview, Wash.	1270
KBAR	Burley, Idaho	1230
KBBA	Benton, Ark.	690
KBBB	Borger, Tex.	1600
KBBC	Centerville, Utah	1600
KBBS	Buffalo, Wyo.	1450
KBCH	Oceanlake, Oreg.	1380
KBCL	Bossier City, La.	1220
KBEC	Waxahachie, Tex.	1390
KBEE	Modesto, Calif.	970
KBEL	Idabel, Okla.	1240
KBEN	Carrizo Sprgs., Tex.	1450
KBET	Reno, Nev.	1340
KBHM	Branson, Mo.	1220
KBHS	Hot Springs, Ark.	590
KBIA	Columbia, Mo.	1580
KBIF	Fresno, Calif.	900
KBIG	Avalon, Calif.	740
KBIM	Roswell, N.Mex.	910
KBIS	Bakersfield, Calif.	970
KBIX	Muskogee, Okla.	1490
KBIZ	Ottumwa, Iowa	1240
KBKC	Mission, Kans.	1480
KBKR	Baker, Oreg.	1490
KBKW	Aberdeen, Wash.	1450
KBLA	Burbank, Calif.	1490
KBLF	Red Bluff, Calif.	1490
KBLI	Blackfoot, Idaho	690
KBLO	Hot Springs, Ark.	1470
KBLR	Goodland, Kans.	730
KBLT	Big Lake, Tex.	1290
KBMI	Henderson, Nev.	1400
KBMN	Bozeman, Mont.	1230
KBMO	Benson, Minn.	1290
KBMW	Breckinrdg., Minn.	1450
KBMX	Coalinga, Calif.	1470
KBMY	Billings, Mont.	1240
KBND	Bend, Oreg.	1110
KBNZ	LaJunta, Colo.	1400
KBOA	Kennett, Mo.	830
KBOE	Oskaloosa, Iowa	740
KBOI	Boise, Idaho	950
KBOK	Malvern, Ark.	1310
KBOL	Boulder, Colo.	1490
KBOM	Mandan, N.Dak.	1270
KBON	Omaha, Nebr.	1490
KBOP	Pleasanton, Tex.	1380
KBOR	Brownsville, Tex.	1600
KBOW	Butte, Mont.	1490
KBOY	Medford, Oreg.	730
KBOX	Dallas, Tex.	1480
KBPS	Portland, Oreg.	1450
KBRC	Mt. Vernon, Wash.	1430
KBRK	Brookings, S.Dak.	1430
KBRL	McCook, Nebr.	1300
KBRO	Bremerton, Wash.	1490
KBRS	Springdale, Ark.	1340
KBRV	Soda Sprgs., Ida.	540
KBRX	O'Neill, Nebr.	1350
KBRZ	Freeport, Texas	1460
KBSF	Springhill, La.	1460
KBST	Big Spring, Tex.	1490
KBTA	Batesville, Ark.	1340
KBTK	Missoula, Mont.	1340
KBTM	Jonesboro, Ark.	1230
KBTN	Neosho, Mo.	1420
KBTO	El Dorado, Kans.	1360
KBUC	Corona, Calif.	1370
KBUD	Athens, Tex.	1410
KBUH	Brigham City, Utah	800
KBUN	Bemidji, Minn.	1450
KBUR	Burlington, Iowa	1490
KBUS	Mexia, Tex.	1590
KBUZ	Mesa, Ariz.	1310
KBVM	Lancaster, Calif.	1380
KBWD	Brownwood, Tex.	1380
KBYE	Okla. City, Okla.	890
KBYG	Big Spring, Tex.	1400
KBYR	Anchorage, Alaska	1270

C.L.	Location	Kc.
KBZY	Salem, Oreg.	1490
KCAL	Redlands, Calif.	1410
KCAP	Helena, Mont.	1340
KCAR	Clarksville, Tex.	1350
KCBC	Des Moines, Iowa	1390
KCBD	Lubbock, Tex.	1590
KCBQ	San Diego, Calif.	1170
KCBS	San Fran., Calif.	740
KCCO	Lawton, Okla.	1050
KCCR	Pierre, S.Dak.	1590
KCCT	Corpus Christi, Tex.	1150
KCEE	Tucson, Ariz.	790
KCFA	Spokane, Wash.	1330
KCFH	Cuero, Tex.	1600
KCHA	Charles City, Iowa	1580
KCHE	Cherokee, Iowa	1440
KCHI	Chillicothe, Mo.	1010
KCHJ	Delano, Calif.	1010
KCHR	Charleston, Mo.	1350
KCHS	Truth or Consequences, New Mexico	1400
KCHV	Coachella, Calif.	970
KCID	Caldwell, Idaho	1490
KCIJ	Shreveport, La.	1050
KCIL	Houma, La.	1490
KCIM	Carroll, Iowa	1380
KCJB	Minot, N.Dak.	910
KCKC	San Bernardino, Cal.	1350
KCKN	Kansas City, Kans.	1340
KCKY	Coolidge, Ariz.	1150
KCLA	Pine Bluff, Ark.	1400
KCLE	Cleburne, Tex.	1120
KCLF	Clifton, Ariz.	1400
KCLN	Clinton, Iowa	1390
KCLO	Leavenworth, Kans.	1410
KCLP	Rayville, La.	990
KCLS	Flagstaff, Ariz.	600
KCLV	Clovis, N.Mex.	1240
KCLW	Hamilton, Tex.	900
KVLX	Colfax, Wash.	1450
KCMC	Texarkana, Tex.	1230
KCMJ	Palm Sprgs., Calif.	1010
KCMO	Kansas City, Mo.	810
KCMR	McCamey, Tex.	1450
KCMS	Manitou Sprgs., Colo.	1490
KCNI	Broken Bow, Nebr.	1280
KCNO	Alturas, Calif.	570
KCNY	San Marcos, Tex.	1470
KCOB	Newton, Iowa	1280
KCOG	Centerville, Iowa	1400
KCOH	Houston, Tex.	1430
KCOK	Tulare, Calif.	1270
KCOL	Ft. Collins, Colo.	1410
KCON	Conway, Ark.	1230
KCOR	San Antonio, Tex.	1350
KCOW	Alliance, Nebr.	1400
KCOY	Santa Maria, Calif.	1400
KCRA	Sacramento, Calif.	1320
KCRB	Chanute, Kans.	1460
KCRC	Enid, Okla.	1390
KCRE	Crescent City, Calif.	1240
KCRG	Cedar Rapids, Iowa	1600
KCRS	Midland, Tex.	550
KCRT	Trinidad, Colo.	1240
KCRV	Caruthersville, Mo.	1370
KCSJ	Pueblo, Colo.	590
KCSR	Chadron, Nebr.	1450
KCTI	Gonzales, Tex.	1450
KCTX	Childress, Tex.	1510
KCUB	Tucson, Ariz.	1290
KCUE	Red Wing, Minn.	1250
KCUL	Fort Worth, Tex.	1540
KCVL	Colville, Wash.	1270
KCVR	Lodi, Calif.	1570
KCYL	Lampasas, Tex.	1450
KDAC	Ft. Bragg, Calif.	1230
KDAL	Duluth, Minn.	610
KDAN	Eureka, Calif.	790
KDAV	Lubbock, Tex.	580
KDAY	Santa Monica, Calif.	1580
KDB	Santa Barbara, Calif.	1490
KDBC	Mansfield, La.	1360
KDBM	Dillon, Mont.	800
KDBS	Alexandria, La.	1410
KDDD	Dumas, Tex.	800
KDEC	Decorah, Iowa	1240
KDEF	Albuquerque, N.Mex.	1150
KDEN	Denver, Colo.	1340
KDEO	El Cajon, Calif.	910
KDES	Palm Sprgs., Calif.	920
KDET	Center, Tex.	930
KDEX	Dexter, Mo.	1590
KDGO	Durango, Colo.	1240
KDHL	Faribault, Minn.	920
KDIO	Ortonville, Minn.	1350
KDIX	Dickinson, N.Dak.	1230
KDJI	Holbrook, Ariz.	1270
KDKA	Pittsburgh, Pa.	1020
KDKD	Clinton, Mo.	1280
KDLA	DeRidder, La.	1010
KDLK	Del Rio, Tex.	1230
KDLM	Detroit Lakes, Minn.	1340
KDLR	Devils Lake, N.Dak.	1240
KDMA	Montevideo, Minn.	1450
KDMO	Carthage, Mo.	1490
KDMS	El Dorado, Ark.	1290
KDNT	Denton, Tex.	1440
KDOK	Tyler, Tex.	1330
KDOM	Windom, Minn.	1580
KDON	Salinas, Calif.	1460
KDOT	Reno, Nev.	1230
KDQN	DeQueen, Ark.	1390
KDRO	Sedalia, Mo.	1490
KDRS	Paragould, Ark.	1490
KDSJ	Deadwood, S.Dak.	980
KDSN	Denison, Iowa	1580
KDSX	Denison, Tex.	950

C.L.	Location	Kc.
KDTA	Delta, Colo.	1400
KDTH	Dubuque, Iowa	1370
KDUB	Lubbock, Tex.	1340
KDUZ	Hutchinson, Minn.	1260
KDWT	Stamford, Tex.	1400
KDXU	St. George, Utah	1450
KDYL	Salt Lake City, Utah	1320
KDZA	Pueblo, Colo.	1230
KEAN	Brownwood, Tex.	1240
KEAP	Fresno, Calif.	980
KEBE	Jacksonville, Tex.	1400
KECK	Odessa, Tex.	920
KEDO	Longview, Wash.	1400
KEED	Springfield, Oreg.	1050
KEEE	Nacogdoches, Tex.	1230
KEEL	Shreveport, La.	710
KEEN	San Jose, Calif.	1370
KEEP	Twin Falls, Idaho	1450
KELA	Centralia, Wash.	1470
KELD	El Dorado, Ark.	1400
KELK	Elko, Nev.	1240
KELO	Sioux Falls, S.Dak.	1320
KELP	El Paso, Tex.	920
KENA	Mena, Ark.	1450
KENE	Toppenish, Wash.	1490
KENI	Anchorage, Alaska	550
KENL	Arcata, Calif.	1340
KENM	Portales, N.Mex.	1450
KENN	Farmington, N.M.	1390
KENO	Las Vegas, Nev.	1460
KENS	San Antonio, Tex.	680
KENT	Shreveport, La.	1550
KENY	Bellingham-Ferndale, Wash.	930
KEOK	Payette, Idaho	1450
KEOS	Flagstaff, Ariz.	1290
KEPR	Kennewick, Wash.	610
KEPS	Eagle Pass, Tex.	1270
KERB	Kermit, Tex.	600
KERC	Eastland, Tex.	1590
KERG	Eugene, Oreg.	1280
KERN	Bakersfield, Calif.	1410
KERV	Kerrville, Tex.	1230
KETX	Livingston, Tex.	1440
KEUN	Eunice, La.	1490
KEVA	Shamrock, Tex.	1580
KEVE	Minneapolis, Minn.	1440
KEVL	White Castle, La.	1590
KEVT	Tucson, Ariz.	690
KEWB	Oakland, Calif.	910
KEX	Portland, Oreg.	1190
KEXO	Grand Junc., Colo.	1230
KEYE	Perryton, Tex.	1400
KEYJ	Jamestown, N.Dak.	1400
KEYS	Corpus Christi, Tex.	1440
KEYY	Provo, Utah	1450
KEYZ	Williston, N.Dak.	1360
KFAB	Omaha, Nebr.	1110
KFAC	Los Angeles, Calif.	1330
KFAL	Fulton, Mo.	900
KFAM	St. Cloud, Minn.	1450
KFAR	Fairbanks, Alaska	660
KFAY	Fayetteville, Ark.	1250
KFBB	Great Falls, Mont.	1310
KFBC	Cheyenne, Wyo.	1240
KFBI	Wichita, Kans.	1070
KFBK	Sacramento, Calif.	1530
KFDA	Amarillo, Tex.	1440
KFDF	Van Buren, Ark.	1580
KFDM	Beaumont, Tex.	560
KFDR	Grand Coulee, Wash.	1360
KFEL	Pueblo, Colo.	970
KFEQ	St. Joseph, Mo.	680
KFFA	Helena, Ark.	1360
KFGQ	Boone, Iowa	1260
KFH	Wichita, Kans.	1330
KFI	Los Angeles, Calif.	640
KFIR	North Bend, Oreg.	1340
KFIV	Modesto, Calif.	1360
KFIZ	Fond du Lac, Wis.	1450
KFJB	Marshalltown, Iowa	1230
KFJI	Klamath Falls, Oreg.	1150
KFJM	Grand Forks, N.Dak	1370
KFJZ	Ft. Worth, Tex.	1270
KFKA	Greeley, Colo.	1310
KFKF	Bellevue, Wash.	1330
KFKU	Lawrence, Kans.	1250
KFLD	Floydada, Tex.	900
KFLJ	Walsenburg, Colo.	1380
KFLW	Klamath Falls, Oreg.	1450
KFLY	Corvallis, Oreg.	1240
KFMA	Davenport, Iowa	1580
KFMB	San Diego, Calif.	540
KFMJ	Tulsa, Okla.	1050
KFML	Denver, Colo.	1390
KFMO	Flat River, Mo.	1240
KFNF	Shenandoah, Iowa	920
KFNV	Ferriday, La.	1600
KFNW	Fargo, N.Dak.	900
KFOR	Lincoln, Nebr.	1240
KFOX	Long Beach, Calif.	1280
KFPW	Ft. Smith, Ark.	1230
KFQD	Anchorage, Alaska	730
KFRB	Fairbanks, Alaska	900
KFRC	San Francisco, Calif.	610
KFRD	Rosenberg, Tex.	980
KFRE	Fresno, Calif.	940
KFRM	Kansas City, Mo.	550
KFRO	Longview, Tex.	1370
KFRU	Columbia, Mo.	1400
KFSA	Ft. Smith, Ark.	950
KFSB	Joplin, Mo.	1310
KFSC	Denver, Colo.	1220
KFSD	San Diego, Calif.	600
KFSG	Los Angeles, Calif.	1150
KFST	Ft. Stockton, Tex.	860
KFTM	Ft. Morgan, Colo.	1400

C.L.	Location	Kc.
KFTV	Paris, Tex.	1250
KFUN	Las Vegas, N.Mex.	1230
KFUO	St. Louis, Mo.	850
KFVS	Cape Girardeau, Mo.	960
KFWB	Los Angeles, Calif.	980
KFXD	Nampa, Idaho	580
KFXM	San Bernardino, Calif.	590
KFYN	Bonham, Tex.	1420
KFYO	Lubbock, Tex.	790
KFYR	Bismarck, N.Dak.	550
KGA	Spokane, Wash.	1510
KGAF	Gainesville, Tex.	1580
KGAK	Gallup, N.Mex.	1330
KGAL	Lebanon, Oreg.	920
KGAN	Bastrop, La.	1340
KGAS	Carthage, Tex.	1590
KGAY	Salem, Oreg.	1430
KGB	San Diego, Calif.	1360
KGBC	Galveston, Tex.	1540
KGBT	Harlingen, Tex.	1530
KGBX	Springfield, Mo.	1260
KGCX	Sidney, Mont.	1480
KGDN	Edmonds, Wash.	630
KGEE	Bakersfield, Calif.	1230
KGEK	Sterling, Colo.	1230
KGEM	Boise, Idaho	1140
KGEN	Tulare, Calif.	1370
KGER	Long Beach, Calif.	1390
KGEZ	Kalispell, Mont.	600
KGFF	Shawnee, Okla.	1450
KGFJ	Los Angeles, Calif.	1230
KGFL	Roswell, N.Mex.	1400
KGFW	Kearney, Nebr.	1340
KGFX	Pierre, S.Dak.	630
KGGF	Coffeyville, Kans.	690
KGGM	Albuquerque, N.Mex.	610
KGHF	Pueblo, Colo.	1350
KGHI	Little Rock, Ark.	1250
KGHL	Billings, Mont.	790
KGHM	Brookfield, Mo.	1470
KGIL	San Fernando, Calif.	1260
KGIW	Alamosa, Colo.	1450
KGKB	Tyler, Tex.	1490
KGKL	San Angelo, Tex.	960
KGLC	Miami, Okla.	910
KGLN	Glenwood Sprgs., Colo.	980
KGLO	Mason City, Iowa	1300
KGLU	Safford, Ariz.	1480
KGMB	Honolulu, Hawaii	590
KGMC	Englewood, Colo.	1150
KGMO	Cape Girardeau, Mo.	1220
KGMS	Sacramento, Calif.	1380
KGNB	New Braunfels, Tex.	1420
KGNC	Amarillo, Tex.	710
KGNO	Dodge City, Kans.	1370
KGO	San Francisco, Calif.	810
KGON	Oregon City, Oreg.	1520
KGOS	Torrington, Wyo.	1490
KGPC	Grafton, N.Dak.	1340
KGRI	Henderson, Tex.	1000
KGRN	Grinnell, Iowa	1410
KGRO	Gresham, Oreg.	1230
KGRT	Las Cruces, N.Mex.	570
KGST	Fresno, Calif.	1600
KGU	Honolulu, Hawaii	760
KGVL	Greenville, Tex.	1400
KGVO	Missoula, Mont.	1290
KGW	Portland, Oreg.	620
KGWA	Enid, Okla.	960
KGY	Olympia, Wash.	1240
KGYN	Guymon, Okla.	1220
KHAM	Albuquerque, N.Mex.	1580
KHAS	Hastings, Nebr.	1230
KHAT	Phoenix, Ariz.	1480
KHBC	Hilo, Hawaii	970
KHBG	Okmulgee, Okla.	1240
KHBM	Monticello, Ark.	1430
KHBR	Hillsboro, Tex.	1560
KHEM	Big Springs, Tex.	1270
KHEN	Henryetta, Okla.	1590
KHEP	Phoenix, Ariz.	1280
KHEY	El Paso, Tex.	690
KHFH	Sierra Vista, Ariz.	1420
KHHH	Pampa, Tex.	1230
KHIL	Brighton-Fort Lupton, Colorado	800
KHIT	Walla Walla, Wash.	1320
KHJ	Los Angeles, Calif.	930
KHMO	Hannibal, Mo.	1070
KHOB	Hobbs, N.Mex.	1280
KHOG	Fayetteville, Ark.	1450
KHOT	Madera, Calif.	1250
KHOW	Denver, Colo.	630
KHOZ	Harrison, Ark.	900
KHQ	Spokane, Wash.	590
KHSL	Chico, Calif.	1290
KHUB	Fremont, Nebr.	1340
KHUZ	Borger, Tex.	1490
KHVH	Honolulu, Hawaii	1040
KIBE	Palo Alto, Calif.	1220
KIBH	Seward, Alaska	1340
KIBL	Beeville, Tex.	1490
KIBS	Bishop, Calif.	1230
KICA	Clovis, N.Mex.	980
KICD	Spencer, Iowa	1240
KICK	Springfield, Mo.	1340
KICN	Denver, Colo.	710
KICO	Calexico, Calif.	1490
KID	Idaho Falls, Idaho	590
KIDD	Monterey, Calif.	630
KIDO	Boise, Idaho	630
KIEM	Eureka, Calif.	1480
KIEV	Glendale, Calif.	870
KIFI	Idaho Falls, Idaho	1260
KIFN	Phoenix, Ariz.	860
KIFW	Sitka, Alaska	1230
KIHN	Hugo, Okla.	1340

C.L.	Location	Kc.
KIHO	Sioux Falls, S.Dak.	1270
KIHR	Hood River, Oreg.	1340
KIJV	Huron, S.Dak.	1340
KIKK	Bakersfield, Calif.	800
KIKI	Honolulu, Hawaii	830
KIKO	Miami, Ariz.	1340
KIKS	Sulphur, La.	1310
KILE	Galveston, Tex.	1400
KILO	Grand Forks, S.Dak.	1440
KILT	Houston, Tex.	610
KIMA	Yakima, Wash.	1460
KIMB	Kimball, Nebr.	1260
KIML	Gillette, Wyo.	1490
KIMO	Hilo, Hawaii	850
KIMN	Denver, Colo.	950
KIMP	Mt. Pleasant, Tex.	960
KIND	Independence, Kans.	1010
KINE	Kingsville, Tex.	1330
KING	Seattle, Wash.	1090
KINS	Eureka, Calif.	980
KINY	Juneau, Alaska	800
KIOA	Des Moines, Iowa	940
KIOX	Bay City, Tex.	1270
KIPA	Hilo, Hawaii	1110
KIRO	Seattle, Wash.	710
KIRT	Mission, Tex.	1580
KIRX	Kirksville, Mo.	1450
KISD	Sioux Falls, S.Dak.	1230
KISN	Vancouver, Wash.	910
KIST	Santa Barbara, Calif.	1340
KIT	Yakima, Wash.	1280
KITE	San Antonio, Tex.	930
KITI	Chehalis, Wash.	1420
KITN	Olympia, Wash.	920
KITO	San Bernardino, Calif.	1290
KIUL	Garden City, Kans.	1240
KIUN	Pecos, Tex.	1400
KIUP	Durango, Colo.	930
KIVY	Crockett, Tex.	1290
KIXL	Dallas, Tex.	1040
KIXX	Provo, Utah	1400
KIXZ	Amarillo, Tex.	940
KJAN	Atlantic, Iowa	1220
KJAX	Santa Rosa, Calif.	1150
KJAY	Topeka, Kans.	1440
KJBC	Midland, Tex.	1150
KJBS	San Francisco, Calif.	1100
KJCF	Festus, Mo.	1010
KJCK	Junction City, Kans.	1420
KJEF	Jennings, La.	1290
KJET	Beaumont, Tex.	1380
KJFJ	Webster City, Iowa	1570
KJIM	Ft. Worth, Tex.	870
KJLT	North Platte, Nebr.	970
KJNO	Juneau, Alaska	630
KJOE	Shreveport, La.	1480
KJOY	Stockton, Calif.	1280
KJR	Seattle, Wash.	950
KJRG	Newton, Kans.	950
KJSK	Columbus, Nebr.	900
KKEY	Vancouver, Wash.	1150
KKID	Pendleton, Oreg.	1240
KKIS	Pittsburg, Calif.	990
KKOG	Ogden, Utah	730
KKSN	Grand Prairie, Tex.	730
KLAC	Los Angeles, Calif.	570
KLAD	Klamath Falls, Oreg.	960
KLAK	Lakewood, Colo.	1600
KLAM	Cordova, Alaska	1450
KLAS	Las Vegas, Nev.	1230
KLBM	La Grande, Oreg.	1450
KLBS	Livingston, Tex.	1220
KLCN	Blytheville, Ark.	910
KLCO	Poteau, Okla.	1280
KLEA	Lovington, N.Mex.	630
KLEE	Ottumwa, Iowa	1480
KLEM	LeMars, Iowa	1410
KLEN	Killeen, Tex.	1050
KLEO	Wichita, Kans.	1480
KLER	Orofino, Idaho	950
KLEX	Lexington, Mo.	1570
KLFD	Litchfield, Minn.	1410
KLFT	Golden Meadow, La.	1600
KLGA	Algona, Iowa	1600
KLGN	Logan, Utah	1390
KLGR	Redwood Falls, Minn.	1490
KLIC	Monroe, La.	1230
KLIF	Dallas, Tex.	1190
KLIK	Jefferson City, Mo.	950
KLIL	Estherville, Iowa	1340
KLIN	Lincoln, Nebr.	1400
KLIQ	Portland, Oreg.	1290
KLIR	Denver, Colo.	990
KLIX	Twin Falls, Idaho	1310
KLIZ	Brainerd, Minn.	1380
KLKC	Parsons, Kans.	1540
KLLA	Leesville, La.	1570
KLLL	Lubbock, Tex.	1460
KLMO	Longmont, Colo.	1050
KLMR	Lamar, Colo.	920
KLMS	Lincoln, Nebr.	1480
KLMX	Clayton, N.Mex.	1450
KLO	Ogden, Utah	1430
KLOG	Kelso, Wash.	1490
KLOH	Pipestone, Minn.	1050
KLOK	San Jose, Calif.	1170
KLOO	Corvallis, Oreg.	1340
KLOS	Albuquerque, N.Mex.	1450
KLOU	Lake Charles, La.	1580
KLOV	Loveland, Colo.	1570
KLPL	Lake Providence, La.	1050
KLPM	Minot, N.Dak.	1390
KLPR	Okla. City, Okla.	1140
KLPW	Union, Mo.	1220
KLRA	Little Rock, Ark.	1010
KLRS	Mountain Grove, Mo.	1360
KLTF	Little Falls, Minn.	960
KLTI	Longview, Tex.	1280

C.L.	Location	Kc.
KLTR	Blackwell, Okla.	1580
KLTZ	Glasgow, Mont.	1240
KLUB	Salt Lake City, Utah	570
KLUK	Evanston, Wyo.	1240
KLUV	Haynesville, La.	1580
KLVC	Leadville, Colo.	1230
KLVI	Vivian, La.	1600
KLVL	Pasadena, Tex.	1480
KLVT	Levelland, Tex.	1230
KLWN	Lawrence, Kans.	1320
KLWT	Lebanon, Mo.	1230
KLYD	Bakersfield, Calif.	1350
KLYK	Spokane, Wash.	1230
KLYR	Clarksville, Ark.	1360
KLZ	Denver, Colo.	560
KMA	Shenandoah, Iowa	960
KMAC	San Antonio, Tex.	630
KMAE	McKinney, Tex.	1600
KMAK	Fresno, Calif.	1340
KMAM	Tularosa, N.Mex.	1590
KMAN	Manhattan, Kans.	1350
KMAP	Bakersfield, Calif.	1490
KMAQ	Maquoketa, Iowa	1320
KMAR	Winnsboro, La.	1570
KMBC	Kansas City, Mo.	980
KMBL	Junction, Tex.	1450
KMBY	Monterey, Calif.	1240
KMCD	Fairfield, Iowa	1570
KMCM	McMinnville, Oreg.	1260
KMCO	Conroe, Tex.	900
KMDO	Ft. Scott, Kans.	1600
KMED	Medford, Oreg.	1440
KMEL	Wenatchee, Wash.	1340
KMHL	Marshall, Minn.	1400
KMHT	Marshall, Tex.	1450
KMIL	Cameron, Tex.	1330
KMIN	Grants, N.M.	980
KMJ	Fresno, Calif.	580
KMLB	Monroe, La.	1440
KMLW	Marlin, Tex.	1010
KMMJ	Grand Island, Nebr.	750
KMMO	Marshall, Mo.	1300
KMNS	Sioux City, Iowa	620
KMO	Tacoma, Wash.	1360
KMON	Great Falls, Mont.	560
KMOP	Tucson, Ariz.	1330
KMOX	St. Louis, Mo.	1120
KMPC	Los Angeles, Calif.	710
KMRC	Morgan City, La.	1430
KMRS	Morris, Minn.	1570
KMUL	Muleshoe, Tex.	1380
KMUR	Murray, Utah	1230
KMUS	Muskogee, Okla.	1380
KMVI	Wailuku, T. H.	550
KMYC	Marysville, Calif.	1410
KNAF	Fredericksburg, Tex.	1340
KNAK	Salt Lake City, Utah	1280
KNAL	Victoria, Tex.	1410
KNBA	Vallejo, Calif.	1190
KNBC	San Francisco, Calif.	680
KNBX	Kirkland, Wash.	1050
KNBY	Newport, Ark.	1280
KNCK	Concordia, Kans.	1390
KNCM	Moberly, Mo.	1230
KNCO	Garden City, Kans.	1050
KNDC	Hettinger, N.Dak.	1490
KNDY	Marysville, Kans.	1570
KNEA	Jonesboro, Ark.	970
KNEB	Scottsbluff, Nebr.	960
KNED	McAlester, Okla.	1150
KNEL	Brady, Tex.	1490
KNEM	Nevada, Mo.	1240
KNET	Palestine, Tex.	1450
KNEU	Provo, Utah	1450
KNEW	Spokane, Wash.	790
KNEX	McPherson, Kans.	1540
KNEZ	Lompoc, Calif.	960
KNGS	Hanford, Calif.	620
KNIM	Maryville, Mo.	1580
KNIT	Abilene, Tex.	1280
KNLR	N. Little Rock, Ark.	1380
KNOC	Natchitoches, La.	1450
KNOE	Monroe, La.	1390
KNOG	Nogales, Ariz.	1340
KNOK	Ft. Worth, Tex.	970
KNOR	Norman, Okla.	1400
KNOT	Prescott, Ariz.	1450
KNOW	Austin, Tex.	1490
KNOX	Grand Forks, N.Dak.	1310
KNPT	Newport, Ore.	1310
KNUJ	New Ulm, Minn.	860
KNUZ	Houston, Tex.	1230
KNWS	Waterloo, Iowa	1090
KNX	Los Angeles, Calif.	1070
KOA	Denver, Colo.	850
KOAC	Corvallis, Oreg.	550
KOAL	Price, Utah	1230
KOAM	Pittsburg, Kans.	860
KOB	Albuquerque, N.Mex.	1030
KOBE	Las Cruces, N.Mex.	1450
KOBY	San Francisco, Calif.	1550
KOCA	Kilgore, Tex.	1240
KOCY	Oklahoma City, Okla.	1340
KODE	Joplin, Mo.	1230
KODI	Cody, Wyo.	1400
KOOL	The Dalles, Oreg.	1440
KODY	North Platte, Nebr.	1240
KOEL	Oelwein, Iowa	950
KOFA	Yuma, Ariz.	1240
KOFE	Pullman, Wash.	1150
KOFI	Kalispell, Mont.	930
KOFO	Ottawa, Kans.	1220
KOFY	San Mateo, Calif.	1050
KOGA	Ogallala, Nebr.	930
KOGT	Orange, Tex.	1600
KOH	Reno, Nev.	630
KOHU	Hermiston, Oreg.	1570
KOIL	Omaha, Nebr.	1290

C.L.	Location	Kc.
KOIN	Portland, Oreg.	970
KOJM	Havre, Mont.	610
KOKA	Shreveport, La.	980
KOKE	Austin, Tex.	1370
KOKO	Warrensburg, Mo.	1450
KOKX	Keokuk, Iowa	1310
KOKY	Little Rock, Ark.	1440
KOL	Seattle, Wash.	1300
KOLD	Tucson, Ariz.	1450
KOLE	Port Arthur, Tex.	1340
KOLJ	Quanah, Tex.	1150
KOLL	Libby, Mont.	1230
KOLO	Reno, Nev.	920
KOLR	Sterling, Colo.	1490
KOLS	Pryor, Okla.	1570
KOLT	Scottsbluff, Nebr.	1320
KOLY	Mobridge, S.Dak.	1300
KOMA	Okla. City, Okla.	1520
KOMB	Cottage Grove, Oreg.	1400
KOME	Tulsa, Okla.	1300
KOMO	Seattle, Wash.	1000
KOMW	Omak, Wash.	680
KOMY	Watsonville, Calif.	1340
KONE	Reno, Nev.	1450
KONG	Visalia, Calif.	1400
KONI	Phoenix, Ariz.	1400
KONO	San Antonio, Tex.	860
KONP	Port Angeles, Wash.	1450
KOOK	Billings, Mont.	970
KOOL	Phoenix, Ariz.	960
KOOO	Omaha, Nebr.	1420
KOOS	Coos Bay, Oreg.	1230
KOPR	Butte, Mont.	550
KOPY	Alice, Tex.	1070
KORA	Bryan, Tex.	1240
KORC	Mineral Wells, Tex.	1140
KORD	Pasco, Wash.	910
KORE	Eugene, Oreg.	1450
KORK	Las Vegas, Nev.	1340
KORN	Mitchell, S.Dak.	1490
KORT	Grangeville, Idaho	1230
KOSA	Odessa, Tex.	1230
KOSE	Osceola, Ark.	860
KOSI	Aurora, Colo.	1430
KOSY	Texarkana, Ark.	790
KOTA	Rapid City, S.Dak.	1380
KOTE	Fergus Falls, Minn.	1250
KOTN	Pine Bluff, Ark.	1490
KOTS	Deming, N.M.	1230
KOVC	Valley City, N.Dak.	1490
KOVE	Lander, Wyo.	1330
KOVO	Provo, Utah	960
KOWB	Laramie, Wyo.	1340
KOWH	Omaha, Nebr.	660
KOWL	Lake Tahoe, Calif.	1490
KOWN	Escondido, Calif.	1450
KOXR	Ornard, Calif.	910
KOY	Phoenix, Ariz.	550
KOYE	El Paso, Tex.	1150
KOYL	Odessa, Tex.	1310
KOYN	Billings, Mont.	910
KOZE	Lewiston, Idaho	1300
KOZI	Chelan, Wash.	1220
KOZY	Grand Rapids, Minn.	1490
KPAC	Port Arthur, Tex.	1250
KPAL	Palm Springs, Calif.	1450
KPAM	Portland, Oreg.	1410
KPAN	Hereford, Tex.	860
KPAP	Redding, Calif.	1270
KPAS	Banning, Calif.	1490
KPAY	Chico, Calif.	1060
KPBA	Pine Bluff, Ark.	1590
KPBM	Carlsbad, N.Mex.	740
KPCA	Marked Tree, Ark.	1580
KPDN	Pampa, Tex.	1340
KPDQ	Portland, Oreg.	800
KPEG	Spokane, Wash.	1380
KPEL	Lafayette, La.	1420
KPEP	San Angelo, Tex.	1420
KPER	Gilroy, Calif.	1290
KPET	Lamesa, Tex.	690
KPHO	Phoenix, Ariz.	910
KPIG	Cedar Rapids, Iowa	1450
KPIK	Colorado Sprgs., Colo.	1580
KPIN	Casa Grande, Ariz.	1260
KPKW	Pasco, Wash.	1340
KPLC	Lake Charles, La.	1470
KPLK	Dallas, Oreg.	1460
KPMC	Bakersfield, Calif.	1560
KPOA	Honolulu, T.H.	630
KPOC	Pocahontas, Ark.	1420
KPOF	Denver, Colo.	910
KPOI	Honolulu, Hawaii	1380
KPOJ	Portland, Oreg.	1330
KPOK	Scottsdale, Ariz.	1440
KPOL	Los Angeles, Calif.	1540
KPOP	Los Angeles, Calif.	1020
KPOR	Quincy, Wash.	1370
KPOS	Post, Tex.	1370
KPOW	Powell, Wyo.	1260
KPPC	Pasadena, Calif.	1240
KPQ	Wenatchee, Wash.	560
KPRB	Redmond, Oreg.	1240
KPRC	Houston, Tex.	950
KPRK	Livingston, Mont.	1340
KPRL	Paso Robles, Calif.	1230
KPRO	Riverside, Calif.	1440
KPRS	Kansas City, Mo.	1590
KPSO	Falfurrias, Tex.	1260
KPST	Preston, Idaho	1340
KPTL	Carson City, Nev.	1400
KPUG	Bellingham, Wash.	1170
KPVA	Camas, Wash.	1480
KQDE	Renton, Wash.	910
KQDI	Bismarck, N.Dak.	1350
KQDY	Minot, N.Dak.	1320
KQEO	Albuquerque, N.Mex.	920
KQIK	Lakeview, Oreg.	1230

C.L.	Location	Kc.
KQTY	Everett, Wash.	1230
KQV	Pittsburgh, Pa.	1410
KRAC	Alamogordo, N.M.	1270
KRAI	Craig, Colo.	550
KRAK	Stockton, Calif.	1140
KRAL	Rawlins, Wyo.	1240
KRAM	Las Vegas, Nev.	920
KRAY	Amarillo, Tex.	1360
KRBA	Lufkin, Tex.	1340
KRBC	Abilene, Tex.	1470
KRBI	St. Peter, Minn.	1310
KRBO	Las Vegas, Nev.	1050
KRCK	Ridgecrest, Calif.	1360
KRCO	Prineville, Oreg.	690
KRCT	Baytown, Tex.	650
KRDG	Redding, Calif.	1230
KRDO	Colo. Springs, Colo.	1240
KRDU	Dinuba, Calif.	1240
KRE	Berkeley, Calif.	1400
KREH	Oakdale, La.	900
KREI	Farmington, Mo.	800
KREL	Baytown, Tex.	1360
KREM	Spokane, Wash.	970
KREO	Indio, Calif.	1400
KRES	St. Joseph, Mo.	1550
KREW	Sunnyside, Wash.	1230
KREX	Grand Junc., Colo.	920
KRFO	Owatonna, Minn.	1390
KRGI	Grand Island, Neb.	1430
KRGV	Weslasco, Tex.	1290
KRHD	Duncan, Okla.	1350
KRIB	Mason City, Iowa	1490
KRIC	Beaumont, Tex.	1450
KRIG	Odessa, Tex.	1410
KRIO	McAllen, Tex.	910
KRIZ	Phoenix, Ariz.	1230
KRKC	King City, Calif.	1570
KRKD	Los Angeles, Calif.	1150
KRKO	Everett, Wash.	1380
KRKS	Ridgecrest, Calif.	1240
KRLC	Lewiston, Idaho	1350
KRLD	Dallas, Tex.	1080
KRLN	Canon City, Colo.	1400
KRLW	Walnut Ridge, Ark.	1320
KRMD	Shreveport, La.	1340
KRMG	Tulsa, Okla.	740
KRMO	Monett, Mo.	990
KRMS	Osage Beach, Mo.	1150
KRNO	San Bernardino, Calif.	1240
KRNR	Roseburg, Oreg.	1490
KRNS	Burns, Oreg.	1230
KRNT	Des Moines, Iowa	1350
KRNY	Kearney, Nebr.	1460
KROC	Rochester, Minn.	1340
KROD	El Paso, Tex.	600
KROF	Abbeville, La.	960
KROG	Sonora, Calif.	1450
KROP	Brawley, Calif.	1300
KROS	Clinton, Iowa	1340
KROX	Crookston, Minn.	1260
KROY	Sacramento, Calif.	1240
KRPL	Moscow, Idaho	1400
KRRV	Sherman, Tex.	910
KRSC	Othello, Wash.	1450
KRSD	Rapid City, S.Dak.	1340
KRSL	Russell, Kans.	990
KRSN	Los Alamos, N.Mex.	1490
KRTN	Raton, N.Mex.	1490
KRTR	Thermopolis, Wyo.	1490
KRUN	Ballinger, Tex.	1400
KRUS	Ruston, La.	1490
KRUX	Glendale, Ariz.	1360
KRVN	Lexington, Nebr.	1010
KRWC	Forest Grove, Oreg.	1570
KRXK	Rexburg, Idaho	1230
KRXL	Roseburg, Oreg.	1240
KRYS	Corpus Christi, Tex.	1360
KSAC	Manhattan, Kans.	580
KSAL	Salina, Kans.	1150
KSAM	Huntsville, Tex.	1490
KSAN	San Francisco, Calif.	1450
KSAY	San Francisco, Calif.	1010
KSBW	Salinas, Calif.	1380
KSCB	Liberal, Kans.	1270
KSCJ	Sioux City, Iowa	1360
KSCO	Santa Cruz, Calif.	1080
KSD	St. Louis, Mo.	550
KSDA	Redding, Calif.	1400
KSDN	Aberdeen, S.Dak.	930
KSDO	San Diego, Calif.	1130
KSEI	Pocatello, Idaho	930
KSEK	Pittsburg, Kans.	1340
KSEL	Lubbock, Tex.	950
KSEM	Moses Lake, Wash.	1470
KSEN	Shelby, Mont.	1150
KSEO	Durant, Okla.	750
KSET	El Paso, Tex.	1340
KSEW	Sitka, Alaska	1400
KSEY	Seymour, Tex.	1230
KSFA	Nacogdoches, Tex.	860
KSFE	Needles, Calif.	1340
KSFO	San Francisco, Calif.	560
KSGM	Ste. Genevieve, Mo.	980
KSIB	Creston, Iowa	1520
KSID	Sidney, Nebr.	1340
KSIG	Crowley, La.	1450
KSIJ	Gladewater, Tex.	1430
KSIL	Silver City, N.Mex.	1340
KSIM	Sikeston, Mo.	1400
KSIR	Wichita, Kans.	900
KSIS	Sedalia, Mo.	1050
KSIW	Woodward, Okla.	1450
KSIX	Corpus Christi, Tex.	1230
KSJB	Jamestown, N.Dak.	600
KSJO	San Jose, Calif.	1590

C.L.	Location	Kc.
KSKY	Dallas, Tex.	660
KSL	Salt Lake City, Utah	1160
KSLM	Salem, Oreg.	1390
KSLO	Opelousas, La.	1230
KSLV	Monte Vista, Colo.	1240
KSMA	Santa Maria, Calif.	1240
KSML	Seminole, Tex.	1250
KSMN	Mason City, Iowa	1010
KSMO	Salem, Mo.	1340
KSNY	Snyder, Tex.	1450
KSO	Des Moines, Iowa	1460
KSOK	Arkansas City, Kans.	1280
KSON	San Diego, Calif.	1240
KSOO	Sioux Falls, S.Dak.	1140
KSOP	Salt Lake City, Utah	1370
KSOX	Raymondville, Tex.	1240
KSPA	Santa Paula, Calif.	1400
KSPI	Stillwater, Okla.	780
KSPL	Diboll, Tex.	1260
KSPR	Casper, Wyo.	1470
KSPT	Sandpoint, Idaho	1400
KSRC	Socorro, N.Mex.	1290
KSRO	Santa Rosa, Calif.	1350
KSRV	Ontario, Oreg.	1380
KSSS	Colorado Springs, Colo.	740
KSST	Sulphur Springs, Tex.	1230
KSTA	Coleman, Tex.	1000
KSTB	Breckenridge, Tex.	1430
KSTL	St. Louis, Mo.	690
KSTN	Stockton, Calif.	1420
KSTP	St. Paul, Minn.	1500
KSTR	Grand Junction, Colo.	620
KSTT	Davenport, Iowa	1170
KSTV	Stephenville, Tex.	1510
KSUB	Cedar City, Utah	590
KSUE	Susanville, Calif.	1240
KSUM	Fairmont, Minn.	1370
KSUN	Bisbee, Ariz.	1230
KSVC	Richfield, Utah	980
KSVP	Artesia, N.Mex.	990
KSWA	Graham, Tex.	1330
KSWI	Council Bluffs, Iowa	1560
KSWO	Lawton, Okla.	1380
KSWS	Roswell, N.Mex.	1230
KSYC	Yreka, Calif.	1490
KSYD	Wichita Falls, Tex.	990
KSYL	Alexandria, La.	970
KTAC	Tacoma, Wash.	850
KTAE	Taylor, Tex.	1260
KTAN	Tucson, Ariz.	580
KTAR	Phoenix, Ariz.	620
KTAT	Frederick, Okla.	1570
KTBB	Tyler, Tex.	600
KTBC	Austin, Tex.	590
KTCB	Malden, Mo.	1470
KTCN	Berryville, Ark.	1480
KTCS	Fort Smith, Ark.	1410
KTEE	Carmel, Calif.	1410
KTEL	Walla Walla, Wash.	1490
KTEM	Temple, Tex.	1400
KTER	Terrell, Tex.	1570
KTFI	Twin Falls, Idaho	1270
KTFS	Texarkana, Tex.	1400
KTFY	Bronwfield, Tex.	1300
KTHE	Thermopolis, Wyo.	1240
KTHS	Little Rock, Ark.	1090
KTHT	Houston, Tex.	790
KTIB	Thibodaux, La.	630
KTIL	Tillamook, Oreg.	1590
KTIM	San Rafael, Calif.	1510
KTIP	Porterville, Calif.	1450
KTIS	Minneapolis, Minn.	900
KTIX	Seattle, Wash.	1590
KTJS	Hobart, Okla.	1420
KTKN	Ketchikan, Alaska	930
KTKR	Taft, Calif.	1310
KTKT	Tucson, Ariz.	990
KTLD	Tullulah, La.	1360
KTLN	Denver, Colo.	1280
KTLO	Mtn. Home, Ark.	1490
KTLQ	Tahlequah, Okla.	1350
KTLU	Rusk, Tex.	1580
KTLW	Texas City, Tex.	920
KTMC	McAlester, Okla.	1400
KTMS	Santa Barbara, Calif.	1250
KTNC	Falls City, Nebr.	1230
KTNM	Tucumcari, N.Mex.	1400
KTNT	Tacoma, Wash.	1400
KTOC	Jonesboro, La.	920
KTOE	Mankato, Minn.	1420
KTOH	Lihue, Hawaii	1490
KTOK	Oklahoma City, Okla.	1000
KTOO	Henderson, Nev.	1280
KTOP	Topeka, Kans.	1490
KTOW	Oklahoma City, Okla.	800
KTRB	Modesto, Calif.	860
KTRC	Santa Fe, N.Mex.	1400
KTRE	Lufkin, Tex.	1420
KTRF	Thief River Falls, Minn.	1230
KTRH	Houston, Tex.	740
KTRI	Sioux City, Iowa	1470
KTRM	Beaumont, Tex.	990
KTRN	Wichita Falls, Tex.	1290
KTRY	Bastrop, La.	730
KTSA	San Antonio, Tex.	550
KTSM	El Paso, Tex.	1380
KTTN	Trenton, Mo.	1600
KTTR	Rolla, Mo.	1490
KTTS	Springfield, Mo.	1400
KTUC	Tucson, Ariz.	1400
KTUE	Tulia, Tex.	1260
KTUL	Tulsa, Okla.	1430
KTUR	Turlock, Calif.	1390
KTUT	Tooele, Utah	990
KTW	Seattle, Wash.	1250
KTXJ	Jasper, Tex.	1350
KTXL	San Angelo, Tex.	1340
KTXO	Sherman, Tex.	1500
KTYM	Inglewood, Calif.	1460
KUBA	Yuba City, Calif.	1600
KUBC	Montrose, Colo.	580
KUBE	Pendleton, Oreg.	1050
KUBO	San Antonio, Tex.	1540
KUDE	Oceanside, Calif.	1320
KUDI	Great Falls, Mont.	1450
KUDL	Kansas City, Mo.	1380
KUDU	Ventura, Calif.	1590
KUDY	Littleton, Colo.	1510
KUEN	Wenatchee, Wash.	900
KUEQ	Phoenix, Ariz.	740
KUGN	Eugene, Oreg.	590
KUIK	Hillsboro, Oreg.	1360
KUJ	Walla Walla, Wash.	1420
KUKI	Ukiah, Calif.	1400
KUKU	Willow Springs, Mo.	1330
KULA	Honolulu, Hawaii	690
KULE	Ephrata, Wash.	730
KULP	El Campo, Tex.	1390
KUMA	Pendleton, Oreg.	1290
KUNO	Corpus Christi, Tex.	1400
KUOA	Siloam Springs, Ark.	1290
KUOM	Minneapolis, Minn.	770
KUPI	Idaho Falls, Idaho	980
KURA	Moab, Utah	1450
KURV	Edinburg, Tex.	710
KURY	Brookings, Oreg.	910
KUSD	Vermillion, S.Dak.	690
KUSH	Cushing, Okla.	1600
KUSN	St. Joseph, Mo.	1270
KUTI	Yakima, Wash.	980
KUTY	Palmdale, Calif.	1470
KUVR	Holdredge, Nebr.	1380
KUZN	W. Monroe, La.	1310
KVCK	Wolf Point, Nebr.	1450
KVCL	Winnfield, La.	1270
KVCV	Redding, Calif.	600
KVEC	San Luis Obispo, Calif.	920
KVEL	Vernal, Utah	1250
KVEN	Ventura, Calif.	1450
KVET	Austin, Tex.	1300
KVFC	Cortez, Colo.	740
KVFD	Ft. Dodge, Iowa	1400
KVGB	Great Bend, Kans.	1590
KVHL	Homer, La.	1320
KVI	Seattle, Wash.	570
KVIC	Victoria, Tex.	1340
KVIM	New Iberia, La.	1360
KVIN	Vinita, Okla.	1470
KVIP	Redding, Calif.	540
KVKM	Monahans, Tex.	1340
KVLB	Cleveland, Tex.	1410
KVLC	Little Rock, Ark.	1050
KVLF	Alpine, Tex.	1240
KVLH	Pauls Valley, Okla.	1470
KVLV	Fallon, Nev.	1250
KVMA	Magnolia, Ark.	630
KVMC	Colorado City, Tex.	1320
KVNA	Flagstaff, Ariz.	690
KVNC	Winslow, Ariz.	1010
KVNI	Coeur d'Alene, Idaho	1240
KVNU	Logan, Utah	610
KVOC	Casper, Wyo.	1230
KVOE	Emporia, Kans.	1400
KVOG	Ogden, Utah	1490
KVOL	Lafayette, La.	1330
KVOM	Morrilton, Ark.	800
KVON	Napa, Calif.	1440
KVOO	Tulsa, Okla.	1170
KVOP	Plainview, Tex.	1400
KVOR	Colo. Springs, Colo.	1300
KVOS	Bellingham, Wash.	790
KVOU	Uvalde, Tex.	1400
KVOW	Littlefield, Tex.	1490
KVOX	Moorhead, Minn.	1280
KVOY	Yuma, Ariz.	1400
KVOZ	Laredo, Tex.	1490
KVPI	Ville Platte, La.	1050
KVRC	Arkadelphia, Ark.	1240
KVRH	Salida, Colo.	1340
KVRS	Rock Springs, Wyo.	1360
KVSA	McGehee, Ark.	1220
KVSF	Santa Fe, N.Mex.	1260
KVSO	Ardmore, Okla.	1240
KVWC	Vernon, Tex.	1490
KVWM	Show Low, Ariz.	1050
KVWO	Cheyenne, Wyo.	1370
KWAD	Wadena, Minn.	920
KWAK	Stuttgart, Ark.	1240
KWAL	Wallace, Idaho	620
KWAM	Memphis, Tenn.	990
KWAT	Watertown, S.Dak.	950
KWBB	Wichita, Kans.	1410
KWBE	Beatrice, Nebr.	1450
KWBG	Boone, Iowa	1590
KWBR	Oakland, Calif.	1310
KWBW	Hutchinson, Kans.	1450
KWCB	Searcy, Ark.	1300
KWCL	Oak Grove, La.	1280
KWCO	Chickasha, Okla.	1560
KWDM	Des Moines, Iowa	1150
KWEB	Rochester, Minn.	1270
KWED	Seguin, Tex.	1580
KWEI	Weiser, Idaho	1260
KWEL	Midland, Tex.	1600
KWEW	Hobbs, N.Mex.	1480
KWFR	San Angelo, Tex.	1260
KWFT	Wichita Falls, Tex.	620
KWG	Stockton, Calif.	1230
KWHI	Brenham, Tex.	1280
KWHK	Hutchinson, Kans.	1260
KWHN	Fort Smith, Ark.	1320
KWHO	Salt Lake City, Utah	860
KWHW	Altus, Okla.	1450
KWIC	Salt Lake City, Utah	1570
KWIK	Pocatello, Idaho	1240
KWIL	Albany, Oreg.	790
KWIN	Ashland, Oreg.	1400
KWIV	Douglas, Wyo.	1050
KWIZ	Santa Ana, Calif.	1480
KWJB	Globe, Ariz.	1240
KWJC	Natchitoches, La.	1450
KWJJ	Portland, Oreg.	1080
KWIP	Merced, Calif.	1580
KWIQ	Moses Lake, Wash.	1260
KWK	St. Louis, Mo.	1380
KWKC	Abilene, Tex.	1340
KWKH	Shreveport, La.	1130
KWKW	Pasadena, Calif.	1300
KWLC	Decorah, Iowa	1240
KWLM	Willmar, Minn.	1340
KWMT	Ft. Dodge, Iowa	540
KWNA	Winnemucca, Nev.	1400
KWNO	Winona, Minn.	1230
KWOA	Worthington, Minn.	730
KWOC	Poplar Bluff, Mo.	930
KWOE	Clinton, Okla.	1320
KWON	Bartlesville, Okla.	1400
KWOR	Worland, Wyo.	1340
KWOS	Jefferson City, Mo.	1240
KWOW	Pomona, Calif.	1600
KWPC	Muscatine, Iowa	860
KWPM	West Plains, Mo.	1450
KWPR	Claremore, Okla.	1270
KWRD	Henderson, Tex.	1470
KWRE	Warrenton, Mo.	730
KWRF	Warren, Ark.	860
KWRL	Riverton, Wyo.	1450
KWRO	Coquille, Oreg.	1450
KWRT	Boonville, Mo.	1370
KWRW	Guthrie, Okla.	1490
KWSC	Pullman, Wash.	1250
KWSD	Mt. Shasta, Calif.	620
KWSH	Wewoka-Seminole, Oklahoma	1260
KWSK	Pratt, Kans.	1570
KWSO	Wasco, Calif.	1050
KWTC	Barstow, Calif.	1230
KWTO	Springfield, Mo.	560
KWTX	Waco, Tex.	1230
KWVY	Waverly, Iowa	1470
KWWL	Waterloo, Iowa	1330
KWYK	Farmington, N.Mex.	960
KWYN	Wynne, Ark.	1400
KWYO	Sheridan, Wyo.	1410
KWYR	Winner, S.Dak.	1260
KXA	Seattle, Wash.	770
KXAR	Hope, Ark.	1490
KXEL	Waterloo, Iowa	1540
KXEO	Mexico, Mo.	1340
KXGI	Ft. Madison, Iowa	1360
KXGN	Glendive, Mont.	1400
KXGO	Fargo, N.D.	790
KXIC	Iowa City, Iowa	800
KXIT	Dalhart, Tex.	1410
KXJK	Forrest City, Ark.	950
KXL	Portland, Oreg.	750
KXLA	Pasadena, Calif.	1110
KXLE	Ellensburg, Wash.	1240
KXLF	Butte, Mont.	1370
KXLJ	Helena, Mont.	1240
KXLK	Great Falls, Mont.	1400
KXLL	Missoula, Mont.	1450
KXLO	Lewiston, Mont.	1230
KXLR	No. Little Rock, Ark.	1150
KXLW	Clayton, Mo.	1320
KXLY	Spokane, Wash.	920
KXO	El Centro, Calif.	1230
KXOA	Sacramento, Calif.	1470
KXOK	St. Louis, Mo.	630
KXOL	Ft. Worth, Tex.	1360
KXOX	Sweetwater, Tex.	1240
KXRA	Alexandria, Minn.	1490
KXRJ	Russellville, Ark.	1490
KXRO	Aberdeen, Wash.	1320
KXRX	San Jose, Calif.	1500
KXXI	Golden, Colo.	1250
KXXL	Bozeman, Mont.	1450
KXXX	Colby, Kans.	790
KXYZ	Houston, Tex.	1320
KYA	San Francisco, Calif.	1260
KYCA	Prescott, Ariz.	1490
KYJC	Medford, Oreg.	1230
KYME	Boise, Idaho	740
KYNO	Fresno, Calif.	1300
KYNG	Coos Bay, Oreg.	1420
KYNT	Yankton, S.Dak.	1450
KYOK	Houston, Tex.	1590
KYOR	Blythe, Calif.	1450
KYOS	Merced, Calif.	1480
KYOU	Greeley, Colo.	1450
KYRO	Potosi, Mo.	1280
KYSM	Mankato, Minn.	1230
KYSN	Colorado Sprgs., Colo.	1460
KYTE	Pocatello, Idaho	1290
KYUM	Yuma, Ariz.	560
KYW	Cleveland, Ohio	1100
KZEE	Weatherford, Tex.	1220
KZEY	Tyler, Tex.	690
KZIN	Coeur d'Alene, Idaho	1050
KZIP	Amarillo, Tex.	1310
KZOK	Prescott, Ariz.	1340
KZOL	Muleshoe, Tex.	1570
KZUM	Farmington, N.Mex.	1280
KZUN	Opportunity, Wash.	630
WAAA	Winston-Salem, N.C.	980
WAAB	Worcester, Mass.	1440
WAAF	Chicago, Ill.	950
WAAG	Adel, Ga.	1470
WAAY	Huntsville, Ala.	1550
WABA	Aguadilla, P.Rico	850
WABB	Mobile, Ala.	1480
WABC	New York, N.Y.	770
WABG	Greenwood, Miss.	960
WABI	Bangor, Maine	910
WABJ	Adrian, Mich.	1490
WABL	Amite, La.	1570
WABM	Houlton, Maine	1340
WABO	Waynesboro, Miss.	990
WABQ	Cleveland, Ohio	1540
WABR	Winter Park, Fla.	1440
WABT	Tuskegee, Ala.	580
WABV	Abbeville, S.C.	1590
WABW	Annapolis, Md.	810
WABY	Albany, N.Y.	1400
WABZ	Albemarle, N.C.	1010
WACA	Camden, S.C.	1590
WACB	Kittanning, Pa.	1380
WACE	Chicopee, Mass.	730
WACK	Newark, N.Y.	1420
WACL	Waycross, Ga.	570
WACO	Waco, Tex.	1460
WACR	Columbus, Miss.	1050
WACT	Tuscaloosa, Ala.	1420
WADA	Shelby, N.C.	1390
WADC	Akron, Ohio	1350
WADE	Wadesboro, N.C.	1210
WADK	Newport, R.I.	1540
WADP	Kane, Pa.	960
WADS	Ansonia, Conn.	690
WAEB	Allentown, Pa.	790
WAEL	Mayaguez, P.Rico	600
WAEW	Crossville, Tenn.	1330
WAFC	Staunton, Va.	900
WAGA	Atlanta, Ga.	590
WAGC	Chattanooga, Tenn.	1450
WAGE	Leesburg, Va.	1290
WAGF	Dothan, Ala.	1320
WAGG	Franklin, Tenn.	950
WAGM	Presque Isle, Maine	1450
WAGN	Menominee, Mich.	1340
WAGR	Lumberton, N.C.	1480
WAGS	Bishopville, S.C.	1380
WAGY	Forest City, N.C.	1320
WAIL	Baton Rouge, La.	1460
WAIM	Anderson, S.C.	1230
WAIN	Columbia, Ky.	1270
WAIP	Prichard, Ala.	1270
WAIR	Winston-Salem, N.C.	1340
WAIT	Chicago, Ill.	820
WAJF	Decatur, Ala.	1490
WAJR	Morgantown, W.Va.	1440
WAKE	Atlanta, Ga.	1340
WAKN	Aiken, S.C.	990
WAKR	Akron, Ohio	1590
WAKU	Latrobe, Pa.	1570
WAKY	Louisville, Ky.	790
WALA	Mobile, Ala.	1410
WALB	Albany, Ga.	1590
WALD	Walterboro, S.C.	1220
WALE	Fall River, Mass.	1400
WALK	Patchogue, N.Y.	1370
WALL	Middletown, N.Y.	1340
WALM	Albion, Mich.	1260
WALO	Humacao, P.R.	1240
WALT	Tampa, Fla.	1110
WALY	Herkimer, N.Y.	1420
WAMD	Aberdeen, Md.	970
WAME	Miami, Fla.	1260
WAMI	Opp, Ala.	860
WAML	Laurel, Miss.	1340
WAMM	Flint, Mich.	1420
WAMO	Homestead, Pa.	860
WAMP	Pittsburgh, Pa.	1320
WAMS	Wilmington, Del.	1380
WAMV	E. St. Louis, Ill.	1490
WAMW	Washington, Ind.	1580
WAMY	Amory, Miss.	1580
WANA	Anniston, Ala.	1490
WANB	Waynesburg, Pa.	1580
WAND	Canton, Ohio	900
WANE	Ft. Wayne, Ind.	1450
WANN	Annapolis, Md.	1190
WANS	Anderson, S.C.	1280
WANT	Richmond, Va.	990
WANY	Albany, Ky.	1390
WAOK	Atlanta, Ga.	1380
WAOV	Vincennes, Ind.	1450
WAPA	San Juan, P.R.	680
WAPE	Jacksonville, Fla.	690
WAPF	McComb, Miss.	980
WAPG	Arcadia, Fla.	1480
WAPI	Birmingham, Ala.	1070
WAPL	Appleton, Wis.	1570
WAPO	Chattanooga, Tenn.	1150
WAPX	Montgomery, Ala.	1600
WAQE	Towson, Md.	1570
WARA	Attleboro, Mass.	1320
WARB	Covington, La.	730
WARD	Johnstown, Pa.	1490
WARE	Ware, Mass.	1250
WARF	Jasper, Ala.	1240
WARK	Hagerstown, Md.	1490
WARL	Arlington, Va.	780
WARM	Scranton, Pa.	590
WARN	Ft. Pierce, Fla.	1330
WARU	Peru, Ind.	1600
WASA	Havre de Grace, Md.	1330
WASK	Lafayette, Ind.	1450
WATA	Boone, N.C.	1450
WATC	Gaylord, Mich.	900
WATE	Knoxville, Tenn.	620
WATH	Athens, Ohio	970
WATK	Antigo, Wis.	900
WATM	Atmore, Ala.	1590
WATN	Watertown, N.Y.	1240
WATO	Oak Ridge, Tenn.	1290
WATP	Marion, S.C.	1430
WATR	Waterbury, Conn.	1320

C.L.	Location	Kc.
WATS	Sayre, Pa.	960
WATT	Cadillac, Mich.	1240
WATV	Birmingham, Ala.	900
WATW	Ashland, Wis.	1400
WATZ	Alpena, Mich.	1450
WAUC	Wauchula, Fla.	1310
WAUD	Auburn, Ala.	1230
WAUG	Augusta, Ga.	1050
WAUX	Waukesha, Wis.	1510
WAVE	Louisville, Ky.	970
WAVI	Dayton, Ohio	1210
WAVL	Apollo, Pa.	910
WAVN	Stillwater, Minn.	1220
WAVO	Avondale Estates, Ga.	1420
WAVP	Avon Park, Fla.	1390
WAVU	Albertville, Ala.	630
WAVY	Portsmouth, Va.	1350
WAVZ	New Haven, Conn.	1300
WAWK	Kendallville, Ind.	1570
WAWZ	Zarephath, N.J.	1380
WAXE	Vero Beach, Fla.	1370
WAXX	Chippewa Falls, Wis.	1150
WAYB	Waynesboro, Va.	1490
WAYE	Dundalk, Md.	860
WAYN	Rockingham, N.C.	900
WAYS	Charlotte, N.C.	610
WAYX	Waycross, Ga.	1230
WAYZ	Waynesboro, Pa.	1380
WAZA	Bainbridge, Ga.	1360
WAZF	Yazoo City, Miss.	1230
WAZL	Hazelton, Pa.	1490
WBAA	West Lafayette, Ind.	920
WBAB	Babylon, N.Y.	1440
WBAC	Cleveland, Tenn.	1340
WBAL	Baltimore, Md.	1090
WBAM	Montgomery, Ala.	740
WBAP	Ft. Worth, Tex.	570, 820
WBAR	Bartow, Fla.	1460
WBAT	Marion, Ind.	1400
WBAX	Wilkes-Barre, Pa.	1240
WBAW	Barnwell, S.C.	740
WBAY	Green Bay, Wis.	1360
WBBA	Pittsfield, Ill.	1580
WBBB	Burlington, N.C.	920
WBBC	Flint, Mich.	1330
WBBF	Rochester, N.Y.	950
WBBI	Abingdon, Va.	1230
WBBL	Richmond, Va.	1480
WBBM	Chicago, Ill.	780
WBBN	Perry, Ga.	980
WBBO	Forest City, N.C.	780
WBBQ	Augusta, Ga.	1340
WBBW	Youngstown, Ohio	1240
WBBZ	Ponca City, Okla.	1230
WBCA	Bay Minette, Ala.	1150
WBCB	Levittown, Pa.	1490
WBCH	Hastings, Mich.	1220
WBCK	Battle Creek, Mich.	930
WBCM	Bay City, Mich.	1440
WBCR	Christiansburg, Va.	1260
WBCU	Union, S.C.	1460
WBEC	Pittsfield, Mass.	1420
WBEE	Harvey, Ill.	1570
WBEJ	Elizabethton, Tenn.	1240
WBEL	Beloit, Wis.	1380
WBEN	Buffalo, N.Y.	930
WBET	Brockton, Mass.	1460
WBEU	Beaufort, S.C.	960
WBEV	Beaver Dam, Wis.	1430
WBEX	Chillicothe, Ohio	1490
WBFC	Fremont, Mich.	1490
WBFD	Bedford, Pa.	1310
WBGC	Chipley, Fla.	1240
WBGR	Jesup, Ga.	1370
WBHB	Fitzgerald, Ga.	1240
WBHC	Hampton, S.C.	1270
WBHF	Cartersville, Ga.	1450
WBHP	Huntsville, Ala.	1230
WBIA	Augusta, Ga.	1230
WBIE	Marietta, Ga.	1050
WBIG	Greensboro, N.C.	1470
WBIL	Leesburg, Fla.	1410
WBIP	Booneville, Miss.	1400
WBIR	Knoxville, Tenn.	1240
WBIS	Bristol, Conn.	1440
WBIW	Bedford, Ind.	1340
WBIZ	Eau Claire, Wis.	1400
WBKH	Hattiesburg, Miss.	950
WBKN	Newton, Miss.	1410
WBKV	West Bend, Wis.	1470
WBLA	Elizabethtown, N.C.	1450
WBLE	Batesville, Miss.	1290
WBLF	Bellefonte, Pa.	1330
WBLG	Lexington, Ky.	1300
WBLJ	Dalton, Ga.	1230
WBLO	Evergreen, Ala.	1470
WBLR	Batesburg, S.C.	1430
WBLT	Bedford, Va.	1350
WBLU	Salem, Va.	1480
WBLY	Springfield, Ohio	1600
WBMA	Beaufort, N.C.	1400
WBMC	McMinnville, Tenn.	960
WBMD	Baltimore, Md.	750
WBMK	West Point, Ga.	1310
WBML	Macon, Ga.	1240
WBNC	Conway, N.H.	1050
WBNL	Boonville, Ind.	1540
WBNS	Columbus, Ohio	1460
WBNX	New York, N.Y.	1380
WBNY	Buffalo, N.Y.	1400
WBOB	Galax, Va.	1360
WBOC	Salisbury, Md.	960
WBOF	Virginia Beach, Va.	1600
WBOK	New Orleans, La.	800
WBOP	Pensacola, Fla.	980
WBOS	Brookline, Mass.	1600
WBOW	Terre Haute, Ind.	1230
WBOX	Bogalusa, La.	920
WBOY	Clarksburg, W.Va.	1400
WBPD	Orangeburg, S.C.	1580
WBPZ	Lock Haven, Pa.	1230
WBRB	Mt. Clemens, Mich.	1430
WBRC	Birmingham, Ala.	960
WBRD	Bradenton, Fla.	1420
WBRE	Wilkes-Barre, Pa.	1340
WBRG	Lynchburg, Va.	1050
WBRK	Pittsfield, Mass.	1340
WBRM	Marion, N.C.	1250
WBRN	Big Rapids, Mich.	1460
WBRO	Waynesboro, Ga.	1310
WBRT	Bardstown, Ky.	1320
WBRV	Boonville, N.Y.	900
WBRX	Berwick, Pa.	1280
WBRY	Waterbury, Conn.	1590
WBSC	Bennetsville, S.C.	1550
WBSM	New Bedford, Mass.	1420
WBSR	Pensacola, Fla.	1450
WBT	Charlotte, N.C.	1110
WBTA	Batavia, N.Y.	1490
WBTH	Williamson, W.Va.	1400
WBTM	Danville, Va.	1330
WBTN	Bennington, Vt.	1370
WBTO	Linton, Ind.	1600
WBUD	Trenton, N.J.	1260
WBUT	Butler, Pa.	1050
WBUX	Doylestown, Pa.	1570
WBUY	Lexington, N.C.	1440
WBUZ	Fredonia, N.Y.	1570
WBVL	Barbourville, Ky.	950
WBVP	Beaver Falls, Pa.	1230
WBYE	Calera, Ala.	1370
WBYS	Canton, Ill.	1560
WBZ	Boston, Mass.	1030
WBZA	Springfield, Mass.	1030
WBZY	Torrington, Conn.	990
WCAE	Pittsburgh, Pa.	1250
WCAL	Northfield, Minn.	770
WCAM	Camden, N.J.	1310
WCAO	Baltimore, Md.	600
WCAP	Lowell, Mass.	980
WCAR	Detroit, Mich.	1130
WCAS	Gadsden, Ala.	570
WCAT	Orange, Mass.	1390
WCAU	Philadelphia, Pa.	1210
WCAW	Charleston, W.Va.	1300
WCAX	Burlington, Vt.	620
WCAY	Cayce, S.C.	620
WCAZ	Carthage, Ill.	990
WCBA	Corning, N.Y.	1350
WCBC	Anderson, Ind.	1470
WCBD	Chicago, Ill.	820
WCBG	Chambersburg, Pa.	1590
WCBI	Columbus, Miss.	550
WCBL	Benton, Ky.	1290
WCBM	Baltimore, Md.	680
WCBQ	St. Helen, Mich.	1590
WCBS	New York, N.Y.	880
WCBT	Roanoke Rapids, N.C.	1230
WCBY	Cheboygan, Mich.	1240
WCCC	Hartford, Conn.	1290
WCCM	Lawrence, Mass.	800
WCCN	Neillsville, Wis.	1370
WCCO	Minneapolis, Minn.	830
WCCP	Savannah, Ga.	1450
WCDL	Carbondale, Pa.	1440
WCDJ	Edenton, N.C.	1260
WCDT	Winchester, Tenn.	1340
WCEC	Rocky Mount, N.C.	810
WCED	DuBois, Pa.	1420
WCEH	Hawkinsville, Ga.	610
WCEM	Cambridge, Md.	1240
WCEN	Mt. Pleasant, Mich.	1150
WCER	Charlotte, Mich.	1390
WCFL	Chicago, Ill.	1000
WCFR	Springfield, Vt.	1480
WCFV	Clifton Forge, Va.	1230
WCGA	Calhoun, Ga.	900
WCGC	Belmont, N.C.	1270
WCHA	Chambersburg, Pa.	800
WCHB	Inkster, Mich.	1440
WCHI	Chillicothe, Ohio	1350
WCHJ	Brookhaven, Miss.	1470
WCHK	Canton, Ga.	1290
WCHO	Washington Court House, Ohio	1250
WCHL	Chapel Hill, N.C.	1360
WCHN	Norwich, N.Y.	970
WCHS	Charleston, W.Va.	580
WCHV	Charlottesville, Va.	1260
WCIL	Carbondale, Ill.	1020
WCIN	Cincinnati, Ohio	1480
WCJU	Columbia, Miss.	1450
WCKB	Dunn, N.C.	780
WCKI	Greer, S.C.	1300
WCKR	Miami, Fla.	610
WCKY	Cincinnati, Ohio	1530
WCLA	Claxton, Ga.	1470
WCLB	Camilla, Ga.	1220
WCLC	Jamestown, Tenn.	1260
WCLD	Cleveland, Miss.	1490
WCLE	Cleveland, Tenn.	1570
WCLG	Morgantown, W.Va.	1300
WCLI	Corning, N.Y.	1450
WCLO	Janesville, Wis.	1230
WCLS	Columbus, Ga.	1580
WCLT	Newark, Ohio	1430
WCLW	Mansfield, Ohio	1570
WCMA	Corinth, Miss.	1230
WCMB	Harrisburg, Pa.	1460
WCMC	Wildwood, N.J.	1230
WCME	Brunswick, Maine	900
WCMI	Ashland, Ky.	1340
WCMN	Arecibo, P.R.	1280
WCMP	Pine City, Minn.	1350
WCMR	Elkhart, Ind.	1270
WCMS	Norfolk, Va.	1050
WCMT	Martin, Tenn.	1410
WCMW	Canton, Ohio	1060
WCMY	Ottawa, Ill.	1430
WCNB	Connersville, Ind.	1580
WCNC	Elizabeth City, N.C.	1240
WCNG	Canonsburg, Pa.	540
WCNH	Quincy, Fla.	1230
WCNR	Bloomsburg, Pa.	930
WCNT	Centralia, Ill.	1210
WCNU	Crestview, Fla.	1010
WCNX	Middletown, Conn.	1150
WCOA	Pensacola, Fla.	1370
WCOC	Meridian, Miss.	910
WCOG	Greensboro, N.C.	1320
WCOH	Newnan, Ga.	1400
WCOJ	Coatesville, Pa.	1420
WCOL	Columbus, Ohio	1230
WCOM	Parkersburg, W.Va.	1230
WCON	Cornelia, Ga.	1450
WCOP	Boston, Mass.	1150
WCOR	Lebanon, Tenn.	900
WCOS	Alma, Ga.	1400
WCOU	Lewiston, Maine	1240
WCOV	Montgomery, Ala.	1170
WCOW	Sparta, Wis.	1290
WCOY	Columbia, Pa.	1580
WCPA	Clearfield, Pa.	900
WCPC	Houston, Miss.	1320
WCPH	Etowah, Tenn.	1220
WCPK	College Park, Ga.	1570
WCPM	Cumberland, Ky.	1280
WCPO	Cincinnati, Ohio	1230
WCPS	Tarboro, N.C.	760
WCRA	Effingham, Ill.	1090
WCRB	Waltham, Mass.	1330
WCRE	Cheraw, S.C.	1420
WCRI	Scottsboro, Ala.	1050
WCRK	Morristown, Tenn.	1150
WCRL	Oneonta, Ala.	1570
WCRO	Johnstown, Pa.	1230
WCRR	Corinth, Miss.	1330
WCRS	Greenwood, S.C.	1450
WCRT	Birmingham, Ala.	1260
WCRV	Washington, N.J.	1580
WCRW	Chicago, Ill.	1240
WCRY	Macon, Ga.	900
WCSC	Charleston, S.C.	1390
WCSH	Portland, Maine	970
WCSI	Columbus, Ind.	1010
WCSR	Hillsdale, Mich.	1340
WCSS	Amsterdam, N.Y.	1490
WCST	Berkeley Springs, W.Va.	1010
WCTA	Andalusia, Ala.	920
WCTC	New Brunswick, N.J.	1450
WCTT	Corbin, Ky.	680
WCUB	Manitowoc, Wis.	980
WCUE	Akron, Ohio	1150
WCUM	Cumberland, Md.	1230
WCVA	Culpeper, Va.	1490
WCVI	Connellsville, Pa.	1340
WCVP	Murphy, N.C.	600
WCVS	Springfield, Ill.	1450
WCWC	Ripon, Wis.	1600
WCYB	Bristol, Va.	690
WCYN	Cynthiana, Ky.	1400
WDAD	Indiana, Pa.	1450
WDAE	Tampa, Fla.	1250
WDAF	Kansas City, Mo.	610
WDAK	Columbus, Ga.	540
WDAL	Meridian, Miss.	1330
WDAN	Danville, Ill.	1490
WDAR	Darlington, S.C.	1350
WDAS	Philadelphia, Pa.	1480
WDAT	South Daytona Beach, Fla.	1590
WDAX	McRae, Ga.	1410
WDAY	Fargo, N. Dak.	970
WDBC	Escanaba, Mich.	680
WDBF	Delray Beach, Fla.	1420
WDBJ	Roanoke, Va.	960
WDBL	Springfield, Tenn.	1590
WDBM	Statesville, N.C.	550
WDBO	Orlando, Fla.	580
WDBQ	Dubuque, Iowa	1490
WDCF	Dade City, Fla.	1350
WDCL	Tarpon Sprgs., Fla.	1470
WDCR	Hanover, N.H.	1340
WDDT	Greenville, Miss.	900
WDDY	Gloucester, Va.	1420
WDEA	Ellsworth, Me.	1350
WDEC	Americus, Ga.	1290
WDEF	Chattanooga, Tenn.	1370
WDEH	Sweetwater, Tenn.	800
WDEL	Wilmington, Del.	1150
WDEV	Waterbury, Vt.	550
WDEW	Westfield, Mass.	1570
WDGY	Minneapolis, Minn.	1130
WDIA	Memphis, Tenn.	1070
WDIG	Dothan, Ala.	1450
WDIX	Orangeburg, S.C.	1150
WDKD	Kingstree, S.C.	1310
WDKN	Dickson, Tenn.	1260
WDLA	Walton, N.Y.	1270
WDLB	Marshfield, Wis.	1450
WDLC	Port Jervis, N.Y.	1490
WDLT	Indianola, Miss.	1380
WDLP	Panama City, Fla.	590
WDMF	Buford, Ga.	1460
WDMG	Douglas, Ga.	860
WDMJ	Marquette, Mich.	1320
WDNC	Durham, N.C.	620
WDNE	Elkins, W.Va.	1240
WDNG	Anniston, Ala.	1450
WDNT	Dayton, Tenn.	1280
WDOB	Canton, Miss.	1370
WDOC	Prestonsburg, Ky.	1310
WDOD	Chattanooga, Tenn.	1310
WDOE	Dunkirk, N.Y.	1410
WDOG	Marine City, Mich.	1590
WDOK	Cleveland, Ohio	1260
WDOL	Athens, Ga.	1470
WDON	Wheaton, Md.	1540
WDOR	Sturgeon Bay, Wis.	910
WDOS	Oneonta, N.Y.	730
WDOT	Burlington, Va.	1400
WDOV	Dover, Del.	1410
WDQN	DuQuoin, Ill.	1580
WDRC	Hartford, Conn.	1360
WDRF	Chester, Pa.	1590
WDSC	Dillon, S.C.	800
WDSG	Dyersburg, Tenn.	1450
WDSK	Cleveland, Miss.	1410
WDSM	Superior, Wis.	710
WDSP	DeFuniak Springs, Florida	1280
WDSR	Lake City, Fla.	1340
WDSU	New Orleans, La.	1280
WDTV	St. John, V.I.	1190
WDUN	Gainesville, Ga.	1240
WDUX	Waupaca, Wis.	800
WDUZ	Green Bay, Wis.	1400
WDVA	Danville, Va.	1250
WDVH	Gainesville, Fla.	980
WDVM	Pocomoke City, Md.	540
WDWD	Dawson, Ga.	990
WDWS	Champaign, Ill.	1400
WDXB	Chattanooga, Tenn.	1490
WDXE	Lawrenceburg, Tenn.	1370
WDXI	Jackson, Tenn.	1310
WDXL	Lexington, Tenn.	1490
WDXN	Clarksville, Tenn.	540
WDXR	Paducah, Ky.	1560
WDZ	Decatur, Ill.	1050
WEAB	Greer, S.C.	800
WEAG	Alcoa, Tenn.	1470
WEAM	Arlington, Va.	1390
WEAN	Providence, R.I.	790
WEAS	Decatur, Ga.	1010
WEAT	W. Palm Beach, Fla.	850
WEAU	Eau Claire, Wis.	790
WEAV	Plattsburg, N.Y.	960
WEAW	Evanston, Ill.	1330
WEBB	Baltimore, Md.	1360
WEBC	Duluth, Minn.	560
WEBJ	Brewton, Ala.	1240
WEBO	Owego, N.Y.	1330
WEBQ	Harrisburg, Ill.	1240
WEBR	Buffalo, N.Y.	970
WEBY	Milton, Fla.	1330
WECL	Eau Claire, Wis.	1050
WEDC	Chicago, Ill.	1240
WEDO	McKeesport, Pa.	810
WEDR	Birmingham, Ala.	1220
WEEB	Southern Pines, N.C.	990
WEED	Rocky Mount, N.C.	1390
WEEI	Boston, Mass.	590
WEEK	Peoria, Ill.	1350
WEEL	Fairfax, Va.	1310
WEEN	Lafayette, Tenn.	1460
WEEP	Pittsburgh, Pa.	1080
WEER	Warrenton, Va.	1570
WEEU	Reading, Pa.	850
WEEX	Easton, Pa.	1230
WEGO	Concord, N.C.	1410
WEHH	Elmira Heights-Horseheads, N.Y.	1590
WEIC	Charleston, Ill.	1270
WEIM	Fitchburg, Mass.	1280
WEIR	Weirton, W.Va.	1430
WEJL	Scranton, Pa.	630
WEKR	Fayetteville, Tenn.	1240
WEKY	Richmond, Ky.	1340
WEKZ	Monroe, Wis.	1260
WELB	Elba, Ala.	1350
WELC	Welch, W.Va.	1150
WELD	Fisher, W.Va.	690
WELI	New Haven, Conn.	960
WELK	Charlottesville, Va.	1010
WELL	Battle Creek, Mich.	1400
WELM	Elmira, N.Y.	1400
WELO	Tupelo, Miss.	1490
WELP	Easley, S.C.	1360
WELR	Roanoke, Ala.	1360
WELS	Kinston, N.C.	1010
WELY	Ely, Minn.	1450
WEMB	Erwin, Tenn.	1420
WEMP	Milwaukee, Wis.	1250
WENA	Bayamon, P.R.	1560
WENC	Whiteville, N.C.	1220
WEND	Baton Rouge, La.	1380
WENE	Endicott, N.Y.	1430
WENK	Union City, Tenn.	1240
WENN	Bessemer, Ala.	1450
WENO	Madison, Tenn.	1430
WENT	Gloversville, N.Y.	1340
WENY	Elmira, N.Y.	1230
WEOA	Evansville, Ind.	1400
WEOK	Poughkeepsie, N.Y.	1390
WEOL	Elyria, Ohio	930
WEPG	S. Pittsburgh, Tenn.	910
WEPM	Martinsburg, W.Va.	1340
WERC	Erie, Pa.	1260
WERD	Atlanta, Ga.	860
WERE	Cleveland, Ohio	1300
WERH	Hamilton, Ala.	970
WERI	Westerly, R.I.	1230
WERT	Van Wert, Ohio	1220
WESA	Charleroi, Pa.	940
WESB	Bradford, Pa.	1490
WESC	Greenville, S.C.	660
WESO	Southbridge, Mass.	970
WESR	Tasley, Va.	1330

C.L.	Location	Kc.
WEST	Easton, Pa.	1400
WESX	Salem, Mass.	1230
WESY	Leland, Miss.	1580
WETB	Johnson City, Tenn.	790
WETO	Gadsden, Ala.	930
WETU	Wetumpka, Ala.	1250
WETZ	New Martinsville, West Virginia	1330
WEUC	Ponce, P.R.	1420
WEUP	Huntsville, Ala.	1600
WEVA	Emporia, Va.	860
WEVD	New York, N.Y.	1330
WEVE	Eveleth, Minn.	1340
WEW	St. Louis, Mo.	770
WEWO	Laurinburg, N.C.	1080
WEXL	Royal Oak, Mich.	1340
WEYE	Sanford, N.C.	1290
WEZB	Homewood, Ala.	1320
WEZE	Boston, Mass.	1260
WEZL	Richmond, Va.	1590
WEZN	Elizabethtown, Pa.	1600
WEZY	Cocoa, Fla.	1480
WFAA	Dallas, Tex.	570, 820
WFAH	Alliance, Ohio	1310
WFAR	Farrell, Pa.	1470
WFAS	White Plains, N.Y.	1230
WFAU	Augusta, Me.	1340
WFAX	Falls Church, Va.	1220
WFBC	Greenville, S.C.	1330
WFBF	Fernandina Bch., Fla.	1570
WFBG	Altoona, Pa.	1340
WFBL	Syracuse, N.Y.	1390
WFBM	Indianapolis, Ind.	1260
WFBR	Baltimore, Md.	1300
WFBS	Ft. Walton Bch., Fla.	950
WFDF	Flint, Mich.	910
WFDR	Manchester, Ga.	1370
WFEA	Manchester, N.Y.	1370
WFEB	Sylacauga, Ala.	1340
WFEC	Miami, Fla.	1220
WFGM	Fitchburg, Mass.	960
WFGN	Gaffney, S.C.	1570
WFHG	Bristol, Va.	980
WFHK	Pell City, Ala.	1430
WFHR	Wis. Rapids, Wis.	1340
WFIG	Sumter, S.C.	1290
WFIL	Philadelphia, Pa.	560
WFIN	Findlay, Ohio	1330
WFIS	Fountain Inn, S.C.	1600
WFIW	Fairfield, Ill.	1390
WFKN	Franklin, Ky.	1220
WFKY	Frankfort, Ky.	1490
WFLA	Tampa, Fla.	970
WFLB	Fayetteville, N.C.	1490
WFLN	Philadelphia, Pa.	900
WFLO	Farmville, Va.	870
WFLR	Dundee, N.Y.	1570
WFLW	Monticello, Ky.	1360
WFMC	Goldsboro, N.C.	730
WFMD	Frederick, Md.	930
WFMH	Cullman, Ala.	1460
WFMJ	Youngstown, Ohio	1390
WFMO	Fairmont, N.C.	860
WFMW	Madisonville, Ky.	730
WFNC	Fayetteville, N.C.	1390
WFNS	Burlington, N.C.	1150
WFOB	Fostoria, Ohio	1430
WFOM	Marietta, Ga.	1230
WFOR	Hattiesburg, Miss.	1400
WFOX	Milwaukee, Wis.	860
WFOY	St. Augustine, Fla.	1240
WFPA	Fort Payne, Ala.	1400
WFPG	Atlantic City, N.J.	1450
WFPM	Fort Valley, Ga.	1150
WFPR	Hammond, La.	1400
WFRA	Franklin, Pa.	1430
WFRB	Frostburg, Md.	740
WFRC	Reidsville, N.C.	1600
WFRL	Freeport, Ill.	1570
WFRM	Coudersport, Pa.	600
WFRO	Fremont, Ohio	900
WFRX	West Frankfort, Ill.	1300
WFSC	Franklin, N.C.	1050
WFST	Caribou, Maine	600
WFTC	Kinston, N.C.	960
WFTG	London, Ky.	1400
WFTL	Ft. Lauderdale, Fla.	1400
WFTM	Maysville, Ky.	1240
WFTR	Front Royal, Va.	1450
WFTW	Ft. Walton Beach, Florida	1260
WFUL	Fulton, Ky.	1270
WFUN	Huntsville, Ala.	1450
WFUR	Grand Rapids, Mich.	1570
WFVA	Fredericksburg, Va.	1230
WFVG	Fuquay Sprgs., N.C.	1460
WFWL	Camden, Tenn.	1220
WFYC	Alma, Mich.	1280
WFYI	Mineola, N.Y.	1520
WGAA	Cedartown, Ga.	1340
WGAC	Augusta, Ga.	580
WGAD	Gadsden, Ala.	1350
WGAF	Valdosta, Ga.	910
WGAI	Elizabeth City, N.C.	560
WGAL	Lancaster, Pa.	1490
WGAN	Portland, Maine	560
WGAP	Maryville, Tenn.	1400
WGAR	Cleveland, Ohio	1220
WGAU	Athens, Ga.	1340
WGAW	Gardner, Mass.	1340
WGAY	Silver Spring, Md.	1050
WGBA	Columbus, Ga.	1270
WGBB	Freeport, N.Y.	1240
WGBF	Evansville, Ind.	1280
WGBG	Greensboro, N.C.	1400
WGBI	Scranton, Pa.	910
WGBR	Goldsboro, N.C.	1150
WGBS	Miami, Fla.	710
WGCB	Red Lion, Pa.	1440
WGCD	Chester, S.C.	1490
WGCM	Gulfport, Miss.	1240
WGEA	Geneva, Ala.	1150
WGEE	Indianapolis, Ind.	1590
WGEM	Quincy, Ill.	1440
WGES	Chicago, Ill.	1390
WGET	Gettysburg, Pa.	1450
WGEZ	Beloit, Wis.	1490
WGFS	Covington, Ga.	1430
WGGA	Gainesville, Ga.	550
WGGG	Gainesville, Fla.	1230
WGGH	Marion, Ill.	1150
WGGO	Salamanca, N.Y.	1590
WGH	Newport News, Va.	1310
WGHM	Skowegan, Maine	1150
WGHN	Grd. Haven, Mich.	1370
WGHQ	Saugerties, N.Y.	920
WGIG	Brunswick, Ga.	1440
WGIL	Galesburg, Ill.	1400
WGIR	Manchester, N.H.	610
WGIV	Charlotte, N.C.	1600
WGKA	Atlanta, Ga.	1600
WGKV	Charleston, W.Va.	1300
WGL	Fort Wayne, Ind.	1250
WGLC	Centreville, Miss.	1580
WGLI	Babylon, N.Y.	1290
WGMA	Hollywood, Fla.	1320
WGMS	Washington, D.C.	570
WGN	Chicago, Ill.	720
WGNI	Wilmington, N.C.	1450
WGNS	Murfreesboro, Tenn.	1450
WGNY	Newburgh, N.Y.	1220
WGOA	Winter Garden, Fla.	1600
WGOK	Mobile, Ala.	900
WGOL	Goldsboro, N.C.	1300
WGOR	Georgetown, Ky.	1580
WGOV	Valdosta, Ga.	950
WGPA	Bethlehem, Pa.	1100
WGPC	Albany, Ga.	1450
WGR	Buffalo, N.Y.	550
WGRA	Cairo, Ga.	790
WGRD	Grand Rapids, Mich.	1410
WGRF	Aguadella, P.R.	1340
WGRM	Greenwood, Miss.	1240
WGRO	Lake City, Fla.	960
WGRV	Greeneville, Tenn.	1340
WGRY	Gary, Ind.	1370
WGSA	Savannah, Ga.	1400
WGSM	Huntington, N.Y.	740
WGSR	Millen, Ga.	1570
WGST	Atlanta, Ga.	920
WGSV	Guntersville, Ala.	1270
WGSW	Greenwood, S.C.	1350
WGTA	Summerville, Ga.	950
WGTC	Greenville, N.C.	1590
WGTL	Kannapolis, N.C.	870
WGTM	Wilson, N.C.	590
WGTN	Georgetown, S.C.	1400
WGTO	Cypress Gardens, Fla.	540
WGUS	North Augusta, S.C.	1600
WGUY	Bangor, Maine	1230
WGVA	Geneva, N.Y.	1240
WGVM	Greenville, Miss.	1260
WGWC	Selma, Ala.	1340
WGWR	Asheboro, N.C.	1260
WGY	Schenectady, N.Y.	810
WGYV	Greenville, Ala.	1380
WHA	Madison, Wis.	970
WHAB	Baxley, Ga.	1260
WHAI	Greenfield, Mass.	1240
WHAK	Rogers City, Mich.	960
WHAL	Shelbyville, Tenn.	1400
WHAM	Rochester, N.Y.	1180
WHAP	Hopewell, Va.	1340
WHAR	Clarksburg, W.Va.	1340
WHAS	Louisville, Ky.	840
WHAT	Philadelphia, Pa.	1340
WHAV	Haverhill, Mass.	1490
WHAW	Weston, W.Va.	1450
WHAY	New Britain, Conn.	910
WHAZ	Troy, N.Y.	1330
WHB	Kansas City, Mo.	710
WHBB	Selma, Ala.	1490
WHBC	Canton, Ohio	1480
WHBF	Rock Island, Ill.	1270
WHBG	Harrisonburg, Va.	1360
WHBI	Newark, N.J.	1280
WHBL	Sheboygan, Wis.	1330
WHBN	Harrodsburg, Ky.	1420
WHBO	Tampa, Fla.	1050
WHBQ	Memphis, Tenn.	560
WHBT	Harriman, Tenn.	1600
WHBU	Anderson, Ind.	1240
WHBY	Appleton, Wis.	1230
WHCC	Waynesville, N.C.	1400
WHCO	Sparta, Ill.	1230
WHCU	Ithaca, N.Y.	870
WHDF	Houghton, Mich.	1400
WHDH	Boston, Mass.	850
WHDL	Olean, N.Y.	1450
WHDM	McKenzie, Tenn.	1440
WHEB	Portsmouth, N.H.	750
WHEC	Rochester, N.Y.	1460
WHEE	Martinsville, Va.	1370
WHEN	Syracuse, N.Y.	620
WHER	Memphis, Tenn.	1430
WHEY	Millington, Tenn.	1220
WHFB	Benton Harbor, Mich.	1060
WHFC	Cicero, Ill.	1450
WHGB	Harrisburg, Pa.	1400
WHGR	Houghton L., Mich.	1290
WHHH	Warren, Ohio	1440
WHHY	Montgomery, Ala.	1440
WHHM	Memphis, Tenn.	1340
WHIE	Griffin, Ga.	1320
WHIL	Medford, Mass.	1430
WHIM	E. Providence, R.I.	1110
WHIN	Gallatin, Tenn.	1010
WHIO	Dayton, Ohio	1290
WHIP	Mooresville, N.C.	1350
WHIR	Danville, Ky.	1230
WHIS	Bluefield, W.Va.	1440
WHIT	New Bern, N.C.	1450
WHIY	Orlando, Fla.	1270
WHIZ	Zanesville, Ohio	1240
WHJB	Greensburg, Pa.	620
WHJC	Matawan, W.Va.	1360
WHK	Cleveland, Ohio	1420
WHKK	Akron, Ohio	640
WHKP	Hendersonville, N.C.	1450
WHKY	Hickory, N.C.	1290
WHLB	Virginia, Minn.	1400
WHLD	Niagara Falls, N.Y.	1270
WHLF	South Boston, Va.	1400
WHLI	Hempstead, N.Y.	1100
WHLL	Wheeling, W.Va.	1600
WHLM	Bloomsburg, Pa.	550
WHLN	Harlan, Ky.	1410
WHLP	Centerville, Tenn.	1570
WHLS	Port Huron, Mich.	1450
WHLT	Huntington, Ind.	1300
WHMA	Anniston, Ala.	1390
WHMI	Howell, Mich.	1350
WHMP	Northampton, Mass.	1400
WHMS	Charleston, W.Va.	1490
WHNC	Henderson, N.C.	890
WHNY	McComb, Miss.	1250
WHO	Des Moines, Iowa	1040
WHOA	San Juan, P.R.	1400
WHOC	Philadelphia, Miss.	1490
WHOK	Lancaster, Ohio	1320
WHOL	Allentown, Pa.	600
WHOM	New York, N.Y.	1480
WHOO	Orlando, Fla.	990
WHOP	Hopkinsville, Ky.	1230
WHOS	Decatur, Ala.	800
WHOT	Campbell, Ohio	1570
WHOW	Clinton, Ill.	1520
WHP	Harrisburg, Pa.	580
WHPB	Belton, S.C.	1390
WHPE	High Point, N.C.	1070
WHRT	Hartselle, Ala.	860
WHRV	Ann Arbor, Mich.	1600
WHRW	Bowling Green, Ohio	730
WHSC	Hartsville, S.C.	1450
WHSM	Hayward, Wis.	910
WHSY	Hattiesburg, Miss.	1230
WHTC	Holland, Mich.	1450
WHTG	Eatontown, N.J.	1410
WHTN	Huntington, W.Va.	800
WHUB	Cookeville, Tenn.	1400
WHUC	Hudson, N.Y.	1230
WHUM	Reading, Pa.	1240
WHUN	Huntington, Pa.	1150
WHVF	Wausau, Wis.	1230
WHVH	Henderson, N.C.	1450
WHVR	Hanover, Pa.	1280
WHWB	Rutland, Vt.	1000
WHYE	Roanoke, Va.	910
WHYL	Carlisle, Pa.	960
WHYN	Springfield, Mass.	560
WHYS	Ocala, Fla.	1370
WIAC	San Juan, P.R.	580
WIAM	Williamston, N.C.	900
WIBA	Madison, Wis.	1310
WIBB	Macon, Ga.	1280
WIBC	Indianapolis, Ind.	1070
WIBG	Philadelphia, Pa.	990
WIBM	Jackson, Mich.	1450
WIBR	Baton Rouge, La.	1300
WIBU	Poynette, Wis.	1240
WIBV	Belleville, Ill.	1260
WIBW	Topeka, Kans.	580
WIBX	Utica, N.Y.	950
WICA	Ashtabula, Ohio	970
WICC	Bridgeport, Conn.	600
WICE	Providence, R.I.	1290
WICH	Norwich, Conn.	1310
WICK	Scranton, Pa.	1400
WICO	Salisbury, Md.	1320
WICU	Erie, Pa.	1330
WICY	Malone, N.Y.	1490
WIDE	Biddeford, Maine	1400
WIDU	Fayetteville, N.C.	1600
WIEL	Elizabethtown, Ky.	1400
WIFM	Elkin, N.C.	1540
WIGM	Medford, Wis.	1490
WIIN	Atlanta, Ga.	970
WIKB	Iron River, Mich.	1230
WIKC	Bogalusa, La.	1490
WIKE	Newport, Vt.	1490
WIKY	Evansville, Ind.	820
WIL	St. Louis, Mo.	1430
WILA	Danville, Va.	1580
WILD	Boston, Mass.	1090
WILE	Cambridge, Ohio	1270
WILI	Willimantic, Conn.	1400
WILK	Wilkes-Barre, Pa.	980
WILL	Urbana, Ill.	580
WILM	Wilmington, Del.	1450
WILO	Frankfort, Ind.	1570
WILS	Lansing, Mich.	1320
WILZ	St. Petersburg Beach, Florida	1590
WIMA	Lima, Ohio	1150
WIMO	Winder, Ga.	1300
WIMS	Michigan City, Ind.	1420
WINA	Charlottesville, Va.	1400
WINC	Winchester, Va.	1400
WIND	Chicago, Ill.	560
WINE	Kenmore, N.Y.	1080
WINF	Manchester, Conn.	1230
WING	Dayton, Ohio	1410
WINI	Murphysboro, Ill.	1420
WINK	Fort Myers, Fla.	1240
WINN	Louisville, Ky.	1240
WINQ	Tampa, Fla.	1010
WINR	Binghamton, N.Y.	680
WINS	New York, N.Y.	1010
WINT	Winter Haven, Fla.	1360
WINX	Rockville, Md.	1600
WINZ	Miami, Fla.	940
WIOD	Sanford, Fla.	1360
WIOK	Mount Dora, Fla.	1580
WION	Ionia, Mich.	1430
WIOU	Kokomo, Ind.	1350
WIP	Philadelphia, Pa.	610
WIPC	Lake Wales, Fla.	1280
WIPR	San Juan, P.R.	940
WIPS	Ticonderoga, N.Y.	1250
WIRA	Fort Pierce, Fla.	1400
WIRB	Enterprise, Ala.	600
WIRC	Hickory, N.C.	630
WIRE	Indianapolis, Ind.	1430
WIRJ	Humboldt, Tenn.	740
WIRK	W. Palm Beach, Fla.	1290
WIRL	Peoria, Ill.	1290
WIRO	Ironton, Ohio	1230
WIRY	Plattsburg, N.Y.	1340
WIS	Columbia, S.C.	560
WISC	Madison, Wis.	1480
WISE	Asheville, N.C.	1310
WISH	Indianapolis, Ind.	1310
WISK	So. St. Paul, Minn.	630
WISL	Shamokin, Pa.	1480
WISN	Milwaukee, Wis.	1150
WISO	Ponce, P.R.	1260
WISP	Kinston, N.C.	1230
WISR	Butler, Pa.	680
WIST	Charlotte, N.C.	930
WISV	Viroqua, Wis.	1360
WITA	San Juan, P.R.	1140
WITH	Baltimore, Md.	1230
WITT	Lewisburg, Pa.	1010
WITY	Danville, Ill.	980
WITZ	Jasper, Ind.	990
WIVI	Christiansted, V.I.	1040
WIVK	Knoxville, Tenn.	860
WIVV	Vieques, P.R.	1370
WIVY	Jacksonville, Fla.	1050
WIZE	Springfield, Ohio	1340
WIZZ	Streator, Ill.	1250
WJAC	Johnstown, Pa.	1400
WJAG	Norfolk, Nebr.	780
WJAK	Jackson, Tenn.	1460
WJAM	Marion, Ala.	1310
WJAR	Providence, R.I.	920
WJAS	Pittsburgh, Pa.	1320
WJAT	Swainsboro, Ga.	800
WJAX	Jacksonville, Fla.	930
WJAY	Mullins, S.C.	1280
WJAZ	Albany, Ga.	1050
WJBB	Haleyville, Ala.	1230
WJBC	Bloomington, Ill.	1230
WJBD	Salem, Ill.	1350
WJBK	Detroit, Mich.	1500
WJBL	Holland, Mich.	1260
WJBO	Baton Rouge, La.	1150
WJBS	DeLand, Fla.	1490
WJBW	New Orleans, La.	1230
WJCD	Seymour, Ind.	1390
WJCM	Sebring, Fla.	960
WJDA	Quincy, Mass.	1300
WJDB	Thomasville, Ala.	630
WJDX	Jackson, Miss.	620
WJDY	Salisbury, Md.	1470
WJEF	Grand Rapids, Mich.	1230
WJEH	Gallipolis, Ohio	990
WJEJ	Hagerstown, Md.	1240
WJEM	Valdosta, Ga.	1150
WJER	Dover, Ohio	1450
WJET	Erie, Pa.	1400
WJGD	Columbia, Tenn.	1280
WJHB	Talladega, Ala.	1580
WJHL	Johnson City, Tenn.	910
WJHO	Opelika, Ala.	1400
WJIG	Tullahoma, Tenn.	740
WJIM	Lansing, Mich.	1240
WJIV	Savannah, Ga.	900
WJJC	Commerce, Ga.	1270
WJJD	Chicago, Ill.	1160
WJJL	Niagara Falls, N.Y.	1440
WJJM	Lewisburg, Tenn.	1490
WJKO	Springfield, Mass.	1600
WJLB	Detroit, Mich.	1400
WJLD	Homewood, Ala.	1400
WJLK	Asbury Park, N.J.	1310
WJLS	Beckley, W.Va.	560
WJMA	Orange, Va.	1340
WJMB	Brookhaven, Miss.	1340
WJMC	Rice Lake, Wis.	1240
WJMJ	Philadelphia, Pa.	1540
WJMO	Cleveland Hgts., Ohio	1490
WJMR	New Orleans, La.	990
WJMS	Ironwood, Mich.	630
WJMW	Athens, Ala.	730
WJMX	Florence, S.C.	970
WJNC	Jacksonville, N.C.	1240
WJNO	W. Palm Beach, Fla.	1230
WJOB	Hammond, Ind.	1230
WJOC	Jamestown, N.Y.	1340
WJOE	Ward Ridge, Fla.	1570
WJOI	Florence, Ala.	1340
WJOL	Joliet, Ill.	1340
WJON	St. Cloud, Minn.	1240
WJOT	Lake City, S.C.	1260
WJOY	Burlington, Vt.	1230
WJPA	Washington, Pa.	1450
WJPD	Ishpeming, Mich.	1240
WJPF	Herrin, Ill.	1340
WJPG	Green Bay, Wis.	1440

C.L.	Location	Kc.
WJPR	Greenville, Miss.	1330
WJPS	Evansville, Ind.	1330
WJQS	Jackson, Miss.	1400
WJR	Detroit, Mich.	760
WJRD	Tuscaloosa, Ala.	1150
WJRI	Lenoir, N.C.	1340
WJSB	Crestview, Fla.	1050
WJSO	Jonesboro, Tenn.	1590
WJTN	Jamestown, N.Y.	1240
WJUN	Mexico, Pa.	1220
WJVA	South Bend, Ind.	1580
WJW	Cleveland, Ohio	850
WJWL	Georgetown, Del.	900
WJWS	South Hill, Va.	1370
WJXN	Jackson, Miss.	1450
WJZM	Clarksville, Tenn.	1400
WKAB	Mobile, Ala.	840
WKAI	Macomb, Ill.	1510
WKAL	Rome, N.Y.	1450
WKAM	Goshen, Ind.	1460
WKAN	Kankakee, Ill.	1320
WKAP	Allentown, Pa.	1320
WKAQ	San Juan, P.R.	580
WKAR	East Lansing, Mich.	870
WKAT	Miami Beach, Fla.	1360
WKAY	Glasgow, Ky.	1490
WKAZ	Charleston, W.Va.	950
WKBC	N. Wilkesboro, N.C.	810
WKBH	La Crosse, Wis.	1410
WKBI	St. Mary's, Pa.	1400
WKBJ	Milan, Tenn.	1600
WKBL	Covington, Tenn.	1250
WKBN	Youngstown, Ohio	570
WKBO	Harrisburg, Pa.	1230
WKBR	Manchester, N.H.	1240
WKBV	Richmond, Ind.	1490
WKBW	Buffalo, N.Y.	1520
WKBZ	Muskegon, Mich.	850
WKCB	Berlin, N.H.	1230
WKCT	Bowling Green, Ky.	930
WKDA	Nashville, Tenn.	1240
WKDK	Newberry, S.C.	1240
WKDL	Clarksdale, Miss.	1600
WKDN	Camden, N.J.	800
WKDX	Hamlet, N.C.	1400
WKEI	Kewanee, Ill.	1450
WKEN	Dover, Del.	1600
WKEU	Griffin, Ga.	1450
WKEY	Covington, Va.	1340
WKGN	Knoxville, Tenn.	1340
WKHM	Jackson, Mich.	970
WKIC	Hazard, Ky.	1390
WKID	Urbana, Ill.	1580
WKIK	Leonardtown, Md.	1370
WKIN	Kingsport, Tenn.	1320
WKIP	Poughkeepsie, N.Y.	1450
WKIS	Orlando, Fla.	740
WKIX	Raleigh, N.C.	850
WKJB	Mayaguez, P.R.	710
WKJG	Fort Wayne, Ind.	1380
WKKO	Cocoa, Fla.	860
WKKS	Vanceburg, Ky.	1570
WKLA	Ludington, Mich.	1450
WKLC	St. Albans, W.Va.	1300
WKLE	Washington, Ga.	1370
WKLF	Clanton, Ala.	980
WKLK	Cloquet, Minn.	1230
WKLM	Wilmington, N.C.	980
WKLO	Louisville, Ky.	1080
WKLV	Blackstone, Va.	1440
WKLX	Paris, Ky.	1440
WKLY	Hartwell, Ga.	980
WKLZ	Kalamazoo, Mich.	1470
WKMC	Roaring Sprgs., Pa.	1370
WKMF	Flint, Mich.	1470
WKMH	Dearborn, Mich.	1310
WKMI	Kalamazoo, Mich.	1360
WKMT	Kings Mtn., N.C.	1220
WKNB	New Britain, Conn.	840
WKNE	Keene, N.H.	1290
WKNX	Saginaw, Mich.	1210
WKNY	Kingston, N.Y.	1490
WKOA	Hopkinsville, Ky.	1480
WKOK	Sunbury, Pa.	1240
WKOP	Binghamton, N.Y.	1360
WKOV	Wellston, Ohio	1330
WKOW	Madison, Wis.	1070
WKOX	Framingham, Mass.	1190
WKOY	Bluefield, W.Va.	1240
WKOZ	Kosciusko, Miss.	1350
WKPA	New Kensington, Pa.	1150
WKPT	Kingsport, Tenn.	1400
WKRC	Cincinnati, Ohio	550
WKRK	Murphy, N.C.	1390
WKRG	Mobile, Ala.	710
WKRM	Columbia, Tenn.	1340
WKRO	Cairo, Ill.	1490
WKRS	Waukegan, Ill.	1220
WKRT	Cortland, N.Y.	920
WKRZ	Oil City, Pa.	1340
WKSB	Milford, Del.	930
WKSR	Pulaski, Tenn.	1420
WKST	New Castle, Pa.	1280
WKTC	Charlotte, N.C.	1310
WKTF	Warrenton, Va.	1420
WKTG	Thomasville, Ga.	730
WKTL	Sheboygan, Wis.	950
WKTM	Mayfield, Ky.	1050
WKTQ	South Paris, Maine	1450
WKTX	Atlantic Beach, Fla.	1600
WKTY	LaCrosse, Wis.	580
WKUL	Cullman, Ala.	1340
WKVA	Lewistown, Pa.	920
WKVM	San Juan, P.R.	810
WKWF	Key West, Fla.	1600
WKWK	Wheeling, W.Va.	1400
WKXL	Concord, N.H.	1450
WKXV	Knoxville, Tenn.	900

C.L.	Location	Kc.
WKXY	Sarasota, Fla.	930
WKY	Oklahoma City, Okla.	930
WKYB	Paducah, Ky.	570
WKYR	Keyser, W.Va.	1270
WKYW	Louisville, Ky.	900
WKZO	Kalamazoo, Mich.	590
WLAC	Nashville, Tenn.	1510
WLAD	Danbury, Conn.	800
WLAF	LaFollette, Tenn.	1450
WLAG	La Grange, Ga.	1240
WLAK	Lakeland, Fla.	1430
WLAM	Lewiston, Maine	1470
WLAN	Lancaster, Pa.	1390
WLAP	Lexington, Ky.	630
WLAQ	Rome, Ga.	1410
WLAR	Athens, Tenn.	1450
WLAT	Conway, S.C.	1330
WLAU	Laurel, Miss.	1600
WLAV	Grand Rapids, Mich.	1340
WLAW	Lawrenceville, Ga.	1360
WLAY	Muscle Shoals, Ala.	1450
WLBA	Gainesville, Ga.	1580
WLBB	Carrollton, Ga.	1100
WLBC	Muncie, Ind.	1340
WLBE	Leesburg, Fla.	790
WLBG	Laurens, S.C.	860
WLBH	Mattoon, Ill.	1170
WLBJ	Bowling Green, Ky.	1410
WLBK	DeKalb, Ill.	1360
WLBL	Auburndale, Wis.	930
WLBN	Lebanon, Ky.	1590
WLBR	Lebanon, Pa.	1270
WLBZ	Bangor, Maine	620
WLCK	Scottsville, Ky.	1250
WLCM	Lancaster, S.C.	1360
WLCO	Eustis, Fla.	1240
WLCS	Baton Rouge, La.	910
WLCX	LaCrosse, Wis.	1490
WLDB	Atlantic City, N.J.	1490
WLDS	Jacksonville, Ill.	1180
WLDY	Ladysmith, Wis.	1340
WLEA	Hornell, N.Y.	1480
WLEC	Sandusky, Ohio	1450
WLEE	Richmond, Va.	1480
WLEM	Emporium, Pa.	1250
WLEO	Ponce, P.R.	1170
WLET	Toccoa, Ga.	1420
WLEU	Erie, Pa.	1450
WLEW	Bad Axe, Mich.	1340
WLFA	Lafayette, Ga.	1590
WLFH	Little Falls, N.Y.	1230
WLIB	New York, N.Y.	1190
WLIK	Newport, Tenn.	1270
WLIL	Lenoir, Tenn.	730
WLIP	Kenosha, Wis.	1050
WLIS	Old Saybrook, Conn.	1420
WLIV	Livingston, Tenn.	920
WLLH	Lowell, Mass.	1400
WLLY	Richmond, Va.	1320
WLMJ	Jackson, Ohio	1280
WLNA	Peekskill, N.Y.	1420
WLNH	Laconia, N.H.	1350
WLOA	Braddock, Pa.	1550
WLOB	Portland, Maine	1310
WLOE	Leaksville, N.C.	1490
WLOF	Orlando, Fla.	950
WLOG	Logan, W.Va.	1230
WLOH	Princeton, W.Va.	1490
WLOI	LaPorte, Ind.	1540
WLOK	Memphis, Tenn.	1480
WLOL	Minneapolis, Minn.	1330
WLON	Lincolnton, N.C.	1050
WLOS	Asheville, N.C.	1380
WLOU	Louisville, Ky.	1350
WLOW	Portsmouth, Va.	1400
WLOX	Biloxi, Miss.	1490
WLPM	Suffolk, Va.	1450
WLPO	LaSalle, Ill.	1220
WLRP	New Albany, Ind.	1570
WLS	Chicago, Ill.	890
WLSB	Copper Hill, Tenn.	1400
WLSC	Loris, S.C.	1570
WLSD	Big Stone Gap, Va.	1220
WLSE	Wallace, N.C.	1400
WLSH	Lansford, Pa.	1410
WLSI	Pikeville, Ky.	900
WLSM	Louisville, Miss.	1270
WLST	Escanaba, Mich.	600
WLSV	Wellsville, N.Y.	790
WLTC	Gastonia, N.C.	1370
WLVA	Lynchburg, Va.	590
WLW	Cincinnati, Ohio	700
WLYC	Williamsport, Pa.	1050
WLYN	Lynn, Mass.	1360
WMAB	Munising, Mich.	1400
WMAF	Madison, Fla.	1230
WMAG	Forest, Miss.	860
WMAJ	State College, Pa.	1450
WMAK	Nashville, Tenn.	1300
WMAL	Washington, D.C.	630
WMAM	Marinette, Wis.	570
WMAN	Mansfield, Ohio	1400
WMAP	Monroe, N.C.	1060
WMAQ	Chicago, Ill.	670
WMAS	Springfield, Mass.	1450
WMAX	Grand Rapids, Mich.	1480
WMAY	Springfield, Ill.	970
WMAZ	Macon, Ga.	940
WMBA	Ambridge, Pa.	1460
WMBC	Macon, Miss.	1400
WMBD	Peoria, Ill.	1470
WMBG	Richmond, Va.	1380
WMBH	Joplin, Mo.	1450
WMBI	Chicago, Ill.	1110
WMBL	Morehead City, N.C.	740
WMBM	Miami Beach, Fla.	800
WMBN	Petoskey, Mich.	1340
WMBO	Auburn, N.Y.	1340

C.L.	Location	Kc.
WMBR	Jacksonville, Fla.	1460
WMBS	Uniontown, Pa.	590
WMC	Memphis, Tenn.	790
WMCA	New York, N.Y.	570
WMCH	Church Hill, Tenn.	1260
WMCK	McKeesport, Pa.	1360
WMCW	Harvard, Ill.	1600
WMDC	Hazlehurst, Miss.	1220
WMDD	Fajardo, P.R.	1490
WMDN	Midland, Mich.	1490
WMEG	Eau Gallie, Fla.	920
WMEK	Chase City, Va.	980
WMEN	Tallahassee, Fla.	1330
WMET	Miami Beach, Fla.	1490
WMEV	Marion, Va.	1010
WMEX	Boston, Mass.	1510
WMFC	Monroeville, Ala.	1360
WMFD	Wilmington, N.C.	630
WMFG	Hibbing, Minn.	1240
WMFJ	Daytona Beach, Fla.	1450
WMFR	High Point, N.C.	1230
WMFS	Chattanooga, Tenn.	1260
WMFT	Terre Haute, Ind.	1300
WMGA	Moultrie, Ga.	1400
WMGM	New York, N.Y.	1050
WMGR	Bainbridge, Ga.	930
WMGW	Meadville, Pa.	1490
WMGY	Montgomery, Ala.	800
WMIC	Monroe, Mich.	560
WMID	Atlantic City, N.J.	1340
WMIE	Miami, Fla.	1140
WMIK	Middlesboro, Ky.	560
WMIL	Milwaukee, Wis.	1290
WMIN	Mpls.-St. Paul, Minn.	1400
WMIQ	Iron Mountain, Mich.	1450
WMIS	Natchez, Miss.	1240
WMIX	Mt. Vernon, Ill.	940
WMJM	Cordele, Ga.	1490
WMLF	Pineville, Ky.	1230
WMLP	Milton, Pa.	1570
WMLS	Sylacauga, Ala.	1290
WMLT	Dublin, Ga.	1330
WMLY	Millville, N.J.	1440
WMMB	Melbourne, Fla.	1240
WMMH	Marshall, N.C.	1460
WMMN	Fairmont, W.Va.	920
WMMS	Bath, Maine	730
WMMT	McMinnville, Tenn.	1230
WMMW	Meriden, Conn.	1470
WMNA	Gretna, Va.	730
WMNB	No. Adams, Mass.	1230
WMNC	Morganton, N.C.	1430
WMNE	Menomonie, Wis.	1360
WMNF	Richwood, W.Va.	1280
WMNI	Columbus, Ohio	920
WMNS	Olean, N.Y.	1360
WMOA	Marietta, Ohio	1490
WMOD	Moundsville, W.Va.	1370
WMOG	Brunswick, Ga.	1490
WMOH	Hamilton, Ohio	1450
WMOK	Metropolis, Ill.	920
WMON	Montgomery, W.Va.	1340
WMOP	Ocala, Fla.	900
WMOR	Morehead, Ky.	1330
WMOV	Ravenswood, W.Va.	1360
WMOX	Meridian, Miss.	1240
WMOZ	Mobile, Ala.	960
WMPA	Aberdeen, Miss.	1240
WMPC	Lapeer, Mich.	1230
WMPL	Hancock, Mich.	920
WMPM	Smithfield, N.C.	1270
WMPS	Memphis, Tenn.	680
WMPT	So. Williamsport, Pa.	1450
WMRB	Greenville, S.C.	1490
WMRC	Milford, Mass.	1490
WMRE	Monroe, Ga.	1490
WMRF	Lewistown, Pa.	1490
WMRI	Marion, Ind.	860
WMRN	Marion, Ohio	1490
WMRO	Aurora, Ill.	1280
WMRP	Flint, Mich.	1570
WMSA	Massena, N.Y.	1340
WMSC	Columbia, S.C.	1320
WMSJ	Sylva, N.C.	1480
WMSL	Decatur, Ala.	1400
WMSR	Manchester, Tenn.	1320
WMST	Mt. Sterling, Ky.	1150
WMT	Cedar Rapids, Iowa	600
WMTA	Central City, Ky.	1380
WMTC	Vancleve, Ky.	730
WMTE	Manistee, Mich.	1340
WMTL	Leitchfield, Ky.	1580
WMTM	Moultrie, Ga.	1300
WMTN	Morristown, Tenn.	1300
WMTR	Morristown, N.J.	1250
WMTS	Murfreesboro, Tenn.	860
WMUS	Muskegon, Mich.	1090
WMUU	Greenville, S.C.	1260
WMVA	Martinsville, Va.	1450
WMVB	Millville, N.J.	1440
WMVG	Milledgeville, Ga.	1450
WMVO	Mt. Vernon, Ohio	1300
WMYB	Myrtle Beach, S.C.	1450
WMYN	Mayodan, N.C.	1420
WMYR	Ft. Myers, Fla.	1410
WNAB	Bridgeport, Conn.	1450
WNAC	Boston, Mass.	680
WNAD	Norman, Okla.	640
WNAE	Warren, Pa.	1310
WNAG	Grenada, Miss.	1400
WNAH	Nashville, Tenn.	1360
WNAK	Nanticoke, Pa.	730
WNAM	Neenah, Wis.	1280
WNAR	Norristown, Pa.	1110
WNAT	Natchez, Miss.	1450
WNAU	New Albany, Miss.	1470
WNAV	Annapolis, Md.	1430
WNAX	Yankton, S.Dak.	570

C.L.	Location	Kc.
WNBF	Binghamton, N.Y.	1290
WNBH	New Bedford, Mass.	1340
WNBP	Newburyport, Mass.	1470
WNBS	Murray, Ky.	1340
WNBT	Wellsboro, Pa.	1490
WNBZ	Saranac Lake, N.Y.	1240
WNCA	Siler City, N.C.	1570
WNCC	Barnesboro, Pa.	950
WNCO	Ashland, Ohio	1340
WNDB	Daytona Beach, Fla.	1150
WNDR	Syracuse, N.Y.	1260
WNDU	South Bend, Ind.	1490
WNEB	Worcester, Mass.	1230
WNEG	Taccoa, Ga.	1320
WNER	Live Oak, Fla.	1250
WNES	Central City, Ky.	1600
WNEW	New York, N.Y.	1130
WNEX	Macon, Ga.	1400
WNGO	Mayfield, Ky.	1320
WNHC	New Haven, Conn.	1340
WNIA	Cheektowaga, N.Y.	1230
WNIK	Arecibo, P.R.	1230
WNIL	Niles, Mich.	1290
WNJR	Newark, N.J.	1430
WNKY	Neon, Ky.	1480
WNLC	New London, Conn.	1490
WNLK	Norwalk, Conn.	1350
WNMP	Evanston, Ill.	1590
WNNC	Newton, N.C.	1230
WNNJ	Newton, N.J.	1360
WNNT	Warsaw, Va.	690
WNOE	New Orleans, La.	1060
WNOG	Naples, Fla.	1270
WNOK	Columbia, S.C.	1230
WNOP	Newport, Ky.	740
WNOR	Norfolk, Va.	1230
WNOS	High Point, N.C.	1590
WNOW	York, Pa.	1250
WNOX	Knoxville, Tenn.	990
WNPS	New Orleans, La.	1450
WNPT	Tuscaloosa, Ala.	1280
WNRG	Grundy, Va.	1250
WNRI	Woonsocket, R.I.	1380
WNRV	Narrows, Va.	990
WNSL	Laurel, Miss.	1260
WNSM	Valparaiso-Niceville, Florida	1340
WNTA	Newark, N.J.	970
WNUZ	Talladega, Ala.	1230
WNVA	Norton, Va.	1350
WNVY	Pensacola, Fla.	1230
WNYC	New York, N.Y.	830
WNYS	Salamanca, N.Y.	1590
WNXT	Portsmouth, Ohio	1260
WOAI	San Antonio, Tex.	1200
WOAP	Owosso, Mich.	1080
WOAY	Oak Hill, W.Va.	860
WOBS	Jacksonville, Fla.	1360
WOBT	Rhinelander, Wis.	1240
WOC	Davenport, Iowa	1420
WOCB	W. Yarmouth, Mass.	1240
WOCH	North Vernon, Ind.	1460
WOHI	E. Liverpool, Ohio	1490
WOHO	Toledo, Ohio	1470
WOHP	Bellefontaine, Ohio	1390
WOHS	Shelby, N.C.	730
WOI	Ames, Iowa	640
WOIA	Saline, Mich.	1290
WOIC	Columbia, S.C.	1470
WOKE	Charleston, S.C.	1340
WOKK	Meridian, Miss.	1450
WOKJ	Jackson, Miss.	1590
WOKO	Albany, N.Y.	1460
WOKS	Columbus, Ga.	1340
WOKY	Milwaukee, Wis.	920
WOKZ	Alton, Ill.	1570
WOL	Washington, D.C.	1450
WOLF	Syracuse, N.Y.	1490
WOLS	Florence, S.C.	1230
WOMI	Owensboro, Ky.	1490
WOMP	Bellaire, Ohio	1290
WOMT	Manitowoc, Wis.	1240
WONA	Winona, Miss.	1570
WOND	Pleasantville, N.J.	1400
WONE	Dayton, Ohio	980
WONG	Oneida, N.Y.	1600
WONN	Lakeland, Fla.	1230
WONW	Defiance, Ohio	1280
WOOD	Grand Rapids, Mich.	1300
WOOF	Dothan, Ala.	560
WOOK	Washington, D.C.	1340
WOOO	Deland, Fla.	1310
WOOW	Washington, N.C.	1340
WOPA	Oak Park, Ill.	1490
WOPI	Bristol, Tenn.	1490
WOR	New York, N.Y.	710
WORA	Mayaguez, P.R.	1150
WORC	Worcester, Mass.	1310
WORD	Spartanburg, S.C.	910
WORK	York, Pa.	1350
WORL	Boston, Mass.	950
WORM	Savannah, Tenn.	1010
WORX	Madison, Ind.	1270
WOSC	Fulton, N.Y.	1300
WOSH	Oshkosh, Wis.	1490
WOSU	Columbus, Ohio	820
WOTR	Corry, Pa.	1370
WOTW	Nashua, N.H.	900
WOUB	Athens, Ohio	1340
WOV	New York, N.Y.	1280
WOVE	Welch, W.Va.	1340
WOW	Omaha, Nebr.	590
WOWE	Allegan, Mich.	1580
WOWL	Florence, Ala.	1240
WOWO	Ft. Wayne, Ind.	1190

C.L.	Location	Kc.
WOXF	Oxford, N.C.	1340
WOZK	Ozark, Ala.	900
WPAB	Ponce, P.R.	550
WPAC	Patchogue, N.Y.	1580
WPAD	Paducah, Ky.	1450
WPAG	Ann Arbor, Mich.	1050
WPAL	Charleston, S.C.	730
WPAM	Pottsville, Pa.	1450
WPAQ	Mount Airy, N.C.	740
WPAR	Parkersburg, W.Va.	1450
WPAT	Paterson, N.J.	930
WPAW	Pawtucket, R.I.	550
WPAX	Thomasville, Ga.	1240
WPAY	Portsmouth, Ohio	1400
WPAZ	Pottstown, Pa.	1370
WPBC	Minneapolis, Minn.	980
WPCC	Clinton, S.C.	1400
WPCF	Panama City, Fla.	1430
WPCO	Mt. Vernon, Ind.	1590
WPCT	Putnam, Conn.	1350
WPDM	Potsdam, N.Y.	1470
WPDQ	Jacksonville, Fla.	600
WPDR	Portage, Wis.	1350
WPDX	Clarksburg, W.Va.	750
WPEL	Montrose, Pa.	1250
WPEN	Philadelphia, Pa.	950
WPEO	Peoria, Ill.	1020
WPEP	Taunton, Mass.	1570
WPET	Greensboro, N.C.	950
WPFA	Pensacola, Fla.	790
WPFB	Middletown, Ohio	910
WPFP	Park Falls, Wis.	1450
WPGC	Bradbury Hghts., Md.	1580
WPGW	Portland, Ind.	1440
WPHB	Philipsburg, Pa.	1260
WPIC	Sharon, Pa.	790
WPID	Piedmont, Ala.	1280
WPIK	Alexandria, Va.	730
WPIN	St. Petersburg, Fla.	680
WPIT	Pittsburgh, Pa.	730
WPKE	Pikeville, Ky.	1240
WPKO	Waverly, Ohio	1380
WPKY	Princeton, Ky.	1580
WPLA	Plant City, Fla.	910
WPLH	Huntington, W.Va.	1470
WPLM	Plymouth, Mass.	1390
WPLY	Plymouth, Wis.	1420
WPME	Punxsutawney, Pa.	1540
WPMP	Pascagoula, Miss.	1580
WPNC	Plymouth, N.C.	1470
WPNF	Brevard, N.C.	1240
WPNX	Phenix City, Ala.	1460
WPON	Pontiac, Mich.	1460
WPOP	Hartford, Conn.	1410
WPOR	Portland, Maine	1490
WPOW	New York, N.Y.	1330
WPPA	Pottsville, Pa.	1360
WPRA	Mayaguez, P.R.	990
WPRC	Lincoln, Ill.	1370
WPRE	Prairie Du Chien, Wis.	980
WPRT	Prestonsburg, Ky.	960
WPRO	Providence, R.I.	630
WPRP	Ponce, P.R.	910
WPRS	Paris, Ill.	1440
WPRW	Manassas, Va.	1460
WPRY	Perry, Fla.	1400
WPTF	Raleigh, N.C.	680
WPTR	Albany, N.Y.	1540
WPTS	Pittston, Pa.	1540
WPTW	Piqua, Ohio	1570
WPTX	Lexington Pk., Md.	920
WPUV	Pulaski, Va.	1580
WPVA	Colonial Hghts., Va.	1290
WPVL	Painesville, Ohio	1460
WQAM	Miami, Fla.	560
WQBC	Vicksburg, Miss.	1420
WQIC	Meridian, Miss.	1390
WQIK	Jacksonville, Fla.	1280
WQOK	Greenville, S.C.	1440
WQSN	Charleston, S.C.	1450
WQUA	Moline, Ill.	1230
WQUB	Galesburg, Ill.	1590
WQXI	Atlanta, Ga.	790
WQXQ	Ormond Bch., Fla.	1380
WQXR	New York, N.Y.	1560
WQXT	Palm Beach, Fla.	1340
WRAC	Racine, Wis.	1460
WRAD	Radford, Va.	1460
WRAG	Carrollton, Ala.	590
WRAJ	Anna, Ill.	1440
WRAK	Williamsport, Pa.	1400
WRAL	Raleigh, N.C.	1240
WRAM	Monmouth, Ill.	1330
WRAP	Norfolk, Va.	850
WRAW	Reading, Pa.	1340
WRAY	Princeton, Ind.	1250
WRBC	Jackson, Miss.	1300
WRBL	Columbus, Ga.	1420
WRC	Washington, D.C.	980
WRCA	New York, N.Y.	660
WRCD	Dalton, Ga.	1430
WRCO	Richland, Wis.	1450
WRCS	Ahoskie, N.C.	970
WRCV	Philadelphia, Pa.	1060N
WRDB	Reedsburg, Wis.	1400
WRDO	Augusta, Maine	1400
WRDW	Augusta, Ga.	1480
WREB	Holyoke, Mass.	930
WREC	Memphis, Tenn.	600
WREL	Lexington, Va.	1450
WREM	Remsen, N.Y.	1480
WREN	Topeka, Kans.	1250
WREV	Reidsville, N.C.	1220
WRFC	Athens, Ga.	960
WRFD	Worthington, Ohio	880

C.L.	Location	Kc.
WRFS	Alexander City, Ala.	1050
WRGA	Rome, Ga.	1470
WRGR	Starke, Fla.	1490
WRGS	Rogersville, Tenn.	1370
WRHC	Jacksonville, Fla.	1400
WRHI	Rock Hill, S.C.	1340
WRIB	Providence, R.I.	1220
WRIC	Richlands, Va.	540
WRIG	Wausau, Wis.	1400
WRIM	Pahokee, Fla.	1250
WRIO	Rio Piedras, P.R.	1320
WRIP	Rossville, Ga.	980
WRIS	Roanoke, Va.	1410
WRIT	Milwaukee, Wis.	1340
WRIV	Riverhead, N.Y.	1390
WRJN	Racine, Wis.	1400
WRJW	Picayune, Miss.	1320
WRKD	Rockland, Maine	1450
WRKH	Rockwood, Tenn.	580
WRLD	Lanitt, Ala.	1490
WRMA	Montgomery, Ala.	950
WRMF	Titusville, Fla.	1050
WRMN	Elgin, Ill.	1410
WRMT	Rocky Mount, N.C.	1490
WRNB	New Bern, N.C.	1490
WRNL	Richmond, Va.	910
WROA	Gulfport, Miss.	1390
WROB	West Point, Miss.	1450
WROD	Daytona Beach, Fla.	1340
WROK	Rockford, Ill.	1440
WROM	Rome, Ga.	710
WRON	Ronceverte, W.Va.	1400
WROS	Scottsboro, Ala.	1330
WROV	Roanoke, Va.	1240
WROW	Albany, N.Y.	590
WROX	Clarksdale, Miss.	1450
WROY	Carmi, Ill.	1460
WRPB	Warner Robbins, Ga.	1350
WRR	Dallas, Tex.	1310
WRRF	Washington, N.C.	930
WRRR	Rockford, Ill.	1330
WRRZ	Clinton, N.C.	880
WRSA	Saratoga Sprgs., N.Y.	1280
WRSW	Warsaw, Ind.	1480
WRTA	Altoona, Pa.	1240
WRUF	Gainesville, Fla.	850
WRUM	Rumford, Maine	790
WRUN	Utica, N.Y.	1150
WRUS	Russellville, Ky.	610
WRVA	Richmond, Va.	1140
WRVK	Mt. Vernon, Ky.	1460
WRVM	Rochester, N.Y.	680
WRWB	Kissimmee, Fla.	1220
WRWH	Cleveland, Ga.	1380
WRWJ	Selma, Ala.	1570
WRXO	Roxboro, N.C.	1430
WSAC	Radcliff, Ky.	1470
WSAI	Cincinnati, Ohio	1360
WSAJ	Grove City, Pa.	1340
WSAL	Logansport, Ind.	1230
WSAM	Saginaw, Mich.	1400
WSAN	Allentown, Pa.	1470
WSAR	Fall River, Mass.	1480
WSAT	nr. Salisbury, N.C.	1280
WSAU	Wausau, Wis.	550
WSAV	Savannah, Ga.	630
WSAY	Rochester, N.Y.	1370
WSAZ	Huntington, W.Va.	930
WSB	Atlanta, Ga.	750
WSBA	York, Pa.	910
WSBB	New Smyrna Beach, Florida	1230
WSBC	Chicago, Ill.	1240
WSBS	Gt. Barrington, Mass.	860
WSBT	South Bend, Ind.	960
WSCM	Panama City Beach, Florida	1290
WSCR	Scranton, Pa.	1320
WSDB	Homestead, Fla.	1430
WSDR	Sterling, Ill.	1240
WSEN	Baldwinsville, N.Y.	1050
WSEV	Sevierville, Tenn.	930
WSFB	Quitman, Ga.	1490
WSFC	Somerset, Ky.	1240
WSFT	Thomaston, Ga.	1220
WSGA	Savannah, Ga.	1400
WSGC	Elberton, Ga.	1400
WSGN	Birmingham, Ala.	610
WSGW	Saginaw, Mich.	790
WSHE	Raleigh, N.C.	570
WSIC	Statesville, N.C.	1400
WSID	Baltimore, Md.	1010
WSIG	Mount Jackson, Va.	790
WSIP	Paintsville, Ky.	1490
WSIR	Winter Haven, Fla.	1490
WSIV	Pekin, Ill.	1140
WSIX	Nashville, Tenn.	980
WSJC	Magee, Miss.	1280
WSJM	St. Joseph, Mich.	1400
WSJS	Winston-Salem, N.C.	600
WSKI	Montpelier-Barre, Vt.	1240
WSKP	Miami, Fla.	1450
WSKY	Asheville, N.C.	1230
WSLB	Ogdensburg, N.Y.	1400
WSLI	Jackson, Miss.	930
WSLM	Salem, Ind.	1220
WSLS	Roanoke, Va.	610
WSM	Nashville, Tenn.	650
WSMB	New Orleans, La.	1350
WSME	Sanford, Maine	1220
WSMI	Litchfield, Ill.	1540
WSMN	Nashua, N.H.	1590
WSMT	Sparta, Tenn.	1050
WSNJ	nr. Bridgeton, N.J.	1240
WSNT	Sandersville, Ga.	1490
WSNW	Seneca Twnshp., S.C.	1150
WSNY	Schenectady, N.Y.	1240
WSOC	Charlotte, N.C.	1240
WSOK	Savannah, Ga.	1230

C.L.	Location	Kc.
WSOL	Tampa, Fla.	1300
WSON	Henderson, Ky.	860
WSOO	Sit. Ste. Marie, Mich.	1230
WSOY	Decatur, Ill.	1340
WSPA	Spartanburg, S.C.	950
WSPB	Sarasota, Fla.	1450
WSPD	Toledo, Ohio	1370
WSPN	Saratoga Sprgs., N.Y.	900
WSPR	Springfield, Mass.	1270
WSPT	Stevens Pt., Wis.	1010
WSRA	Milton, Fla.	1490
WSRC	Durham, N.C.	1410
WSRO	Marlborough, Mass.	1470
WSRW	Hillsboro, Ohio	1590
WSSB	Durham, N.C.	1490
WSSC	Sumter, S.C.	1340
WSSO	Starkville, Miss.	1230
WSSV	Petersburg, Va.	1240
WSTA	Charlotte Amalie, V.I.	1340
WSTC	Stamford, Conn.	1400
WSTK	Woodstock, Va.	1230
WSTL	Eminence, Ky.	1600
WSTN	St. Augustine, Fla.	1420
WSTP	Salisbury, N.C.	1490
WSTR	Sturgis, Mich.	1230
WSTS	Massena, N.Y.	1050
WSTU	Suart, Fla.	1450
WSTV	Steubenville, Ohio	1340
WSUB	Groton, Conn.	980
WSUH	Oxford, Miss.	1420
WSUI	Iowa City, Iowa	910
WSUN	St. Petersburg, Fla.	620
WSUX	Seaford, Del.	1280
WSUZ	Palatka, Fla.	800
WSVA	Harrisonburg, Va.	550
WSVS	Crewe, Va.	800
WSWN	Belle Glade, Fla.	900
WSWW	Platteville, Wis.	1590
WSYB	Rutland, Vt.	1380
WSYD	Mt. Airy, N.C.	1300
WSYL	Sylvania, Ga.	1490
WSYR	Syracuse, N.Y.	570
WTAB	Tabor City, N.C.	1370
WTAC	Flint, Mich.	600
WTAD	Quincy, Ill.	930
WTAG	Worcester, Mass.	580
WTAL	Tallahassee, Fla.	1270
WTAN	Clearwater, Fla.	1340
WTAO	Cambridge, Mass.	740
WTAQ	LaGrange, Ill.	1300
WTAR	Norfolk, Va.	790
WTAW	Bryan, Tex.	1150
WTAX	Springfield, Ill.	1240
WTAY	Robinson, Ill.	1570
WTBC	Tuscaloosa, Ala.	1230
WTBF	Troy, Ala.	970
WTBO	Cumberland, Md.	1450
WTCB	Flomaton, Ala.	990
WTCH	Shawano, Wis.	960
WTCJ	Tell City, Ind.	1230
WTCM	Traverse City, Mich.	1400
WTCN	Minneapolis, Minn.	1280
WTCO	Campbellsville, Ky.	1450
WTCR	Ashland, Ky.	1420
WTCS	Fairmont, W.Va.	1490
WTCW	Whitesburg, Ky.	920
WTEL	Philadelphia, Pa.	860
WTHE	Spartanburg, S.C.	1400
WTHG	Jackson, Ala.	1290
WTHI	Terre Haute, Ind.	1480
WTHR	Panama City, Fla.	1480
WTIC	Hartford, Conn.	1080
WTIF	Tifton, Ga.	1340
WTIG	Massillon, Ohio	900
WTIK	Durham, N.C.	1310
WTIL	Mayaguez, P.R.	1300
WTIM	Taylorville, Ill.	1410
WTIP	Charleston, W.Va.	1240
WTIX	New Orleans, La.	690
WTJH	East Point, Ga.	1260
WTJS	Jackson, Tenn.	1390
WTKM	Hartford, Wis.	1540
WTKO	Ithaca, N.Y.	1470
WTLB	Utica, N.Y.	1310
WTLO	Somerset, Ky.	1480
WTLS	Tallasee, Ala.	1300
WTMA	Charleston, S.C.	1250
WTMC	Ocala, Fla.	1290
WTMJ	Milwaukee, Wis.	620
WTMP	Tampa, Fla.	1150
WTMT	Louisville, Ky.	620
WTNC	Thomasville, N.C.	790
WTND	Orangeburg, S.C.	920
WTNJ	Trenton, N.J.	1300
WTNS	Coshocton, Ohio	1560
WTNT	Tallahassee, Fla.	1450
WTOB	Winston-Salem, N.C.	1380
WTOC	Savannah, Ga.	1290
WTOD	Toledo, Ohio	1560
WTOE	Spruce Pine, N.C.	1470
WTDL	Toledo, Ohio	1230
WTON	Staunton, Va.	1240
WTOP	Washington, D.C.	1500
WTOR	Torrington, Conn.	1490
WTOT	Marianna, Fla.	980
WTPR	Paris, Tenn.	710
WTRA	Latrobe, Pa.	1480
WTRB	Ripley, Tenn.	1570
WTRC	Elkhart, Ind.	1340
WTRL	Bradenton, Fla.	1490
WTRN	Tyrone, Pa.	1290
WTRO	Dyersburg, Tenn.	1330
WTRP	LaGrange, Ga.	620
WTRR	Sanford, Fla.	1400
WTRU	Muskegon, Mich.	1600
WTRW	Two Rivers, Wis.	1590
WTRY	Troy, N.Y.	980
WTSA	Brattleboro, Vt.	1450

C.L.	Location	Kc.
WTSB	Lumberton, N.C.	1340
WTSL	Hanover-Lebanon, New Hampshire	1400
WTSN	Dover, N.H.	1270
WTSP	St. Petersburg, Fla.	1380
WTSV	Claremont, N.H.	1230
WTTB	Vero Beach, Fla.	1490
WTTH	Port Huron, Mich.	1380
WTTL	Madisonville, Ky.	1310
WTTM	Trenton, N.J.	920
WTTN	Watertown, Wis.	1580
WTTR	Westminster, Md.	1470
WTTS	Bloomington, Ind.	1370
WTTT	Arlington, Fla.	1220
WTUC	Union City, Tenn.	1580
WTUG	Tuscaloosa, Ala.	790
WTUP	Tupelo, Miss.	1380
WTUX	Wilmington, Del.	1290
WTVB	Coldwater, Mich.	1590
WTVL	Waterville, Maine	1490
WTVN	Columbus, Ohio	610
WTWA	Thomson, Ga.	1240
WTWB	Auburndale, Fla.	1570
WTWN	St. Johnsbury, Vt.	1340
WTXL	W. Spgfd., Mass.	1490
WTYC	Rock Hill, S.C.	1150
WTYM	East Longmeadow, Mass.	1600
WTYN	Tryon, N.C.	1580
WTYS	Marianna, Fla.	1340
WULA	Eufaula, Ala.	1240
WUSJ	Lockport, N.Y.	1340
WUST	Bethesda, Md.	1120
WVAM	Altoona, Pa.	1430
WVCG	Coral Gables, Fla.	1070
WVCH	Chester, Pa.	740
WVEC	Hampton, Va.	1490
WVET	Rochester, N.Y.	1280
WVIM	Vicksburg, Miss.	1490
WVIP	Mt. Kisco, N.Y.	1310
WVJP	Caguas, P.R.	1110
WVJS	Owensboro, Ky.	1420
WVKO	Columbus, Ohio	1580
WVLK	Lexington, Ky.	590
WVLN	Olney, Ill.	740
WVMC	Mt. Carmel, Ill.	1360
WVMI	Biloxi, Miss.	570
WVNA	Tuscumbia, Ala.	1590
WVNJ	Newark, N.J.	620
WVOK	Birmingham, Ala.	690
WVOL	Nashville, Tenn.	1470
WVOP	Vidalia, Ga.	970
WVOS	Liberty, N.Y.	1240
WVOT	Wilson, N.C.	1420
WVOW	Logan, W.Va.	1290
WVOX	New Rochelle, N.Y.	1460
WVPO	Stroudsburg, Pa.	840
WVSC	Somerset, Pa.	990
WVVW	Grafton, W.Va.	1260
WWBC	Bay City, Mich.	1250
WWBD	Bamberg, S.C.	790
WWBZ	Vineland, N.J.	1360
WWCA	Gary, Ind.	1270
WWCC	Bremen, Ga.	1440
WWCO	Waterbury, Conn.	1240
WWDC	Washington, D.C.	1260
WWGP	Sanford, N.C.	1050
WWGS	Tifton, Ga.	1430
WWHG	Hornell, N.Y.	1320
WWIL	Ft. Lauderdale, Fla.	1580
WWIN	Baltimore, Md.	1400
WWIS	Black River Falls, Wis.	1260
WWIT	Canton, N.C.	970
WWIZ	Lorain, Ohio	1380
WWJ	Detroit, Mich.	950
WWJB	Brooksville, Fla.	1450
WWKY	Winchester, Ky.	1380
WWL	New Orleans, La.	870
WWNC	Asheville, N.C.	570
WWNH	Rochester, N.H.	930
WWNR	Beckley, W.Va.	620
WWNS	Statesboro, Ga.	1240
WWNY	Watertown, N.Y.	790
WWOD	Lynchburg, Va.	1390
WWOK	Charlotte, N.C.	1480
WWOL	Buffalo, N.Y.	1120
WWON	Woonsocket, R.I.	1240
WWPA	Williamsport, Pa.	1340
WWPF	Palatka, Fla.	1260
WWRI	W. Warwick, R.I.	1450
WWRL	Woodside, N.Y.	1600
WWSC	Glens Falls, N.Y.	1450
WWSR	St. Albans, Vt.	1420
WWST	Wooster, Ohio	960
WWSW	Pittsburgh, Pa.	970
WWVA	Wheeling, W.Va.	1170
WWWB	Jasper, Ala.	1360
WWWF	Fayette, Ala.	990
WWWR	Russellville, Ala.	920
WWWW	Rio Piedras, P.R.	1520
WWXL	Manchester, Ky.	1450
WWYO	Pineville, W.Va.	970
WXAL	Demopolis, Ala.	1400
WXGI	Richmond, Va.	950
WXLI	Dublin, Ga.	1440
WXLW	Indianapolis, Ind.	950
WXOK	Baton Rouge, La.	1260
WXRF	Guayama, P.R.	1590
WXXX	Hattiesburg, Miss.	1310
WXYZ	Detroit, Mich.	1270
WYCL	York, S.C.	1580
WYDE	Birmingham, Ala.	850
WYFE	New Orleans, La.	600
WYLD	New Orleans, La.	940
WYMB	Manning, S.C.	1410
WYRN	Louisburg, N.C.	1480
WYSE	Lakeland, Fla.	1330
WYSR	Franklin, Va.	1250

C.L.	Location	Kc.
WYTH	Madison, Ga.	1250
WYTI	Rocky Mount, Va.	1570
WYUO	Newport News, Va.	1270
WYVE	Wytheville, Va.	1280
WYZE	Atlanta, Ga.	1480
WZEP	DeFuniak Sprgs., Fla.	1460
WZIP	Covington, Ky.	1050
WZKY	Albemarle, N.Dak.	1580
WZOB	Ft. Payne, Ala.	1250
WZOK	Jacksonville, Fla.	1320
WZRO	Jacksonville Beach, Florida	1010
WZYX	Cowan, Tenn.	1440

Canada

C.L.	Location	Kc.
CBA	Sackville, N.B.	1070
CBAF	Moncton, N.B.	1300
CBE	Windsor, Ont.	1550
CBF	Montreal, Que.	690
CBG	Gander, Nfld.	1450
CBH	Halifax, N.S.	1330
CBI	Sydney, N.S.	1140
CBJ	Chicoutimi, Que.	1580
CBK	Regina, Sask.	540
CBL	Toronto, Ont.	740
CBM	Montreal, Que.	940
CBN	St. John's, Nfld.	640
CBO	Ottawa, Ont.	910
CBT	Grand Falls, Nfld.	990
CBU	Vancouver, B.C.	690
CBV	Quebec, Que.	980
CBW	Winnipeg, Man.	990
CBX	Edmonton, Alta.	1010
CBXA	Edmonton, Alta.	740
CBY	Corner Brook, Nfld.	790
CFAB	Windsor, N.S.	1450
CFAC	Calgary, Alta.	960
CFAM	Altona, Man.	1290
CFAR	Flin Flon, Man.	590
CFBC	Saint John, N.B.	930
CFBR	Sudbury, Ont.	550
CFCF	Montreal, Que.	600
CFCH	North Bay, Ont.	600
CFCL	Timmins, Ont.	580
CFCN	Calgary, Alta.	1060
CFCO	Chatham, Ont.	630
CFCW	Camrose, Alta.	1230
CFCY	Charlottetown, P.E.I.	630
CFDA	Victoriaville, Que.	1380
CFGB	Goose Bay, Nfld.	1340
CFGP	Grande Prairie, Alta.	1050
CFGR	Gravelbourg, Sask.	1230
CFGT	St. Joseph d'Alma, Que.	1270
CFJB	Brampton, Ont.	1090
CFJC	Kamloops, B.C.	910
CFJR	Brockville, Ont.	1450
CFKL	Schefferville, Que.	1230
CFNB	Fredericton, N.B.	550
CFNS	Saskatoon, Sask.	1170
CFOB	Fort Frances, Ont.	800
CFOR	Orillia, Ont.	1570
CFOS	Owen Sound, Ont.	560
CFPA	Port Arthur, Ont.	1230
CFPL	London, Ont.	980
CFPR	Prince Rupert, B.C.	1240
CFQC	Saskatoon, Sask.	600
CFRA	Ottawa, Ont.	560
CFRB	Toronto, Ont.	1010
CFRC	Kingston, Ont.	1490
CFRG	Gravelbourg, Sask.	710
CFRN	Edmonton, Alta.	1260
CFRS	Simcoe, Ont.	1560
CFRY	Portage la Prairie, Man.	1570
CFSL	Weyburn, Sask.	1340
CFUN	Vancouver, B.C.	1410
CFWH	Whitehorse, Yukon T.	1240
CFYK	Yellowknife, N.W.T.	1340
CFYT	Dawson, Yukon T.	1230
CHAB	Moose Jaw, Sask.	800
CHAD	Amos, Que.	1340
CHAT	Medicine Hat, Alta.	1270
CHED	Edmonton, Alta.	1080
CHEF	Granby, Que.	1450
CHEX	Peterborough, Ont.	980
CHFA	Edmonton, Alta.	680
CHGB	St. Anne de la Pocatiere, Que.	1350
CHLN	Three Rivers, Que.	550
CHLO	St. Thomas, Ont.	680
CHLT	Sherbrooke, Que.	630
CHML	Hamilton, Ont.	900
CHNC	New Carlisle, Que.	610
CHNO	Sudbury, Ont.	900
CHNS	Halifax, N.S.	960
CHOK	Sarnia, Ont.	1070
CHOV	Pembroke, Ont.	1350
CHOW	Welland, Ontario	1470
CHRC	Quebec, Que.	800
CHRD	Drummondville, Que.	1340
CHRL	Roberval, Que.	910
CHRS	St. Jean, Que.	1090
CHSJ	Saint John, N.B.	1150
CHUB	Nanaimo, B.C.	1570
CHUC	Port Hope, Ont.	1500
CHUM	Toronto, Ont.	1050
CHVC	Niagara Falls, Ont.	1600
CHWK	Chilliwack, B.C.	1270
CHWO	Oakville, Ont.	1250
CJAD	Montreal, Que.	800
CJAT	Trail, B.C.	610
CJAV	Port Alberni, B.C.	1240
CJBC	Toronto, Ont.	860
CJBQ	Belleville, Ont.	800
CJBR	Rimouski, Que.	900
CJCA	Edmonton, Alta.	930
CJCB	Sydney, N.S.	1270
CJCH	Halifax, N.S.	920
CJCS	Stratford, Ont.	1240
CJDC	Dawson Creek, B.C.	1350
CJEM	Edmundston, N.B.	570
CJET	Smiths Falls, Ont.	630
CJFP	Riviere du Loup, Que.	1400
CJFX	Antigonish, N.S.	580
CJGX	Yorkton, Sask.	940
CJIB	Vernon, B.C.	940
CJIC	Sault Ste. Marie, Ont.	1050
CJKL	Kirkland Lake, Ont.	560
CJLS	Yarmouth, N.S.	1240
CJMS	Montreal, Que.	1280
CJMT	Chicoutimi, Que.	1420
CJNB	N. Battleford, Sask.	1460
CJNR	Blind River, Ont.	730
CJOB	Winnipeg, Man.	680
CJOC	Lethbridge, Alta.	1220
CJON	St. John's, Nfld.	930
CJOR	Vancouver, B.C.	600
CJOY	Guelph, Ont.	1450
CJQC	Quebec, Que.	1340
CJRH	Richmond Hill, Ont.	1310
CJRL	Kenora, Ont.	1220
CJRW	Summerside, P.E.I.	1240
CJSO	Sorel, Que.	1320
CJSP	Leamington, Ont.	710
CJVI	Victoria, B.C.	900
CKAC	Montreal, Que.	730
CKAR	Huntsville, Ont.	590
CKBB	Barrie, Ont.	950
CKBC	Bathurst, N.B.	1400
CKBI	Prince Albert, Sask.	900
CKBL	Matane, Que.	1250
CKBM	Montmagny, Que.	1490
CKBW	Bridgewater, N.S.	1000
CKCH	Hull, Que.	970
CKCK	Regina, Sask.	620
CKCL	Truro, N.S.	600
CKCQ	Quesnel, B.C.	570
CKCR	Kitchener, Ont.	1490
CKCV	Quebec, Que.	1280
CKCW	Moncton, N.B.	1220
CKCY	Sault Ste. Marie, Ont.	1400
CKDA	Victoria, B.C.	1220
CKDH	Amherst, N.S.	1400
CKDM	Dauphin, Man.	730
CKEC	New Glasgow, N.S.	1230
CKEK	Cranbrook, B.C.	570
CKEN	Kentville, N.S.	1350
CKEY	Toronto, Ont.	580
CKFH	Toronto, Ont.	1430
CKGB	Timmins, Ont.	680
CKGR	Galt, Ont.	1110
CKJL	St. Jerome, Que.	900
CKLB	Oshawa, Ont.	1350
CKLC	Kingston, Ont.	1380
CKLD	Thetford Mines, Que.	1230
CKLG	N. Vancouver, B.C.	730
CKLN	Nelson, B.C.	1390
CKLS	LaSarre, Que.	1240
CKLW	Windsor, Ont.	800
CKLY	Lindsay, Ont.	910
CKMR	Newcastle, N.B.	790
CKNB	Campbellton, N.B.	950
CKNW	New Westminster, British Columbia	980
CKNX	Wingham, Ont.	920
CKOC	Hamilton, Ont.	1150
CKOK	Penticton, B.C.	800
CKOM	Saskatoon, Sask.	1420
CKOT	Tillsonburg, Ont.	1510
CKOV	Kelowna, B.C.	630
CKOX	Woodstock, Ont.	1340
CKOY	Ottawa, Ont.	1310
CKPC	Brantford, Ont.	1380
CKPG	Prince George, B.C.	550
CKPR	Fort William, Ont.	580
CKRB	Ville St. Georges, Que.	1250
CKRC	Winnipeg, Man.	630
CKRD	Red Deer, Alta.	850
CKRM	Regina, Sask.	980
CKRN	Rouyn, Que.	1400
CKRS	Jonquiere, Que.	590
CKSA	Lloydminster, Alta.	1150
CKSB	St. Boniface, Man.	1050
CKSF	Cornwall, Ont.	1220
CKSL	London, Ont.	1290
CKSM	Shawinigan Falls, Quebec	1220
CKSO	Sudbury, Ont.	790
CKSW	Swift Current, Sask.	1400
CKTB	St. Catharines, Ont.	610
CKTR	Three Rivers, Que.	1150
CKTS	Sherbrooke, Que.	900
CKUA	Edmonton, Alta.	580
CKVD	Val d'Or, Que.	1230
CKVL	Verdun, Que.	850
CKVM	Ville Marie, Que.	710
CKWS	Kingston, Ont.	960
CKWX	Vancouver, B.C.	1130
CKX	Brandon, Man.	1150
CKXL	Calgary, Alta.	1140
CKY	Winnipeg, Man.	580
CKYL	Peace River, Alta.	630
VOAR	St. John's, Nfld.	1230
VOCM	St. John's, Nfld.	590
VOWR	St. John's, Nfld.	800

Mexican and Cuban AM Stations

Mexican stations audible in the Southwest; the more powerful Cuban stations

Abbreviations: C.L., call letters; Kc., frequency in kilocycles; W.P., watt power

Mexico

BAJA CALIFORNIA

Location	C.L.	Kc.	W.P.
Ensenada	XEPF	1400	250
Mexicali	XED	1050	5000
	XEAA	1340	250
	XEAO	910	250
	XECL	990	5000
	XEGE	1570	1000
Tijuana	XEC	1310	250
	XEAC	690	50000
	XEAU	1470	5000
	XEAZ	1270	500
	XEBG	1550	1000
	XEGM	950	2500
	XEMO	860	5000
	XEXX	1420	2000

CHIHUAHUA

Location	C.L.	Kc.	W.P.
Chihuahua	XEM	1390	500
	XEBU	620	1000
	XEBW	1280	1000
	XEFI	1440	1000
	XERA	1490	250
Ciudad Camargo	XEHA	580	1000
Ciudad Delicias	XEBN	1240	250
	XEJK	1340	250
Ciudad Juarez	XEF	1420	250
	XEJ	970	5000
	XEP	1300	500
	XEFV	1240	250
	XELO	800	150000
	XEWG	1490	250
	XEYC	1460	1000
Hidalgo	XEJS	1150	500
N. Casas Grandes	XETX	1010	250

COAHUILA

Location	C.L.	Kc.	W.P.
Ciudad Acuna	XEKD	1010	1000
Monclova	XEMF	1260	250
Piedras Negras	XEMJ	920	1000
	XEMU	580	5000
Sabinas	XEBK	610	5000
Saltillo	XESJ	1250	500
	XESG	1510	1000
Torreon	XEBP	1310	5000
Villa Acuna	XEDH	1340	250
	XERF	1570	250000

DISTRITO FEDERAL

Location	C.L.	Kc.	W.P.
Mexico City	XEL	1260	5000
	XEN	690	20000
	XEQ	940	150000
	XEW	900	250000
	XEX	730	500000
	XEFR	1180	5000
	XEJP	1150	10000
	XELA	830	10000
	XELZ	1440	5000
	XEMX	1380	5000
	XENK	620	5000
	XEOY	1000	50000
	XEPH	590	5000
	XEQK	1350	1000
	XEQR	1030	10000
	XERC	790	1000
	XERCN	1110	50000
	XERH	1500	50000
	XERPM	660	10000
	XESM	1470	10000
	XEUN	860	5000

DURANGO

Location	C.L.	Kc.	W.P.
Durango	XEDU	860	1000

NUEVO LEON

Location	C.L.	Kc.	W.P.
Linares	XER	1260	250
Monterrey	XEG	1050	150000
	XEH	1420	1000
	XET	990	5000
	XEAR	1480	1000
	XEAW	1280	1000
	XEFB	630	5000
	XEMR	1370	500
	XEOK	920	500

SAN LUIS POTOSI

Location	C.L.	Kc.	W.P.
San Luis Potosi	XEWA	540	150000

SONORA

Location	C.L.	Kc.	W.P.
Agua Prieta	XEAQ	1490	250
	XEFH	1310	1000
Cananea	XEFQ	980	500
Ciudad Obregon	XEOX	1430	1000
Hermosillo	XEBH	920	5000
	XEDL	1250	500
	XEDM	1580	50000
	XEHQ	590	500
Magdalena	XEDJ	1450	100
Naco	XETM	1350	1000
Nogales	XEHF	1370	5000
San Luis	XECB	1450	250
Santa Ana	XEAB	1400	250

TAMAULIPAS

Location	C.L.	Kc.	W.P.
Matamoros	XEO	970	1000
	XEAM	1450	250
	XEMT	1340	250
Nuevo Laredo	XEAS	1410	250
	XEBK	1340	100
	XEDF	790	1000
	XEFE	960	1000
	XERG	1090	2500
	XEXO	1550	50000
Reynosa	XEOR	1390	1000
	XERT	590	5000
Rio Bravo	XEFD	1170	1000
Tampico	XEFW	810	50000

Cuba

Location	C.L.	Kc.	W.P.
Camaguey	CMJB	880	1000
	CMJL	920	5000
	CMJN	960	1000
	CMJE	1000	1000
	CMJR	1030	1000
	CMJC	1270	1000
	CMJF	1340	1000
Camajuani	CMHD	890	1000
Ciego de Avila	CMJY	760	1000
Habana	CMW	550	2500
	CMCY	590	15000
	CMQ	630	25000
	CMCU	660	1000
	CMBC	690	50000
	CMCD	740	10000
	CMCH	790	10000
	CMBZ	830	5000
	CMBL	860	15000
	CMCF	910	10000
	CMBF	950	5000
	CMCK	980	5000
	CMBQ	1010	5000
	CMCX	1060	10000
	CMCA	1150	10000
	CMCB	1330	1000
Holguin	CMKJ	730	5000
Holguin Orte	CMKM	560	5000
	CMKV	600	1000
	CMKD	970	1000
	CMDC	1290	1000
Marianao	CMZ	1560	5000
Pinar del Rio	CMAB	760	5000
	CMAN	840	1000
	CMAQ	920	1000
Santa Clara	CMHI	570	10000
	CMHQ	640	15000
	CMHW	810	1000
	CMHO	1310	1000
	CMHM	1130	1000
Sancti Spiritus	CMHT	990	1000
Santiago	CMDA	650	1000
	CMKC	770	1000
	CMKW	800	2000
	CMKU	850	2000
	CMKN	930	1000
	CMKB	1170	1000

World-Wide Short-Wave Stations

Active and Most Commonly Heard in U. S., Listed by Frequency

(For all Canadian Short-Wave Stations, see separate listing, p. 188) Abbreviations: Kc., frequency in kilocycles (to change to megacycles, divide by 1000); C.L. call letters. Due to malfunction of transmitter, interference by other stations, jamming, variance in propagational conditions, or reallocation of frequencies, stations may use other frequencies than those given. The abbreviation (VOA) denotes Voice of America.

The symbol ● denotes stations beaming regular evening broadcasts to the United States.

Kc.	C.L.	Location
3275	VP4RD	Port-of-Spain, Trinidad
3300		Belize, Brit. Honduras
3320	YVQG	Barcelona, Venez.
3330	YVQL	El Tigre, Venez.
3340	YVMV	Carora, Venez.
3350	YVKT	Caracas, Venez.
3360	YVOC	San Cristobal, Vz.
3360	ZQI	Kingston, Jamaica
3365		Grenada, Windward Is.
3370	YVMI	Maracaibo, Venez.
3380	YVQN	Puerto La Cruz, Vz.
3390	YVKX	Caracas, Venez.
3400	YVKP	Caracas, Venez.
3410	YVMK	Cabimas, Venez.
3420	YVOE	Merida, Venez.
3440	YVLI	Maracay, Venez.
3460	YVLC	Valencia, Venez.
3480	YVLE	Puerto Cabello, Vz.
3490	YVRA	Maturin, Venez.
3620	YVLG	Maracay, Venez.
3980		Suva, Fiji Islands
4650	HC2AJ	Guayaquil, Ecua.
4752	YVMA	Maracaibo, Venez.
4768	HJEF	Cali, Colombia
4775	HJGB	Bucaramanga, Col.
4783	HJAB	Barranquilla, Col.
4790	YVQC	Ciudad Bolivar, Vz.
4797	HJFU	Armenia, Colombia
4800	YVME	Maracaibo, Venez.
4805	ZYS8	Manaos, Brazil
4810	YVMG	Maracaibo, Venez.
4815	HJBB	Cucuta, Col.
4820	XEJG	Guadalajara, Mex.
4820	YVNB	Coro, Venez.
4830	YVOA	San Cristobal, Vez.
4835	HJKE	Bogota, Colombia
4840	YVOI	Valera, Venez.
4845	CSA93	Ponta Delgada, Az.
4848	HJGF	Bucaramanga, Col.
4850	YVMS	Barquisimeto, Vz.
4855	HJFN	Neiva, Colombia
4860	JKL	Tokyo, Japan
4860	YVPA	San Filipe, Venez.
4865	PRC5	Belem, Para, Brazil
4865	HJFA	Pereira, Colombia
4871	HJBG	Cucuta, Colombia
4880	YVKF	Caracas, Venez.
4892	YVKB	Caracas, Venez.
4895	HJCH	Bogota, Col.
4895	PRF6	Manaos, Brazil
4897	VLX4	Perth, Aust.
4900	YVQE	Ciudad Bolivar, Vz.
4903	HJAG	Barranquilla, Col.
4907	YVMM	Coro, Venez.
4910	JKI	Nazaki, Japan
4910	YDB2	Djakarta, Indon.
4915		Accra, Ghana
4915	YVKR	Caracas, Venez.
4917	HI9B	Santiago, Dom.Rep.
4917	VLM4	Brisbane, Aus.
4930	HJAP	Cartagena, Col.
4940	JKM	Kawachi, Japan
4940	YVMQ	Barquisimeto, Vz.
4945	HJCW	Bogota, Col.
4950	ZQI	Kingston, Jamaica
4951		Dakar, Senegal
4960	YVQA	Cumana, Venez.
4967	HJAE	Cartagena, Col.
4970	YVLK	Caracas, Venez.
4985	YVMO	Barquisimeto, Vz.
4993	HIIA	Santiago, D.Rep.
5010		Grenada, Windward Is.
5014	PJC3	Willimstad, Curac.
5020	HJFW	Manizales, Col.
5023	HI8Z	Santiago, D.Rep.
5030	YVKM	Caracas, Venez.
5045	ZYP23	Petropolis, Brazil
5050	YVKD	Caracas, Venez.
5053	HI2L	Ciudad Trujillo, D.R.
5055	HJDW	Medellin, Col.
5075	HJKH	Sutatenza, Colom.
5758	PZH5	Paramaribo, Surinam
5880	HRN	Tegucigalpa, Hond.
5920	HRA	Tegucigalpa, Hond.
5940		Khabarovsk, U.S.S.R.
5940		Moscow, U.S.S.R.
5952	TGNA	Guatemala, Guat.
5960	HJCF	Bogota, Colombia
5965		Shanghai, China
5969	HVJ	Vatican City
5970	HI4T	Ciudad Trujillo, D.R.
5981	ZFY	Georgetown, Br.Gui.
5985		Radio Free Europe, Munich, Germany
5990	TGJA	Guatemala, Guat.
5995	HO50	Panama, Panama
6005		Berlin, Germany
6005	HP5K	Colon, Panama
6009	HJFC	Armenia, Colombia
6010	GRB	London, England
6010	OLR2A	Prague, Czecho.
6010	XEOI	Mexico, Mex.
6015	PRA8	Recife, Brazil
6018	HJCX	Bogota, Col.
6020		Kiev, U.S.S.R.
6020		Radio Free Europe, Munich, Germany
6020	KNBH(VOA)	Dixon, Calif.
6020	XEUW	Vera Cruz, Mex.
6024		Brazzaville, Fr.Eq.Africa
6025		Radio Nederland
6025	HIIJ	San Pedro, D.R.
6030		Stuttgart, Germany
6030	DZH6	Manila, P.I.
6030	XEKW	Morelia, Mex.
6030	HP5B	Panama, Pan.
6035	GWS	London, England
6035		Monte Carlo, Monaco
6035	XYZ	Rangoon, Burma
6037		San Jose, Costa Rica
6040	GSY	London, England
6040	KCBR	Delano, Calif.
6040		Tangier, Tangier
6040	WLWO	Cincinnati, U.S.A.
6045	YDF	Djakarta, Indonesia
6050	HIIN	Ciudad Trujillo, D.R.
6050	GSA	London, England
6054	HJEX	Cali, Colombia
6055	HER2	Bern, Switzerland
6060	GSX	London, England
6060	KNBH(VOA)	Dixon, Calif.
6060		Tangier I, Tangier
6060	WDSI	New York, U.S.A.
6065	SBO	Motala, Sweden
6065	XEXE	Mexico City, Mex.
6069	JOB	Tokyo, Japan
6070	GRR	London, England
6075	KGEI	San Fran., U.S.A.
6080		Munich III, Germany
6081	OAX4Z	Lima, Peru
6085	ORU	Brussels, Belgium
6085	VP4RD	Port-of-Spain, Trinidad
6085	ZYK2	Recife, Brazil
6090	GWM	London, England
6090	VLI6	Sydney, Australia
6092		Radio Luxemburg
6095		Horby, Sweden
6095		Radio Free Europe, Munich, Germany
6095	ZYB7	Sao Paulo, Brazil
6095	HJFK	Pereira, Colombia
6100		Belgrade, Yugoslavia
6100	WRCA	New York, U.S.A.
6110	GSL	London, England
6112	HIIZ	Ciudad Trujillo, D.R.
6115		Berlin, Germany
6120	HC2FB	Guayaquil, Ecua.
6120	ZJI4	Limassol, Cyprus
6120		Tangier, Tangier
6120	WRCA	New York, U.S.A.
6122	HP5H	Panama, Pan.
6124	HRQ	San Pedro Sula, Hond.
6125	GWA	London, England
6130	XEUZ	Mexico, Mex.
6130		Radio Spain ●
6130	COCD	Havana, Cuba
6130		Port Moresby, New Guinea
6135	HJED	Cali, Colombia
6140		Munich, Germany
6145	HJDE	Medellin, Col.
6147	PRL9	Rio de Janeiro, Br.
6150	GRW	London, England
6150	TGAZ	Guatemala, Guat.
6160	HJKJ	Bogota, Colombia
6160		Honolulu, Hawaii
6160		Munich, Germany
6165	GWK	London, England
6165	HER3	Bern, Switzerland ●
6167	4VCM	Port-au-Prince, H.
6170		Munich, Germany
6170	GSZ	London, England
6170	KCBR	Delano, Cal.,U.S.A.
6170	YVKO	Caracas, Venez.
6172	ZJM5	Limassol, Cyprus
6175	XEXA	Mexico, Mex.
6180	LRM	Mendoza, Argentina
6180		Ashkabad, U.S.S.R.
6180	GRO	London, England
6182	TGWB	Guatemala, Guat.
6185	KCBR(VOA)	Delano, Calif.
6185	HJCT	Bogota, Colombia
6190		Frankfurt, Germany
6190	HI9T	Puerto Plata, D.R.
6190	WLWO	Cincinnati, U.S.A.
6190	WRCA	New York, U.S.A.
6195	GRN	London, England
6195		Honolulu, Hawaii
6200		Paris, France
6215	SPI3	Warsaw, Poland
6235	HRD2	La Ceiba, Hond.
6235		Karachi, Pakistan
6248		Budapest, Hungary
6285	TGTQ	Guatemala, Guat.
6295	OTMI	Leopoldville, Belgian Congo
6295	TGLA	Guatemala, Guat.
6320		Baden-Baden, Germany
6322	COCW	Havana, Cuba
6335	TGTA	Guatemala, Guat.
6351	HRPI	San Pedro Sula, Hond.
6374	CSA2I	Lisbon, Port.
6405	TGQA	Quezaltenango, Guat.
6450	COCY	Santa Clara, Cuba
6632	HC2RL	Guayaquil, Ecu.
6660	HROW	Tegucigalpa, Hond.
6758	YNVP	Managua, Nic.
6790	ZJM6	Limassol, Cyprus
6830	4XB2I	Tel Aviv, Israel
6870	HC4EB	Manta, Ecuador
7105		Paris, France
7112	CR4AA	Praia, Cape V. Isls.
7120	GRM	London, England
7135	BED7	Taipei, Formosa
7135	MCM	London, England
7145		Radio Free Europe Lisbon, Portugal
7150	GRT	London, England
7165		Moscow, U.S.S.R.
7175	VUD	Delhi, India
7180	JOA	Tokyo, Japan
7185	GRK	London, England
7200	GWZ	London, England
7205		Warsaw, Poland
7210	GWL	London, England
7210	HEI3	Bern, Switzerland
7222		Budapest, Hungary ●
7230	GSW	London, England
7240		Moscow, U.S.S.R.
7240		Paris, France
7250	GWI	London, England
7255		Prague,Czechoslovakia ●
7257	JKH	Tokyo, Japan
7260	GSU	London, England
7260		Moscow, U.S.S.R.
7280	GWN	London, England
7285	JKJ	Tokyo, Japan
7285	TAS	Ankara, Turkey
7290		Hamburg, Germany
7290	VUD	Delhi, India
7295		Moscow, U.S.S.R.
7300		Radio Free Europe, Munich, Germany
7300	SVD2	Athens, Greece
7315	YSO	San Salvador, Salv.
7320	GRJ	London, England
7335	BEC36	Taipei, Formosa
7360		Moscow, U.S.S.R.
7670		Sofia, Bulgaria
7850	ZAA	Tirana, Albania
7863	SUX	Cairo, Egypt
7933	HLKA	Pusan, S. Korea
7951		Alicante, Spain
8036	FXE	Beirut, Lebanon
8664	COJK	Camaguey, Cuba
8825	COCQ	Havana, Cuba
8955	COKG	Santiago, Cuba
9007		Voice of Zion, Tel Aviv, Israel
9026	COBZ	Havana, Cuba
9236	COBQ	Havana, Cuba
9252		Bucharest, Rumania
9290	PRN9	Rio de Janeiro, Brazil
9316	LRS	Buenos Aires, Arg.
9340	OAX4J	Lima, Peru
9363	COBC	Havana, Cuba
9369		Madrid, Spain
9380		Khabarovsk, U.S.S.R.
9400	OTM2	Leopoldville, Belgian Congo
9410	GRI	London, England
9440		Brazzaville, Fr. Eq. Africa
9452	LRYI	Buenos Aires, Arg.
9463	TAP	Ankara, Turkey
9480		Moscow, U.S.S.R.
9490	KUJ39	Agana, Guam.
9500	XEWW	Mexico, Mex.
9504	OLR3B	Prague, Czecho.
9505	HOLA	Colon, Panama
9505	JBD	Kawachi, Japan
9510	YVHJ	Barquisimeto, Ven.
9510	GSB	London, England
9515	KNBH(VOA)	Dixon, Calif.
9515	TAT	Ankara, Turkey
9520		Colombo, Ceylon
9520	HJKF	Bogota, Colombia
9520	OZF	Skamlebak, Denmark ●
9520	VLT9	Port Moresby, British New Guinea
9520	WLWO	Cincinnati, U.S.A.
9525	GWJ	London, England
9525	ZBW3	Victoria, Hong Kong
9527		Warsaw, Poland
9530		Honolulu, Hawaii
9530		Manila, Philippines
9530	KCBR	Delano, Cal., U.S.A.
9530	WABC	New York, U.S.A.
9531	COCO	Havana, Cuba
9535	HER4	Bern, Switzerland ●
9535	SBU	Stockholm, Sweden
9540		Munich, Germany
9540	VLG9	Melbourne, Aus.
9540	ZL2	Wellington, N. Zeal.
9543	XYZ	Rangoon, Burma
9548	XEFT	Vera Cruz, Mex.
9550	HVJ	Vatican City
9550		Paris, France
9550	OLR3A	Prague, Czecho. ●
9550		Grenada, Windward Is.
9555	OIX2	Pori, Finland
9555	XETT	Mexico, Mex.
9560	JBD2	Kawachi, Japan
9560		London, England
9560		Paris, France
9560	WLWO	Cincinnati, U.S.A.
9560	WRCA	New York, U.S.A.
9565		Komsomolsk, U.S.S.R.
9565	ZYK3	Recife, Brazil
9570		Algiers, Algeria
9570	GWX	London, England
9570	KCBR(VOA)	Delano, Calif.
9570		Warsaw, Poland
9570		Bucharest, Rumania ●
9570		Rome, Italy ●
9580	GSC	London, England
9580	VLB9	Shepparton, Aus.
9585		Madrid, Spain ●
9590		Hilversum, Neth. ●
9590	WABC	New York, U.S.A.
9600	GRY	London, England
9600	KCBR	Delano, Cal., U.S.A.
9600	KRCA	San Fran., U.S.A.
9600		Leningrad, U.S.S.R.
9605	HP5J	Panama, Pan.
9605	JKL2	Toyko, Japan
9605		Radio Free Europe, Lisbon, Portugal
9607		Athens, Greece
9610	VLX9	Perth, Australia
9610	ZYC8	Rio de Janeiro, Brazil
9610	LLG	Oslo, Norway
9610	XERQ	Mexico, Mex.
9615		Voice of Amer., Tangier
9615	VLB9	Shepparton, Aus.
9615	WRCA	New York, U.S.A.
9618	TIDCR	San Jose, C.Rica
9620		Horby, Sweden ● (Nov. to Febr. only)
9620		Paris, France
9620	ZL8	Wellington, N.Z.
9625	XEBT	Mexico, Mex.
9625	GWO	London, England
9625	VP4RD	Port-au-Spain, Trinidad
9630	HJKC	Bogota, Colombia
9630	VUD4/10	Delhi, India
9630		Rome, Italy
9635		Munich, Germany
9635		Voice of Amer., Tangier
9640		Accra, Ghana
9640		West Germany Radio, Cologne ●
9640	DZH2	Manila, P.I.
9640	GVZ	London, England
9645		Karachi, Pakistan
9645	LLH	Oslo, Norway
9645	TIFC	San Jose, C.Rica
9646	HVJ9	Vatican City
9650		Honolulu, Hawaii
9650		Moscow, U.S.S.R.
9650		Tangier, Tangier
9650	WDSI(VOA)	Brentwood, N. Y.
9652	ZJM8	Limassol, Cyprus
9654	OTC2	Leopoldville, Belgian Congo
9655	JKI2	Nazaki, Japan
9656	4VEH	Cap-Haitien, Haiti
9660	EQC	Teheran, Iran
9660	GWP	London, England
9660	VLQ9	Brisbane, Aus.
9665	HEU3	Bern, Switzerland
9668	TGNB	Guatemala, Guat.
9670		Munich, Germany
9670		Voice of Amer., Tangier
9670		Moscow, U.S.S.R.
9675	GWT	London, England
9675	JOB3	Tokyo, Japan
9680		Paris, France
9680	XEQQ	Mexico, Mex.
9680	VUD	Delhi, India
9680		Moscow, U.S.S.R.
9680		Voice of America, Tangier

Kc.	C.L.	Location
9680	VLR9/VLH9	Melbourne, Australia
9685		Paris, France
9685	WLWO	Cincinnati, U.S.A.
9690	LRA	Buenos Aires, Arg. ●
9690	GRX	London, England
9690		Moscow, U.S.S.R. ●
9690		Singapore, Malaya
9695	JKM2	Kawachi, Japan
9700	GWY	London, England
9700	WDSI	New York, U.S.A.
9700		Sofia, Bulgaria ●
9700		Voice of America, Tangier
9700	WLWO	Cincinnati, U.S.A.
9700	KCBR	Delano, Cal., U.S.A.
9700	FZF6	Ft. de France, Mart.
9710		Moscow, U.S.S.R. ●
9710		Dakar, Fr. W. Africa
9710	YDF6	Djakarta, Indonesia
9710		Rome, Italy
9715		Cairo, Egypt
9716		Moscow, U.S.S.R. ●
9717		Radio Free Europe, Ger.
9720	PRL7	Rio de Janeiro, Brazil
9730		French Equatorial Africa ●
9730		Nanking, China
9730	DZH7	Manila, P.I.
9730		Leipzig, Germany
9735	HI2T	Ciudad,Trujillo, D.R.
9741	CSA27	Lisbon, Portugal
9743	HCJB	Quito, Ecuador
9745	HCJB	(Missionary Station), Quito, Ecuador ●
9745	ORU	Brussels, Belgium
9760	CR7BE	Lourence Marques, Moz.
9765	TGWA	Guatemala, Guat.
9770		London, England
9770	ORU	Brussels, Belgium
9770	PRL4	Rio de Jan., Brazil
9780		Rome, Italy
9785		Monte Carlo, Monaco
9825	GRH	London, England ●
9833		Budapest, Hungary ●
9833	COBL	Havana, Cuba
9865	YDF8	Djakarta, Indonesia
9915	GRU	London, England
9966		Brazzaville, Fr. Eq. Africa
10058	SUV	Cairo, Egypt
10195		Paris, France
10220	PSH	Rio de Janeiro, Brazil
10258	XRRA	Peiping, China
10780	SDB2	Motala, Sweden
11027	CSA29	Lisbon, Portugal
11090	CSA92	PontaDelgada,Azores
11455		Peking, China
11475	ZNX52	Barbadoes, B.W.I.
11513		Tangier, Morocco
11515		Peking, China
11630		Leningrad, U.S.S.R.
11640		All India Radio, Delhi
11650		Peking, China
11670		Bangkok, Thailand
11680	HJCQ	Bogota, Colombia
11680	GRG	London, England
11685		Peking, China
11695	HP5A	Panama, Panama
11700	GVW	London, England
11702		Paris, France
11705	JOA4	Tokyo, Japan
11705	SBP	Motala, Sweden
11710		Moscow, U.S.S.R.
11710		Voice of America, Tangier
11710	VUD5/7	Delhi, India
11710	WLWO	Cincinnati, U.S.A.
11714	ZJM7	Limassol, Cyprus
11715	HEI5	Bern, Switzerland
11718		Athens, Greece
11720	PRL8	Rio de Janeiro, Brazil
11720		Radio Portugal ●
11720	OTM4	Leopoldville, Belgian Congo
11720	ORY2	Brussels, Belgium
11724	HNG	Baghdad, Iraq
11725	COCY	Havana, Cuba
11730	GVV	London, England
11730	KGEI	San Fran., U.S.A.
11730		Hilversum, Nether. ●
11730	CE1173	Santiago, Chile
11735	BED6	Taipei, Formosa
11735	LKQ	Frederikstad, Nor.
11735		Radio Free Europe, Ger.
11740		Moscow, U.S.S.R.
11740		Warsaw, Poland ●
11740	WRUL	Boston, U.S.A.
11742	CE1174	Santiago, Chile
11750	GSD	London, England
11755		Radio Portugal ●
11740		Moscow, U.S.S.R.
11760	OLR4B	Prague, Czecho.
11760		Voice of America, Tangier
11760	VLA11/VLB11	Shepparton, Aus.
11760	VUD7/11	Delhi, India
11764	CR7BH	Lourenco Marques, Mozambique
11770	GVU	London, England
11770	YDE/YDF7	Djakarta, Indonesia
11775		Radio Poland ●
11780	BBC	London, England ●
11780		Moscow, U.S.S.R.
11780	XEQH	Mexico, D.F.
11780	ZL3	Wellington, N.Z.
11790	WDSI(VOA)	New York
11790	GWV	London, England
11790	VUD	Delhi, India
11790	WRUL	Boston, U.S.A.
11790		Voice of America, Tangier
11795		West Germany Radio, Cologne ●
11795	YDF3	Djakarta, Indonesia
11795	WRUL	Boston, U.S.A.
11795		Radio Pakistan, Karachi
11795	ELWA	Monrovia, Liberia
11800	JK14	Tokyo, Japan
11800	GWH	London, England
11800		Brussels, Belgium
11810		Moscow, U.S.S.R. ●
11810		Radio Sweden ● (except—Nov. to Febr.)
11810		Rome, Italy
11810	VLA11	Shepparton, Aus. ● (Morning program)
11815		Warsaw, Poland
11820	GSN	London, England
11820	XEBR	Hermosillo, Mex.
11825	JK16	Tokyo, Japan
11825		Moscow, U.S.S.R.
11825	ZYK3	Recife, Brazil
11830	FZS4	Saigon, Fr.Indo-C.
11830		Moscow, U.S.S.R. ●
11830		Voice of America, Tangier
11830	WBOU(VOA)	New York, U.S.A.
11830	WDSI(VOA)	New York, U.S.A.
11835	CXA19	Montevideo, Uru.
11835		Prague, Czechoslovakia ●
11840	VLW11	Perth, Australia
11840	OLR4A	Prague, Czecho.
11840	LRT	Tucuman, Argentina
11845		Karachi, Pakistan
11847		Paris, France
11850	VLB11	Shepparton, Aus.
11850	ORU	Brussels, Belgium
11850	TGNC	Guatemala, Guat.
11850	VUD11	Delhi, India
11850	LLK	Oslo, Norway
11855	DZH9	Manila, Philippines
11855		Radio Free Europe, Lisbon, Portugal
11860	GSE	London, England
11860	KWID	San Fran., U.S.A.
11865	CR6RA	Luanda, Angola
11865	HER5	Bern, Switzerland ●
11870		Munich, Germany
11870	KNBH	San Fran., U.S.A.
11870		Voice of America, Tangier
11870	WRUL	Boston, U.S.A.
11875	OLR4C	Prague, Czecho.
11875		Radio Portugal ●
11880		Moscow, U.S.S.R.
11880	LRS	Buenos Aires, Arg.
11880	VLG11/VLH11	Melbourne, Aus.
11880		Horby, Sweden
11880	XEHH	Mexico, Mex.
11880	GRE	London, England
11880	SBP	Stockholm, Sweden
11885	APK3	Karachi, Pakistan
11890		Moscow, U.S.S.R.
11890	GWW	London, England
11890	KZFJ	Manila, P.I.
11890	WBOU	New York, U.S.A.
11895	FHE3	Dakar, Fr.W.Af.
11895		Radio Portugal ●
11895		Manila, Philippines
11900	CE1190	Valparaiso, Chile
11900	CXA10	Montevideo, Uru.
11900	HCJB	Calvary Radio Ministry
11900	XEXE	Mexico City, Mex.
11900		Rome, Italy ●
11910		Budapest, Hungary ●
11910		Karachi, Pakistan
11915		Radio Netherlands ●
11915		Damascus, Syria
11915	HCJB	Quito, Ecuador ●
11915		Radio Portugal ●
11918	BED4	Taipei, Formosa
11924	FZS4	Saigon, Vietnam
11930	GVX	London, England
11935		Warsaw, Poland
11937		Bucharest, Rumania ●
11950		Radio Netherlands ●
11950	YSAX	San Salvador, Salv.
11955	GVY	London, England
11960		Moscow, U.S.S.R.
11964		Lisbon, Portugal ●
11970		Brazzaville, Fr.Eq.Africa ●
11972	TIHH	San Jose, C.Rica
11975		Colombo, Ceylon
11980		Moscow, U.S.S.R.
11995	CSA32	Lisbon, Portugal ●
11998	CE1180	Santiago, Chile
12040	GRV	London, England
12095	GRF	London, England
12175	TFJ	Reykjavik, Iceland
14492		Radio Moscow
14690	PSF	Rio de Janeiro, Brazil
15050	ETAA	Addis Ababa, Eth.
15050	V3USE	Forest Side, Mauritius
15060		Peking, China
15070	GWC	London, England
15095	HVJ	Vatican City
15100	CSA39	Lisbon, Portugal
15100		Moscow, U.S.S.R.
15100	EPB	Teheran, Iran
15105	KGEI	San Fran., U.S.A.
15105	OAX4X	Lima, Peru
15110	GWG	London, England
15110		Moscow, U.S.S.R.
15115	HCJB	Quito, Ecuador ●
15120		Colombo, Ceylon
15120		Moscow, U.S.S.R.
15120		Rome, Italy
15120		Warsaw, Poland ●
15125	CSA36	Lisbon, Portugal
15130		Voice of America, Tangier
15130	WABC	New York, U.S.A.
15130	WLWO	Cincinnati, U.S.A.
15130	KCBR(VOA)	Dolano, Calif.
15130	WBOU	Bound Brook, N. J., U.S.A.
15135		Radio Japan, Tokyo ●
15135	PRB23	Sao Paulo, Brazil
15140	GSF	London, England
15150	YDC	Djakarta, Indonesia
15145	ZYK2	Recife, Brazil
15150	OAX4R	Lima, Peru
15150	CE1515	Santiago, Chile
15155	SBT	Motala, Sweden
15156	ZYB9	Sao Paulo, Brazil
15160	VUD5/7	Delhi, India
15160	VLB15	Shepparton, Aus.
15160	TAU	Ankara, Turkey
15165	WLWO	Cincinnati, U.S.A.
15165	ZYN7	Fortaleza, Brazil
15170	LKV	Oslo, Norway
15170	TGWA	Guatemala, Guat.
15170		Moscow,U.S.S.R.
15175	LLM	Oslo, Norway
15180	GSO	London, England
15180		Moscow, U.S.S.R.
15180	OZH2	Shamlebak, Den.
15190	VUD5/11	Delhi, India
15190	OIX4	Pori, Finland ●
15195	TAQ	Ankara, Turkey
15200		Moscow, U.S.S.R.
15200	VLA15/VLC15	Shepparton, Aus.
15205	XESC	Mexico, Mexico
15205		Voice of America, Tangier
15210		Munich, Germany
15210	GWU	London, England
15210	WBOU(VOA)	New York, U.S.A.
15210	VLG15	Melbourne, Aus.
15220		Hilversum, Neth. ●
15220	ZL10	Wellington, N.Z.
15225	JBD3	Kawachi, Japan
15228		Komsomolsk, U.S.S.R.
15230	GWD	London, England
15230		Moscow, U.S.S.R.
15230	OLR5A	Prague, Czecho.
15230	VLH15	Melbourne, Aus.
15230	WRUL	Boston, U.S.A.
15235	BED3	Taipei, Formosa
15235	JOB5	Tokyo, Japan
15240		Radio China (Canton) ●
15240		Belgrade, Yugoslavia
15240	KRCA	San Fran., U.S.A.
15240		Paris, France
15240	VLH15	Melbourne, Aus.
15240	WLWO	Cincinnati, U.S.A.
15250		Bucharest, Rumania ●
15250		Voice of Amer., Manila, P.I.
15250	WLWO	Cincinnati, U.S.A.
15250		Voice of Amer., Tangier
15260	GSI	London, England
15260		Karachi, Pakistan
15270	KCBR	Delano, Cal., U.S.A.
15270		Munich, Germany
15270	WBOU(VOA)	Now York, U.S.A.
15270		Sverdlovsk, U.S.S.R.
15280		Munich, Germany
15280	ZL4	Wellington, N.Z.
15280		Moscow, U.S.S.R.
15280		Voice of Amer., Tangier
15285	CR7BG	Lourenco Marques, Mozambique
15285	WBOU(VOA)	New York, U.S.A.
15285	WRUL	Boston, U.S.A.
15290	LRU	Buenos Aires, Arg.
15290	VUD5/9	Delhi, India
15295		Voice of Amer., Tangier
15300	DZH8	Manila, P.I.
15300	GWR	London, England
15300		Singapore, Malaya
15305	HER6	Bern, Switzerland ●
15305	RV97	Novosibirsk, U.S.S.R.
15310	KCBR	Delano, Calif.
15310	GSP	London, England ●
15320	VLG15	Melbourne, Aus.
15320		Moscow, U.S.S.R.
15320	OLR5B	Prague, Czech.
15325		Rome, Italy
15330	KGEI	San Fran., U.S.A.
15330		Sofia, Bulgaria
15330	WLWO	Cincinnati, U.S.A.
15335		Brussels, Belgium
15335		Karachi, Pakistan
15340		Moscow, U.S.S.R.
15340	KCBR	Delano, Cal., U.S.A.
15340		Voice of Amer., Tangier
15345		Athens, Greece
15345		Formosa Radio ●
15347	LRA	Buenos Aires, Arg.
15350		Paris, France
15350	WRUL	Boston, U.S.A.
15350	WLWO	Cincinnati, U.S.A.
15350	VUD8	Delhi, India
15352		Radio Luxemburg
15360		London, England
15360		Moscow, U.S.S.R.
15364	ZYC9	Rio de Jan., Brazil
15365		Radio Netherlands ●
15390		Moscow, U.S.S.R.
15390		Radio China (Canton) ●
15400		Paris, France
15400		Rome, Italy ●
15405	DMQ15	Cologne, W. Germany
15405	PZC	Paramaribo, Surinam
15410		Moscow, U.S.S.R.
15420		Paris, France
15420		Brazzaville, Fr.Equat.Africa
15425		Radio Netherlands ●
15435	GWE	London, England
15440		Moscow, U.S.S.R.
15445		Radio Netherlands ●
15450	GRD	London, England
15595		Brazzaville, Fr.Eq.Africa
15620		Madrid, Spain
15880		Peking, China
17700	GVP	London, England
17710	WRUL	Boston, U.S.A.
17715	GRA	London, England ●
17720	LRA5	Buenos Aires, Arg.
17730	GVQ	London, England
17750	WRUL	Boston, U.S.A.
17750		Rome, Italy
17760	WGEO	Schenectady, U.S.A.
17760	VUD	Delhi, India
17770	KCBR	Delano, Cal., U.S.A.
17770		Rome, Italy
17770		Voice of America, Tangier
17770		Radio Sweden, Stockholm
17775		Hilversum, Netherlands
17780	VUD/10/11	Delhi, India
17780	WBOU	New York, U.S.A.
17780		Voice of Amer., Manila, P.I.
17784	HER7	Bern, Switzerland
17785	JOA	Tokyo, Japan
17790	GSG	London, England
17795	WLWO	Cincinnati, U.S.A.
17800	KNBH	San Fran., U.S.A.
17800	WLWO	Cincinnati, U.S.A.
17800		Radio Australia, Melbourne
17800		Radio Poland ●
17800	KRHO	Honolulu, Hawaii
17800		Stockholm, Sweden
17800	OIX5	Pori, Finland ●
17804		Rome, Italy
17805	DZ16	Manila, P.I.
17810		Formosa Radio ●
17810	GSV	London, England
17810		Moscow, U.S.S.R.
17815	WRUL	Boston, U.S.A.
17820		Colombo, Ceylon
17825	LLN	Oslo, Norway
17825	TAV	Ankara, Turkey
17825		Radio Japan, Tokyo ●
17830		Moscow, U.S.S.R.
17830	WDSI(VOA)	New York, U.S.A.
17835		Karachi, Pakistan
17840		Radio Sweden ●
17840		Brazzaville, Fr.Eq.Africa
17840		Moscow, U.S.S.R.
17840	VLC17	Shepparton, Aus.
17840	HVJ	Vatican City
17850		Paris, France
17860	ORU3	Brussels, Belgium
17865		Damascus, Syria
17870	CSA44	Lisbon, Portugal
17890	HCJB	(Missionary Station) Quito, Ecuador
17910		Grenada, Windward Is.
18250	TFTO	Paris, France
18450		United Nations Radio, Geneva, Switzerland
20088		Moscow, U.S.S.R.
21460	KNBH (VOA)	Dixon, Calif.
21470	GSH	London, England
21480		Hilversum, Netherlands
21490		Paris, France
21500	WRCA	New York, U.S.A.
21510	VUD5	Delhi, India
21520	HER8	Bern, Switzerland
21520	WLWO	Cincinnati, U.S.A.
21530	GSJ	London, England
21540	VLB2	Shepparton, Aus.
21550	GST	London, England
21560		Moscow, U.S.S.R.
21560		Rome, Italy
21570	WDSI(VOA)	New York, U.S.A.
21580		Horby, Sweden
21590	WGEO	Schenectady, N.Y.
21610	WLWO(VOA)	Cincinnati, U.S.A.
21620		Colombo, Ceylon
21640	GRZ	London, England
21650	WLWO	Cincinnati, U.S.A.
21660		Lisbon, Portugal
21670	LLP	Oslo, Norway
21675	GVR	London, England
21680	VLC21	Shepparton, Aus.
21690		Voice of America, Tangier
21700	VUD10	Delhi, India
21710	GVS	London, England
21730	WBOU(VOA)	New York, U.S.A.
21740	KCBR	Delano, Cal., U.S.A.
21740	KGEI	San Fran., U.S.A.
21740		Paris, France
21750	GVT	London, England
25615	OE138	Linz, Austria
25640	HER9	Berne, Switzerland
25650	DMQ25	Cologne, West Germany
25670		Sweden Radio, Stockholm
25675		Radio Australia, Melbourne
25750	GSQ	London, England
26080	GSK	London, England

Canadian Short-Wave Stations

Abbreviations: Kc., frequency in kilocycles (to change to megacycles, divide by 1000); C.L., call letters

Kc.	C.L.	Location
5970	CBNX	St. John's, Nfld.
5970	CKNA	Montreal, Que.*
5990	CHAY	Montreal, Que.*
6005	CFCX	Montreal, Que.
6010	CJCX	Sydney, N.S.
6030	CFVP	Calgary, Alta.
6060	CKRZ	Montreal, Que.*
6070	CFRX	Toronto, Ont.
6080	CKFX	Vancouver, B.C.
6090	CBFW	Montreal, Que.
6090	CKOB	Montreal, Que.*
6130	CHNX	Halifax, N.S.
6150	CKRO	Winnipeg, Man.
6160	CBUX	Vancouver, B.C.
6160	CHAC	Montreal, Que.*
9520	CBFR	Montreal, Que.
9585	CKLP	Montreal, Que.*
9610	CBFX	Montreal, Que.
9610	CHLS	Montreal, Que.*
9630	CBFO	Montreal, Que.
9630	CKLO	Montreal, Que.*
9710	CHLR	Montreal, Que.*
9740	CHFO	Montreal, Que.*
11705	CBFY	Montreal, Que.
11705	CKXA	Montreal, Que.*
11720	CBFL	Montreal, Que.
11720	CHOL	Montreal, Que.*
11720	CKRX	Winnipeg, Man.
11760	CBFA	Montreal, Que.
11760	CKRA	Montreal, Que.*
11900	CKEX	Montreal, Que.*
11945	CKEX	Montreal, Que.*
15090	CKLX	Montreal, Que.*
15105	CKUS	Montreal, Que.*
15190	CBFZ	Montreal, Que.
15190	CKCX	Montreal, Que.*
15255	CKSR	Montreal, Que.*
15275	CKBR	Montreal, Que.*
15320	CKCS	Montreal, Que.*
17710	CHSB	Montreal, Que.*
17735	CHRX	Montreal, Que.*
17820	CKNC	Montreal, Que.*
17865	CHYS	Montreal, Que.*
21600	CKRP	Montreal, Que.*
21710	CHLA	Montreal, Que.*

*Transmitter at Sackville, New Brunswick.

United States FM Stations

Abbreviations: Mc., megacycles, asterisk (*) indicates educational station

ALABAMA

Location	C.L.	Mc.
Albertville	WAVU-FM	105.1
Alexander City	WRFS-FM	106.1
Andalusia	WCTA-FM	98.1
Anniston	WHMA-FM	100.5
Birmingham	WAPI-FM	99.5
	WSFM	93.7
Clanton	WKLF-FM	100.9
Cullman	WFMH-FM	101.1
Decatur	WHOS-FM	102.1
Homewood	WJLN	104.7
Lanett	WRLD-FM	102.9
Mobile	WKRG-FM	99.9
Tuscaloosa	WTBC-FM	95.7
	WUOA	*91.7

ARIZONA

Location	C.L.	Mc.
Globe	KWJB-FM	100.3
Mesa	KTYL-FM	104.7
Phoenix	KELE	95.5
	KFCA	*88.5
Tucson	KFMM	99.5

ARKANSAS

Location	C.L.	Mc.
Blytheville	KLCN-FM	96.1
Ft. Smith	KFPW-FM	94.9
Jonesboro	KBTM-FM	101.9
	KASU	91.9
Mammoth Springs	KAMS	103.9
Siloam Springs	KUOA-FM	105.7

CALIFORNIA

Location	C.L.	Mc.
Atherton	KPEN	101.3
Bakersfield	KERN-FM	94.1
	KQXR	101.5
Berkeley	KPFA	94.1
	KPFB	*89.3
	KRE-FM	102.9
Claremont	KSPC	*90.7
Eureka	KRED-FM	96.3
Fresno	KARM-FM	101.9
	KMJ-FM	97.9
	KRFM	93.7
Glendale	KFMU	97.1
	KUTE	101.9
Long Beach	KFOX-FM	102.3
	KLON	*88.1
	KNOB	97.9
Los Angeles	KABC-FM	95.5
	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
	KXLU	*88.7
	KHOF	99.5
Marysville	KMYC-FM	99.9
Modesto	KBEE-FM	103.3
	KTRB-FM	104.1
Oakland	KAFE	98.1
Ontario	KASK-FM	93.5
Oxnard	KOXR-FM	104.7
Pasadena	KPCS	89.3
Riverside	KPLI	99.1
Sacramento	KCRA-FM	96.1
	KFBK-FM	96.9
	KGMS-FM	100.5
	KJML	95.3
	KXOA-FM	107.9
San Bernardino	KVCR	*91.9
San Diego	KFSD-FM	94.1
	KDWD	98.1
	KITT	105.3
	KSDS	*88.3
San Francisco	KALW	*91.7
	KCBS-FM	98.9
	KDFC	102.1
	KEAR	97.3
	KGO	103.7
	KNBC-FM	99.7
	KSFR	94.9
San Jose	KSJO-FM	92.3
San Mateo	KCSM	*90.9
Santa Ana	KWIZ-FM	96.7
Santa Barbara	KRCW	97.5
Santa Clara	KSCU	*90.1
Santa Maria	KEYM	99.1
Santa Monica	KCRW	*89.9
Stockton	KCVN	*91.3
West Covina	KDWC	98.3

COLORADO

Location	C.L.	Mc.
Boulder	KRNW	97.3
Colorado Springs	KRCC	*91.3
	KSHS	90.5
Denver	KFML-FM	98.5
	KDEN-FM	99.5
	KTGM	105.1
Manitou Springs	KCMS-FM	102.7

CONNECTICUT

Location	C.L.	Mc.
Brookfield	WGHF	95.1
Danbury	WLAD-FM	98.3
Hartford	WHCN	105.9
	WRTC-FM	*89.3
	WTIC-FM	96.5
Meriden	WMMW-FM	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	WNDB-FM	94.5
Gainesville	WRUF-FM	*104.1
Jacksonville	WJAX-FM	95.1
	WZFM	96.9
	WMBR-FM	96.1
Miami	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
	WORZ	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
	WAGA-FM	103.3
	WGKA-FM	92.9
	WSB-FM	98.5
Augusta	WAUG-FM	105.7
	WBBQ-FM	103.7
Columbus	WRBL-FM	93.3
Gainesville	WDUN-FM	103.9
Lagrange	WLAG-FM	104.1
Macon	WMAZ-FM	99.1
Newnan	WCOH-FM	96.7
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
	KUOH	*90.5
	KVOK	*88.1

ILLINOIS

Location	C.L.	Mc.
Anna	WRAJ-FM	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
	WNIB	97.1
	WSEL	104.3
Decatur	WSOY-FM	102.1
DeKalb	WNIC	*91.1
Effingham	WSEI	95.7
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
Macomb	WWKS	*91.3
Mattoon	WLBH-FM	96.9
Mt. Vernon	WMIX-FM	94.1
Oak Park	WOPA-FM	102.3
Olney	WVLN-FM	92.9
Paris	WPRS-FM	98.3
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
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
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
	WFMS	95.5
	WIAN	*90.1
Jasper	WITZ-FM	104.7
Madison	WORX-FM	96.7
Marion	WMRI-FM	106.9
Muncie	WMUN	104.1
	WWHI	*91.5
New Albany	WNAS	*88.1
New Castle	WCTW	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
Clinton	KROS-FM	96.1
Davenport	WOC-FM	103.7
Des Moines	KDPS	*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
Lawrence	KANU	*91.5
Manhattan	KSDB-FM	*88.1
Ottawa	KTJO-FM	*88.1
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	WHOP-FM	98.7
Lexington	WBKY	*91.3
	WLAP-FM	94.5
Louisville	WFPK	*91.9
	WFPL	*89.3
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	KMBL-FM	104.1
New Orleans	WBEH	89.3
	WDSU-FM	105.3
	WRCM	97.1
	WMMT	95.7
Shreveport	KRMD-FM	101.1
	KWKH-FM	94.5

MAINE

Location	C.L.	Mc.
Brunswick	WBOR	*91.1
Caribou	WFST-FM	97.7
Lewiston	WCOU-FM	93.9

MARYLAND

Location	C.L.	Mc.
Annapolis	WNAV-FM	99.1
Baltimore	WBJC	*88.1
	WCAO-FM	102.7
	WFDS-FM	97.9
	WITH-FM	104.3
Bethesda	WUST-FM	106.3
Bradbury Heights	WPGC	95.5
Cumberland	WCUM-FM	102.9
Hagerstown	WJEJ-FM	104.7
	WARK-FM	106.9
Oakland	WBUZ	95.5

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	107.1
Greenfield	WHAI-FM	98.3
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

Location	C.L.	Mc.
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
	WDTR	*90.9
	WHFI	94.7
	WJBK-FM	93.1
	WMUZ	103.5
	WMZK	97.9
	WJR-FM	96.3
	WWJ-FM	97.1
	WXYZ-FM	101.1
E. Lansing	WKAR-FM	*90.5
Flint	WFBE	*95.1
Grand Rapids	WFRS	92.5
	WJEF-FM	93.7
	WLAV-FM	96.9
Highland Pk.	WHPR	*88.1
Jackson	WMKZ	94.1
Kalamazoo	WMCR	*102.1
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.
Mankato	KYSM-FM	103.5
Minneapolis	KTIS-FM	*98.5
	KWFM	97.1
	WLOL-FM	99.5
St. Cloud	KFAM-FM	104.7

MISSISSIPPI

Location	C.L.	Mc.
Jackson	WJDX-FM	102.9
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
Kennett	KBOA-FM	98.9
Poplar Bluff	KWOC-FM	94.5
St. Louis	KCFM	93.7
	KSLH	*91.5
Springfield	KTTS-FM	94.7
West Plains	KWPM-FM	93.9

NEBRASKA

Location	C.L.	Mc.
Lincoln	KFMQ	95.3

NEVADA

Location	C.L.	Mc.
Reno	KNEV	95.5

NEW HAMPSHIRE

Location	C.L.	Mc.
Berlin	WKCQ	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
Zarephath	WAWZ-FM	99.1

NEW MEXICO

Location	C.L.	Mc.
Albuquerque	KANW	*89.1
	KHFM	96.3
Los Alamos	KRSN-FM	98.5
Mountain Park	KMFM	97.9

NEW YORK

Location	C.L.	Mc.
Albany	WAMC	*90.7
Auburn	WMBO-FM	96.1
Babylon	WTFM	103.5
Binghamton	WNBF-FM	98.1
	WKOP-FM	95.3
Brooklyn	WNYE	*91.5
Buffalo	WBEN-FM	106.5
	WBNY-FM	92.9
	KWOL-FM	104.1
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	WINE-FM	103.3
Massena	WMSA-FM	105.3
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
	WRCA-FM	97.1
	WRFM	105.1
Niagara Falls	WHLD-FM	98.5
Olean	WHDL-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
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
Woodside	WWRL-FM	105.1

NORTH CAROLINA

Location	C.L.	Mc.
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	WDNC-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	96.1
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

Location	C.L.	Mc.
Akron	WAKR-FM	97.5
	WAPS	*89.1
Alliance	WFAH-FM	101.7
Ashland	WNCO-FM	101.3
Ashtabula	WICA-FM	103.7
Athens	WOUI	*91.5
Bellaire	WOMP-FM	100.5
Berea	WBWC	*88.3
Bowling Green	WBGU	*88.1
Canton	WHBC-FM	94.1
Cincinnati	WCPO-FM	105.1
	WKRC-FM	101.9
	WSAI-FM	102.7
Cleveland	KYW-FM	105.7
	WBOE	*90.3
	WDOK-FM	102.1
	WERE-FM	98.5
	WGAR-FM	99.5
	WHK-FM	100.7
	WJW-FM	104.1
Cleveland Hts.	WSRS-FM	95.3
Columbus	WCBE	*90.5
	WBNS-FM	97.1
	WCOL-FM	92.3
	WOSU-FM	*89.7
	WVKO	94.7
Dayton	WHIO-FM	99.1
Delaware	WSLN	*91.1
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
Marion	WMRN-FM	106.9
Mt. Vernon	WMVO-FM	93.7
Newark	WCLT-FM	100.3
Oxford	WMUB	*88.5
Portsmouth	WPAY-FM	104.1
Salem	WSOM-FM	105.1
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

OKLAHOMA

Location	C.L.	Mc.
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

OREGON

Location	C.L.	Mc.
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
	KOIN-FM	101.1
	KPFM	97.1
	KPOJ-FM	98.7
	KQFM	100.3
	KRRC	*89.3

PENNSYLVANIA

Location	C.L.	Mc.
Allentown	WFMZ	100.7
Altoona	WVAM-FM	100.1
Bethlehem	WGPA-FM	95.1
Bloomsburg	WHLM-FM	106.5
Butler	WBUT-FM	97.7
Chambersburg	WCHA-FM	95.9
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
	WLAN-FM	96.9
Lebanon	WLBR-FM	100.1
Meadville	WMGW-FM	100.3
Philadelphia	WCAU-FM	98.1
	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
	WRTI-FM	*90.1
	WXPN	*88.9
Pittsburgh	KDKA-FM	92.9
	WDUQ	*91.5
	WFMP	99.7
	WKJF	93.7
	WWSW-FM	94.5
Pottsville	WPPA-FM	101.9
Scranton	WGBI-FM	101.3
	WUSV	*88.9
Sharon	WPIC-FM	102.9
State College	WDFM	*91.1
Sunbury	WKOK-FM	94.1
Warren	WRRN	92.3
Washington	WJPA-FM	104.3
Wilkes-Barre	WBRE-FM	98.5
Williamsport	WLYC-FM	105.1
	WRAK-FM	100.3
York	WNOW-FM	105.7

RHODE ISLAND

Location	C.L.	Mc.
Providence	WPJB-FM	105.1
	WPFM	95.5
	WPRO-FM	92.3
	WXCN	101.5
Woonsocket	WWON-FM	106.3

SOUTH CAROLINA

Location	C.L.	Mc.
Anderson	WCAC	101.1
Charleston	WCSC-FM	96.9
	WTMA-FM	95.1
Columbia	WCOS-FM	97.9
	WUSC-FM	*89.9
Dillon	WDSC-FM	92.9
Greenville	WESC-FM	92.5
	WFBC-FM	93.7
Rock Hill	WRHI-FM	98.3
Seneca	WSNW-FM	98.1
Spartanburg	WSPA-FM	98.9

TENNESSEE

Location	C.L.	Mc.
Bristol	WOPI-FM	96.9
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
Nashville	WFMB	105.9

TEXAS

Location	C.L.	Mc.
Abilene	KACC-FM	*91.1
Austin	KHFI	98.3
	KAZZ	95.5
Beaumont	KRIC-FM	97.5
Cedar Hills	KDFW	107.9
Cleburne	KCLE-FM	94.9
Corpus Christi	KDMC	95.5
Dallas	KIXL-FM	104.5
	KNER	*88.1
	KRLD-FM	92.5
	WRR-FM	101.1
	KSFM	105.3
	KVTT	*91.7
Denton	KDNT-FM	106.3
El Paso	KVOF-FM	*88.5
	KHMS	94.7
Ft. Worth	WBAP-FM	96.3
Houston	KHGM	102.9
	KFMK	97.9
	KTRH-FM	101.1
	KUHF	*91.3
Lubbock	KRKH-FM	93.7
Plainview	KHBL	*88.1
San Antonio	KISS	99.5
	KEEZ	97.3
	KONO-FM	92.9
Texarkana	KCMC-FM	98.1

UTAH

Location	C.L.	Mc.
Ephraim	KEPH	*88.9
Logan	KVSC	*88.1
Salt Lake City	KDYL-FM	98.7
	KSL-FM	100.3

VIRGINIA

Location	C.L.	Mc.
Arlington	WARL-FM	105.1
Charlottesville	WINA-FM	95.3
	WTJU	91.3
Crewe	WSVS-FM	104.7
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
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 Norfolk	WFOS	*90.5
Winchester	WRFL	92.5
Woodbridge	WBVA	105.9

WASHINGTON

Location	C.L.	Mc.
Cheney	KEWC-FM	*89.9
Seattle	KING-FM	98.1
	KIRO-FM	100.7
	KISW	99.9
	KMCS	98.9
	KUOW	94.9
Spokane	KREM-FM	92.9
Tacoma	KCPS	90.9
	KTNT-FM	97.3
	KTOY	*91.7
	KTWR	103.9

WEST VIRGINIA

Location	C.L.	Mc.
Beckley	WBKW	99.5
Charleston	WKAZ-FM	97.5
Huntington	WHTN-FM	100.5
Logan	WLOG-FM	103.3
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

Location	C.L.	Mc.
Appleton	WLFM	*91.1
Chilton	WHKW	*89.3
Colfax	WHWC	*88.3
Delafield	WHAD	*90.7
Eau Claire	WEAU-FM	94.
Greenfield Twp.	WWCF	94.5
Highland	WHHI	91.3
Highland Twp.	WHSA	*89.9
Janesville	WCLO-FM	99.9
La Crosse	WHLA	*90.3
Madison	WHA-FM	*88.7
	WISC-FM	98.1
	WMFM	104.1
Merrill	WLIN	100.7
Milwaukee	WFMR	96.5
	WQFM	93.3
Racine	WRJN-FM	100.7
Rice Lake	WJMC-FM	96.3
Wausau	WHRM	*91.9
West Bend	WBKV-FM	92.5
Wisc. Rapids	WFHR-FM	103.3

Canadian FM Stations

Location	C.L.	Mc.
Brantford, Ont.	CKPC-FM	92.1
Cornwall, Ont.	CKSF-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
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
Sydney, N.S.	CJCB-FM	94.9
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
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
Mobile	WALA-TV	10
	WKRG-TV	5
Montgomery	WCOV-TV	20
	WSFA-TV	12
Munford	WTIQ	*7

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	KNAC-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
Chico	KHSL-TV	12
El Centro	XEM-TV	3
Eureka	KIEM-TV	3
	KVIQ-TV	6
Fresno	KFRE-TV	12
	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

CONNECTICUT

Location	C.L.	Chan.
Bridgeport	WICC-TV	43
Hartford	WTIC-TV	3
	WHCT	18
New Britain	WNBC	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 Myers	WINK-TV	11
Gainesville	WUFT	*5
Jacksonville	WFGA-TV	12
	WJCT	*7
	WJXT	4
Miami	WCKT	7
	WPST-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
Tampa	WFLA-TV	8
	WEDU	3
	WTVT	13
W. Palm Beach	WEAT-TV	12

GEORGIA

Location	C.L.	Chan.
Albany	WALB-TV	10
Atlanta	WAGA-TV	5
	WSB-TV	2
	WETV	*30
	WLW-A	11
Augusta	WJBF	6
	WRDW-TV	12
Columbus	WRBL-TV	4
	WTVM	28
Macon	WMAZ-TV	13
Savannah	WSAV-TV	3
	WTOC-TV	11
Thomasville	WCTV	6

HAWAII

Location	C.L.	Chan.
Hilo	KHBC-TV	9
Honolulu	KGMB-TV	9
	KONA	2
	KULA-TV	4
Wailuku	KMAU	3
	KALA	7
	KMVI-TV	12

IDAHO

Location	C.L.	Chan.
Boise	KBOI	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	WDAN-TV	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
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
	WJMR-TV	20
	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	WDMJ-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
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
Hattiesburg	WDAM-TV	9
Jackson	WJTV	12
	WLBT	3
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
Las Vegas	KLAS-TV	8
	KSHO-TV	13
Reno	KOLO-TV	8

NEW HAMPSHIRE

Location	C.L.	Chan.
Durham	WENH	*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	KICA-TV	12
Roswell	KSWS-TV	8

NEW YORK

Location	C.L.	Chan.
Albany	WTEN	10
	WTRI	35
Binghamton	WINR-TV	40
	WNBF-TV	12
Buffalo	WBEN-TV	4
	WBUF	17
	WGR-TV	2
	WKBW	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
	WRCA-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	13

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
Grand Forks	KNOX-TV	10
Minot	KXMC-TV	13
	KMOT	10
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
Steubenville	WSTV-TV	9
Toledo	WSPD-TV	13
	WTOL-TV	11
Youngstown	WFMJ-TV	21
	WKBN-TV	27
	WKST-TV	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.
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
	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	13
Greenville	WFBC-TV	4
Spartanburg	WSPA-TV	7

SOUTH DAKOTA

Location	C.L.	Chan.
Aberdeen	KXAB-TV	9
Florence	KDLO-TV	3
Rapid City	KOTA-TV	3
	KRSD-TV	7
Reliance	KPLO-TV	6
Sioux Falls	KELO-TV	11

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
	WFAA-TV	8
El Paso	KELP-TV	13
	KROD-TV	4
	KTSM-TV	9
(Ciudad Juarez, Mex.)	XEJ-TV	5
Ft. Worth	KFJZ-TV	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
Nacogdoches	KTES	19
Odessa	KOSA-TV	7
Port Arthur-Beaumont	KPAC-TV	4
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.
Provo	KLOR-TV	11
Salt Lake City	KSL-TV	5
	KTVT	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	15
Harrisonburg	WSVA-TV	3
Lynchburg	WLVA-TV	13
Norfolk	WTAR-TV	3
	WAVY-TV	10
	WTOV-TV	27
Petersburg	WXEX-TV	8
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	*9
	KING-TV	5
	KIRO-TV	7
	KOMO-TV	4
Spokane	KHQ-TV	6
	KREM-TV	2
	KXLY-TV	4
Tacoma	KTNT-TV	11
	KTVW	13
Yakima	KIMA-TV	29

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	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
	WMVS-TV	*10
	WTMJ-TV	4
Wausau	WSAU-TV	7
Whitefish Bay	WITI-TV	6

WYOMING

Location	C.L.	Chan.
Casper	KTWO-TV	2
	KSPR-TV	6
Cheyenne	KFBC-TV	5
Riverton	KWRB-TV	10

GUAM

Location	C.L.	Chan.
Agana	KUAM-TV	8

PUERTO RICO

Location	C.L.	Chan.
Mayaguez	WORA-TV	5
Ponce	WRIK-TV	7
San Juan	WSUR-TV	9
	WAPA-TV	4
	WIPR-TV	*6
	WKAQ-TV	2

Canadian Television Stations

ALBERTA

Location	C.L.	Chan.
Calgary	CHCT-TV	2
Edmonton	CFRN-TV	3
Lethbridge	CJLH-TV	7
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
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.
Brandon	CKX-TV	5
Winnipeg	CBWT	3

NEW BRUNSWICK

Location	C.L.	Chan.
Moncton	CKCW-TV	2
Saint John	CHSJ-TV	4

NEWFOUNDLAND

Location	C.L.	Chan.
Argentia	CJOX-TV	10
St. John's	CJON-TV	6
Stephenville	CFSN-TV	8

NOVA SCOTIA

Location	C.L.	Chan.
Halifax	CBHT	3
Liverpool	CBHT-1	12
Shelburne	CBHT-2	8
Sydney	CJCB-TV	4
Yarmouth	CBHT-3	11

ONTARIO

Location	C.L.	Chan.
Barrie	CKVR-TV	3
Elk Lake	CFCL-TV-2	2
Elliot Lake	CKSO-TV-1	3
Hamilton	CHCH-TV	11
Kapuskasing	CFCL-TV-1	3
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.
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.
Prince Albert	CKBI-TV	5
Regina	CKCK-TV	2
Saskatoon	CFQC-TV	8
Swift Current	CFJB-TV	5
Yorkton	CKOS-TV	3

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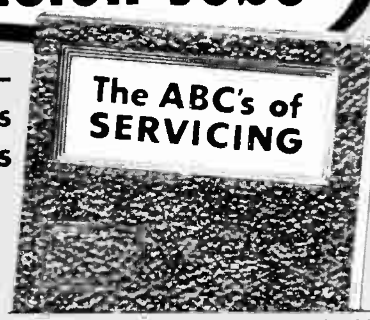

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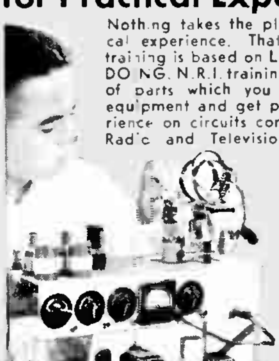

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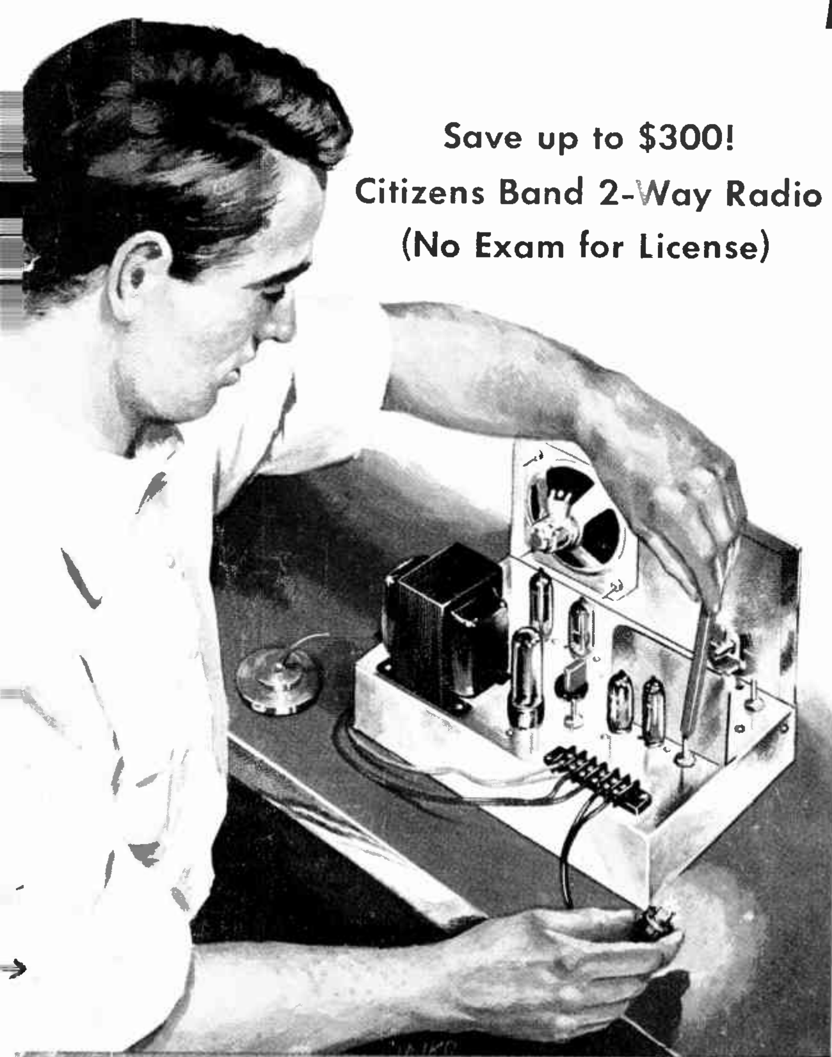

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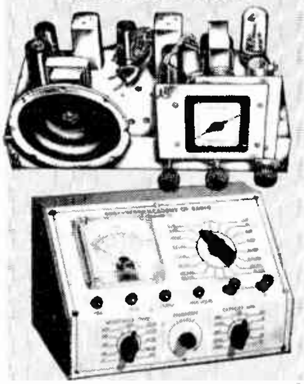

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NUMBER 562

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The Radio-TV Experimenter contains a selection of the most popular electronics projects and radio and TV maintenance articles that have appeared in *Science and Mechanics Magazine*, plus a number of projects and helpful articles on the same subjects appearing for the first time.

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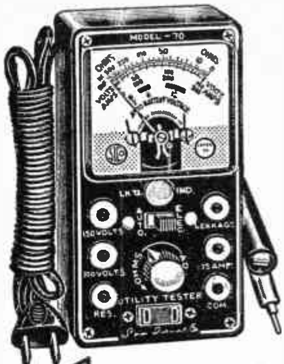

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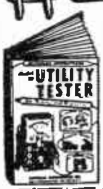

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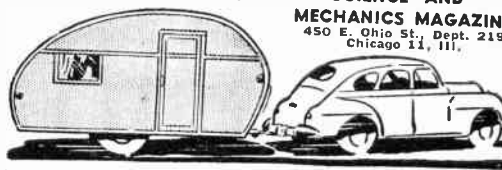

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Citizens Band Transceiver

A project for the individual, the civilian defense group, or the radio club—and one that can be used on the Amateur band as well as the Citizens band

By C. F. ROCKEY

Low in cost for what it delivers, this transceiver is specifically designed for use on the Citizens Band, but does double duty in the 10-meter amateur band.

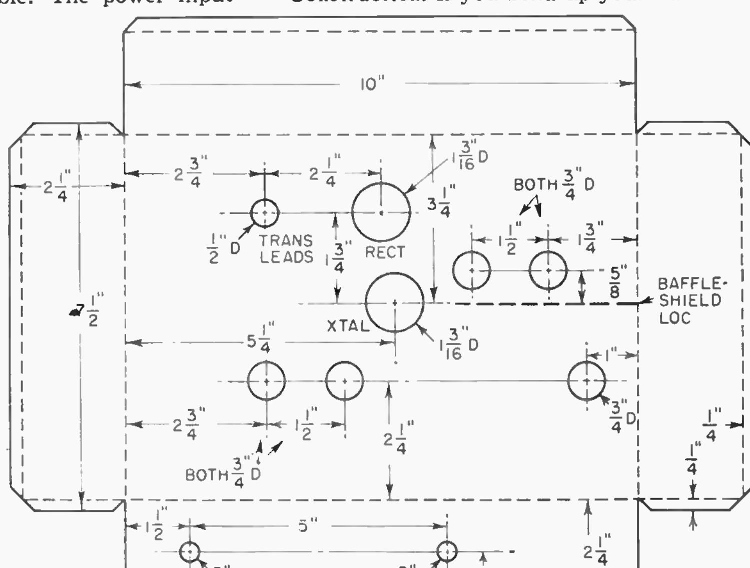
ALTHOUGH specifically designed for the Class D Citizens Band radio service (see box copy on page 25), this simple transceiver is also suitable for low-power telephony in the 28 megacycle band. Inexpensive, readily available tubes and parts are used throughout, and the total cost to build will be about $40. The writer believes that it is hardly possible to build an effective, truly legal radiotelephone unit for much less money.

The transmitter employs a stable, straightforward circuit that can be made to operate well with a minimum of trouble. The power input normally runs slightly less than the 5-watt maximum allowed to Class D Citizen's Band stations. The receiver employs the super-regenerative principle, providing maximum gain and sensitivity per tube. It also will be found easy to "get going." An RF stage reduces radiation and increases stability.

The frequency range of both transmitter and receiver is approximately 25 to 30 megacycles, which includes both the 27 megacycle Citizens Radio and the "10-meter" amateur bands. One cannot accurately predict the communication range, but about 4 or 5 miles (between two similar units) with the maximum legal antenna (see box copy) may be expected in the Citizens Band. Although a 117-*v* commercial *ac* power source is required for this unit, it may be readily modified to operate from an automobile storage battery if a different power supply system is installed.

Before beginning construction of this project, make sure that you have a grid-dip meter available (see p. 130 of this handbook). Proper adjustment will be very difficult without one of these, but almost every experimentally minded amateur owns one, and may lend it to you.

Construction. If you bend up your own chassis



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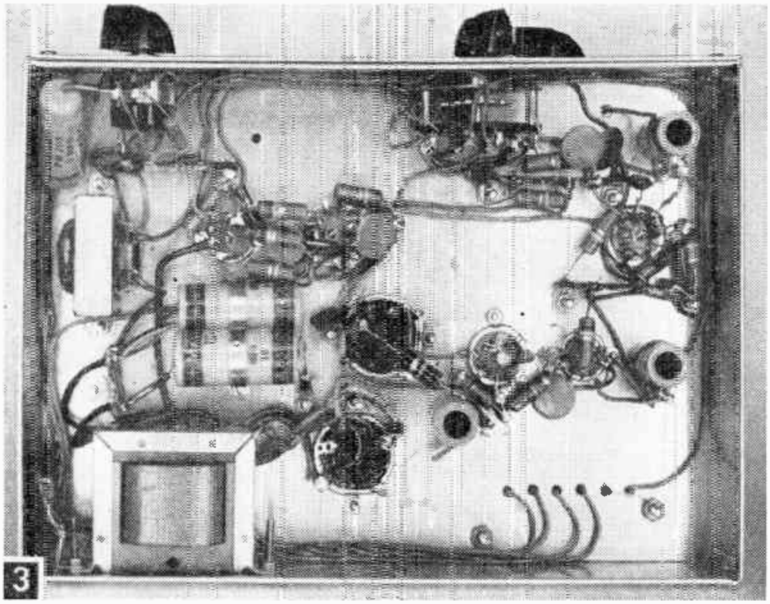
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Under-chassis view of transceiver.

When installing the electrolytic capacitors, be sure to observe the polarity of their connections. Otherwise, if reversed, they will generate internal gas and may explode, taking rectifier tube and possibly the power transformer to destruction with them. Recheck your wiring for correctness, being careful also to look for and remove any inadvertent solder shorts to chassis or between tube socket lugs. Each soldered joint (rosin-core solder only) should be clean, smooth and shiny. Make all ground connections to soldering lugs, since soldering to aluminum is generally unsatisfactory.

from sheet aluminum, complete this metalwork first. A developed view is shown in Fig. 2. If you do not have metalworking equipment (shear and small bending brake) you can use a commercially available 2 x 7 x 10-in. aluminum chassis and a 1/16 x 7 x 10- in. aluminum sheet for the panel.

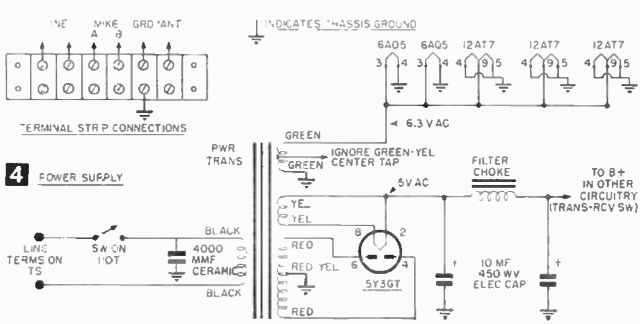
With panel and chassis at hand, begin by drilling and punching the major holes in the chassis. Mount all sockets and terminal strips before fastening the power transformer in place, using 6-32 *rh* machine screws for fastening everything except the miniature tube sockets, which require 4-36 screws. If you anticipate portable operation, put lock washers under each screw head for additional security.

The insulated tie-point strips may now be fastened under the chassis also, using the under-chassis photo, Fig. 3, as a guide. Mount the Send-Receive switch and the potentiometer and switch temporarily onto chassis, but temporarily omit the filter choke and do not install panel as yet.

Wire the power supply first, making sure to connect the power switch (on the potentiometer) in series with the transformer primary (see Fig. 4). And don't forget the 4000 mmfd line bypass capacitor to ground (ground indicates chassis in every case). Complete all power transformer and rectifier tube socket wiring before installing the filter choke, which mounts on back of chassis under power transformer. The green-yellow wire on the power transformer is the 6.3-*v* winding center tap. Cut this wire short and tape the end, so that it will not cause trouble with other circuits. Mount and connect filter choke after power transformer has been wired.

When the power supply has been wired and carefully checked, connect the line cord to the terminal strip, and insert the 5Y3 rectifier tube in its socket. When the line switch is on, the rectifier tube filament should glow, and a dc voltmeter should indicate about 275 *v* when connected from B+ to ground. (This voltage will drop to 250 *v* when a load is applied.) Since the power supply is straight-forward, a no-voltage condition indicates incorrect wiring, a bad tube, or a defective part. Remember that good electrolytic capacitors store a charge, so short 'em (with power off!) before continuing work; otherwise, you might get bit by a "dead" circuit.

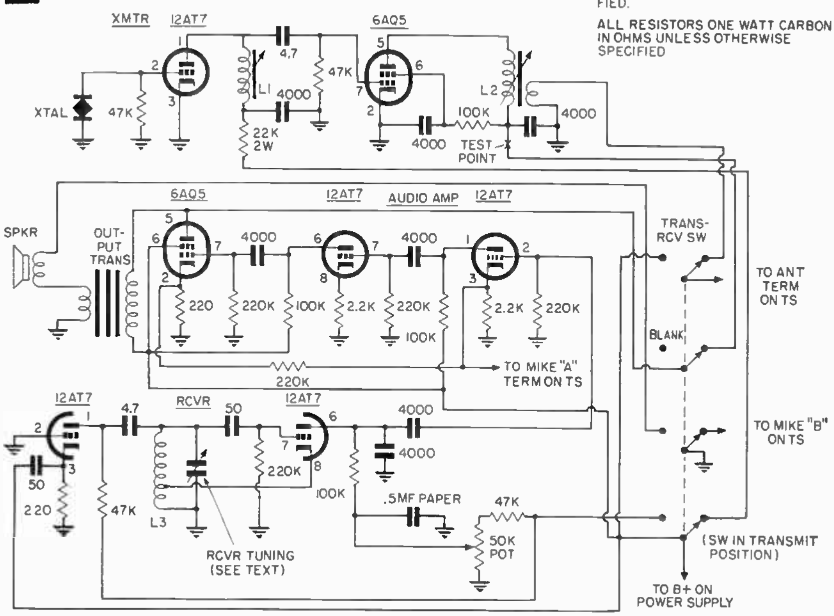
Wire all of the 6.3-*v* heater circuits next, as per Fig. 4. Don't forget the ground-return for heater current at each socket. When heater wiring is completed, plug in other tubes, plug in set and turn it on. All tube heaters should light and warm-up directly. Again, watch out for shorts between those pesky little miniature socket lugs. If all's well, pull out line plug and tubes, and continue work.



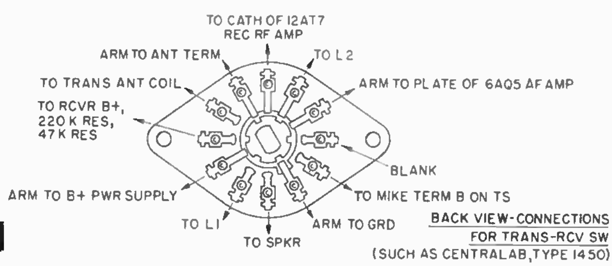
4 POWER SUPPLY

Install the speaker output transformer and wire the audio amplifier section, beginning with the 6AQ5 (see Fig. 5). Bring a pair of leads for the loudspeaker topside through a ⅛-in. deburred hole, twisting the leads to keep them together. Be especially careful when wiring the Send-Receive switch to Receive position. When tubes warm, cautiously touch screwdriver to control grid, pin No. seven. A buzzy click from loudspeaker means all's okay. If not, recheck wiring, particularly looking for solder shorts. A bad tube could also cause trouble.

5 TRANSMITTER-RECEIVER

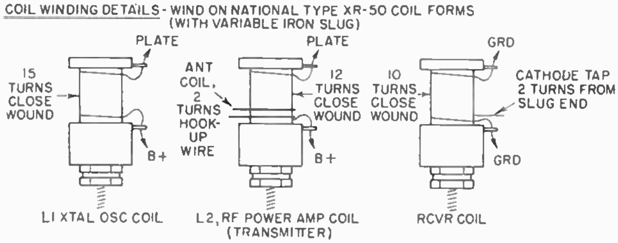


When 6AQ5 is working, unhook and continue with 12AT7 audio amplifier. Plan your wiring as you progress (using Fig. 3 as a rough guide) so that you can hang the carbon resistors and ceramic capacitors in the wiring in the shortest and most direct manner. Where a bare lead might wiggle around and short to something, cover it with a piece of spaghetti tubing. You can check the 12AT7 amplifier as you did the 6AQ5: when wired, plug in 12AT7, 6AQ5 and 5Y3; turn on power and switch S-R switch to Receive position. A cautious touch of screwdriver to each grid should produce that clicky buzz, louder at the 12AT7 grids, of course.



6 BACK VIEW-CONNECTIONS FOR TRANS-RCV SW (SUCH AS CENTRALAB, TYPE 1450)

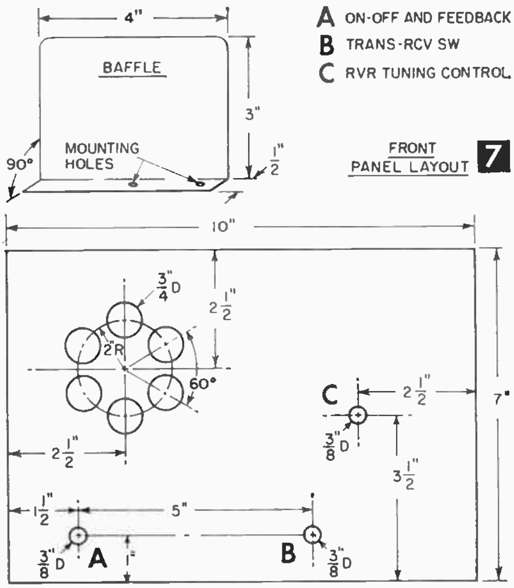
COIL WINDING DETAILS - WIND ON NATIONAL TYPE XR-50 COIL FORMS (WITH VARIABLE IRON SLUG)



Begin the receiver section by winding the coil carefully (see Fig. 6). If you can't get double cotton-covered wire, use single cotton-covered—but if you use enamelled or Formvar insulated wire, use one less turn (on *each* of the three coils) to compensate for increased capacitance. Be careful to place the tap properly, since proper feedback relationships depend upon it. Keep the high-frequency leads short and direct in this circuit. Note that the grid of the RF amplifier is grounded; the signal enters the cathode of this tube. Observe also that the cathode of the detector is connected to the tap on the coil; it must *not* be grounded otherwise. The feedback-control potentiometer controls the plate voltage upon the super-regenerative detector; the voltage upon the plate should increase as the shaft is rotated to the right, looking from the front.

It will improve the appearance of the wiring if the plate supply, heater supply, and other non-critical leads are run along the corners of the chassis. Grid, plate, and other important connections, however, should be made as short and direct as possible. Use tie-lugs to support small parts.

Now, drill and install the panel (upon which the receiver tuning capacitor is mounted, see Fig. 7). When drilled, install the panel along with the tuning capacitor and the loud speaker, drilling a hole in the chassis to pass the tuning capacitor stator leads. Then, make and install aluminum baffle shield (Fig. 7). This shield serves to reduce interaction



FRONT PANEL LAYOUT 7

between receiver and transmitter. Fasten it to the chassis with two 6-32 machine screws whose nuts (underneath chassis) may also hold a four-lug tie point strip.

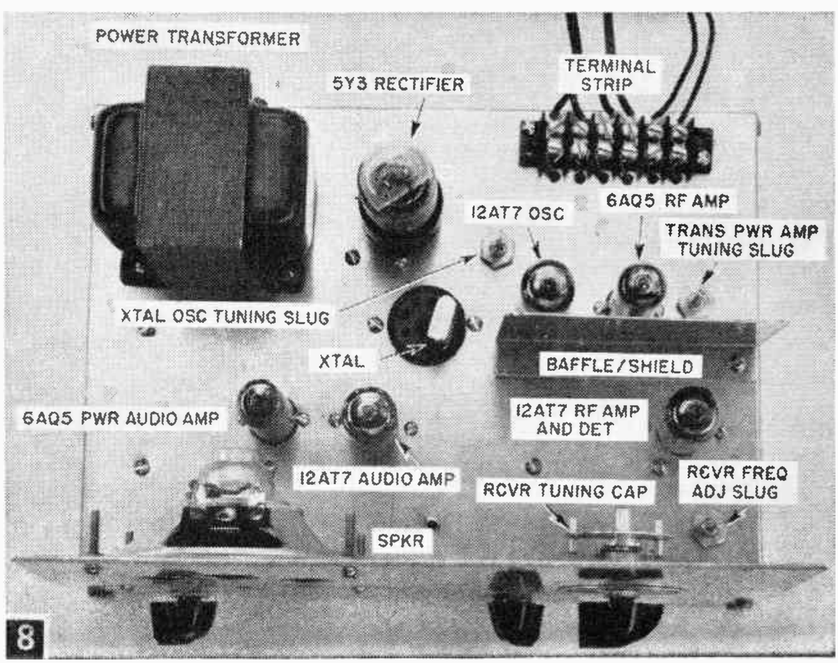
The receiver tuning capacitor should be modified by carefully removing one of its rotary plates. Grasp the rearmost plate firmly with a pair of long nose pliers and pull out the plate. This operation reduces the maximum capacitance and insures the correct tuning range. Be sure to put the calibrated dial plate under the fastening nut of this capacitor on the front of the panel.

Now you can insert tubes in all completed sections, plug in, and put Send-Receive switch in Receive position. As the feedback control is advanced toward the right, a smooth hiss should issue from the loudspeaker, indicating that super-regenerative action is occurring properly. If no hiss is forthcoming, check the wiring again. Be sure the coil has been wound and connected *exactly* as directed. Measure the voltage from the plate of the 12AT7 detector section to ground. As the feedback control is turned, this voltage should vary from zero to over 50 *v*, indicating correct *dc* plate conditions. With correct voltage available, coil wound as specified, and a good tube, this receiver cannot fail.

When proper super-regenerative action has been assured, adjust the tuning range of the receiver, using a grid dip meter. Screw the iron slug carefully into or out of the coil until the grid dip meter indicates a tuning range from about 25 to about 30 megacycles. A slightly wider tuning range does no harm. A reasonably good antenna connected to the antenna terminal should now provide a number of amateur signals in the 10-meter band, particularly during the daytime. Adjust the feedback control to provide the best response from each signal. The Citizens Radio Band should fall near the middle of the tuning range, the amateur 10-meter band further toward the low capacity end of the dial.

With the receiver operating properly, begin wiring the transmitter section (Fig. 5). Commence with the crystal oscillator (see Table A for crystal). Only half of the 12AT7 tube is used, the elements of the second triode remaining unconnected. This apparent waste of a good triode section may seem unthrifty until one remembers that the 12AT7 tube costs no more, and is often more available than a single-triode equivalent type.

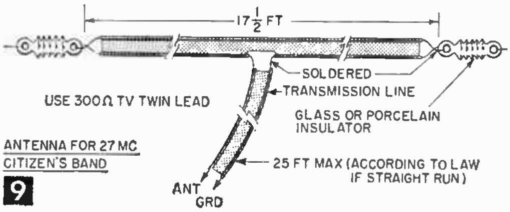
The standard quartz crystal holder will plug into any two *alternate* (not adjacent) holes in the standard octal socket, so pick any alternate pair of pins and use these for the crystal. The remainder of the pins may be used as tie-points, if desired.



Top-chassis view of transceiver.

The crystal oscillator circuit is simple and direct, and is recommended by most crystal manufacturers for use with their overtone crystals. Just follow the schematic diagram Fig. 5, keep the leads short and direct, and you will have no trouble. To test for oscillation, insert the rectifier and the crystal oscillator tubes, throw switch to Send position, and apply power. Make sure crystal is plugged securely into the correct holes. Tune your grid-dip meter to the crystal frequency and adjust the slug in the oscillator coil to obtain maximum RF output. No oscillation indicates wiring difficulties, poor tube, or defective crystal.

Wiring the transmitter RF power amplifier completes the project. This amplifier is simple and, if built as specified, may be expected to work well. Note especially however that the



ANTENNA FOR 27 MC CITIZEN'S BAND

9

transmitter RF amplifier obtains its B+ supply through the Send-Receive Switch from the plate of the 6AQ5 *audio* power amplifier, rather than directly through the switch from the power supply. This is because, in Send condition, the power audio amplifier acts as a *modulator,* causing the RF amplifier's supply voltage to vary in accordance with the voice variations. This is how the

What the Class D License Is—and Is Not

On September 11, 1958, the Federal Communications Commission vastly expanded the scope of the Citizens Radio Service. Of particular interest to the radio-TV experimenter is the inauguration of the Class D Citizens radiotelephone service in the 27-megacycle band. The opening of this class of service provides the opportunity of private radiotelephony to every U. S. citizen over 18 years of age. He may use this radiotelephone privilege for any legitimate, not-for-hire communication purpose.

Of course, *a license is required*, as it is for any radio transmission of any sort within the jurisdiction of the United States Government. But since it involves merely an operating privilege, no technical examination is required; neither is one required to master the radiotelegraph code. On the other hand, an individual so licensed is restricted as to the type of equipment he may operate and the frequencies he may use.

The new Class D Citizens Radio Service may be employed by any duly licensed individual or organization for personal communication, or for intra-organizational communication such as: communication between a man's home and his car (a boon to physicians, for instance); communication between various buildings or vehicles on a ranch or farm; communication between delivery trucks or service technicians on the job and their home office; exchange of information between college students and their professors upon legitimate, personal, educational matters; consultation between construction foremen and the architect or engineer of a large construction job; coordination of the activities of a school athletic contest, and other situations.

The sort of thing that the Commission frowns upon, or directly *forbids*, however, would be: the broadcasting of any type of music or entertainment; long-winded gab sessions, or clowning-around which might interfere with sincere users; foreign contacts, or contacts with stations of any radio service, *including amateurs*, except in a demonstrated emergency; deliberate interference with another station, or monopolizing of a frequency for nonconstructive purposes; tinkering with the equipment by persons not authorized to make circuit changes or adjustments.

It is thus very clear that the Citizens Radio Service is not intended to be an amendment to or substitute for amateur radio. Furthermore, it is not an electronic playground for those too lazy to acquire an amateur license. In fact, the Citizens Radio license does not permit the use of any of the amateur bands, nor conversely, does the amateur license permit operation upon the Citizens Service band. One must have a Citizens Radio license to operate upon the Citizens Band, no other kind of license will do!

Several classes of Citizens Radio licenses are available, and are described in Part Nineteen of the Regulations of the Federal Communications Commission. These, for instance, provide legitimately for the privilege of controlling model planes, boats, etc., by radio. Another class provides for the use of the 465 megacycle UHF citizens band. But the class of most direct interest to the experimenter is *the Class D Citizens Radiotelephone Service.* It is the class D license which permits those communication privileges already described.

To obtain a Class D Citizens Radio Service you must: 1) Be a citizen of the United States; 2) be at least 18 years of age; 3) have a legitimate purpose for such communication; 4) obtain, read, and be prepared to take an oath to the effect that you have read, Part Nineteen of the Regulations of the Federal Communications Commission (available for 10¢ from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.); 5) fill out, notarize, and send to the Federal Communications Commission, Washington, D. C. *FCC Form Number 505* (available from the FCC Field Engineer's Office nearest you. These offices are located in each of the country's major cities).

The equipment for use under provisions of the class D license must meet the following requirements:

1) The dc plate power input to the stage feeding power to the antenna must not exceed 5 watts.

2) The transmitter must be crystal-controlled, and the frequency of operation must be held to within .005% of the assigned frequency. (Purchase of an approved crystal from a reputable manufacturer, and use of it in an approved circuit, will insure compliance with this regulation. Tell the manufacturer the circuit in which the crystal is to be used and specify a frequency tolerance of .005%.)

3) Statement of how compliance with these above regulations will be maintained must be filed along with your license application.

4) The antenna system to be used with a permanent (home) installation shall not be higher than 20 ft. above the building or other structure upon which it is erected.

5) The distance between the center of the antenna and the transmitter control point shall not exceed 25 ft.

Although the provisions of this class of license are indeed liberal, the prospective user should have no delusions as to the limitations involved. You are not going to set the world afire with 5 watts and a 20-ft. antenna. Under normal conditions, consistent communication over distances of three or four miles is about all one has a right to expect, though occasional thousand-mile contacts may be made.

Lastly, although building your own equipment is permissible, it must be tuned and adjusted finally by a licensed *commercial* operator, holding at least a second-class radiotelephone operator's license.

But if you're looking for low-cost radio communication over a restricted range with relatively inexpensive gear, the Class D Citizens radio service is definitely for you.

intelligence is impressed upon the radiated signal. Also observe that both the plate and screen supply are thus modulated.

To test the completed amplifier, insert tubes and apply power. With the switch in Send position, recheck the crystal oscillator for oscillation with the grid-dip meter. You may find it necessary to readjust the slug in the oscillator coil; this is normal. With the crystal oscillator operating, connect a No. 46 pilot lamp bulb across the antenna terminals. Now adjust the RF amplifier tuning slug until the bulb burns at its brightest. When the transmitter is operating correctly, the bulb should light brightly. Carefully adjust both transmitter coil slugs for best output, then unscrew the *oscillator* coil slug about three turns (outward) to provide best reliability of oscillation.

Using the grid-dip meter, carefully explore the output of the transmitter at the amplifier coil for spurious signals at frequencies other than that of the crystal. If you have built the unit as described, you should find absolutely none. This will keep you out of trouble with the FCC.

Finally, connect the microphone to its terminals upon the terminal strip. In transmit position, speaking into the mike should cause the bulb to flicker appreciably. If so, modulation is satisfactory, and you can consider your transceiver ready for use.

You may use any single-button *carbon* microphone but do not try to use a crystal or dynamic mike; the latter types will not work. One of the older telephone transmitters will work well, this may be obtained from Army Surplus or, from the Telephone Engineering Company, Simpson, Pa. Use the transmitter only, you do not need or want the receiver. Of course, with this type of mike the voice quality will be rather thin, but this is preferable for communications work, since it cuts through interference much better than the round, full response of the broadcast station. (You're not allowed to transmit music or entertainment anyway.)

Table A—Frequencies Available For Class D Citizens Band Operation: (All In Kilocycles)

26965	27035	27125
26975	27055	27135
26985	27065	27145
27005	27075	27155
27015	27085	27165
27025	27105	27175
	27115	27185
		27205
		27215
		27225

You may choose a crystal from any of these frequencies.

Crystals manufactured to the required .005% tolerance may be obtained from: Texas Crystal Co., 8538 W. Grand Ave., River Grove Ill., or American Crystal Co., 821 E. 5th St., Kansas City 6, Mo.

Although you now have your station completed, do not go on the air until you have received your Citizens Radio permit. To do so exposes you to a two year penitentiary sentence and/or a $10,000 fine. Remember, also, that an amateur license of any grade does *not* permit you to use the Citizens radio frequencies, per se.

However, if you hold a *general*, or higher, class of amateur license, you may operate this unit within the 10-meter amateur 'phone band, if you have an overtone crystal for operation therein. Usual amateur regulations will then apply.

If you wish, you may install this transceiver in either a metal or wooden cabinet. The only precaution is to provide ample ventilation for the tubes and parts and, if a metal cabinet is chosen, to avoid short-circuiting under-chassis components.

MATERIALS LIST—CITIZENS BAND TRANSCEIVER

No. Req.	Size and Description
1	aluminum chassis (as per text) 2 x 7 x 10"
1	piece of aluminum, 3½ x 4" (baffle shield)
1	aluminum panel (see text) or 7 x 10"
1	power transformer (Chicago-Standard type PC 8403; secondaries: 250-0-250 v at 70 ma., 5 v at 2 amps; 6.3 volts at 2½ amps.)
1	filter choke (Chicago-Standard type C-1708; 13 Henrys at 65 ma.)
1	output transformer (Chicago-Standard type A-3877; 5 watts; single-plate to 4-ohm voice coil)
1	4 inch P.M. loudspeaker (Jensen type 4 J 6)
1	Jones barrier terminal strip, 6-terminal, 2⅞" long
1	15 mmfd variable capacitor (Bud type MC-1870)
2	8-prong tube sockets (Amphenol)
3	9-prong miniature tube sockets (Amphenol)
2	7-prong miniature tube sockets (Amphenol)
3	National type XR-50 coil forms with iron slug
1	50 K linear taper potentiometer with switch (IRC)
1	4-pole DT phenolic insulated wafer switch (Centralab type 1450)
2	10 mfd, 450 w. v. tubular electrolytic capacitors (Mallory type TC-72)
1	0.5 mfd tubular paper capacitor 200 w. v. (Cornell-Dubilier)
3	bar knobs, set-screw type
1	dial plate calibrated 0 to 100 in 180° (Crowe type 55H)
1	power line cord with plug
1	quartz crystal for appropriate Citizens band frequency (see Table A)
1	single-button carbon microphone
3	4-lug insulated tie points
2	2-lug insulated tie points
5	220K ohm, 1-watt carbon resistors
10	4000 mmfd, disc type ceramic capacitors
2	50 mmfd, disc type ceramic capacitors
2	4.7 mmfd, disc type ceramic capacitors
1	5Y3 GT tube
3	12 AT 7 tubes
2	6 AQ 7 tubes
	plastic insulated hookup wire
	No. 22 double-cotton-covered magnet wire (¼ lb. roll)
	rosin core solder
	6–32 and 4–26 *rh* steel machine screws with nuts
	soldering lugs, spaghetti tubing, antenna materials
	For testing and adjustment the following is required:
1	2-watt neon bulb
1	pilot lamp bulb, type 46
1	0-100 milliampere DC milliammeter
1	grid dip meter with coils
1	radio service man's volt meter

One form of antenna suitable for Class D Citizens Band operation is shown in Fig. 9. If you contemplate operation with portable or mobile units, suspend the antenna vertically; if with other fixed stations, either vertical or horizontal antennas may be used. One thing to remember, though—all units working together must use similar-oriented antennas for best results. That is, all must use either vertical or horizontal arrangement. For operation within the amateur 10-meter band, make the antenna one ft. shorter overall.

When a dipole or similar antenna is used, connect one side of the feedline to the antenna, the other to the ground terminal. If a coaxial feedline is used, connect the inner conductor to the antenna terminal, the sheath to the ground.

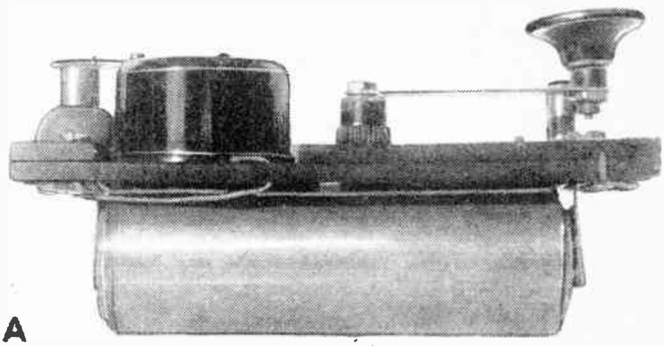
After arrival of your license, peak the final power amplifier tuning with the antenna connected.

With the transmitter on, hold a neon lamp bulb with its glass against the 6AQ5 RF power amplifier tube and adjust the amplifier slug for brightest glow of the neon lamp.

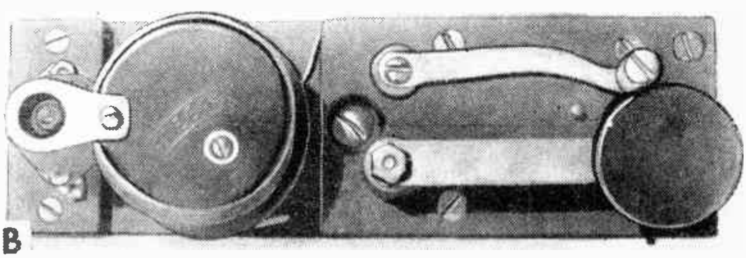
The law states that final tuning adjustment of a Citizens Band transmitter must be made by a person holding a second class radio-telephone (commercial) operator's license, or higher. (The operator of your local broadcast station or of your town's police radio system, when off-duty, may be willing to help you with this. When testing or adjusting the transmitter with the No. 46 dummy load lamp, no such license is required since useful radiation will not occur.) Once this adjustment is made, however, your Citizens Radio permit is all you need for further operation.

One last thought: The U. S. government is showing unusual generosity in allowing the use of the Citizens Band frequencies as liberally as it is. As of this writing, no other government permits such liberties. Ours is thus a rare privilege; let us remember this and never conduct ourselves on the air in such a way as to make our government regret its generosity.

Coat-Pocket Code Practice Unit



1A

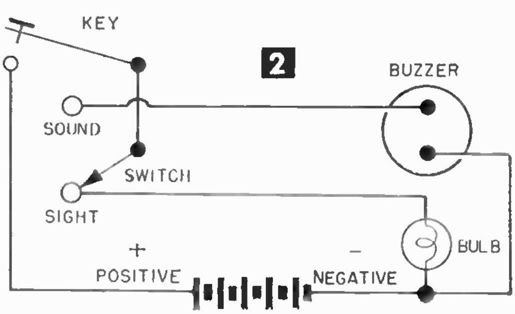


B

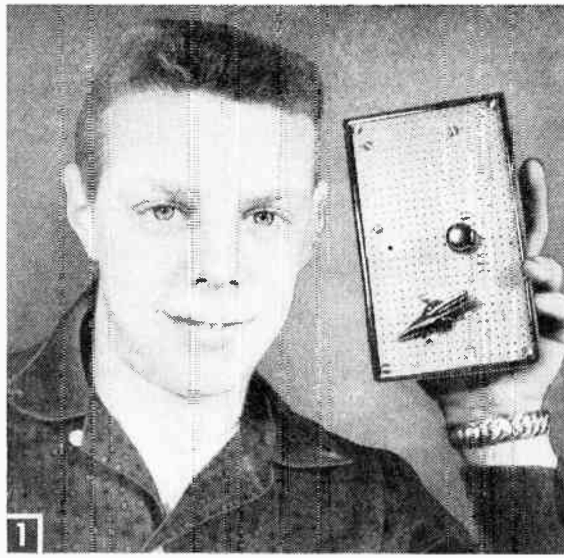
Side (1A) and top (1B) views of coat-pocket code unit.

HERE'S a code practice unit—sight or sound—small enough to carry around in your coat pocket, and all you need to buy to build it is a buzzer (Johnson Speed-X Model 114-400, $1.85), two size D flashlight cells (15¢ each), and a two-cell bulb, focusing type (10¢). The rest of the materials can be taken from your scrap box.

Mounting board for the unit is a 3/16 x 1⅞ x 6⅛-in. piece of Masonite, doubled on either side of the buzzer (see Fig. 1). A brass tube holder for the batteries is made from 1½-in. O.D. plumbing drain stock, battery contacts are spring brass, key and switch (see Fig. 2) are taken from an old telegraph key, socket for bulb can be salvaged from a discarded flashlight.—VICTOR A. ULRICH.



Here's the transistor portable you've been waiting for. It operates on ordinary pen-lite cells, drives a loudspeaker with plenty of volume, has phone jack output for private listening, automatic volume control for smooth volume, and plenty of sensitivity. No outside antenna is required—and it can also be used as a tuner for a larger amplifier.



Small, but powerful, that's the transistorized superhet for which step-by-step building instructions are given in this article. 1

Three-Transistor Superhet Portable

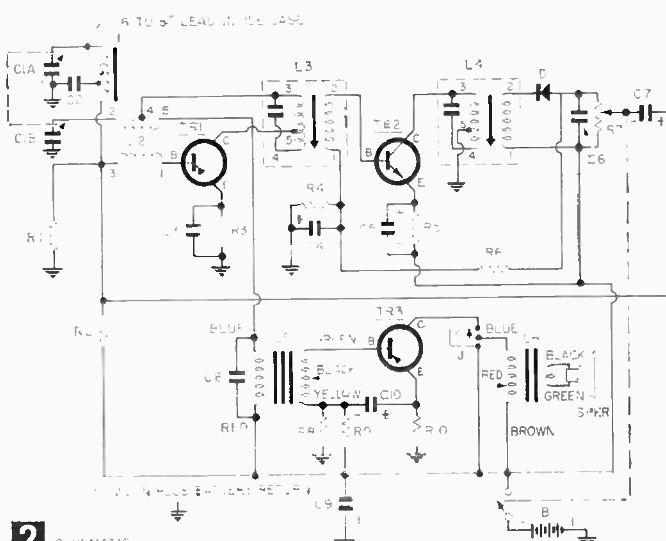
By FORREST H. FRANTZ, SR.

THE circuit diagram of this three-transistor superhet is shown in Fig. 2. The transistor TR1, RCA 2N412, does triple duty. The RF signal (550 to 1500 *kc*) which it receives from the antenna loop L1 and antenna tuning capacitor C1A is amplified and mixed with the oscillator signal. The oscillator signal, also generated by TR1, is always 455 *kc* above the received RF signal.

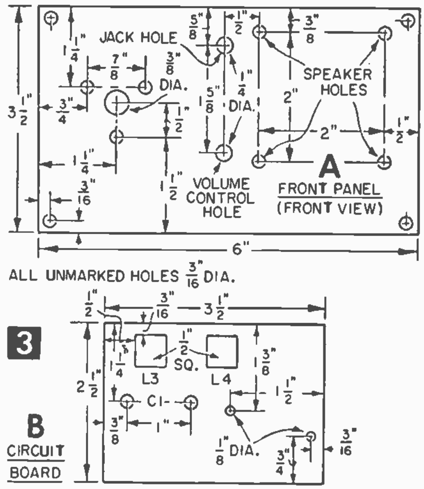
The oscillator tuning capacitor C1B is ganged to the antenna tuning capacitor so that oscillator and antenna tuning track. The signal through L3 is amplified by the IF amplifier transistor TR2. This transistor is a high-gain, high-frequency GE 2N168A. Diode D detects the signal after it passes through L4. Capacitor C6 filters out the RF signal components so that the signal across volume control R7 is audio frequency (AF). The signal is then passed through R6 and the audio is filtered out so that a *dc* bias proportional to the strength of the received signal is provided to control the gain of the IF amplifier TR2. The stronger the signal, the lower the gain of TR2. Thus, fading is minimized for reasonably strong signals. This is the automatic volume control (AVC).

The slider on volume control R7 picks off the audio signal for audio amplification. Transistor TR1 performs its third job as the first audio amplifier. It's possible to use the same transistor for the mixing oscillator and audio amplifier functions, since the frequencies are widely separated. The amplified audio output of TR1 appears across transformer L5 and is transferred to the audio output stage TR3 which amplifies the audio signal for speaker or headphone output.

This receiver has several outstanding features that make exceptional performance possible with only three transistors. The advantage of making TR1 do several jobs, for instance, is apparent. Further, the antenna loop L1 is the Miller 2003 high-Q loop which has a Q of 500 and this



2 SCHEMATIC



unusually high Q builds up the signal and allows the tuning capacitor to select the desired station with considerable discrimination against interfering signals before the transistors even begin to go to work.

The audio output stage TR3 is transformer coupled to TR1—and two transformer-coupled audio stages have almost as much gain as three! Actually, a considerable amount of the available audio gain of TR1 is not exploited since the emitter bias resistor R3 of TR1 is not bypassed by a large capacitor. A large capacitor would increase the gain but would degrade the fidelity and create a tendency for the receiver to go into regeneration.

Preparing Parts for Assembly. First, cut out and prepare the front panel and the circuit board (Fig. 3). Cut the tuning capacitor (C1) shaft to a length of ½ in., the volume control (R7) shaft to a length of ¼ in. Remove the antenna loop from its mounting by cutting off the ends of the fiber retainer with tin snips; fasten the output transformer (L6) on the loudspeaker (see Fig. 5) by bending the transformer mounting lugs to fit around the magnet frame. A few drops of Pliobond or a similar cement placed under the transformer prior to mounting will steady it against the magnet frame.

Next, solder the connection lugs of the battery holder for series connection as shown in Fig. 4. Use rosin core solder only! Mark the battery end polarities to avoid making mistakes in connections or inserting batteries. Rotate the battery lugs with a pair of pliers and simply solder them together to make connections, and then fill with solder the surfaces of the eyelets which will contact the batteries.

Figure 5 shows the parts and wiring on the back of the front panel. Mount the loudspeaker (SPKR), volume control (R7) and the phone jack (J), and complete wiring as shown. Be cautious in soldering; too much heat can damage the volume control. The same precaution applies to the other components, especially transistors, in subsequent soldering.

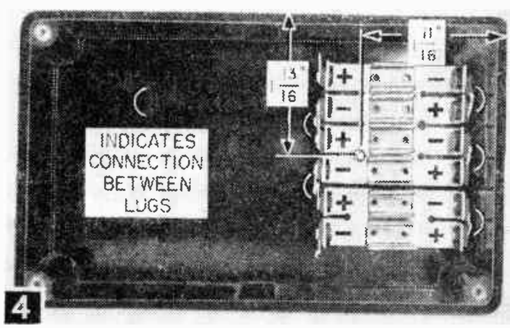
The Wiring Board. Top and bottom views of the assembled wiring board are shown in Fig. 6. Fasten L3 and L4 by inserting them in the holes and bending the mounting lugs against the back of the board.

Next, you will mount C1, L1 and L2. (Be careful not to let the screws which hold C1 pass through far enough to touch the plates of the capacitor; use washers or spacers if necessary.) Fasten L1 and L2 with Duco cement, give the cement time to set, then fasten L5 and T1 to the board.

The next step is to solder B of TR1 to terminal 1 on L2, C to terminal 5 of L3, pass E through the circuit board, and fasten TR1 against the case of L3 with a rubber band.

The remaining components are fastened to the circuit board as the wiring progresses. Be sure to connect the frame of C1 and the cases of L3 and L4 to the common plus battery return (designated by the "ground" symbol in Fig. 2). When circuit board wiring is completed, connect a lead 6 in. long to the common return for later connection to the plus terminal of the 9-v battery. The other lead from the circuit board is a 6 to 8 in. length of wire connected to C1A. The other end of this lead hangs free inside of the case after final assembly. This lead is essentially a short antenna which gives the set additional pick-up.

Final Assembly. There are five lead ends extending from the front panel (Fig. 5). The lead from the switch will connect to the minus terminal of the battery. The other four leads connect to the circuit board. The circuit board is joined to



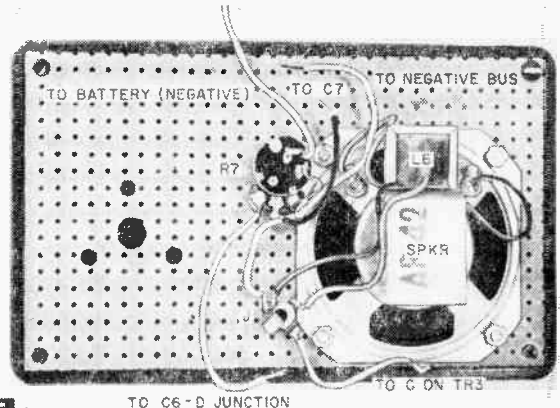
Battery-holder mounting in case, and connections.

the front panel by the tuning capacitor's (C1) three mounting screws. Place fiber washers or cardboard spacers 1/16-in. thick between C1 and the front panel when you join panel and circuit board.

Check for clearance between the circuit board components and the panel components. Particular items to watch are interference of TR2 with J, C9 with S on R7 and L6 with SPKR. Place the assembly in the cabinet to check fit and make any necessary adjustments in parts placement.

The leads from the front panel connect as follows: 1) The lead from the junction of R7, S and J connects to the circuit board minus line. 2) The lead from J connects to C of T3. 3) The lead from the "hi" terminal of R7 connects to the junction of D, C6, and R6. 4) The center terminal lead of R7 connects to the minus terminal of C7.

With these connections completed, adjust the slug of L2 flush with or just slightly below the coil form viewed from the back of the assembly. There are two trimmers on C1 which were intentionally eliminated from Fig. 2 to avoid confusion. These trimmers in parallel with C1A and C1B are provided to align the antenna and oscillator circuits respectively for proper high-frequency tracking. Open the antenna trimmer till the trimmer tension is nearly released (minimum trimmer capacity). Turn the oscillator trimmer full closed (maximum trimmer capacity), and then back the screw off ½ turn. Place the knobs on C1 and R7. (You can provide a calibrated dial made of paper and covered with plastic for C1 later if you wish). With S off, connect the leads from the assembly to the battery to complete wiring and assembly. These leads should be about 6 in. long to allow easy removal of the assembly from the case. To prevent the screws which hold the battery holders in place from scratching furniture, fasten rubber grommets to the back of the case with Pliobond cement.

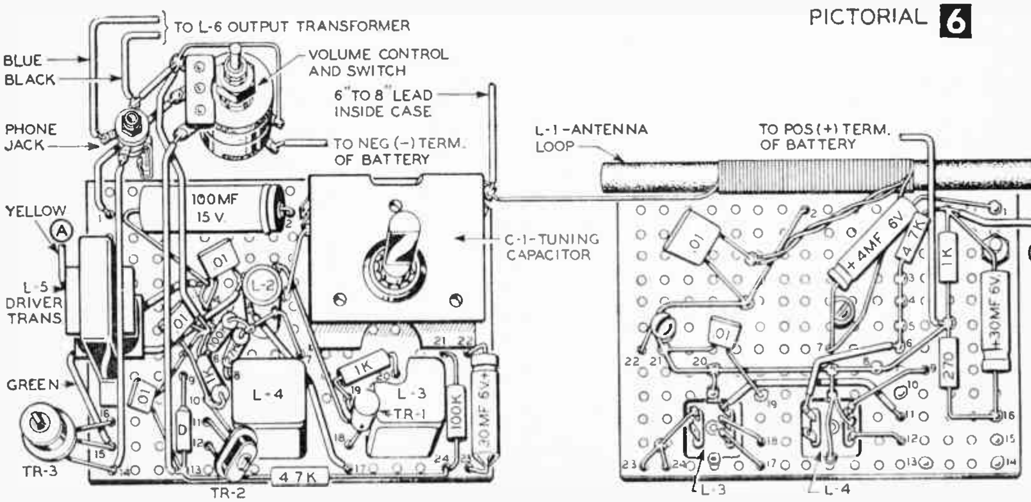


5 Back of front-panel view, showing connections.

Tune-Up. If you have a milliammeter, connect it across the terminals of switch S. The meter should read between 6 and 15 *ma* if all is well. Don't worry if the set motorboats when you make this measurement. If the current exceeds 15 *ma*, look for a short or an incorrect connection. If the current is less than 6 *ma*, the trouble is probably low battery voltage or an incorrect connection.

Assuming all is well at this point—or that you don't have a meter to make this measurement—turn the set on and turn the volume control about ⅞ths up (clockwise). Maximum volume does not occur at the full clockwise position of the volume control. This is a normal characteristic of the reflex circuit. (The term reflex is applied to a receiver which uses one transistor or tube to amplify both RF or IF and AF signals). With the volume control turned approximately ⅞ths full clockwise, rotate the tuning dial slowly. If you're in a metropolitan area or within about 10 or 15 miles of a large station, you'll probably pick up a signal even though the set is not accurately aligned. But if you don't pick a station up, there's no cause for alarm because the IF transformers (L3 and L4) may be way out of adjustment. If you pick up a station you can feel reasonably sure the wiring is correct. If you can't pick up a station, the presence of noise of any kind from the speaker indicates that at least part of the audio is working properly. In either case; you're ready to try alignment.

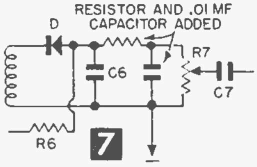
PICTORIAL **6**



TOP VIEW OF PERFORATED BAKELITE MOUNTING BOARD

BOTTOM VIEW OF PERFORATED BAKELITE MOUNTING BOARD

The steps in the alignment procedure are: 1) Adjust the IF transformers. 2) Adjust the tuning capacitor trimmers at the high frequency end of the broadcast band.



3) Adjust the oscillator coil slug at the low frequency end of the band. 4) Repeat step 2. A signal source is required to carry out the alignment procedure. This source may be an RF signal generator or it may be an ordinary broadcast receiver if you don't have, or can't borrow a signal generator. The use of a broadcast superhet for aligning other superhets is discussed on pages 66, 67 and 68 of the *Radio-TV Experimenter*, No. 559, Volume 7, available from SCIENCE AND MECHANICS, 450 East Ohio Street, Chicago 11, Illinois.

To adjust the IF transformers, connect the high side of the signal source through a .01 *mfd* capacitor to the stator of C1A (the antenna terminal), and the low side to set ground. With the signal source tuned to 455 *kc.*, adjust the slugs of L3 and L4 for maximum output. Keep the signal from the source so weak that you can barely hear it (to minimize AVC action). Adjust the volume control to the point where the signal is loudest. The slugs of L3 and L4 are accessible through the holes in their bottoms. Use a small screwdriver, preferably one with very little metal in it such as a radio-TV serviceman's alignment tool.

After IF alignment is completed, disconnect the signal source.

You should easily be able to complete the remainder of the alignment procedure with broadcast station signals. Tune in a weak station between 1300 and 1450 *kc*. Increase the antenna trimmer capacity. If this increases the speaker output, adjust this trimmer for maximum speaker output. If the volume decreases, repeat the procedure.

Next, tune the receiver to a station between 550 and 650 *kc*. Detune C1 slightly to one side and adjust the slug of L2 for maximum output. If this output is greater than the previous output, repeat the process till the most sensitive point is found.

If the output is less than the previous output, detune C1 in the other direction and adjust L2 till the point of maximum output is found.

Finally, repeat the alignment procedure at the high-frequency end of the band. This is necessary since the adjustment of L2 has some influence on the high frequency end of the band, too. Capacitor C1 may be tracked across the broadcast band by bending the outer plates of C1A, but the process is tedious and not always worth the effort.

You may experience oscillation at high volume control settings, but this oscillation will occur beyond the actual maximum volume point and is therefore harmless. But if you wish to eliminate it, add a resistor and .01 *mfd* capacitor in the volume control circuit as shown in Fig. 7. The

MATERIALS LIST—THREE-TRANSISTOR PORTABLE SUPERHET

Desig.	Description
R10	270 ohms
R3, R5, R8	1K
R6, R9	4.7K
R1	27K
R2, R4 (all resistors, ½ watt, ±20%)	100K
R7-S	5K miniature volume control with switch (Lafayette VC-27)
C2, C3, C5, C6, C8	.01 mfd subminiature square capacitor (Lafayette C-612)
C7	4 mfd, 6v ultraminiature electrolytic capacitor (Lafayette CF-101)
C4, C10	30 mfd, 6v ultraminiature electrolytic capacitor (Lafayette CF-104)
C9	100 mfd, 15v ultraminiature electrolytic capacitor (Lafayette CF-126)
C1	2-gang tuning capacitor, A-123 mmfd, B-78 mmfd (Lafayette MS-261)
L1	miniature antenna loop (Miller 2003)
L2	transistor oscillator coil (Lafayette MS-265)
L3	1st IF transformer, 455 kc (Lafayette MS-268)
L4	output IF transformer, 455 kc (Lafayette MS-269)
L5	transistor driver transformer 10K:500 ohms (Lafayette TR-96)
L6	transistor output transformer 500:3.2 ohms (Lafayette TR-95)
TR1	transistor (RCA 2N412)
TR2	transistor (GE 2N168A)
TR3	transistor (GE 2N241A)
D	diode (Raytheon 1N66)
B	9v battery—6 penlite cells in series (RCA VS074)
J	miniature phone jack (Lafayette MS-282)
SPKR	2½" PM speaker, 3.2 ohm (Lafayette SK-65)
1	2-cell battery holder (Lafayette MS-138)
1	4-cell battery holder (Lafayette MS-170)
1	miniature perforated board for front panel (Lafayette MS-305)
1	miniature perforated board for chassis (Lafayette MS-304)
1	miniature knob (Lafayette MS-185)
1	pointer knob (Lafayette KN-40)
1	2 x 3¾ x 6¼" Bakelite case (Lafayette MS-216)
	For earphone listening, use a 2K earphone (Lafayette MS-268)

Parts available from Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, New York.

resistance value should be determined experimentally. It will be between 500 ohms and 1K in most cases.

This three-transistor portable may be used as an amplifier tuner by connecting a 10K resistor from C of TR3 to the negative voltage line. This resistor provides *dc* return for the collector of TR1 when a plug is inserted in the jack. If the amplifier to be used with the tuner does not have a capacitor in series with the input, provide one of about 0.1 *mfd* capacity. The connection of the 10K resistance will have negligible effect on the loudspeaker or headphone performance of the set. The Lafayette MS-281 plug fits the jack and should be used in making the amplifier connection cable.

The receiver may be equipped with a calibrated dial to simplify station finding. The calibrations may be painted on the panel face or many be placed on paper with India ink. A sheet of celluloid or clear plastic placed over the dial scale will protect it.

Both the scale and its plastic protector can be held in place by the three screws which fasten the variable capacitor.

The tone and volume of the set can be improved by placing a thin sheet of cardboard between the back of the panel and the components.

1

Stereo-Hi-Fi cabinet ensemble is modern (and modular) in design, antique in finish; units are flexible in arrangement, can be used separately also. Sliding doors bypass each other.

build yourself a . . . Stereo Music Center

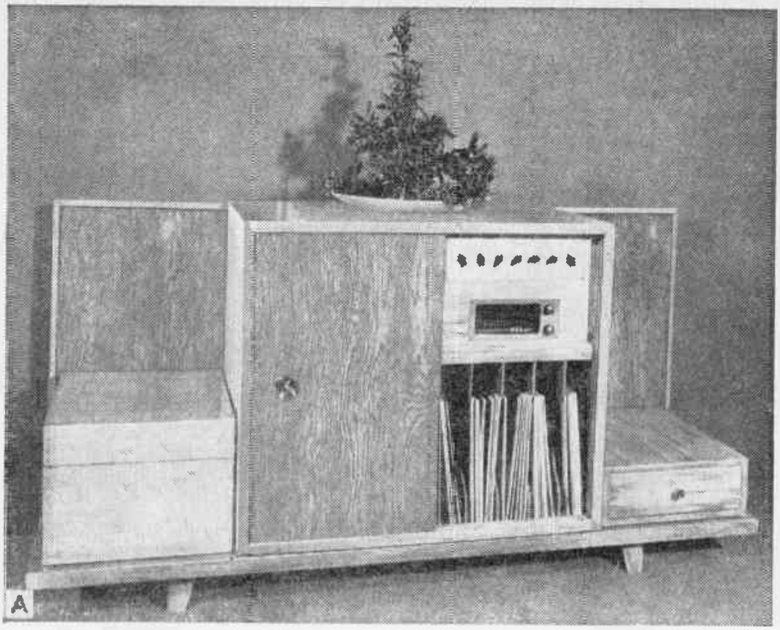
By R. J. DeCRISTOFORO

IF stereo (or hi-fi) hasn't gotten to you yet, it will, and here is a music center unit that will not only house your present components of any make, but also any future additions to your equipment (Fig. 1). This music center houses stereo tape deck or turntable, two-channel (stereo) preamplifier and two-channel or separate amplifiers and also has room for an AM-FM tuner placed in the stereo (two-channel) preamp compartment. In addition to arrangement adaptability, the music center provides building flexibility (Fig. 2B). You must have the main cabinet which houses stereo components plus records and the changer unit, but you can add the other units later. However, we'll begin construction with the bench so you'll have an understanding for the other units.

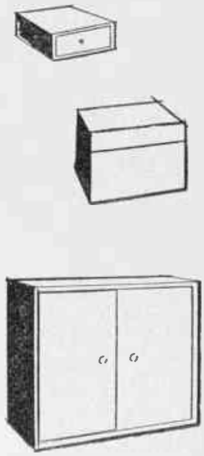
Building the bench. Square the slab top, part 1 in Fig. 2 and the Materials List, to size. Next cut the frames, parts 2 and 3, slightly longer than called for. Rabbet these pieces, then miter one piece at a time and fit to the slab top. Use plenty of glue to attach the frame pieces and drive nails up through the flange into the underside of the top. Wipe off excess glue before it dries. Now, shape the legs, parts 4, then slot the top of each to receive parts 5. Glue and nail these in place and then add the cross pieces, part 6. Locate the assembly on the underside of the top and glue and nail it in place as in Figs. 2 and 3 with 2-in. finishing nails.

Drawer and Compartment. The drawer (Figs. 2 and 4) holds extra needles, pick-ups and record cleaning equipment. Make the compartment first, using the rabbet joint construction shown in Fig. 2. Glue and nail parts 7 and 8, then cut part 9 to a tight fit. Apply glue to its edges, press in place and fasten with 2-in. finishing nails in all edges.

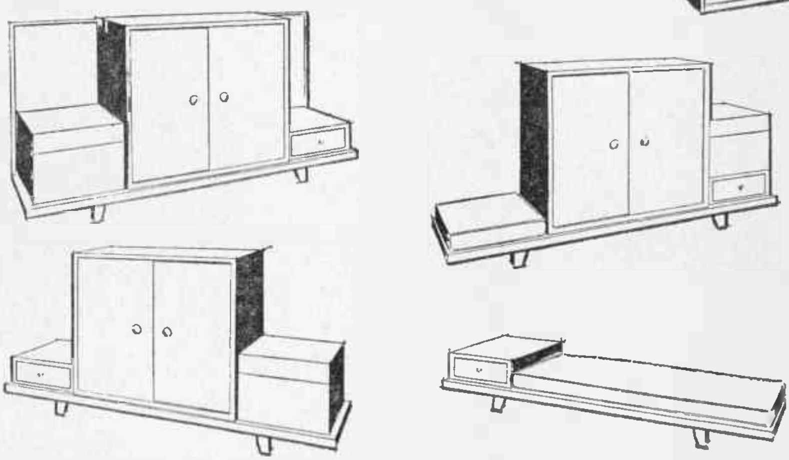
Make the drawer front and sides first. Then rabbet each end of the front to receive the sides. Cut the grooves in the sides and the front for the drawer bottom. Attach the sides to the front



Lower half of main cabinet has plenty of record storage space.



2B



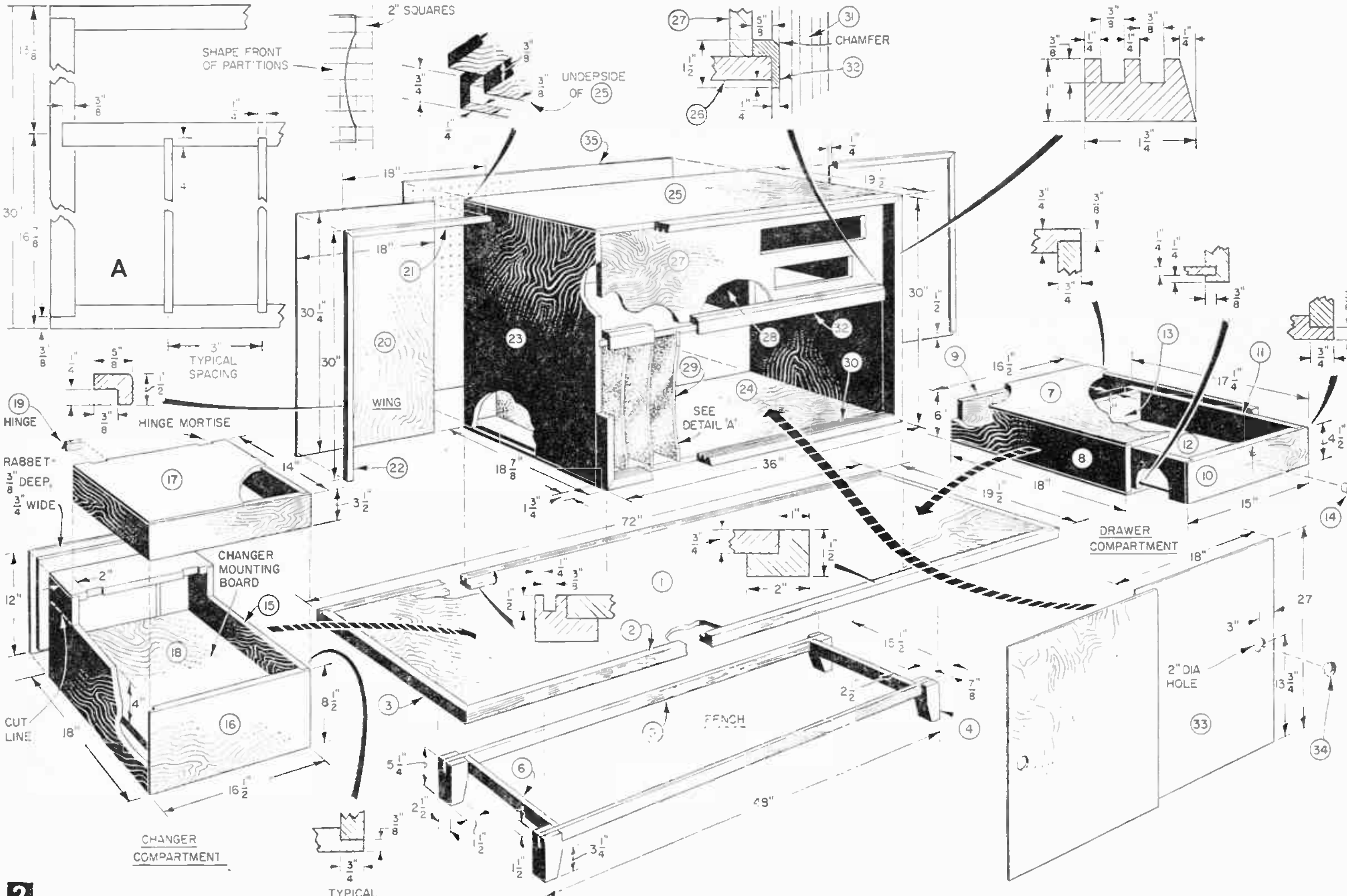
using glue and driving the nails through the side pieces. Slip the bottom into place, then make and add the back. Secure this by driving nails into it through the drawer sides and up through the drawer bottom.

Be sure the drawer slides easily in its compartment. If it's a tight fit, dress the top with sandpaper.

The cabinet for the changer is made like a bottomless box even though the construction details (Fig. 2) show the parts as they appear after they have been cut apart. Best bet is to cut the sides (parts 15) first, then the front and back (parts 16). The front piece is rabbeted along its two outer edges, the back piece is rabbeted the same way but also along the top edges. Glue and nail these parts in place, then add the top, but be sure to space nails so they will clear the cut line (3½-in. down from the top). When the glue has dried, slice off the top section on the table saw, then cut off the back end of this so you end up with the three parts shown in Figs. 2 and 5.

Next step is to mortise for and attach the hinges. The cut-out in the changer mounting board will have to be tailored to your unit. If you are installing new equipment (Fig. 6), you'll have a template to work with. If you are going to take the changer from an existing cabinet, remove the mounting board, too, and use this as a template to make the new one.

Use plenty of glue when assembling the top to the base and keep it tightly under clamps until the glue is thoroughly dry. To compensate for the saw cut, you'll have to move the top in from the back, but since this is the back of the cabinet, it won't be seen. After the clamps are removed,


2" SQUARES
SHAPE FRONT OF PARTITIONS
UNDERSIDE OF (25)
CHAMFER
A
TYPICAL SPACING
HINGE MORTISE
HINGE
RABBET 3/8" DEEP 3/4" WIDE
CHANGER MOUNTING BOARD
WING
SEE DETAIL 'A'
DRAWER COMPARTMENT
2" DIA HOLE
BENCH
CUT LINE
CHANGER COMPARTMENT
TYPICAL
72"
48"
36"

2

MATERIALS LIST—HI-FI MUSIC CENTER

Part No.	No. Req'd	Description
BENCH		
1	1	¾ x 17½ x 70" D.F. plywood
2	2	1½ x 2 x 72" clear pine
3	2	1½ x 2 x 19½ clear pine
4	4	2½ x 2½ x 5¼" clear pine
5	2	¾ x 1½ x 48" D.F. plywood
6	2	¾ x 1½ x 12¼" D.F. plywood
DRAWER & COMPARTMENT		
7	2	¾ x 16½ x 18" D.F. plywood
8	2	¾ x 5¼ x 18" D.F. plywood
9	1	¾ x 4½ x 15" D.F. plywood
10	1	¾ x 4½ x 15" D.F. plywood
11	2	¾ x 4½ x 16⅞" D.F. plywood
12	1	¼ x 14¼ x 16⅞" D.F. plywood
13	1	¾ x 4 x 13½" D.F. plywood
14	1	1" diameter brass drawer pull
CHANGER COMPARTMENT		
15	2	¾ x 11⅝ x 17¼" D.F. plywood
16	2	¾ x 11⅝ x 16½" D.F. plywood
17	1	¾ x 16½ x 18" D.F. plywood
18	1	¾ x 15 x 16½" D.F. plywood
19	1 pair	2" butt brass hinges
WINGS		
20	2	⅜ x 18 x 30¼" etched plywood
21	2 (1L-1R)	½ x ⅝ x 18" pine
22	2 (1L-1R)	½ x ⅝ x 30" pine
COMPONENTS & RECORD STORAGE CABINET		
23	2	¾ x 17⅛ x 29¼" D.F. plywood
24	1	¾ x 17⅛ x 36" D.F. plywood
25	1	¾ x 17¾ x 36" D.F. plywood
26	1	¾ x 17⅛ x 35¼" D.F. plywood
27	1	¾ x 12 x 34½" D.F. plywood
28	1	¾ x 12 x 15¾" D.F. plywood
29	10	¼ x 16¼ x 17⅛" Masonite
30	2	1 x 1¾ x 36" pine
31	2	1 x 1¾ x 30" pine
32	1	⅞ x 1½ x 34½" pine
33	2	⅜ x 18 x 27½" etched plywood
34	2	2" diameter flush door pulls (brass)
35	1	¼ x 30⅛ x 35¼" perforated Masonite
		finishing nails, glue

check to see that the top closes correctly. It may be a little tight on the hinge side, and if so, will require sanding.

The wings are merely pieces of etched plywood dimensioned as shown in Fig. 2 and trimmed along two edges with the molding strips shown. Both top (part 21) and bottom (part 22) trim pieces are shorter than the corresponding dimension on part 20 so that the wing can fit in the slot cut in the top of the bench and a small amount of the other free edge can be behind the main cabinet.

Component Cabinet. The main cabinet (Fig. 7) is fairly simple to build but you must use care when laying out for the edge joints and when cutting the dadoes for the shelf and the record storage area partitions.

Cut the sides first and run the dadoes that will receive part 26. Next, cut the bottom (part 24). Before going further, cut the dadoes for the record partitions and be sure you place them on the top surface of the bottom and the underside of the center shelf. With this done, you can assemble the two sides, the bottom and the center shelf.

Next, cut out part 27. Here, the cutout for the components (tuner, pre-amp) will have to be cut out to fit your own equipment. Work carefully —be sure you're right *before* doing any cutting. Put this part in place, spacing it ⅝ in. from the front edge of the parts so far assembled. Check this with a square before nailing to be sure the part is perfectly vertical. Now make and add the center divider (part 28) and the top (part 25). Part 32 is a decorative detail but also serves to hide the plywood edge on part 26.

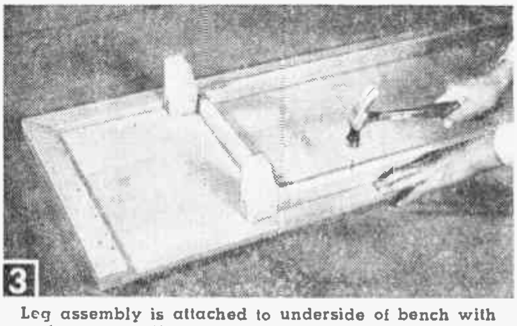
Next step is to make the front frame of the cabinet. Size these as shown in Materials List and bevel the front edge of each strip. The grooves for the sliding doors are the same in each piece except the top. Here, although spacing is the same, the grooves should be ¼ in. greater in depth to provide room so the sliding doors can be put into place (Fig. 8) or removed.

When attaching the frame pieces to the cabinet front, drill holes for 2½-in. finishing nails. Make the holes smaller than the nail shank diameter but not so deep that you can't drive the nails in solidly.

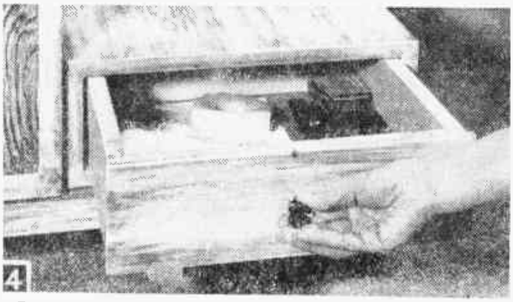
Put plenty of glue on mating edges before you begin nailing.

Cut the partition pieces to size, then make the layout for the slight curve in the front edge on one piece. Tape, or otherwise hold all the pieces together and make the cut.

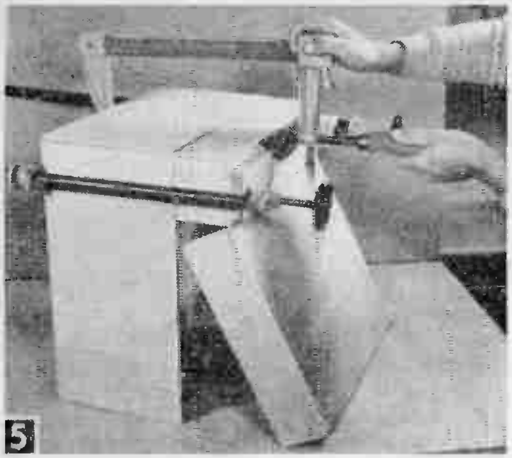
You will note, incidentally, that the 3-in. spacing between partitions will leave a narrower



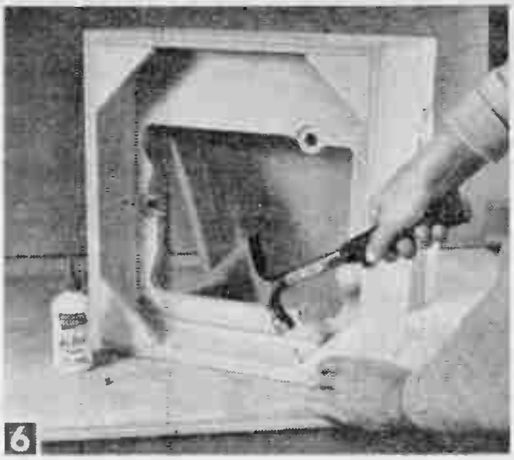
Leg assembly is attached to underside of bench with glue and nails. Structure is simple but strong.



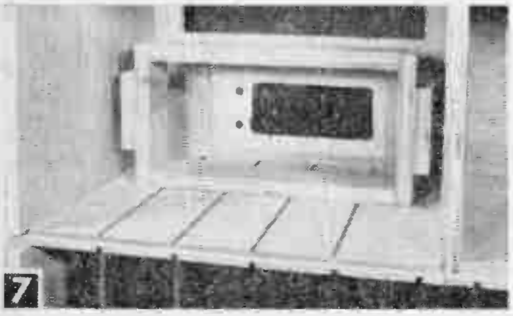
Drawer is good place to keep accessories—needles, record cleaning cloth, etc.



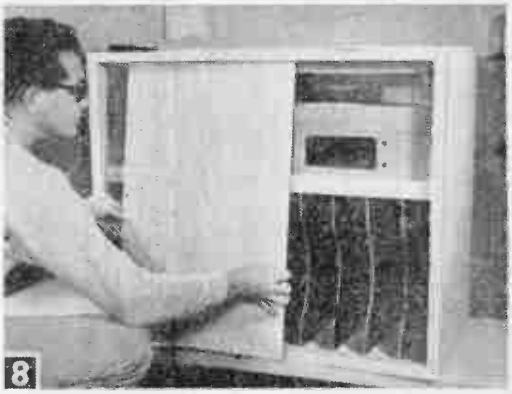
Top is sliced off changer compartment box, then glued back on again.



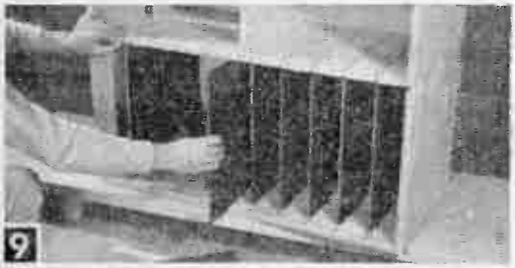
Glue blocks (not shown in Fig. 2) can be added to increase rigidity. Note cut-out for record changer.



Skeleton structures are sufficient to support components, in this case, tuner and pre-amp.



Deeper groove in top front-frame member allows sliding doors to be inserted.



Masonite panels make good record storage dividers. Note narrower compartment in center.

space in the center of the cabinet, but the sliding-door overlap compensates for this. (You can use this narrower section for records you're sorry you bought.) When the partitions are shaped and edges have been sanded, slip them into place in the dadoes previously cut (Fig 9).

The back of the cabinet is a piece of perforated Masonite. Somewhere in the back, near the bottom edge, drill a 1-in. hole for speaker and record changer wiring pass-through.

Finishing. The antique finish we used is applied as follows: First, set all nail heads below the surface of the wood and fill with wood putty. Brush a full coat of clear resin sealer on all surfaces (inside and out) and let dry. On all outside surfaces brush a full coat of flat-finish, white undercoat.

After the undercoat dries, make an antique glaze by mixing equal parts of turpentine and glazing liquid and tinting it to the tone desired. Colors-in-oil can be used or you can do a good job with walnut or maple stain. Best bet is to experiment with slight amounts of scrap wood until you get the effect that pleases you most.

Wipe the glaze on with a rough cloth, being sure that it piles up in corners. Technique of application with the glaze has much to do with final appearance. Practice to establish the best wiping stroke.

Note that some leeway is possible by letting the glaze dry a while and then wiping again with a cloth dipped in turpentine. This way you can lighten the finish overall or achieve a high-lighted effect with areas of light and dark.

Let the glaze dry thoroughly, then finish up with two coats of satin-finish varnish. The last varnish coat can be rubbed with steel wool and lustered with paste wax rubbed to a high, gleaming polish.

The Mini-Player

Employing a transistorized wireless broadcaster and flash-battery-powered turntable, this self-contained record player plays all microgroove records from 33 to 16 rpm through any radio set

1 The Mini-player operates equally well in conjunction with a battery portable set as shown here, or with transistor, auto or line powered sets. Trim, three-speed motor is completely self-contained.

By THOMAS A. BLANCHARD

HOW would you like a record player that would work anywhere there was a radio—*without* any electrical plug-in's? Here is probably the smallest non-toy, three-speed, wireless record player that could be designed.

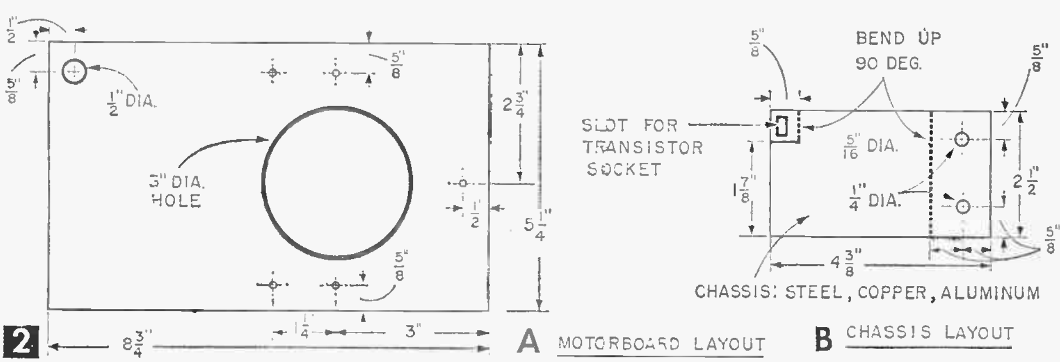
Since components are standard, the most important item is to get a 25's cigar box 1½ x 5½ x 9 in.

Remove the box lid and then, with a medium grit sandpaper, remove loose paper from both lid and box. Drill holes in the motor board as shown in Fig. 2A. The trim final finish is obtained by covering the box with self-stick plastic fabric sold in most variety stores under the trade name "Con-Tact."

The phonograph turntable is just 6 in. in dia. Power is provided by a tiny 6-*v* PM motor operated with four flashlight cells wired in series. A spring tension clip fashioned from a strip of metal secures the cells in the cabinet. A single pole toggle switch turns the motor on and off.

Note that the two rows of flashlight cells (see Fig. 3) are separated by a strip of wood cemented to the bottom of the box. This strip measures ⅜ x ⅝ x 4¼ in. The bronze turntable spindle bearing extends below the motorboard, and this spacer strip allows bearing clearance which would otherwise be blocked if the batteries were in two close rows.

Two brass upholstery tacks to which motor leads are soldered provide the 6 *v* plus and minus power takeoff. These are mounted inside the box opposite the spring brass battery retainer clip. Insert batteries so first cell has the small *plus* button in contact with one tack head with the fourth cell's zinc case contacting the remaining tack head. When power is turned on, turntable should rotate away from the crystal pickup arm. If not, simply reverse the sequence of the flashlight cells and motor will



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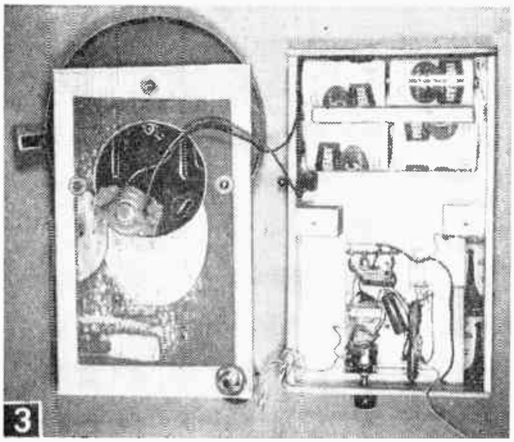
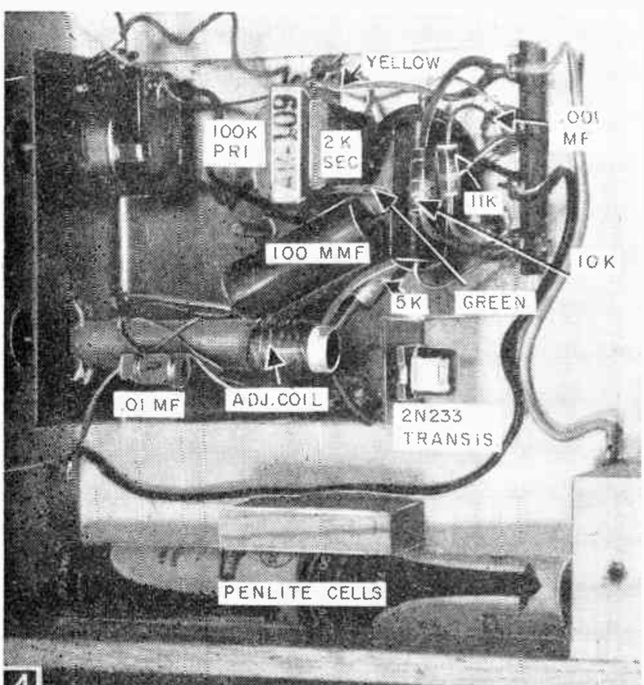


Underside of Mini-player motorboard and arrangement of penlite and standard size cells.

turn in the correct clockwise direction. For future reference, the inside of box can be marked with an outline of batteries in correct polarity position.

The pickup can be any popular standard-size crystal unit with a turnover cartridge if you expect to use old records. Otherwise a pickup with a single 1 mil needle will be sufficient. The turntable features a built in adaptor for playing 45 *rpm* records and drops down for playing 33 *rpm* and 16 *rpm* discs—any size up to 12 in.



Closeup view of chassis. Small block of wood holds penlite cells in position. Four-lug tie-strip simplifies mounting small components. Chassis is secured in box with a pair of 3-48 *fh* machine screws.

MATERIALS LIST—MINI-PLAYER

No. Req.	Size and Description
1	ferrite slug-tuned radio antenna "Loop" coil
1	Argonne miniature transformer #AR 145 (100K Primary; 2K secondary)
1	Sylvania type 2N233 N-P-N radio frequency transistor
1	molded plastic transistor socket and retainer ring
2	100 or 150 mmf. ceramic tubular or disc capacitors
1	.01 mfd. disc ceramic capacitor
1	.001 mfd. disc ceramic capacitor
1	10K (10,000) ohm ½ or ¼-watt resistor
1	11K ohm ½ or ¼-watt resistor
1	5K ohm ½ or ¼-watt resistor
1	2½ x 4⅜ pc. of thin steel, copper or aluminum for chassis
1	cigar box—minimum dimensions: 1½ x 5½ x 9"
¼ yd	"Con-Tact" plastic fabric
1	crystal phonograph pickup with 1 mil needle
1	miniature, battery-operated phono motor with 6" turntable (Alliance, General Industries, German/British import)
2	1½v. penlite cells
4	1½v. size D flashlight cells

To secure the motorboard to the cabinet, cement two blocks of wood ¾ x 1 x 1⅜ in. in the center of box. Fashion a spring clip to form a contact for one of the penlite cells used to power the transistorized phono oscillator and secure it with a small wood screw before the block in foreground (see Fig. 4) is cemented in place. A flat strip of metal is cemented to the corner of the box for contact to the second penlite cell.

Some experimenters might at this point get the urge to obtain the 3 *v* needed to operate the oscillator by tapping the larger batteries at the spring retainer clip. Boys, it won't work! The PM motor is a brush type unit, not induction, and the hash noise will be broadcast along with the recorded music. Separate power supplies eliminate any chance of electrical interference.

Transistor Oscillator. The most interesting part of the project is the tiny transistor-operated oscillator by virtue of which it is only necessary to place the record player near any radio, tune the set to 1600 *kc* or any nearby point where a regular station doesn't tune in, and you are able to listen to the recorded music through the set's speaker loud and clear with no physical connections of any kind.

The oscillator is a transistorized version of the Colpitts circuit. The tank coil is nothing more than the popular ferrite type radio antenna coil. The ferrite slug is turned in or out to tune the oscillator to any frequency from 1620 *kc* to about 1000 *kc* so that a "clear channel" can be found on the radio dial.

The chassis is fashioned from a small piece of aluminum, copper or tin-plate as shown in Fig. 2B. Note that one corner is slotted, then bent up to provide a convenient mounting arrangement for the transistor socket. Note, also, in Fig. 4 that the original design included a 4-lug tie strip for convenience in making circuit connections.

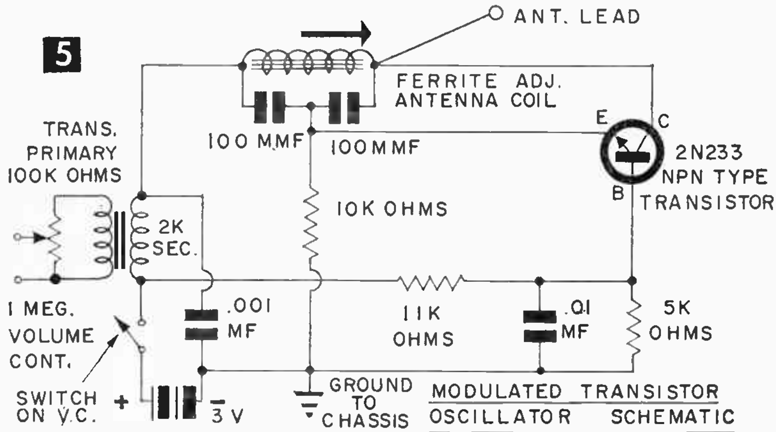
So long as the wiring of components agrees with Fig. 5, you can vary the design to suit your whims. A piece of flexible insulated hookup wire attached to the coil lug is all the antenna necessary. A longer wire will, of course, increase the range of the oscillator.

While the circuit is almost foolproof, it must be pointed out that just any transistor will not work as an oscillator. The transistor must be of the RF N-P-N type such as the popular-priced Sylvania 2N233; *AF P-N-P* type will not work.

Since a switch was required to turn off or on penlite power to the oscillator, we employed a miniature 1 megohm potentiometer with switch and included a separate volume control. You can, for all practical purposes, leave out the volume control so long as you provide an on-off switch. The phonograph pickup leads may be connected directly to the 100K primary of the miniature Argonne #AR 145 input transformer and volume controlled from the radio set.

If hum appears when the pickup is handled so long as you hold it, ground the pickup arm's swivel to the chassis. Of course, the hum isn't present while records are playing, so this grounding can be optional.

This truly novel record player can even be used with car radios, simply by wrapping the oscillator lead loosely around the car's whip antenna.



Starting the countdown—ten seconds, nine, eight, seven . . .

Small, versatile and powerful—that's this miniaturized power supply.

1

Miniature Variable Voltage Power Supply

By BRICE L. WARD

THOUGH miniature in cost, labor and physical size, this power supply is big in all other respects. It will supply a full 25 *v* adjustable from zero, and up to 35 *ma* of current depending on the load. It will save hair-pulling and gnashing of teeth by supplying the voltage you need for your transistor circuits with the twist of a knob and it can handle any five- or six-transistor circuit with ease.

It has no fuse or switch because it needs none. If the leads are accidentally shorted, the current will jump to its maximum of 40 or 50 *ma*, the voltage will drop to a low value and it could be left this way all day with no harm.

Printed Circuit. Begin construction by laying out the printed circuit (Fig. 2) on a piece of single side laminate board (see Materials List) using 1/16-in. tape resist or, if preferred, a ballpoint resist tube. You can use tape resist circles at the numbered points, if you wish. These should be pressed down firmly and care should be taken to eliminate air pockets where the circles and lines join, otherwise undercutting will result during the etching process. One excellent way to eliminate this air space is with thinned liquid resist (resist can be thinned with lighter fluid). Using a small brush, carefully touch up the air spaces, allowing the liquid resist to flow under the tape.

Remove the small cutouts from the center of the tape resist circles. The etched centers will serve as drill guides later. The large circles can be painted in with liquid resist, put on with a ballpoint tube or laid out with tape resist and trimmed or left square.

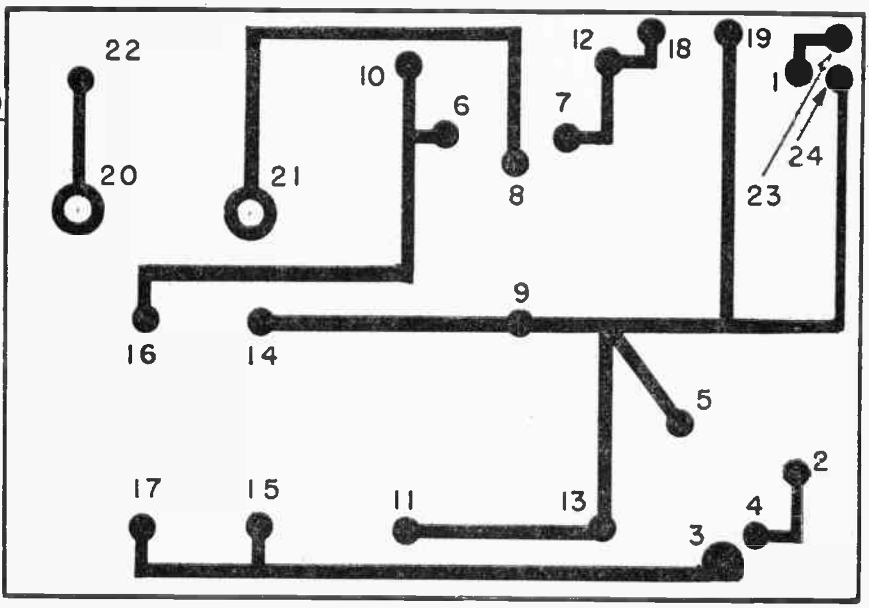
After etching the board, remove the resist and clean the board thoroughly with scouring powder. Tape resist can be pulled off. Liquid or ballpoint resist is removed with lighter fluid.

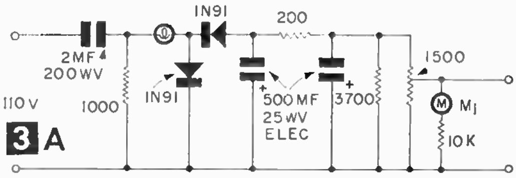
2

FULL SIZE CIRCUIT AND DRILLING LAYOUT

1-19 #50 DRILL

20 AND 21 #26 DRILL (FOR #6-32 SCREWS)





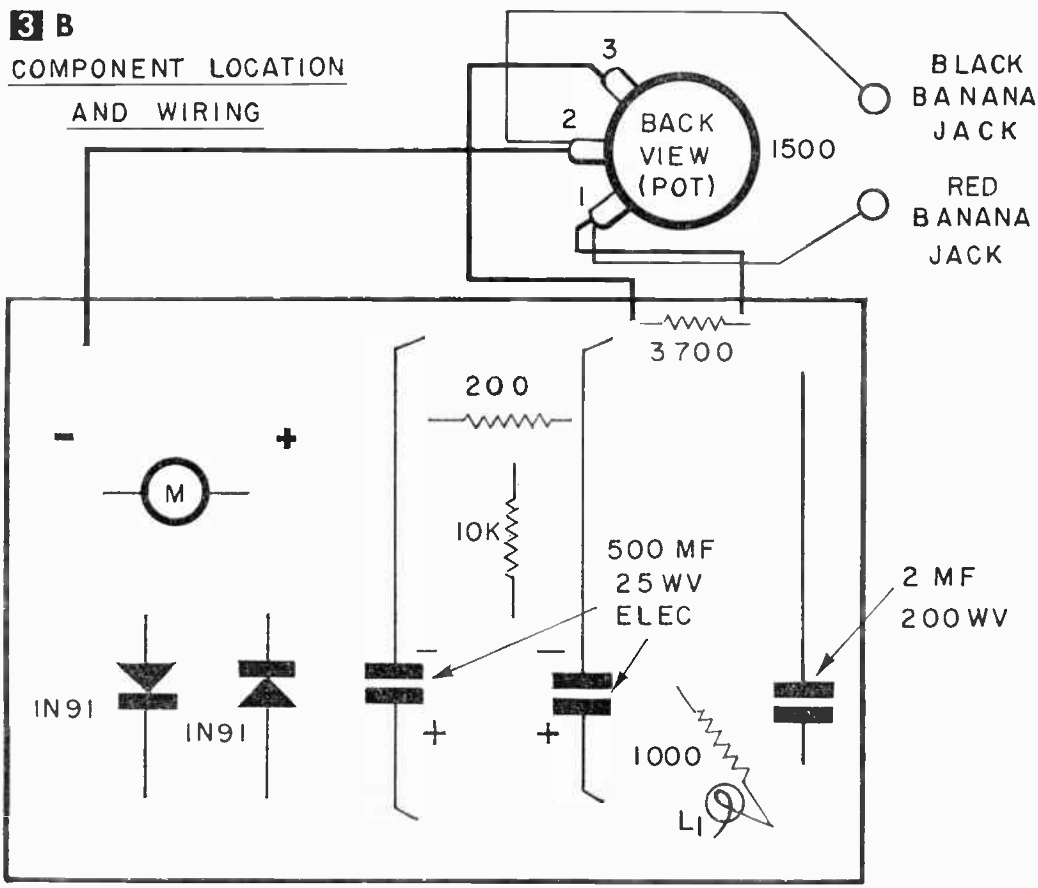
As indicated in Fig. 2, drill points 1, 2 and 4-19 with a #50 drill (about 1/16-in.) and 20 and 21 with a #26 drill. Match the distance between points 20 and 21 with your meter lugs to get a good fit.

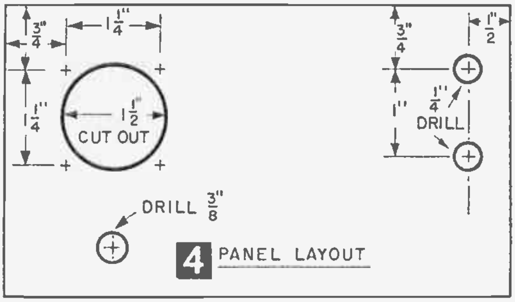
Now, using a hot soldering iron and working quickly to prevent blistering of the copper laminate, mount the following components in the order given, following schematic-pictorial of Fig. 3. Mount all components on the etched side of the board. Bend the leads of C1 down and push them through the holes at points 1 and 2. Push the capacitor down against the board and solder points 1 and 2. Clip off the leads behind the board. In the same way, mount R1, R2, R3, R5, CR1 and CR2 but solder only points 5-9 and 14-17 inclusive. Be sure CR1 and CR2 are mounted with polarity shown in Fig. 3B. Mount C2 and C3 with their positive ends at 11 and 13 respectively.

MATERIALS LIST—MINIATURE POWER SUPPLY

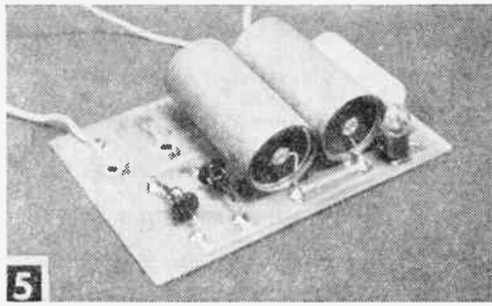
Desig.	Size and Description
C1	2-mfd, 200-v metalized paper capacitor (Aerovox P82Z)
C2, C3	500-mfd. 25-v dry electrolytic capacitors (C-D Type 5002)
CR1, CR2	GE 1N91 germanium rectifiers
L1	GE #51 pilot lamp
M1	0-5 dc milliammeter (Lafayette miniature panel meter TM-401)
R1	1000-ohm, 1/2-watt carbon resistor
R2	200-ohm, 1/2-watt carbon resistor
R3	3700-ohm, 1/2-watt carbon resistor
R4	1500-ohm, 2-watt wire wound potentiometer (Mallory R1500L)
R5	10K-ohm, 1/2-watt ±1% precision resistor (Aerovox Carbofilm)
Case	Lafayette Bakelite case #MS-216 and panel #MS-217
	Banana jacks, zip cord and plug
P. C. Material	XXXP copper laminate—one side—3 x 4 1/2" (MS-512)
	6 oz. of etchant (PE-3)
	Tape resist 1/16" (PRT-2)
	Tape resist circles (PRTD-6)

Solder a piece of bare wire to the shell of L1 and tin the button on the bottom, then tin point 3 at the same time, pressing the lamp firmly into place. Solder point 4. Strip ends of three 5-in. pieces of insulated wire (about 1/4-in.) and push them into the holes at points 18, 19 and 22. Solder these three points and clip off all the leads on the





4 PANEL LAYOUT



5 P.C. board-mounted components.

opposite side of the board, leaving that side as smooth as possible.

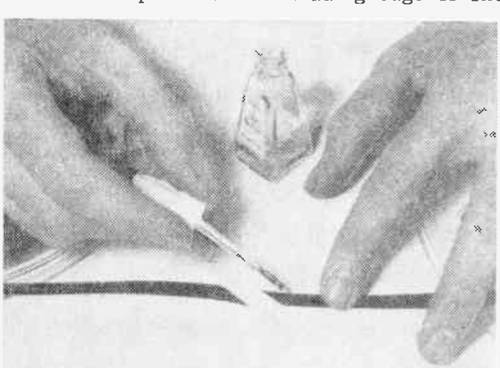
Assembly. Lay out and drill the front panel as shown in Fig. 4. The meter cutout is best made with a fine tooth coping saw or jigsaw. Drill a ¼-in. hole for the line cord (centered and about ¾ in. down) on one end of the case. Mount the meter using four 4-40 machine screws and nuts, and mount the potentiometer and banana jacks. Sandwich the components between the printed circuit board and the front panel and using the screws supplied with the meter, attach the printed circuit board to the meter lugs through holes 20 and 21. Complete the wiring according to Fig. 3A. Tin the ends of the line cord and run it through the hole in the case. Tie a single knot about two inches back from the tinned ends and solder one lead to 23, the other to 24. Now carefully recheck the wiring and attach the panel to the case with 6-32 screws.

Testing. Turn the potentiometer completely counter-clockwise and plug the unit into the receptacle. Turn the pot clockwise (up) and you should get a reading on the meter. The maximum reading will be between 20 and 30 *v*. Turn the pot down again and put a multimeter, set to read *at least* 100 *ma*, across the output leads. Again turn the pot up *slowly*. The reading will go to about 50 *ma* and drop back to between 30 and 40 *ma*. The voltmeter will indicate a very low voltage. This latter test is not necessary, but serves to show the inherent safety in the power supply.

There are one or two precautions to observe. Always turn the pot up *slowly* to the desired voltage to prevent sudden current surges, and before disconnecting or connecting the load, always turn the pot all the way down (zero voltage). That's all! Enjoy your experiments.

Tape Splicing Technique

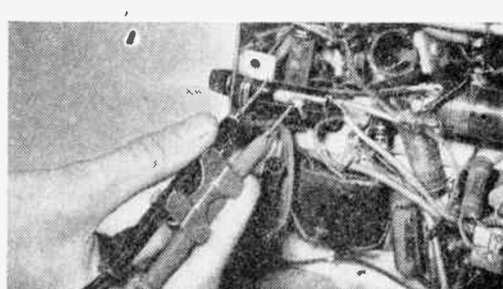
• Clear fingernail polish serves as an excellent cement when splicing recording tape. Taper cut the two ends of tape at a 45° angle, then daub some of the polish on the leading edge of one



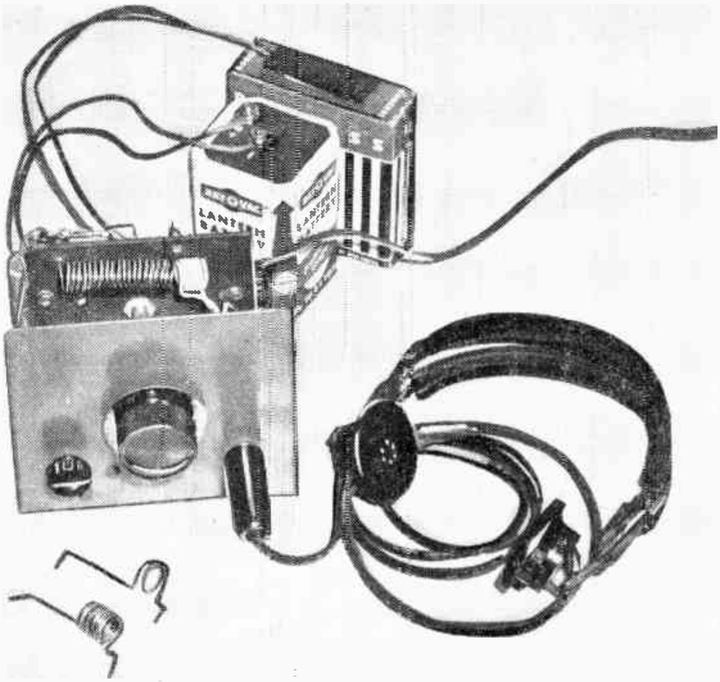
piece and overlap the other piece ⅛ in. Let dry for about ten minutes, then daub polish on the overlapping edges to insure a perfect splice. You'll have a firm, long-lasting splice that can withstand considerable tension and flexing as the tape passes through the recording machine, and is just as good as one made with cellulose splicing tape.—John A Comstock.

Fuse Holder Eases Testing

• Ever wish there were some way you could hang on to both of your test prods with one hand while the other works the meter knob? Take one of those fuse holders used when you replace a pigtail fuse with an ordinary fuse and snap the barrels of your test prods into it. You can often touch the red prod to a hot terminal and the other to a chassis ground point nearby. If the two test points are located farther apart, take the barrel of each prod out of the clips at the lower end of the holder and this will put the prod tips farther apart. You can even use the fuse holder to keep pairs of test leads from becoming separated when many are stored together.



With four coils, this one-tube receiver covers the range from 27 to 200 megacycles.



1

One-Tube VHF Receiver

By JOE A. ROLF, K5JOK

IF you're a short-wave listener, signals from Europe, South America, and Asia are probably old friends. Many interesting signals, however, originate within a few miles of your home that your receiver does not hear. Here is a simple receiver that will pick up those signals—those above 30 *Mc*—and bring the police, fire department, and a dozen other local stations right into your shack.

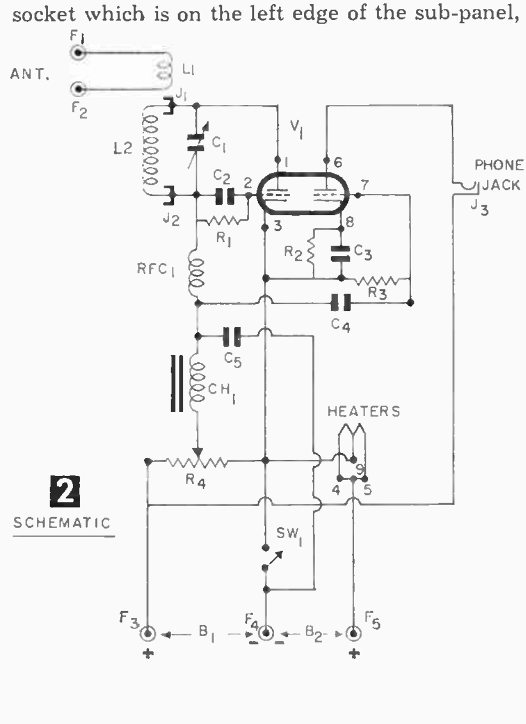
Since the 10-meter Amateur band is covered, there's also plenty of DX. Besides most of the VHF stations within 50 miles, this receiver (in Jonesboro, Ark.) has logged hams in Mexico, Cuba, Alaska, and Japan; paging services from California to Puerto Rico; and South American Police nets—all with only a 4-ft. antenna! The surprise came when it was hooked to a beam antenna and received signals from the BBC Television Service in London. . . . DX in anybody's book!

The receiver covers 27 to 200 *Mc* with four coils. The type of stations you'll hear are listed with the coil winding chart. In many localities signals from ships, highway departments, motion picture studios, pipelines, ambulances, and industrial plants can also be heard.

The set uses only one tube, but is actually a two-tube receiver. The 12AT7 has two tubes in the same package, one operating as a super-regenerative detector and the other as an audio amplifier. The detector (so sensitive that it makes electron noise sound like a frying egg) detects FM or AM signals which the second section of the tube amplifies. The receiver is battery powered and can be operated anywhere.

The base of the chassis is a piece of ¾ x 5 x 5-in. pine, the panel is 1/16-in. aluminum sheet, 5 x 5½-in. Round the panel corners with a file and wash it in vinegar to give it a dull satin finish. The sub-panel is a piece of ⅛-in. Masonite, 3¼ x 4¼-in. Two ¾ x ¾-in. brackets of 1/16-in. aluminum hold the sub-panel to the base with machine and wood screws. The sub-panel is placed 1½ in. from the rear edge of the pine block.

A small aluminum bracket supports the tube socket which is on the left edge of the sub-panel,



2 SCHEMATIC

about ¾-in. from the top. The tuning capacitor (C1 in Fig. 2) is in the center of the sub-panel, 1½ in. from the top. Antenna jacks (F1 and F2) are on the right side, ¾ in. apart, and the coil jacks (J1 and J2) are mounted 2 in. apart and ¼ in. from the top edge of the panel. Screwfasten the front panel to the pine block.

Center the hole for the tuning capacitor shaft in the panel 2¼ in. from the top edge. The regeneration control (R4) and headphone jack (J3) are mounted directly to this panel; J3 is insulated from the panel by drilling the mounting hole a little larger than required and using two fiber washers for insulation.

It is necessary to modify the tuning capacitor (C1) before mounting it. With pliers, carefully remove all but the middle, stationary plate of the capacitor. Do *not* remove any of the plates that rotate. The capacitor C1 must also be insulated from front panel to avoid changing the receiver's frequency when the panel is touched. If the regeneration control is purchased new, the shaft will be longer than necessary and most of it will have to be cut off with a hacksaw. Slip a 1-in. piece of small rubber tubing (¼-in. ID) over the shaft of C1 and slip the shaft from the regeneration control into the other end of the tube. The fit should be tight, but the two metal shafts should not touch. Use a panel bearing or rubber grommet to support the shaft at the front panel.

The battery clips (F3, F4, F5) are mounted with small wood screws on the right rear of the chassis (see Fig. 3). Identify each clip to avoid mistakes in connecting batteries. Solder the antenna coupling coil (L1) to terminal lugs on the machine screws holding the antenna terminals. The leads on this coil are twisted together and long enough to permit the coil to be brought next to L2.

Choke Ch-1 is mounted next to the regeneration control (R4). This part can be a small audio choke or the primary winding of a miniature output transformer (found in most scrap boxes or obtained from an old radio at a radio service shop. This part can also be purchased new and is less expensive than a coupling transformer.)

It is important, in wiring the receiver, that the leads connected to J1, J2, and C1 be kept as short as possible. Solder one lead of RFC1 to the terminal of C1 and the other to a terminal lug mounted on the chassis. Connect one lead of C4, C5, and Ch-1 to the lug on the chassis also. The other lead of C4 can be connected to another lug with a piece of hookup wire leading from the lug to the tube socket. Connect C5 to F4.

Wind the coils on ½-in. forms (see Table A) and then slip them off and spread to the right length. Bend the ends of the coils so they plug easily into J1 and J2. The single strand #12 copper wire used in house-wiring is easiest to obtain for these coils. Strip off the insulation and clean the wire with fine sandpaper.

When the wiring is completed, connect the batteries, plug in headphones and Coil A. After the set has been turned on and has warmed up, a loud hissing noise should be heard in the headset as the regeneration control is rotated clockwise. If this frying sound is not heard, check to see that the tube filaments are lit. If not, there is a wiring mistake or the tube is bad. If filaments are lit, check the wiring again and try a .002 or .003 *mf* capacitor in place of C5. The capacitor C5 is critical and the correct value may vary with different receivers.

Once the hissing sound is heard,

TABLE A—COIL WINDING DATA

▶COIL A—27-45 Mc.

- TURNS—19
- LENGTH—2 in.
- STATIONS HEARD

Amateur (10 meters)
City, State Police Services
Foreign Police Services
City Transit Companies
Towing Companies
Motor Carrier Services
Highway Trucks
Utility Companies
Paging Services
Foreign Television
Russian Satellites

▶COIL B—40-65 Mc.

- TURNS—10
- LENGTH—1 in.
- STATIONS HEARD

Amateur (6 meters)
Utility Companies
Logging Vehicles
Television (domestic)

▶COIL C—60-140 Mc.

- TURNS—2
- LENGTH—⅜ in.
- STATIONS HEARD

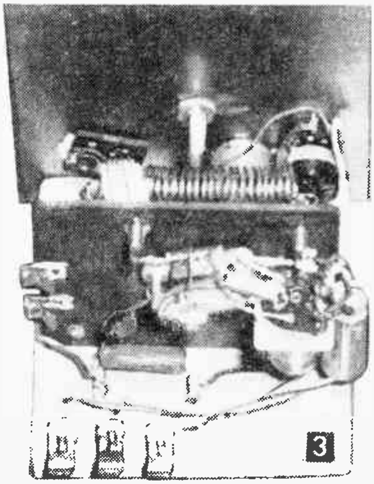
FM Broadcast
Television (domestic)
Military
Air Navigation Services
US Satellites

▶COIL D—130-200 Mc.

- TURNS—1
- LENGTH—¼ in.
- STATIONS HEARD

Amateur (2 meters)
Television (domestic)
Local Police
Logging Vehicles
Utility Companies
Railroads
Taxi Companies

Base of receiver is ¾-in. pine stock, sub-panel (behind front panel) is ⅛-in. Masonite.



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Coils are all ½ in. in diam., of #12 copper wire. Close-wind coils and spread turns evenly to given length with a knife or screwdriver blade. To raise frequency coverage of coils, increase spacing between turns; to lower frequency, squeeze coil so spacing is decreased.

MATERIALS LIST—VHF RECEIVER

Desig.	Description	Desig.	Description
B1	67½-v. battery, Burgess K45 with snap-on connector	R2	500 ohm, ½-watt resistor
B2	6-v. lantern battery, Burgess, Eveready, or Ray-O-Vac	R3	1 megohm, ½-watt resistor
C1	3-15 mmf. variable capacitor, Bud MC 1870, modified according to text	R4	50,000-ohm volume control, Centralab B-31 with KB-1 switch (Sw 1)
C2	47 mmf. mica capacitor	RFC1	1 mh RF choke, National 5-50, or 6′ to 8′ of #28 dcc solid copper wire wound on ¼″ form
C3	.25 mf. 100-v. tubular, Sprague 68P19	V1	12AT7 radio tube
C4	.01 mf. 400v tubular, Sprague 68P8	1	9-pin miniature tube socket
C5	.001 1 kv. disc ceramic	1 pr	magnetic headphones
Ch1	midget audio choke or primary of midget output transformer	10	#8 terminal lugs
F1, F2, F3, F4, F5	medium Fahnstock clips	6	6-32 x ¼″ machine screws with nuts
J1, J2	metal or molded tip jacks	10	small wood screws
J3	standard phone jack	1	coil of solid strand hook up wire
L1	5 turns copper hookup wire, closewound ½″ dia.		1/16″ aluminum sheet, ¾″ pine, and Masonite for chassis, brackets and panel
L2	#12 copper wire wound according to Table A		tuning dial and knob
R1	4.7 megohm, ½-watt resistor	1 pc	rubber tubing 1″ long with ¼″ inside dia.
		2	fiber washers ¼″ I.D. and ⅝″ O.D.

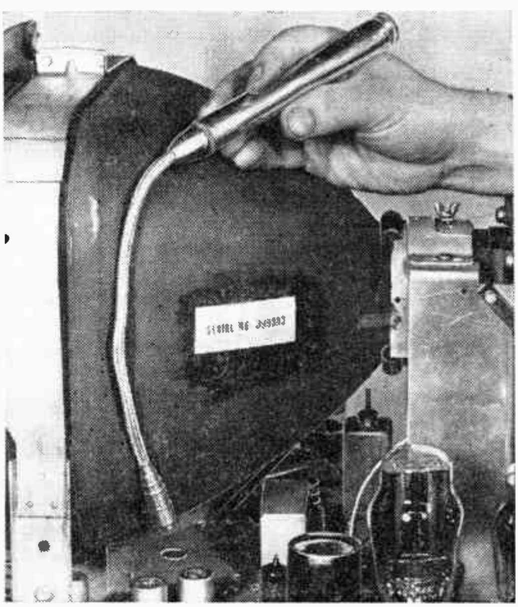
connect an antenna and move L1 close to L2. Tune across the band until a station is heard, then adjust the regeneration control for the best reception. If the hissing sound is not present all across the band, move L1 away from L2 until the receiver regenerates at any setting of C1.

Naturally, any radio works best with a good antenna, but this receiver will do surprisingly well with only a short piece of wire as an antenna. For best performance, the antenna should be cut exactly to your favorite frequency and it should be as high as possible. A simple folded dipole or vertical antenna will work well and, in some cases, it is best to ground one of the antenna terminals.

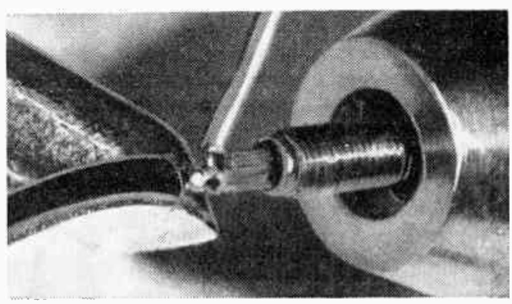
If you happen to live in an area where TV signals are weak, this receiver may interfere with nearby TV sets when tuned to a TV station. This is because the detector generates a weak signal which the TV set receives. If such interference is noted, do not listen to TV stations when it may disturb a nearby set.

Light for Tube Replacement

• When replacing miniature tubes in a TV set, a penlight flashlight with an 8- to 10-in. flexible extension (available at tool and surplus stores) will provide light at sockets which can not be otherwise lighted.—H. Leeper.



Drill's Chuck Vises Work



• A drill's chuck can double as that extra hand that's needed to hold small lugs, jacks, plugs, and other parts while you solder wires to them. Soldering is a lot easier and there's no chance of painfully burning your fingers on hot parts by trying to hand-hold them. You can use an ordinary hand drill for the purpose or an electric drill—either does the job nicely.—J.A.C.

Hum in Iron-Core Transformer

In the case of hum due to vibration of the laminations in an iron-core transformer, loosen the mounting screws so the laminations will spread apart slightly, paint the edges of the laminations with shellac or varnish, allow to dry for several hours, then tighten the mounting screws.

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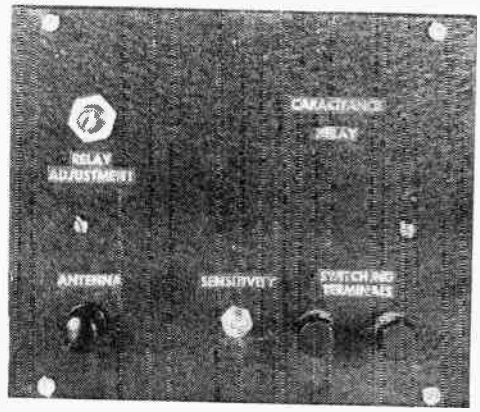


A compact and efficient unit designed for continuous service—a transistorized capacitor relay, front-panel and under-chassis views.

Transistorized Capacitance Relay

By W. F. GEPHART

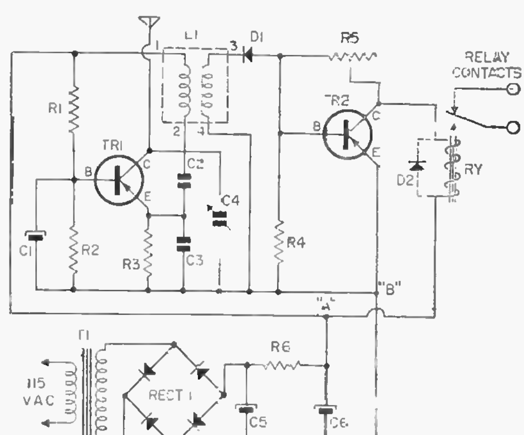
Vacuum-tube capacitance relay circuits have several disadvantages in certain applications such as burglar alarm and other continuous-duty circuits. This transistorized unit overcomes those disadvantages

VACUUM-TUBE capacitance relay circuits consume appreciable power, requiring line voltage or excessive battery replacement, and are prone to trouble due to the tubes and high voltage required. Transistorizing these circuits, though it sacrifices sensitivity to some extent, provides a means of continuous trouble-free, economical operation. The unit shown in Fig. 1, for instance, will operate continuously on *ac* for less than half-a-cent a day and operation cost is very little more on battery operation. And, since transistors are used, shock hazard is eliminated and the chance for circuit breakdown is greatly reduced.

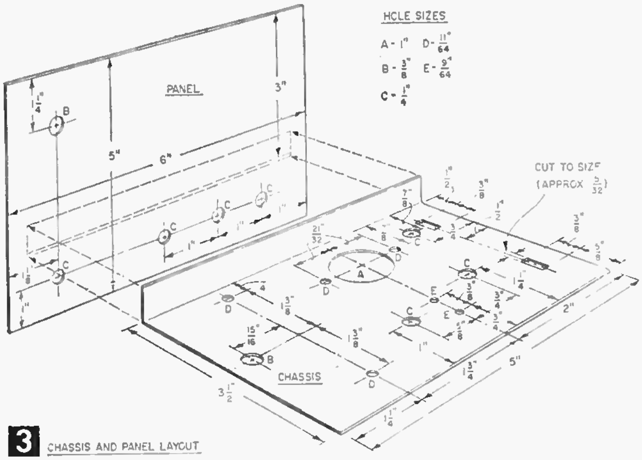
The circuit (see Fig. 2) consists of a transistor oscillator feeding a transistor-controlled relay. The oscillator biases the second transistor to the point of conducting enough current to close the relay, and when an outside capacitance stops oscillation, current flow in the second transistor is reduced and the relay opens. Even though the relay is *energized* under "normal" conditions, the current flowing through its coil (1.8 *ma*) is far below the coil's continuous-duty rating.

Several types of coils may be used for the oscillator coil (L1). The one shown is a broadcast band antenna coil, but a BC band oscillator coil or IF transformer may also be used. The connections for the coils that can be used are:

Terminal on Schematic, Fig. 2	Antenna Coil	BC Osc. Coil	IF Transformer
1	Grid	Grid	Plate
2	AVC	Ground	B+
3	Antenna	Plate	Grid (or diode)
4	Ground	B+	Grid (or diode) return



2 SCHEMATIC DIAGRAM



3 CHASSIS AND PANEL LAYOUT

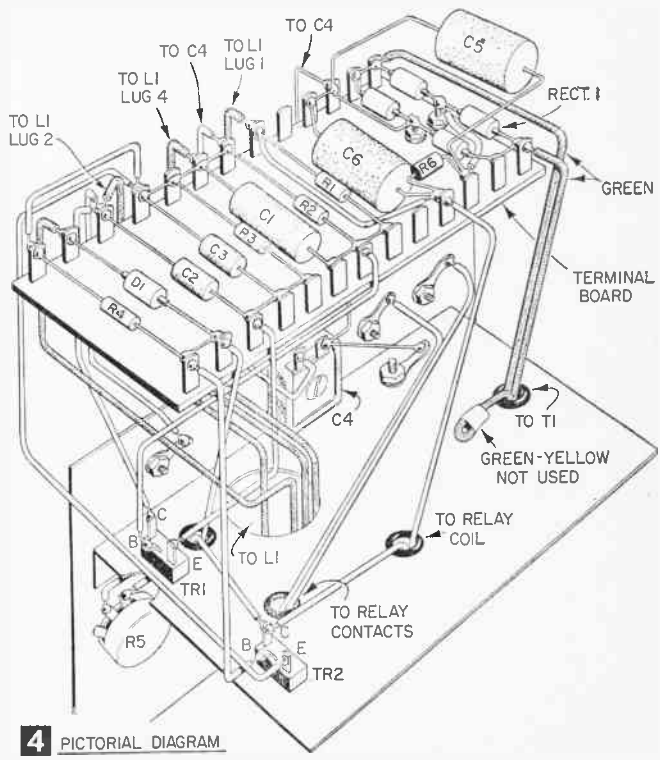
In all cases, the coil should be shielded. If you use an IF coil, use a 270 *kc* version to avoid the possibility of interfering with nearby radios. Except when an IF coil is used, no capacitor is used across coil; the distributed capacity of the coil and wiring is utilized for oscillation. In the unit shown in Fig. 1, with a BC antenna coil, the oscillation frequency of the components will be approximately 100 *kc*.

The "antenna" is connected to the collector of TR1, and touching it provides a capacitative ground between the collector and emitter, and stops oscillation. In burglar alarm applications, this lead can be connected to the metallic frame of the item to be protected (cash register, safe, door knob, etc.), so that touching it will stop oscillations. In other cases, a metal plate may be fastened to a window sill or other place to achieve the same result (see *Radio-TV Experimenter*, No. 555, 75¢, "Experimenting with a Capacity Control," p. 143), or the lead may be attached to a door or window screen. If the "ground" lead (+15 *v*) is connected to another metal plate in the vicinity of the antenna plate or screen, often the circuit will trip without the person actually touching the antenna plate. The voltage is so low that touching both leads is harmless and cannot be felt.

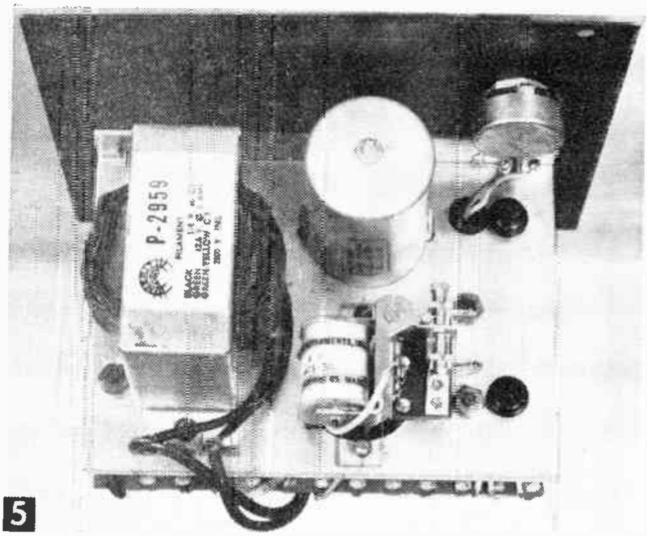
A trimmer capacitor (C4) is connected between the collector of TR1 and ground to minimize the additional capacity required to stop oscillations. With the antenna connected, this should be adjusted so that oscillations are just maintained at a level that will hold the relay closed, and any additional capacity in the circuit will cause the relay to open. Sometimes, in the case of long antenna leads, the distributed capacity of the lead itself will stop oscillations, and the trimmer capacitor should then be disconnected. If the capacity of the lead is still too great, the unit must be moved closer to the antenna to enable a shorter lead to be used.

Figure 3 shows the panel and chassis layout. Any layout could be used, but the unit should be enclosed in a steel cabinet in all cases. The unit is shown with a built-in *ac* power supply, although batteries could be used by connecting a 15-*v* battery supply to points "A" and "B" (Fig. 2), observing proper polarity. The *ac* power supply shown delivers in excess of 15 *v* under full load, and this voltage must be reduced to the 15-*v* limit of the transistors by selecting a proper value for R6. Normally, 800-900 ohms will be correct. An *ac* switch was not included in the unit shown, since it was intended to be wired into the power lines, but one can be placed on the front panel.

Terminal board wiring was used in the unit shown, and the terminal board was mounted on ½-in. spacers under the chassis. If a surplus terminal board is not available, one can be made out of a 2½ x 5-in. piece of plastic or Bakelite, spacing thirteen ½-in. 2-56 machine screws along each side, and centering two at one end. The transistors could be wired directly into the circuit, but the use of sockets simplifies replacement.



4 PICTORIAL DIAGRAM



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Back-of-panel, top view of unit showing transformer, coil, relay, sensitivity control and two transistors.

MATERIALS LIST—CAPACITANCE RELAY
(All resistors are ½ watt)

Desig.	Description
R1	.1 megohm
R2	47K
R3	10K
R4	2.2 megohm
R5	5 meg potentiometer
R6	820 ohms (see text)
C1	.01 mfd., 200 v
C2, C3	22 mmf. ceramic
C4	70-480 mmf. trimmer capacitor
C5, C6	25 mfd. 50-v electrolytic
L1	oscillator coil (see text)
T1	12.6-v filament transformer (Merit P-2959)
TR1, TR2	2N107 PNP transistor
D1	1N48 diode
D2	1N38 diode
Ry	SPDT relay, 8000-ohm coil (Sigma 4F-8000-S/SIL)
Rect. 1	four 1N48 diodes, bridge-connected
	Steel cabinet 4 x 5 x 6" (Bud CU-729); two transistor sockets; three insulated binding posts; miscellaneous hardware

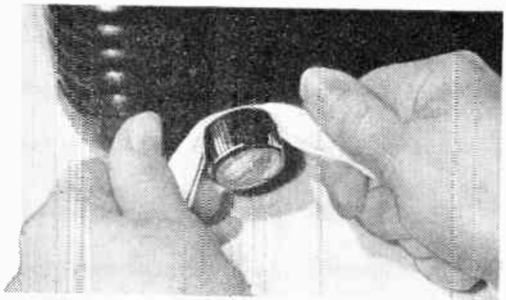
If the unit is to be placed in a service where the relay will operate frequently, such as in a counting circuit or, say, a customer-activated window display, place a diode (D2) across the relay coil (shown in dotted lines in Fig. 2). The inductive pulse from the relay coil when it releases is hard on the transistor, and frequent usage would ultimately damage TR2 unless the diode D2 is used.

The relay specified in the Materials List is adjusted to close on 1.5 *ma* at the factory. This adjustment should not have to be changed since TR2 will normally draw about 1.8 *ma* when biased by the oscillator output. Potentiometer R5 is used to adjust the "no-signal" bias on TR2 so that the relay barely closes when the circuit is oscillating normally. A reduction in the amplitude of, or the cessation of oscillations then causes the relay to open, closing the circuit to the external terminals.

The circuit can be used for burglar alarms as mentioned, or for any other "touch" or proximity operated circuit switching. By placing two metal plates close together, where a raindrop will bridge the gap between them, the circuit can be used as a "rain alarm." The high resistance direct connection between the plates (one connected to "antenna" and one to "ground") will not damage the power supply, but will stop oscillations. However, in the case of a direct, low-resistance connection between the "antenna" and "ground," the circuit should be disconnected promptly after the alarm to minimize drain on the power supply, particularly if batteries are used.

Cloth Removes Stubborn Knobs

• When you wish to remove a stubborn press-on type of radio or TV knob, just loop a twisted scrap of strong soft cloth behind the knob, gripping the loose ends firmly in your fingers. Press



against the cabinet front with your thumb tips, at the same time pulling firmly at the cloth. The knob should work free without damage to cabinet or knob.—Frank A. Javor.

It's an infinite baffle—

Six-Meter Station for the VHF Amateur

By C. F. ROCKEY, W9SCH/W9EDC

For hams only, the new improved six-meter rig that reaches out.

SPECIFIC features provided in this six-meter station are:

1) A stable, sensitive superheterodyne receiver, free from overloading effects under reasonable operating conditions.

2) A variable-frequency oscillator, controlling the transmitter output frequency. This makes it possible to move out from under powerful interfering stations, and to select a clear operating frequency.

3) Transmitter power input of 15 to 17 watts. This is sufficient for consistent six-meter work.

4) Provision for CW radiotelegraph operation on the six-meter band. This feature is not usually provided on many commercially-built units.

5) Clean, crisp signal quality, even when an inexpensive carbon microphone is used.

6) All parts are readily available from any well-stocked amateur parts distributor. No expensive, "special" tubes are required. (Furthermore, many of the more-expensive parts used in the first unit—see copy beneath dotted line below—can be appropriated for this one. But even if all new parts are purchased, the total cost should not exceed $100.)

As with all VHF equipment, construction of this unit requires a degree of experience and judgment, but the unit itself is neither difficult nor tricky to set up. Before you start this, or any other serious VHF project, make sure you have a good grid-dip meter at hand (see pp. 130-131).

Power Supply, AF Circuits, Receiver. Begin construction by drilling and punching the major holes in the chassis, as shown in Fig. 2. Make the power transformer cut-out with a 1-in. square Greenlee punch (taking successive bites from the corners) or with a nibbling tool. All socket holes, except the rectifier and voltage regulator sockets, should be punched with a ¾-in. dia. Greenlee punch; the rectifier and voltage regulator socket holes are punched with a 1$\frac{1}{16}$-in. dia. Greenlee socket punch. The clearance hole for the pivot of the Send-Receive switch, and the lug-holes for the receiver IF transformers may likewise be punched with the ¾-in. punch, elongating the latter with a ¼-in. rat-tail file until each provides ample clearance for the transformer connecting lugs. Although the mounting holes for them should be drilled and checked, do not mount the power transformer, IF transformers, modulation transformer, or filter choke until they are actually wired into the circuit.

The small mounting holes are best located by using the particular component to be mounted as a template, or measuring directly from it. Tube socket key or pin positions are best decided by direct reference with the under-chassis photo

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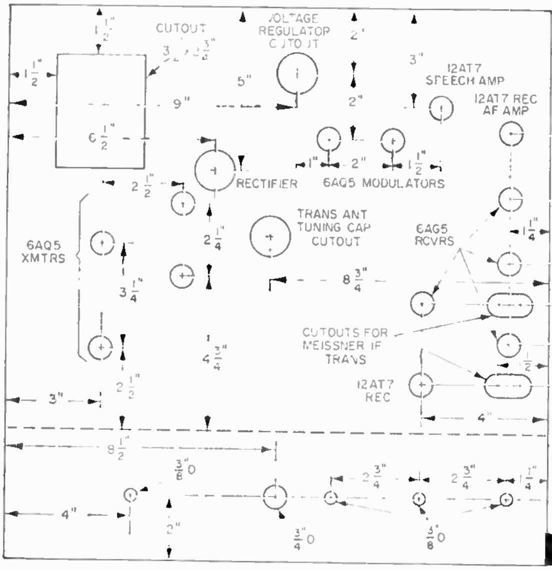
In Volume 6 of the *Radio-TV Experimenter* (No. 555) we described a six-meter amateur radiophone station, suitable for the beginning or "technician-class" operator. Reader response to this project was so enthusiastic we felt an improved model of such a station in order. While the first station is still a useful and interesting project, it does possess a few disadvantages, particularly when used in regions of intense amateur VHF activity such as the Chicago, New York, and New England areas where occasionally transmitter output power becomes insufficient for consistent communication. Likewise, while sensitive, the simple receiver is occasionally overridden by powerful nearby stations in metropolitan areas.

This *improved six-meter station*, on the other hand, has proven itself practical in both big cities and in the less active VHF regions. Here in the Chicago area, for instance, it has seldom failed to provide enjoyable contact whenever turned-on, even though only a simple dipole antenna is used with it. A good directional, "beam" antenna will enable it to compete anywhere, and against commercially built equipment costing several times as much.



2

Now, connect a line cord to the *line* terminals on the terminal strip and plug in the 5U4 and the VR 150/OD3 regulator tube.

Turn on the switch on the regeneration control potentiometer and plug the cord into the power line. The rectifier (5U4) filaments should glow a dull red, and the VR tube should be filled with a pale purple glow. Measure the *dc* B+ voltage to the chassis. Any value between 400 and 500 *v* is normal. Between pin No. 5 and ground the voltage should be very close to 150 *v*. Under load, the full voltage will be about 350 *v*.

With the power supply completed and checked out, complete the audio frequency sections in both the receiver (Fig. 6) and the transmitter, (speech amplifier and modulator, Fig. 7). Each 12AT7 triode section comprises a separate and distinct AF amplifier stage. (Refer to Table A to insure correct connections to the pins of these and all other tubes.) To check the operation of each stage as it is wired, plug in the tube and apply power. Connect a ceramic or mica capacitor of at least 1000 *mmf* in series with a good pair of magnetic headphones, ground the other wire of the phones and connect the free end of the capacitor to the plate of each AF stage as it is completed. Now touch a screwdriver to the *grid* of that same tube. If the circuit is operating correctly, a characteristic clicky buzz will be heard in the phones.

(Fig. 4) and by reference to circuit diagrams (Figs. 5, 6 and 7). Provide the shortest, most direct grid and plate leads in each case. Mount each socket to the chassis, using 4-36 *rh* screws and hex nuts for the miniatures and 6-32 *rh* screws with nuts for the octals. Place a soldering lug under one of the screws of each socket to provide a common ground point for that stage. Mount the insulated tie-lug strips using the under-chassis photo (Fig. 4) as a guide. A liberal use of insulated tie-lug strips makes possible a neat and mechanically rigid wiring job. If you plan portable operation, put lock washers under all nuts for increased mechanical security. Mount all tube sockets and the terminal strip, as well as most insulated tie-lug strips before beginning the wiring, as well as the four-pole Send-Receive switch.

Wire all of the power supply (Fig. 5), except the power transformer, then mount and wire the power transformer, running *ac* power line connections, B+ supply leads, and 6.3-*v* heater supply leads along the edges of the chassis. Fasten electrolytic filter capacitors, by their leads, between suitable lugs, to hold them firmly in place.

When you have finished wiring the power supply, including a B+ lead to the Send-Receive switch, measure the *dc* resistance from B+ to ground with a serviceman's ohmmeter. There is no limit as to how high this resistance should be, but it should not be less than 50,000 ohms.

For an overall check of the receiver audio amplifier when this section is completed, plug the phones into the energized circuit (Send-Receive switch in Receive position) and listen for the clicky buzz when each grid is touched in turn. The transmitter AF system can be given an overall check by connecting a 100-K ohm resistor in series with phones and connecting this series combination between the green and black (across the secondary) of the modulation transformer. With all tubes in place, power applied, and the S-R switch in Send position, loud, clear speech should be heard when the mike (connected to appropriate terminals) is spoken into.

With audio-frequency and power-supply circuitry completed and checked, begin on the receiver second detector by winding the coil for this stage, L_4 (see Fig. 8). Be sure that this, and other coils are wound *exactly* as described. More trouble probably can arise over an improperly-wound and connected coil than from almost any

TABLE A—TUBE PIN CONNECTIONS

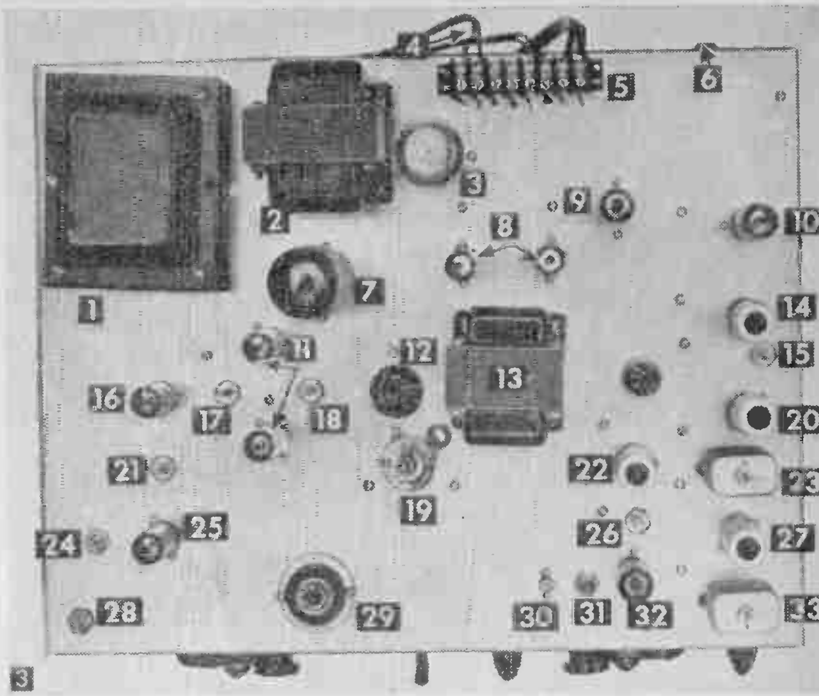
5U4	6AQ5		12AT7	Triode No. 1	Triode No. 2	6AG5		VR150
Fil. 2 and 8	Heaters	3 and 4	Heaters	4 and 5 (Tied together) & 9		Heaters	3 and 4	Pin 2 Ground
Plates 4 and 6	Grid No. 1	1 or 7	Grid	2	7	Grid No. 1	1	Pin 5 to 6000 ohm resistor and B+
	Grid No. 2 (screen)	6	Plate	1	6	Grid No. 2 (screen)	6	
	Plate	5	Cathode	3	8	Grid No. 3	2	
	Cathode	2				Plate	5	
						Cathode	7	

(Note: Grids numbered starting from cathode) other error. Be sure that the specified *iron* slug forms (National XR-50) are used in all instances.

The regeneration-control potentiometer controls the screen grid (grid No. 2) voltage on the 6AG5 second detector tube.

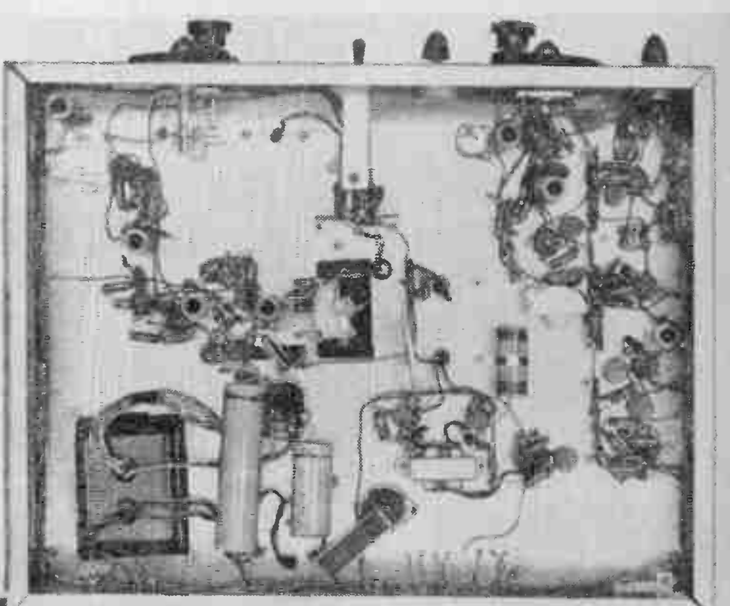
Wire this, and the rest of the second detector by reference to Fig. 6. Keep the grid, plate and cathode leads short and direct, although the heater, B+, and screen supply leads may be run in the corners of the chassis for convenience.

You will note that the second detector receives its B+ supply directly from pin No. 5 on regulator tube. Be careful to avoid shorts between the pins of the tube socket, (use no more solder than necessary upon any connection) and don't forget the 50 *mmf* ceramic capacitor across the coil. When the second-detector wiring is completed and checked for errors, plug in the 6AG5, the receiver 12AT7 and the phones. With power applied and the S-R switch in Receive position, slowly advance the regeneration control toward the right. A smooth, quiet "thud" indicates that this circuit is operating correctly. If there is no "thud," recheck wiring; if tube is



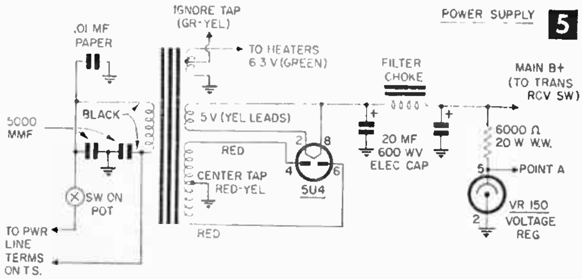
3

1) Power Transformer; 2) Filter Choke; 3) VR150 Voltage Regulator; 4) Line Cord; 5) Terminal Strip; 6) Phone Jack; 7) 5U4 Rectifier; 8, 9), 6AQ5 Modulator Tubes; 10) 12AT7 Receiver A.F. Amplifier; 11) 6AQ5 Transmitter Power Amplifiers; 12) Antenna Tuning (Transmitter); 13) Modulation Transformer; 14) 6AG5 Second Detector; 15) Second Detector Tuning Slug; 16) 6AQ5 Frequency Doubler; 17) Frequency Doubler Coil Slug; 18) Transmitter Power Amplifier Tuning Slug; 19) Tuning Lamp; 20) 6AG5 Second I.F. Amplifier; 21) Oscillator Plate Tuning Slug; 22) 6AG5 R.F. Amplifier; 23) I.F. Transformer; 24) Transformer Oscillator Tank Capacitor (100 mmf); 25) 6AQ5 Oscillator; 26) R.F. Amplifier Tuning Slug; 27) 6AG5 First I.F. Amplifier; 28) Transmitter Oscillator Slug; 29) V.F.O. Push Button; 30) Receiver Oscillator Tank Capacitor; 31) Receiver Oscillator Tuning Slug; 32) 12AT7 Oscillator and Mixer; 33) I.F. Transformer.



4

Under-chassis view of six-meter rig, showing typical placement of circuit components.



POWER SUPPLY 5

to 12-megacycle region particularly at night.

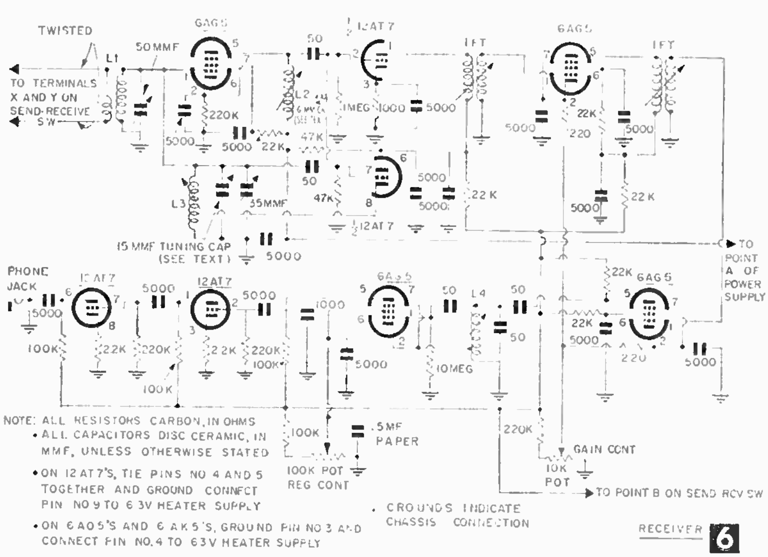
good, little else can cause difficulty except an improperly wound or connected coil. When the detector is thus apparently operating, bring the lead-in from a fairly large antenna near (but not touching) the coil. By rotation of the slug of this coil, it should be possible to hear a number of shortwave code and phone stations in the 10-

Wire the two IF amplifier stages next. Keep all grid and plate leads in the IF amplifier as short and direct as possible, or they may couple with each other or with other leads, and cause the amplifier to oscillate. Uncontrolled oscillation is evidenced by loud squeals and other raucous noises in the phones when the circuit is tested. A properly operating IF amplifier contributes no noise other than a smooth hiss in the phones. If oscillation occurs with good tubes in the sockets and all shields firmly in place, the only cure is careful rearrangement of the leads. (The 10K-ohm gain control potentiometer controls the cathode bias upon the two IF amplifiers. Advancing the control to the right should bring the cathodes closer to ground potential and increase the amplification of the system.)

TABLE B
RESONANT FREQUENCY DATA FOR COIL ADJUSTMENT:

Coil No.	Resonant Frequency	Remarks
L_1	51 Mc	Peak with 50 mmf
L_2	51 Mc	
L_3	Should tune from about 30 to 43 Mc as receiver tuning capacitor is rotated	Adjust both coil slug and 35 mmf oscillator tank capacitor
L_4	Peak at 10.7 Mc	
L_5	Should tune from about 6.24 to about 6.75 Mc as trans. VFO tuning dial is rotated	Adjust both slug and 100 mmf VFO tank
L_6	Peak at 12.5 Mc	
L_7	Peak at 25 Mc	
L_8	Peak at 51 Mc	
L_9	Peak for maximum output on operating freq. (50 to 54 Mc)	

When the IF amplifier has been completely wired, check it over carefully for mistakes and for solder shorts. Insert the receiver audio tube, second detector, and both IF amplifier tubes, make sure all shields are in place upon those tubes requiring them, plug in phones and apply power. Then, using a grid dip meter, carefully adjust the second detector coil to resonance at 10.7 megacycles. Throw the S-R switch to Receive and turn down the IF gain control. Turn up the second detector regeneration control just past the "thud" point, on the oscillating side, and readjust the second detector coil tuning slug until the whistle of the grid dip meter is clearly heard in the phones. Now, turn up the IF gain control and adjust each tuning slug (top and bottom) on each IF transformer carefully for the loudest response from the grid dipper. Adjust the gain and the location of the dip meter with respect to the set to provide a clear whistle but to avoid overloading. The IF amplifier is now roughly aligned. Final alignment will be completed later.



RECEIVER 6

Proceed with the 12AT7 oscillator-mixer. Wind the mixer coil (L2, Fig. 8) and the oscillator coil (L3, Fig. 8) carefully and install these under the chassis. Also mount the 35 *mmf.* oscillator tank capacitor and the 15 *mmf.* tuning capacitor. Since these circuits operate at high frequency, it is necessary to keep all grid, plate and cathode leads short and direct and return all grounds for one stage to the same lug on the chassis, insofar as possible. Heater and B+ supply leads again should be run around the corners of the chassis. (The os-

MATERIALS LIST—SIX-METER RIG

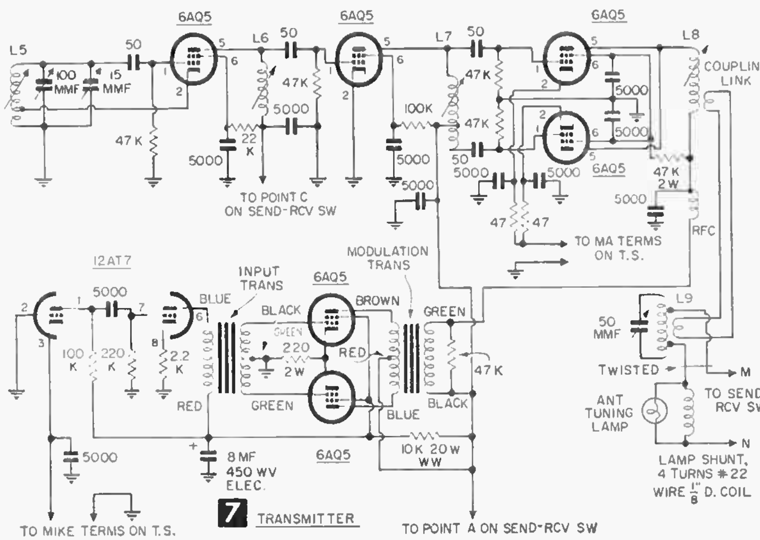
No. Req'd	Description
1	Jones barrier terminal strip, 8-terminal (Model No. 8-140)
1	aluminum chassis 4 x 13 x 17"
2	8-prong, octal tube sockets, Amphenol
6	7-prong miniature tube sockets, Amphenol unshielded
4	7-prong miniature tube sockets, Amphenol unshielded, with fitting for shield
4	shields for above, Amphenol, to fit 6AG5 tubes
3	9-prong miniature tube sockets, Amphenol, unshielded
1	common push button (from any hardware store)
1	miniature porcelain cleat socket (from any hardware store)
2	FM I.F. transformers 10.7 megacycle (type: Meissner 16-6665)
1	line cord and plug
1	4-pole double-throw Federal anti-capacity switch (type 1424)
2	vernier tuning dials (National type BM)
4	plastic knobs, for 1/4" shaft
1	single-circuit phone jack (Mallory)
1 pr	good magnetic head phones (Trimm)
1	single-button carbon microphone (carbon type F-1 from Telephone Engineering Co., Simpson, Pa.)
1	driver transformer (Thordarson type 20A22)
100'	plastic insulated solid hook-up wire (one roll)
1/4-lb.	No. 22 double cotton covered magnet wire
1/4-lb.	No. 26 double cotton covered magnet wire
	Assortment of tie points, insulated, 2, 3, and 4 terminal
1 pkg	rubber grommets 1/4-in. wire hole
1 length	No. 14 tinned-copper wire
	rosin core solder
	4–36 *rh* machine screws 1/4" long with nuts
	6–32 *rh* machine screws 1/4" long with nuts
25	5000 mmf ceramic disc capacitors
8	50 mmf ceramic disc capacitors
1	1000 mmf ceramic disc capacitor
1	.5 mfd, 200 working volt, paper capacitor
1	8 mfd, 450 working volt, electrolytic capacitor (tubular type, Mallory)
2	20 mfd, 600 working volt, electrolytic capacitors (tubular type, Mallory)

No. Req'd	Description
1	.01 mfd, 600 working volt, paper capacitor (Aerovox)
3	1-watt carbon resistors, 220 ohm
6	1-watt carbon resistors, 22K ohm
3	1-watt carbon resistors, 47 ohm
6	1-watt carbon resistors, 47K ohm
1	1-watt carbon resistor, 1000 ohm
5	1-watt carbon resistors, 100K ohm
4	1-watt resistors, 220K ohm
2	1-watt carbon resistors, 1 megohm
1	1-watt carbon resistor, 10 megohm
2	1-watt carbon resistors, 2.2K ohm
1	2-watt carbon resistor, 220 ohm
1	2-watt carbon resistor, 47K ohm
1	10K ohm, 20 watt, wire-wound resistor, I.R.C.
1	6000 ohm, 20 watt, wire-wound resistor, I.R.C.
1	100K linear taper potentiometer with switch (Mallory)
1	10K linear taper potentiometer (no switch, Mallory)
2	50 mmf variable capacitors (Bud type No. 1873)
2	Bud 15 mmf variable capacitors (Bud type No. 1870)
1	35 mmf variable capacitor (Hammarlund type No. MAPC-35)
7	National type XR50 iron slug coil forms
1	power transformer (Thordarson 22R07)
1	filter choke (Thordarson 20C55)
1	modulation transformer (Thordarson 21M54)
1	5U46B tube
1	VR150/OD-3 tube
6	6AQ5 tube
3	12AT7 tubes
4	6AG5 tubes
1	No. 40 dial light 6-volt, screw base
1	beam antenna (Newark Electric Co., Catalog No. 92-F-216 or similar)
	For tuning and adjustment:
1	technician's volt-ohmmeter
1	grid-dip meter (B and W, Heathkit or Millen)
1	0-150 dc milliammeter
1	7.5-watt, 120-v lamp bulb and socket
1	2-watt neon lamp bulb

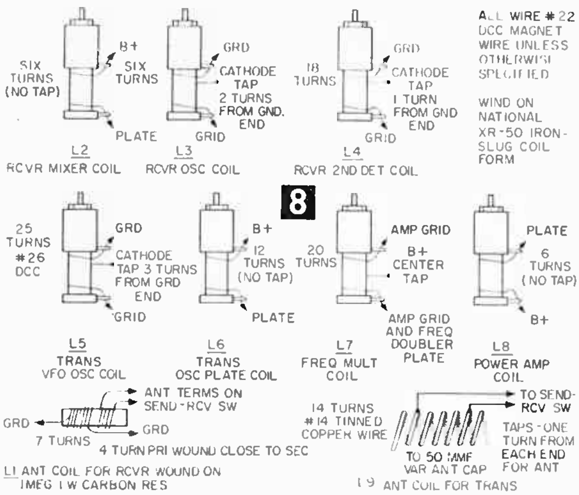
cillator section receives its B+ supply from the voltage regulator tube, pin No. 5, point A in power supply, Fig. 5. The "gimmick" in Fig. 6 is a small capacitor which couples the oscillator signal into the mixer. Make it by twisting five turns of plastic-insulated hookup wire, (insulation still in place, tightly together. No trouble will be experienced if you carefully arrange that the two wires can *not* come into metallic contact. This gimmick must be connected in place before the following oscillator frequency adjustments are made.)

When the oscillator-mixer section has been wired, carefully check it out and then insert the 12AT7 tube in the socket, etc. Close the plates of the tuning capacitor (15 *mmf.*, with vernier dial) completely, and set the oscillator tank capacitor (35 *mmf.*, on chassis) plates exactly half-meshed. Now, adjust the slug in the oscillator until the oscillator coil resonates at 39 megacycles, as determined by grid dipper. Apply power and use the grid dipper to check for oscillation by coupling it to the coil L3. Lack of oscillation indicates an incorrect coil, wrong wiring, or a bad tube.

Receiver wiring is completed by wiring the RF amplifier stage, 6AG5. The only precaution which must be taken here is to keep the grid



7 TRANSMITTER



and plate leads short and direct. The receiver antenna coil, L1, is made by close-winding seven turns of No. 22 DCC wire around a one-watt, one-megohm carbon resistor. The end leads of this coil are soldered to the resistor leads. The primary coil consists of four turns of the same wire wound directly over the ground end of the seven-turn coil. The seven-turn coil is then connected directly across the terminals of the 50 *mmf.* capacitor; it is held firmly in place by the stiff leads of the resistor.

When this coil is soldered in place across the capacitor, mount the latter in position upon the chassis and complete the wiring of the RF stage. Twist and connect the antenna coil primary leads to the receiver (X and Y) antenna connections on the S-R switch. This *tightly twisted* pair of leads may be run around the corner of the chassis with the power leads for appearance's sake, if desired. Treat the tightly-twisted pair of leads from the antenna switch blades to the antenna terminals (on terminal strip) the same way.

Plug all tubes into the receiver and power supply, and place shields firmly upon all tubes requiring them. Before applying power, "grid dip" both L1 (with 50 *mmf* capacitor) and L2 (with slug) to resonance at 50 megacycles.

Now, apply power, and switch the S-R switch to Receive position. Turn up the IF gain control until a slight hiss is audible in the phones and turn up the regeneration control just beyond the thud-point. With the tuning capacitor fully meshed and the grid dip meter oscillating, rotate the grid-dip meter dial slowly about the 50 megacycle point until you hear its whistle in the phones. If overloading occurs, turn down the IF gain. (If you have performed your previous alignment work carefully, this signal should be close to 50 *Mc.*) Now, readjust the tuning controls of L1 and L2 for maximum signal strength, turning down the IF gain to avoid overloading if necessary. When these have been peaked-up, carefully readjust *all* of the IF transformer slugs for the strongest possible signal. You have now aligned the receiver. Connect a six-meter antenna (or, if that is not available yet, a TV receiving antenna) to the antenna terminals on the terminal strip. If there is an amateur six-meter station on the air in your locality, you should have no trouble hearing it. When you do tune in an on-the-air signal, use it to make a final touch-up of all slugs and adjustments. Finish off by installing the vernier dial and knobs.

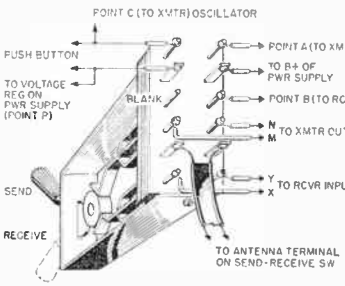
You will receive radiotelephone signals best with the regeneration control just below the thud point. Radiotelegraph CW signals will be received best just above it. Also the regeneration control may be used as an additional volume control on strong voice signals, in addition to the IF gain control. You will also observe that this receiver, while being very sensitive to six-meter signals, is remarkably free of the spurious TV and FM broadcast responses.

The Transmitter. With the receiver completed, and the audio and power circuits checked-out, you are ready to start on the transmitter—if you have a suitable *station* and *operator* license. The United States radio law provides penalties of up to $10,000 fine and/or a two-year federal prison term for those who use a radio transmitter without proper government authorization. You must hold either a *general class* or a *technician class amateur* license to use this transmitter. A novice class amateur, or a Citizens Radio license *will not* do. You may obtain exact information as to the requirements and examinations for such licenses by writing to the field office of the *Federal Communications Commission* nearest you. (The Canadian, Mexican, and the governments of most other countries have, and enforce similar regulations within their own jurisdiction.)

Assuming you are properly licensed, begin by winding the transmitter VFO oscillator coil, L5, Fig. 8. Wind this coil exactly as shown, since the frequency-stability of the entire transmitter depends upon it. When completed, fasten this coil into place and mount the 100 *mmf* VFO tank capacitor and the 15 *mmf* VFO tuning capacitors. (The vernier dial for the latter should not be installed until later.) Next, wire in the heater, cathode, and grid circuits of the VFO, carefully following the transmitter schematic, Fig. 7. Note that the VFO receives its B+ supply from the regulator tube (pin No. 5) through the Send-Receive switch contacts (see the Send-Receive switch diagram, Fig. 9). Also mount and connect the VFO push button, stuffing several layers of friction tape under the push button, between the terminals and the chassis, to forestall shorts. (Gulch's Fourth Law: "Anything that has the slightest chance of shorting is certain to do so," operates here as it does everywhere else in amateur equipment.)

Now, wind the transmitter oscillator plate coil (L6, Fig. 8), mount it, and finish wiring the VFO oscillator circuit. After this is checked, and any possible shorts between tube pins or elsewhere have been cleared, insert the rectifier tube, voltage regulator tube, and 6AQ5 VFO tube, and apply power. After tubes have warmed-up (with the S-R switch in center or neutral position), press the push-button. The voltage regulator tube should dim noticeably but *not* go out. If it does go out, or if it does not dim, check your wiring, and examine the pushbutton carefully. When it dims, release the push button and throw the S-R switch to Send position. With the tuning (15 *mmf*) capacitor fully meshed and the VFO *grid* coil slug screwed all the way *in*, adjust the 100 *mmf* tank capacitor until a definite indication of oscillation is observed on 6.25 megacycles with the grid dip meter. You should find this condition occurring with the 100 *mmf* tank capacitor about 90% meshed.

With the circuit oscillating at 6.25 *Mc*., move your grid-dip meter over to the plate coil and adjust the slug for maximum output at 12.5 *Mc*. With good, strong indication of output here, remove tubes and de-energize before continuing work and move on to the frequency multiplier (doubler) stage, the only critical part of which is the coil. Make *sure* that the center-tap is in the electrical center. This will insure equal drive to both tubes of the final stage, and will minimize spurious responses. Wind the coil exactly as shown in Fig. 8. (If for any reason it should be necessary to alter the number of turns on this coil, a remote possibility, be sure that you add or remove *two* turns at a time, one on each side of the center-tap, to preserve electrical balance.) Install this coil and complete the wiring.



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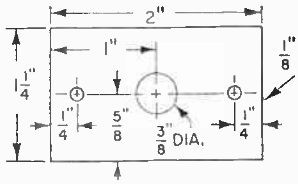


10

A INSULATING STRIP FOR MOUNTING ANTENNA TUNING CAPACITOR

B TOP VIEW OF TERM. STRIP

You will not be able to test the frequency-multiplier until you have also completed the wiring of the grid and cathode circuits of the final amplifier. This is because the grid to ground capacitance of these latter contribute significantly to the tuning capacitance of the frequency multiplier output circuit. So, wire-in the grid and cathode circuits of the final amplifier immediately.

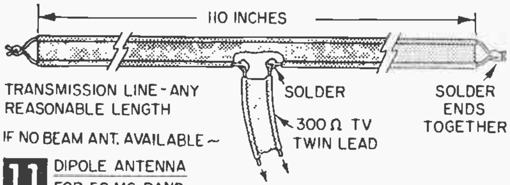
Observe that each of the final amplifier tubes has its own cathode bypass capacitor and 47-ohm isolating resistor. This is to insure stability and reliability of this circuit. The *dc* cathode current flows through the *M-A* terminals on the 8-terminal strip on the back of the chassis (see Fig. 10B); this makes possible a convenient check of the final amplifier cathode current later.

When the grid and cathode circuits of the final amplifier have been completed, as well as all of the circuitry of the frequency multiplier, the latter is ready for a checkout. After re-examining the wiring, plug in the VFO, frequency multiplier, and final amplifier tubes (as well as rectifier and voltage regulator, of course) and apply power. With the S-R switch in Send position, tune the frequency multiplier coil to maximum output on 25 megacycles, using the grid-dip meter. You should also now go back and touch-up the oscillator plate coil for maximum indication at the frequency multiplier output. A 6-*v* dial bulb, connected to a single loop of wire and draped around the frequency multiplier output coil should glow at nearly *full* brilliance, if everything is working—and tuned correctly.

With this accomplished, de-energize, remove tubes for safety's sake, and complete the wiring of the final amplifier. This is a push-push, frequency doubler, a self-neutralizing circuit noted for its effectiveness, stability, and rejection of spurious, harmonic frequencies. Note in Fig. 7 that the grid circuit is connected in push-pull, the plates of the tubes in parallel. Observe, also, that for stability both screen grids are individually bypassed, even though fed from the same *dc* source. Keep all high-frequency leads as short and direct as possible, the heater, B+ supply, and other supply wires may be run around the corners of the chassis for improved appearance.

Wind coil L8 as shown in Fig. 8 and install, and complete and check the wiring of the final stage according to the transmitter schematic, Fig. 7. When wiring is complete, insert all transmitter RF tubes, rectifier tube, and voltage regulator. Before applying power, adjust the final amplifier coil with the grid-dip meter, by tuning the coil slug. If you have trouble making it resonate on 50 *Mc*., try squeezing together, or spreading apart the turns of coil L8. When resonance is found, secure the turns in place with celluloid cement.

Now, jumper the "MA" terminals on strip together and apply power. You should get a strong indication of RF output on 50 *Mc*., but absolutely none on any other frequency within the range of the grid-dip meter. A 6-*v* pilot lamp, connected to a loop of wire and draped over the final output coil should burn extremely brightly (possibly even burn out, so be careful) when this stage is operating correctly. Touch up the tuning of the oscillator plate, the frequency multiplier, and the output of the final amplifier for maximum output on 50 *Mc*.



11 DIPOLE ANTENNA FOR 50 MC BAND

Complete construction by winding the transmitter antenna coil L9 (Fig. 8) with No. 14 copper or tinned-copper antenna wire. Tap this coil one turn from each end to make connection to the transmitting antenna through a tightly-twisted pair of leads, which may run around the corner of the chassis to the Send-Receive switch, points M and N, as shown in Figs. 7 and 10B.

The 50 *mmf* antenna tuning capacitor is insulated from the chassis by means of a laminated phenolic plastic strip (see Fig. 10A), upon which it is mounted. A 1$\frac{1}{16}$-in. "socket" hole assures sufficient clearance from the chassis. *Both* sides of this capacitor must be insulated. Fasten the plastic strip to the chassis with 6-32 *rh* machine screws and nuts.

The antenna coil is coupled to the final amplifier output coil by means of a single-turn loop, coupled closely to each coil—the B+ end of the output coil, and the center of the antenna coil. A twisted pair link of plastic hookup wire connects the loops together. Each loop should be closely coupled to its coil, but this coupling should be adjusted for best results later.

The antenna tuning lamp socket is mounted atop the chassis (see Fig. 3). It is connected between point N on the S-R switch and a tap on the antenna coil. Keep the leads to the lamp socket as short as possible and bring them up through the chassis via a rubber ¼-in. hole grommet adjacent to the socket. The lamp is shunted by a small ⅛-in. dia., 4-turn coil of close-spaced No. 22 DCC wire. Adjust the size of this shunt coil so that, with the antenna you are using, the lamp lights to only about one-quarter brilliance, enough to tune clearly by, but not enough to waste hard-earned RF power.

Final check on the transmitter consists of inserting all tubes and applying power. Connect a 7.5-watt, 120 *v* lamp bulb across the antenna terminals (terminal strip) as a dummy load. Make all RF tuning adjustments for maximum brightness of the bulb. Do not expect a full 7.5 watts of output from this transmitter, but when all tuning and coupling adjustments are optimized, a sizeable amount of output should be shown by the 7.5-watt bulb.

To check modulation, connect a single-button carbon microphone to the mike terminals, apply power, and speak into the mike. The antenna tuning lamp should flicker markedly if modulation is taking place. No modulation indicates possible error in the connections between the secondary of the modulation transformer and the final RF amplifier circuit.

Before putting this transmitter on the air using a live antenna, make sure that the transmitter frequency is definitely within the assigned 50-*Mc.* amateur band, from 50 to 54 *Mc.* Do not rely upon the calibration of your grid-dip meter for such a vital matter, but check against the known crystal frequencies of other amateurs you hear on the air, or with an accurate *heterodyne* frequency meter (often available on a loan basis from radio clubs).

You may compare the frequency of your own VFO with that of other amateurs by simply setting your receiver's second detector regeneration control past the thud point and, with the S-R switch in Receive position, pressing the VFO test push button. Tune the VFO vernier dial until you hear its whistle in the receiver. (You may have to turn down the IF gain to avoid overloading.) Now the transmitter will operate upon the same frequency as that to which the receiver is tuned. Use this technique to set your own frequency to that of the station you're working; this conserves spectrum-space, and makes for better operations. However, unless you wish to be considered a "lid," do not change your operating frequency while the S-R switch is in the Send position. Rather, use the push button to set the frequency, with the switch in Receive position.

A 0-100 *ma dc* milliammeter connected to the *M-A* terminals on the terminal strip should read between 45 and 60 *ma* when the transmitter is tuned-up and operating properly. Once preliminary adjustments have been made, remove the meter and place a jumper across the M-A terminals.

For radiotelegraph CW operation, connect a telegraph key to the M-A terminals instead of meter or jumper, and operate as any other CW amateur station. (When one can find a six-meter operator who will listen for CW signals, much greater distance ranges are possible under poorer conditions than could be obtained by voice operation.)

For best results with this or any other amateur station, thoroughly familiarize yourself with the correct adjustment and operation of all circuits and keep them in trim at all times. Install and use the highest, most-effective antenna you can, for the antenna used is by far the biggest technical factor in successful operation. If possible, use a directional, beam antenna, but a high dipole *will* work if the former is not feasible.

(A word on TVI—Because of its frequency proximity to television channel 2, this transmitter *may* cause some interference on that channel. If it does, have the TV receiver owner install a Drake HF-50 or other good high-pass filter with 54 *Mc.* cut-off design.)

• The wonder of radio is not, as some would have it, that it works at all; but rather that a device that works principally because of evacuated tubes can be responsible for so much hot air.—R. R. DOISTER

Transistorized Telephone Amplifier

The caller, shown at left, uses phone in normal fashion while amplifier unit at other end of line, shown at right above, enables group of people to listen and talk.

This loudspeaker phone attachment frees both your hands while you or a group of people carry on a phone conversation

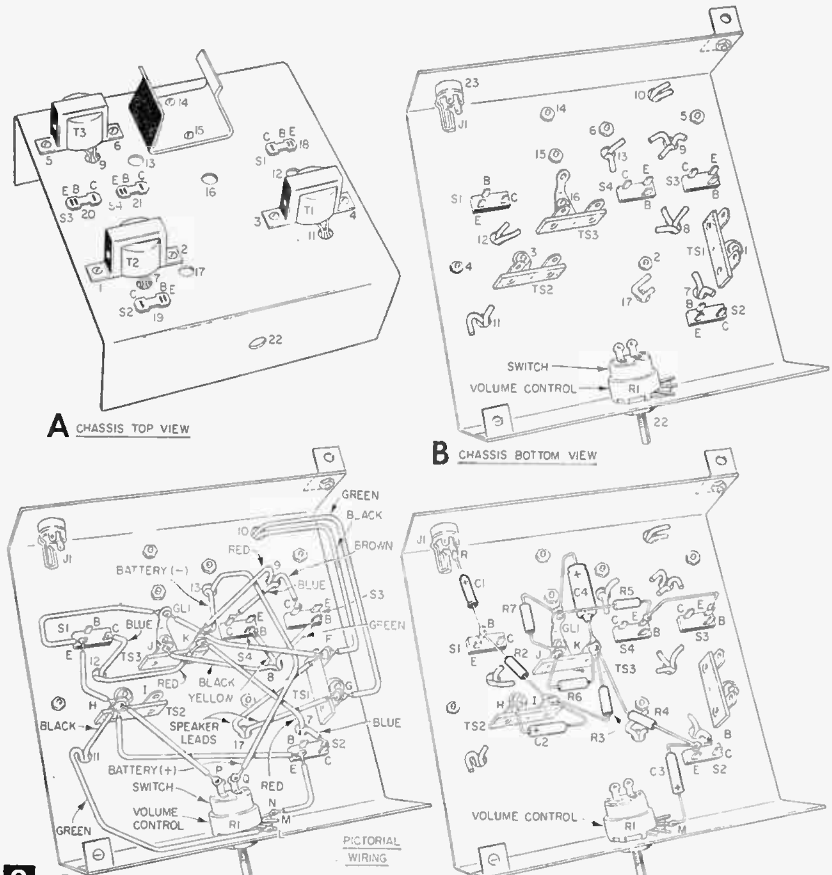
By HAROLD P. STRAND

ALTHOUGH this telephone attachment will enable you to speak and hear someone calling you on your phone as though you were using an intercom, you do not have to make any wiring connections to the telephone circuit.

Since the conversation is picked up inductively, you merely place the pickup unit under the phone cradle set, put the phone on the cabinet as in Fig. 2 and you're ready to start talking or listening. It may be used for incoming or outgoing calls and the whole family, as in Fig. 1, can talk to and hear the caller simultaneously as though he were in the same room. It's very useful for business too, for group phone discussions or taking notes, typing, etc., which requires the use of both hands while carrying on a phone conversation.

Placing the phone hand set in position on the amplifier cabinet when receiving or making a call automatically turns on amplifier switch.

The unit is built around a telephone amplifier kit which is modified for two-way conversation. Complete parts list and source of supply are given in the Materials List. Start by assembling the transformers, battery clip and transistor sockets to the prepunched chassis as in Fig. 3A carefully following the step-by-step instructions included with the kit. The sockets are locked in place by a rectangular spring ring that is forced down over the lower end of the socket with a



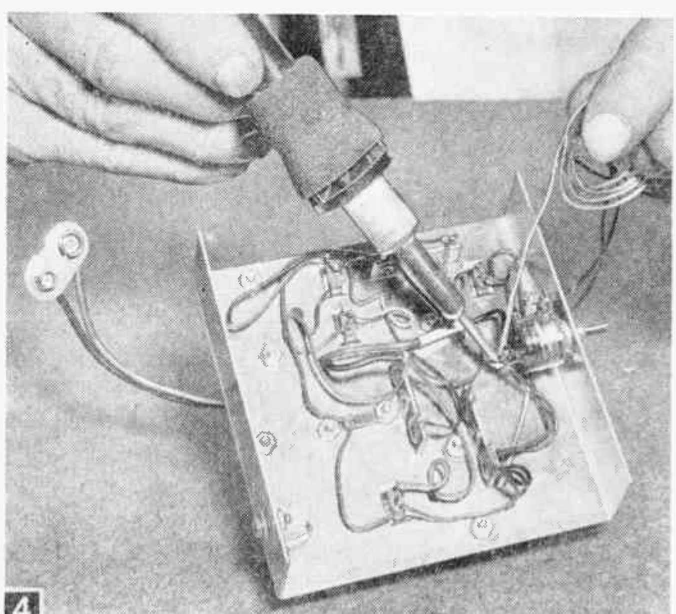
3 A CHASSIS TOP VIEW
B CHASSIS BOTTOM VIEW
C WIRING BOTTOM VIEW (IMPORTANT 1ST STEPS)
D COMPONENT WIRING BOTTOM VIEW (IMPORTANT 2ND STEPS)

Use a small *Ungar* soldering pencil as in Fig. 4 and the resin-core solder furnished with the kit. You will have to splice on additional wires in two instances so the leads can reach their terminals. Slip a small piece of spaghetti tubing over the splices for insulation. It will also be found that spreading the transistor socket terminals a bit will aid in keeping the connections from shorting each other. Where a heavy lead from a resistor or capacitor must be soldered to a socket terminal which already has wire attached, do not attempt to wrap this around the terminal too, as it will make a rather bulky joint. Simply place the end of the lead against the termi-

screwdriver. Be sure to place sockets in their holes so the terminal with the widest spacing is positioned as in Fig. 3.

When mounting the transformers, check with Fig. 3C to make certain you have them positioned so that wires of the correct color can be inserted through the holes intended for them. For example, transformer T2 in Fig. 3A must have a blue and red wire going through hole 7 and a green, yellow and black wire through hole 8 as shown in Fig. 3C.

Before installing the volume control and switch (Fig. 3B), cut off the shaft so it will be 7/16 in. long instead of 3/8 in. as called for in the kit instructions. The additional length is needed because a wooden cabinet will be used in place of the metal one supplied with the kit. Now mount the terminal strips and jack as in the bottom view, Fig. 3B, and prepare to wire the unit.



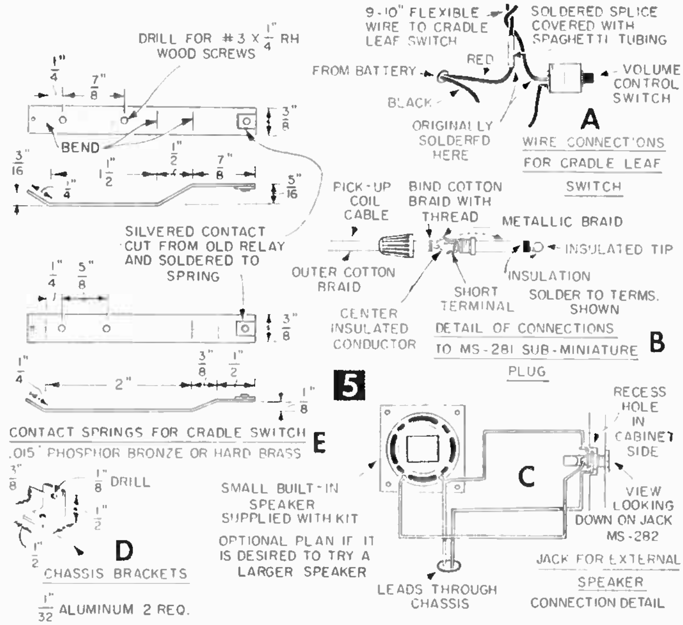
4 Flow the solder into the joints but avoid excessive use of solder which builds up a bulky joint.

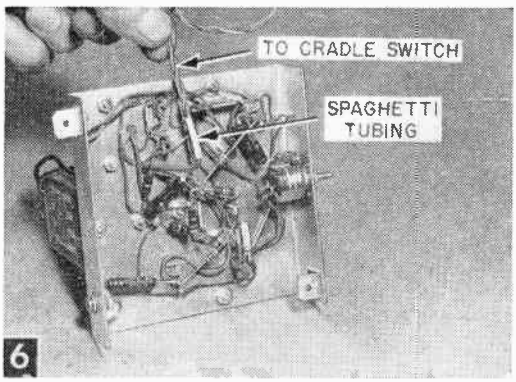
nal and depend on a good soldering job to secure it.

Take particular note of the plus sign on capacitors C1, C2, C3 and C4 and connect them to points shown in Fig. 3D. Two 10-in. speaker leads are specified and after connecting them to points F and G in Fig. 3C, carry them through hole 17 for connection to the speaker. Insert a small sewing needle into the transistor sockets to spread them slightly so you will not have difficulty getting the transistor leads, which have been cut off to 3/8-in. long, started in their sockets without bending.

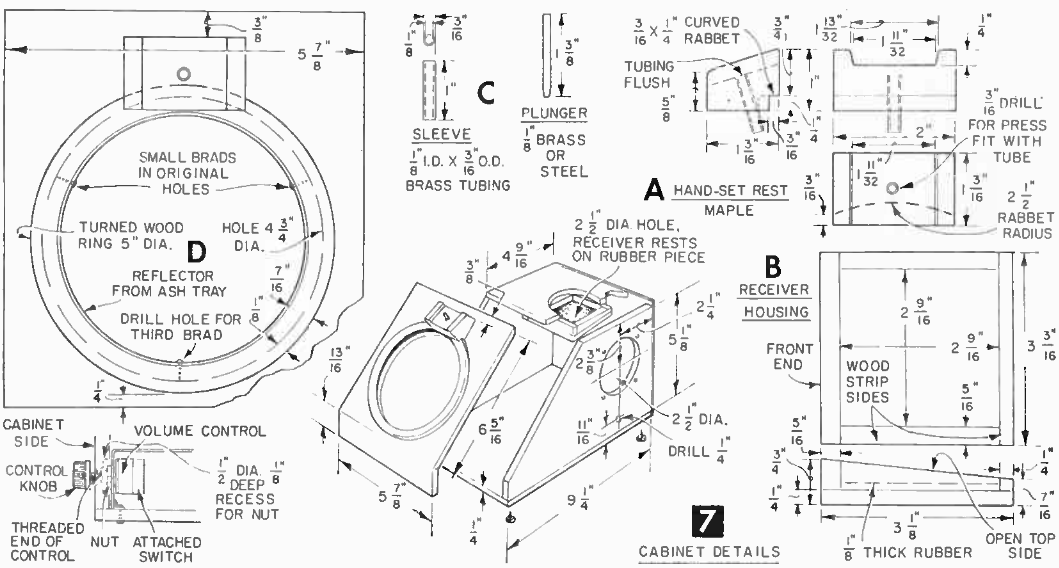
To test the unit, put the battery in its clip and connect it, and insert the phono pick-up coil plug into jack J1 in Fig. 3. Place the pick-up coil under the phone base about two-thirds of the way back, and turn on the amplifier switch by rotating the knob shaft about half way to the right. Then lift the phone hand set and see if you get a dial tone from the speaker. Turning the volume control shaft to the left should lower the volume and to the right increase it. When you turn it to the right too much, however, you will probably get an annoying howl resulting from feed-back oscillations that can be avoided by keeping the tone level below this point at all times.

If you get no sound from the speaker or the volume level is unsatisfactory with the control all the way to the right, you have probably made some error in the wiring or it could be due to a defective transistor. Go over the wiring first,





Slide a piece of spaghetti tubing over the soldered splice after connecting leads for cradle switch.



MATERIALS LIST—TELEPHONE AMPLIFIER

No. Req.	Size and Description
1	telephone pick-up coil MS-16
1	Burgess 9-volt battery 2N6
1	telephone pick-up amplifier kit KT-131 consisting of the following parts:

No. Req.	Size and Description	Symbol	Part No.
1	2MFD-6MFD, 6v-15v electrolytic capacitor	C1	
1	8MFD, 6v-15v electrolytic capacitor	C2	
1	2MFD, 6v-15v electrolytic capacitor	C3	
1	6MFD-10MFD, 15v electrolytic capacitor	C4	
1	5.000-25,000 ohm volume control with switch	R1	
1	470.000 ohm 1/2 watt resistor	R2	
1	150,000 ohm 1/2 watt resistor	R3	
1	270.000 ohm 1/2 watt resistor	R4	
1	12 ohm 1/2 watt resistor	R5	
1	4700 ohm 1/2 watt resistor	R6	
1	68 ohm 1/2 watt resistor	R7	
1	transformer	T1	AR104 (or equiv.)
1	transformer	T2	AR109 (or equiv.)
1	transformer	T3	AR119 (or equiv.)
4	transistors (CK722, 2N107, or equiv.)	TR1, TR2, TR3, TR4	
4	transistor sockets with retainer clips	S1, S2, S3, S4	MS-275
1	speaker, PM-3.2 ohm voice coil		
1	chassis		131-500
1	cabinet		131-549
1	knob for volume control		
1	battery snap assembly		Eby 45-2
3	terminal strip, 2 insulated lugs	TS1, TS2, TS3	
13	4-40 x 1/4" screws, cad. plated		
13	4-40 x 1/4" hexagonal nuts		
1	#6 solder lug	GL1	52
1	jack	J1	MS-282
1	plug	P1	MS-281
	nut, hexagon (for volume control bushing)		
	wire, spaghetti, solder		

The above kit and parts can be obtained from Lafayette Radio, 165-08 Liberty Avenue, Jamaica 33, N. Y.

No. Req.	Size and Description
1	lazy boy ash tray #1435 (cigar and department stores about $1)
2	about .025 x 3/8 x 3 1/2" phosphor bronze or hard spring brass for cradle switch
2	silvered contacts cut from an old relay for cradle switch
1	1/8" I.D. x 3/16 O.D. x 1" long brass tubing for cradle switch
1	1/8" dia. x 1 3/8" long brass rod for cradle switch
1	3 1/2 x 3 1/2" grille cloth for speaker opening
1 pc	1/4 x 12 x 30" birch or gum plywood for cabinet
1	1 1/16 x 1 3/16 x 2" solid maple stock for hand-set rest block
1	3/4 x 5 1/4 x 5 1/4" solid birch or pine (turn to make ring for large front opening)
1	1/8 x 2 1/2 x 2 1/2" rubber for bottom of receiver housing
2	.025-.030 x 1/4 x 1" sheet aluminum or other metal for chassis holding brackets
4	4-40 x 1/4" *rh* machine screws
1	1/16 x 5 7/8 x 5 5/8" black Bakelite or 1/8" plywood for back cover
	Misc. screws, nuts, stain, shellac or enamel, brads, glue, etc.

and if you find it to be okay, have the transistors tested at your local radio repair shop. Also try placing the pick-up unit at various places against the side of the phone base. With the new-type phones it may be found that the loudest signals can be obtained with the pick-up taped to the right side of the phone base.

When everything is working satisfactorily cut the red battery lead from the volume-control switch and solder on two leads as in Figs. 5A and 6 that will later go to the phone cradle switch.

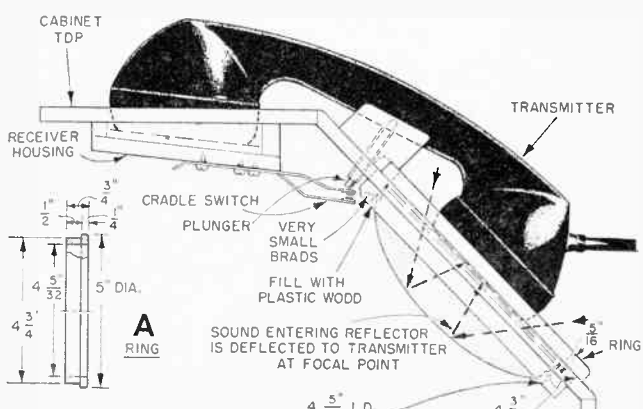
To anchor the chassis to the new wooden cabinet, make up two aluminum brackets as in Fig. 5D and fasten them to the chassis as in Fig. 3D with 4-40 x 1/4-in. *rh* screws.

With the chassis completed, make the wooden cabinet from 1/4-in. birch plywood as detailed in Fig. 7. Cut the holes in the right side, top and front pieces before assembling. Use glue and brads on all joints and fill countersunk brads with wood putty. The back of the cabinet is left open for inserting chassis, speaker etc., and later covered with a piece of 1/16-in. *Bakelite.*

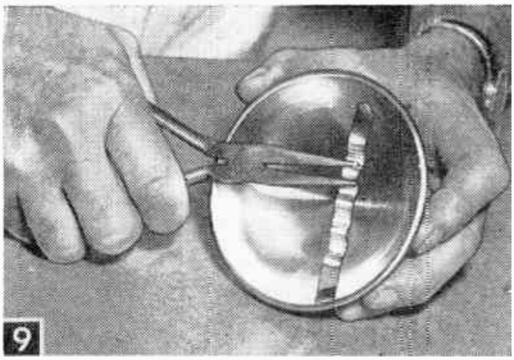
A metal disc from a #1435 *Lazy Boy* ash tray is used to gather and reflect the sound of your voice into the transmitter of the phone hand set as in Fig. 8. This tray is parabolic in shape and serves the purpose very well. Cut off the fabric base and remove the cigaret holder bar with a pliers as in Fig. 9.

To support the ash-tray, turn a wooden ring to the dimensions given in Fig. 8A. Turn the inside diameter of the ring for a snug fit with the ash tray. Set the rim of the tray about 5/16 in. from the outer edge of the ring and fasten with three 1/2-in. long wire brads. Two of the brads can be driven through the original holes in the tray and one additional hole drilled. Fill the space between the tray and wooden ring at the back with wood putty. Assemble the ring into the hole cut in the cabinet front with glue.

To support the receiver end of the phone hand set, make up the shallow box-like housing detailed in Fig. 7B. Cement a 2 1/2 x 2 1/2-in. piece of 1/8-in. thick rubber inside the housing to protect the receiver, and fasten the housing to the underside of the cabinet top with the 3/4 in. side facing front.



8 DETAIL OF SOUND REFLECTOR AND PLACING OF TRANSMITTER



Pinch the bends in the cigaret bar together to remove it from the ash tray.

Make the hand-set rest from solid maple stock as in Fig. 7A. A Handee motorized hand tool was used to cut the curved rabbet, however, hand chisels could be used instead. The rabbet should be large enough to clear the rim of the ring holding the ash tray. Then drill a 3/16 in. hole for the sleeve Figs. 7A and C. Place the hand-set rest in position on the front of the cabinet to locate and drill the 3/16-in. hole through the cabinet top. Also drill four small holes through top for #2 x ½-in. *rh* screws.

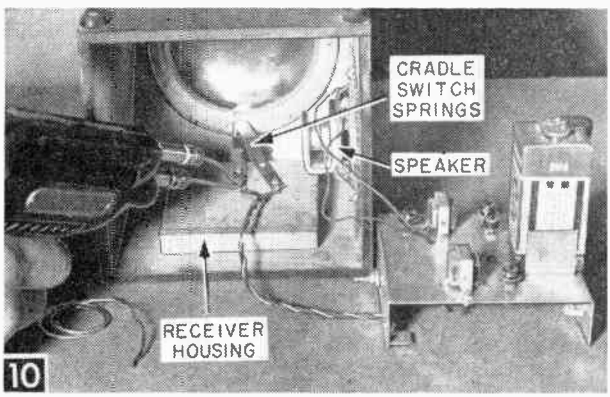
Before fastening the hand-set rest permanently in place finish the cabinet and rest piece with stain, white shellac and varnish for a natural finish, or enamel undercoater followed by a coat of semi-gloss enamel of the color you desire. Sand lightly between all coats except the last one.

When the unit is in use, the phone hand set is placed in position on the cabinet as in Fig. 1. The weight of the hand set automatically turns the unit on because the plunger in the rest is forced down and depresses the switch contact springs and closes the switch as in Fig. 8. Make the two contact springs as in Fig. 5E and cut two contacts from an old relay to solder to the spring ends. Then mount the springs to the underside of the receiver housing as in Fig. 10 so the contacts meet when the plunger is pressed down, and solder on the two leads from the volume-control switch and battery (Fig. 5A). Cement a piece of speaker grille cloth to the inside of the cabinet side over the speaker opening and bolt the speaker in place with four 4-40 x ½-in. screws. Set the chassis inside the cabinet and bolt it down with two 4-40 x ½-in. screws through the chassis brackets.

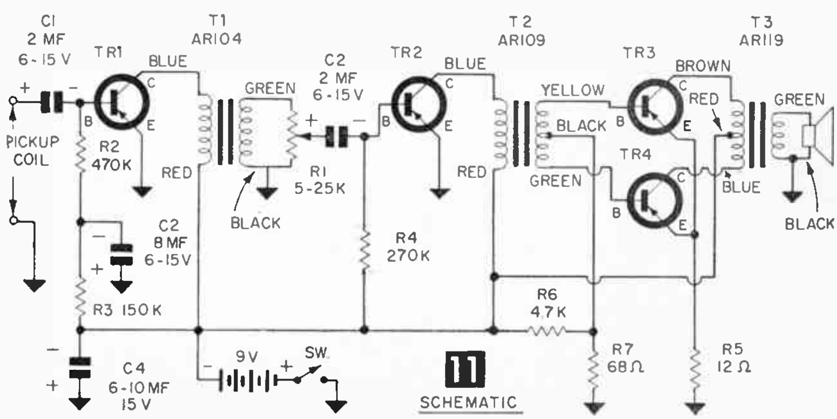
To cover the open back of the cabinet, use a piece of 1/16-in. Bakelite or ⅛-in. plywood and fasten with #2 x ½-in. *fh* screws. A slot can be cut in the cabinet side or back to clear the wire from the phone pickup unit.

To operate the telephone amplifier, place the pickup unit under the phone cradle-set base or tape it to the side, whichever works best, and adjust the volume control about half way to the right. Then pick up the phone hand set and dial the number you're calling in the usual manner. The phone can either be held in your hand while dialing or placed on the cabinet rest. If placed on the cabinet you should be able to hear the dial tone through the loudspeaker. When your party answers, adjust the volume control to bring in the speaker's voice as loud as possible but below the point which causes an annoying howl due to feed-back oscillations.

When you speak, project your voice into the ash tray surrounding the phone transmitter. You need not be closer than 18 in. as long as you are in front of the cabinet and talking in a clear voice. Speaking a little louder than normal, you can carry



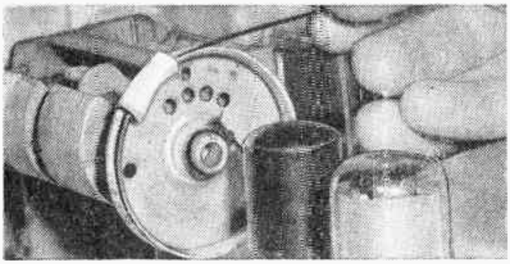
Solder leads connected to red battery lead and volume-control switch to cradle switch springs.



on a conversation standing back as far as 6 ft.

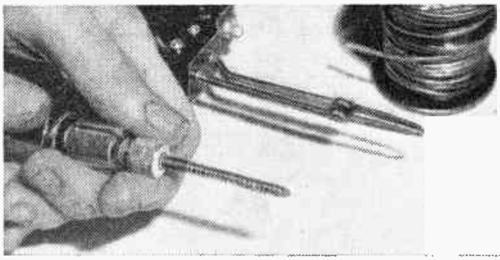
An additional and larger speaker can be added if you wish to have the caller's voice heard louder or in another room. Use a 6-in., 3 to 4 ohm speaker connected with a plug and jack as in Fig. 5C. Plugging in the jack will automatically cut out the small speaker. Removing the plug will again put the small speaker back in the circuit.

Easier Dial Restringing



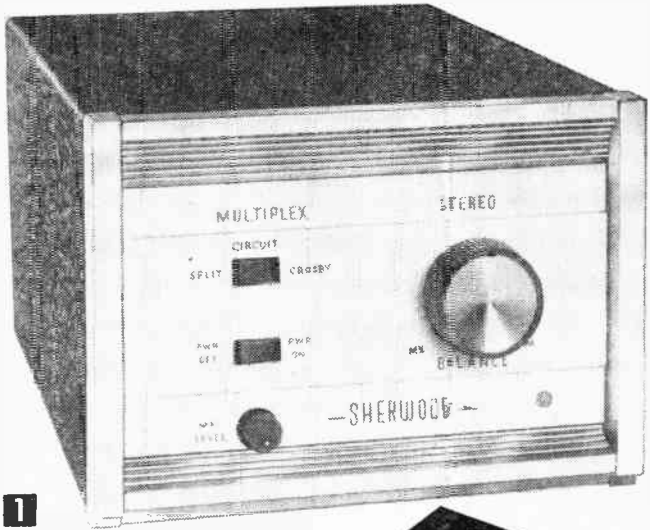
• If you have ever attempted to restring a radio's dial cord, you know how easy and frustrating it is to have the cord slip from a pulley just as you have the job almost finished. There's no need to make several attempts before finishing the job—do it the first time by using strips of masking tape to temporarily hold the cord in place.—J.A.C.

No-Clog File for Solder



• Ever try filing excess solder from a part with an ordinary file? Didn't the file teeth soon lose their bite because they filled up with the soft solder? A headless woodscrew chucked in an interchangeable screwdriver handle makes a "file" that will not ever clog. You can also use it on aluminum, Bakelite, and other soft materials with no danger of its teeth clogging.—J.A.C.

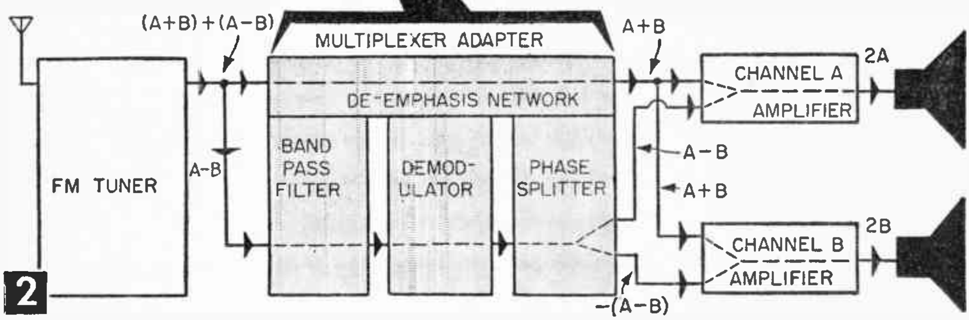
New VOICE for Stereo *and* Hi-Fi



We've had stereo tapes, discs and two-station broadcasts. Now new compatible systems—including multiplexing—make one radio station twins

By CLIFF HALL

New Sherwood multiplex adapter, retailing for about $55.50, is designed to adapt conventional FM tuners to receive multiplexed stereo broadcasts. Function it performs is indicated in drawing below.



IN the broadcasting of stereophonic sound, the big word at the moment, and we think for some time to come, is "multiplexing."

And multiplexing, at the time of writing, has more aspects than a tomcat under attack by six dogs, moves about as fast and is the center of about as heated a controversy. We will get back to multiplexing in a moment, but first let's view the stereo broadcast picture. Stereo can be gotten into your home by radio waves as well as on recordings. And how best to do so has recently set the entire broadcasting industry on its ear.

It's a matter of "you take the A channel and I'll take the B channel"—and we have to get them both to your home at the same time. At a glance, it would appear that two complete radio broadcasting units would be required to radiate the two stereo channels, just as two amplifiers and two speaker systems are required to present them in the home. And in fact, most of the actual stereo broadcasting that has been done until recently has used just this method.

Hands Across the Channels. In many areas, friendly or affiliated AM and FM stations have combined facilities for stereo broadcasts, with each station putting out one channel. In many cases this will continue, at least for a time.

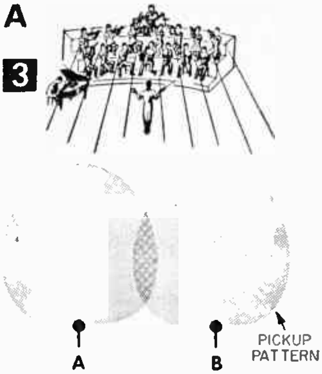
This practice has led to the birth of the so-called stereo tuner which is, actually, an AM and an FM tuner, with separate controls and dials, are mounted on a single chassis. They can feed the two sides of your stereo amplifier simultaneously from any combination of AM and FM stations in your area, and they offer the economy advantages of a power supply and some other parts used in common.

Or you can simply use an AM and an FM radio, appropriately placed, and have a stereo effect of sorts, although without a high level of fidelity nor the advantages of balance and phasing.

Again, in some cases, the two stereo channels have been put on the air by cooperating TV and broadcast stations, as in recent experiments by WTTW, Chicago's non-profit educational television station, and WFMT (FM). This latter method, incidentally, can yield reasonably high fidelity, since the TV sound signal is actually a very high frequency FM signal.

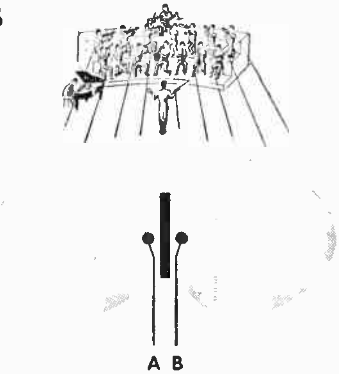
3

A



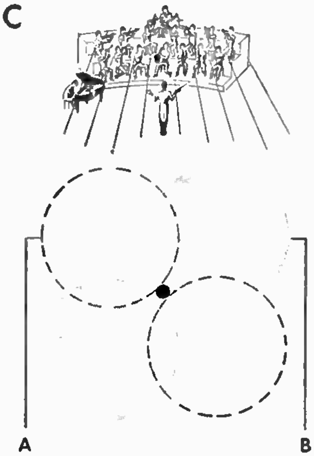
Conventional Concept: 2 cardioid mikes at "normal" listening angle.

B



Binaural Approach: 2 cardioid mikes separated by solid obstruction-like ears.

C



Stereosonic Recording: 2 cosine mikes together separating channels by direction.

Major disadvantage of this broadcast method should be obvious: There's no profit in it. Not only are two broadcasting facilities being tied up to put out a single program, but neither station is putting out a "full" program. In other words, when you tune to only one of the cooperating stations during a stereo broadcast, you hear the full orchestra all right, but you hear it as though you were sitting way at the side of the auditorium. Actually, what you are hearing is the same thing you would hear by playing only one channel from a stereo recording.

Thus, for the millions of listeners who *do not* have stereo tuning facilities, this program is something less than adequate. What's more important, it's mighty close to impossible for this reason to sell to a sponsor, and especially is this true in TV with its vastly higher costs.

Compromises Tried. One of the efforts to lick the problem attempted by some broadcasters has been to increase the "dilution" of the stereo effect, some of which—deliberately—is always present in any case.

While we are accustomed to thinking of stereo as coming from two microphones placed at an appropriate listening angle, this in fact is not usually the case. Depending upon the studio, the program material and the recording method, sound engineers might use a variety of setups.

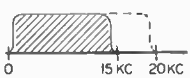
These might vary from the older "binaural," involving two omni-directional mikes about six inches apart with a solid object between them—like the ears on your head—("B" in Fig. 3); through such others as the "stereosonic," using two cosine (two-directional) mikes close together ("C" in Fig. 3); the "longitudinal," using several omni-directional mikes spaced front to back and recording differences by time delay ("D" in Fig. 3); the "mid-side," employing a cosine and a cardioid (one-directional) together, from which A, B and C channels can be derived ("E" in Fig. 3); combinations of any of these methods, or a much larger bank of individually placed mikes.

In recent practice, the last method is the most frequent, with as many as six tapes sometimes recording at once, later to be mixed selectively (some with echo chamber effects, etc.) in making the final master record. In any case, each of your two stereo channels always contains a certain amount of the total or "sum" information, except in some of the stereo demonstration records to which deliberate hokum has been applied.

Thus, some broadcasters have tried diluting the stereo effect enough that each channel held enough sum information to be satisfactory heard alone.

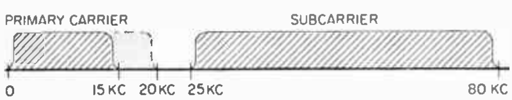
Finally, FM multiplexing has come over the horizon as a "new" stereo broadcasting method, which many think holds the essential answers.

4

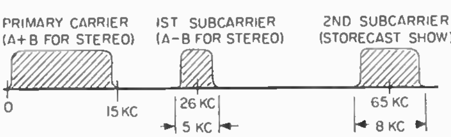


Conventional FM carrier modulates 15-20 *kc*.

Storecast multiplex broadcasts public show on primary carrier cutting off at 15 *kc*, commercial program on subcarrier centered at 50 *kc* (approx.). Gap is used for switching pulses.

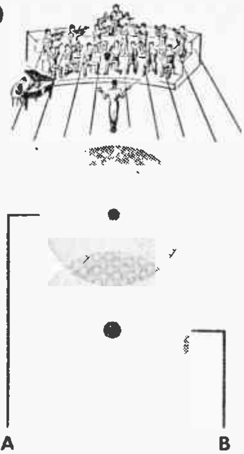


"Ideal" multiplex for stereo might use 1st 15-20 *kc* A+B signal, rest of modulation spectrum to insure fidelity of A—B signal.



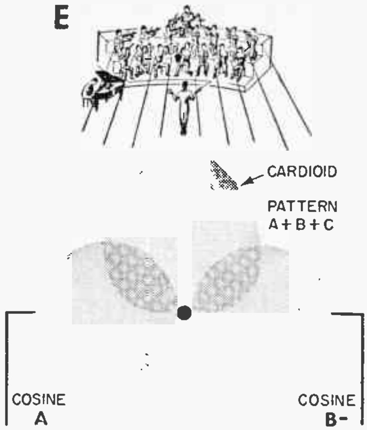
KMLA-FM system compresses stereo "difference" signal into 5-*kc*-wide band at 26 *kc*, broadcasts commercial monophonic program at 65 *kc* separately.

D



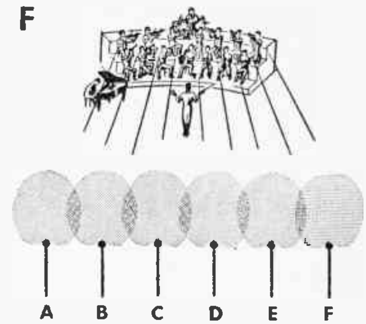
Longitudinal Method: omni-directional mikes separate sound by time delay.

E



Mid-Side Recording: Cosine mike picks up A channel and out-of-phase B channel; B phase is reversed and some cardioid pickup added to both.

F



Current Practice: Mikes placed for individual purpose, separately taped, "mixed" in laboratory.

It permits the broadcasting of a "full" program for listeners who have only monophonic equipment, and the simultaneous broadcast of fully separated stereo over the same station—and more as well.

Poor Broadcaster's Friend. With the burgeoning of TV after World War II, radio time sales became so competitive many FM stations were threatened with extinction. To save themselves, hordes of them went into the background music and storecasting business, leasing receivers to factories, offices and stores and patterning their programs to these commercial clients.

None too happy that this constituted "public" broadcasting in the accepted sense, the FCC none-the-less didn't know what to do about it—until someone thought of multiplexing.

Really, the principle is not new at all. It can be compared with the method by which the phone companies send a number of messages over the same wire or radio relay. The basic message travels, of course, at normal sonic frequencies (referred to as the primary carrier). Then, the next message is translated electronically into a supersonic frequency band (first subcarrier) and travels right along with the first. A second subcarrier at still higher frequency can be placed above the first, and so on. At the receiving end, matching electronic equipment simply translates the subcarriers back to the sonic range.

Adapted to FM, this means the station can broadcast one program, for the general public, on its primary carrier, using the spectrum up to 15 or 20 *kc*. Then, by multiplexing a subcarrier band above that, say centered about 50 *kc*, it can simultaneously transmit an entirely separate program, inaudible to the "public," for its commercial clients. Lo, one FM station is now two, but requiring only a single assigned wavelength, a single transmitter, single antenna tower, etc.

Stereo Weds Multiplex. *But*, to satisfy his advertiser, the broadcaster must put out the full program—channel A plus channel B—over his primary carrier, so that the thousands who do not yet have stereo can hear a full monophonic program.

Next, to modify this primary signal (A+B) so that it can be unscrambled by the receiver into a separate A channel and B channel for stereo listening, he must broadcast over his subcarrier (by multiplex) a signal capable of modulating the primary signal into its components.

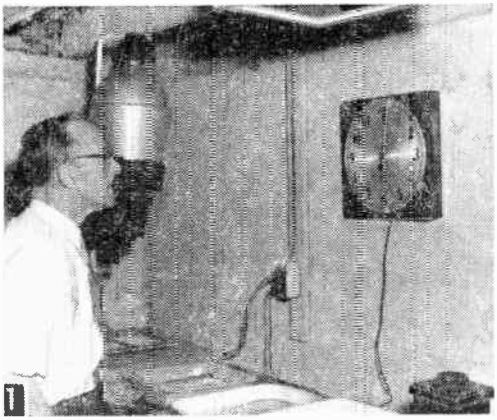
A great many engineers are still at work perfecting methods, the FCC has not yet established standards and there are some differences of opinion on how best to do the job. Yet, in general, the "sum and difference" method is being used. Stated as an algebra problem, this means that while the primary carrier is broadcasting A+B, the multiplex carrier is broadcasting A–B, or the difference between the two channels. Then: $(A+B) + (A-B) = 2A$; $(A+B) - (A-B) = 2B$ —which looks simple on paper. Actually, such problems as evolving the A–B signal and eliminating cross-talk are still bothersome.

In practice, the A+B signal is ordinarily passed through a de-emphasis network and straight on to both stereo amplifiers (Fig. 2). Meanwhile, the A–B signal is picked off by a bandpass filter ahead of the de-emphasis network, is demodulated and is translated by a phase splitter which passes the in-phase portion of the signal to the A amp and the out-of-phase portion to the B amp, thus restoring the stereo effect.

All of this is accomplished within a small multiplex adapter (Fig. 1) which is fed by your conventional FM tuner and which in turn feeds your stereo amplifiers.

Current multiplex adapters are all of the wide-band type, translating into an audible signal whatever material is being broadcast by the station's subcarrier. Thus, if two separate signals are being broadcast at once (as is being done, for instance, by KMLA-FM, Los Angeles, experimentally), both signals would be heard at once, garbled together. To separate them will require adapters specifically designed for the job.

Seconds Timer for Photo Printing



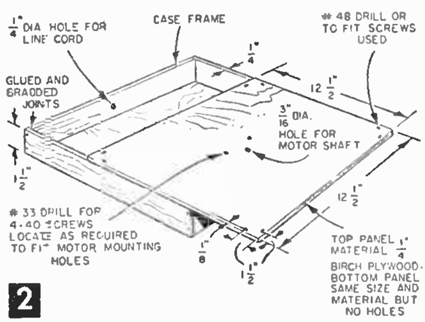
This photo lab timer is easily seen even when the safe light is used. The single hand revolves once a minute, with each major division representing five seconds.

MATERIALS LIST—PHOTO TIMER

Amt.	Description	For
2	¼ x 1½ x 12" birch plywood	frame
2	¼ x 1½ x 12½" birch plywood	frame
2	¼ x 12½ x 12½" birch plywood	front and back panels
1	11½-12" dia. clock dial from old commercial clock or letter on white cardboard clock face	
1	synchronous timer motor such as Hayden, Cramer or Telechron, rated at 115 v., 60 cy., 1 *rpm* (available for $1.49 from Radio Shack, 167 Washington, Boston, Mass. Cat. #R-6821)	
1	terminal strip, Jones type 2-140	wire connections
7 ft	rubber or plastic parallel lamp cord with male plug	line cord
1 pc	1 x 7½" sheet brass, 0.025" thick	hand
1 pc	1/32" thick scrap aluminum or brass	hanger strip
2	4-40 x 3/8" screws and nuts	motor
4	#4 x ¼" *rh* wood screws	dial
2	#4 x 3/8" *rh* wood screws	terminal strip
8	#2 x ½" *rh* brass screws	front panel
	small brads, glue, walnut penetrating oil stain, white shellac, paste wax, acid core solder, flat-black paint	
1	#4 x ¼" *rh* screw hanger strip	

LARGE enough to see in the dim light of your darkroom, this photo timer, which can be made in one evening for a few dollars, will aid you in controlling exposure and development timing to produce uniform prints (Fig. 1).

Make the case (Fig. 2) of ¼-in. birch plywood, cutting the pieces to size and dressing the edges square on a sanding disc. When cutting and sanding front and back panels, brad them together so that they will be exactly the same size. Drill a ¼-in. dia. hole in one of the 12-in. sides, centering it each way for the line cord. Using glue and brads, assemble the case sides, then before the glue sets, attach the back panel with glue and brads. Drill holes in front panel as in Fig. 2, and apply walnut penetrating oil stain to both case sections. Allow to dry for about 5 min., then wipe off surplus stain with a cloth. Set aside to dry for about 2 hours, then apply 2 coats of thinned white shellac, smoothing when dry with fine steel wool. Finish with a coat of paste wax.



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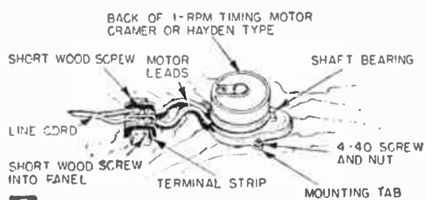
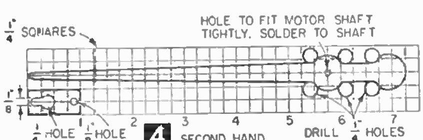


3 MOTOR AND CONNECTIONS



4 SECOND HAND .025" THICK BRASS

Our clock dial came from an old commercial clock found in a repair shop. Use a similar one or letter a piece of white cardboard. Glue or screw-fasten at 12, 3, 6 and 9 to the front panel.

The motor is of the synchronous timer type that can usually be picked up for right around about $1.50 (see Materials List). With motor shaft projecting through the dial, attach motor to back of front panel with 4-40 screws and nuts (Fig. 3). Attach a terminal strip to make the connections between the motor leads and the line cord which runs through hole in frame bottom. Knot cord just inside the frame to prevent strain on terminal strip. Now turn front panel over and attach to case with #2 or 3 x ½-in. *rh* brass screws.

Lay out clock hand on sheet brass as in Fig. 4. Drill ¼-in. holes and cut out roughly to size with tin snips, then file to final shape. Drill the hole for a tight fit with the motor shaft. If the shaft has a square end, file the hole square. Solder the hand in place with a drop of acid core solder and apply a coat of flat black paint. Lastly, make a hanger strip (Fig. 4) and fasten to back of case with an *rh* screw. Mount the timer, plug in, and you're ready to go. The hand makes a round trip each minute so read as you would the clock second hand.—H. P. STRAND.

Transistor Audio Amplifier

By HAROLD P. STRAND

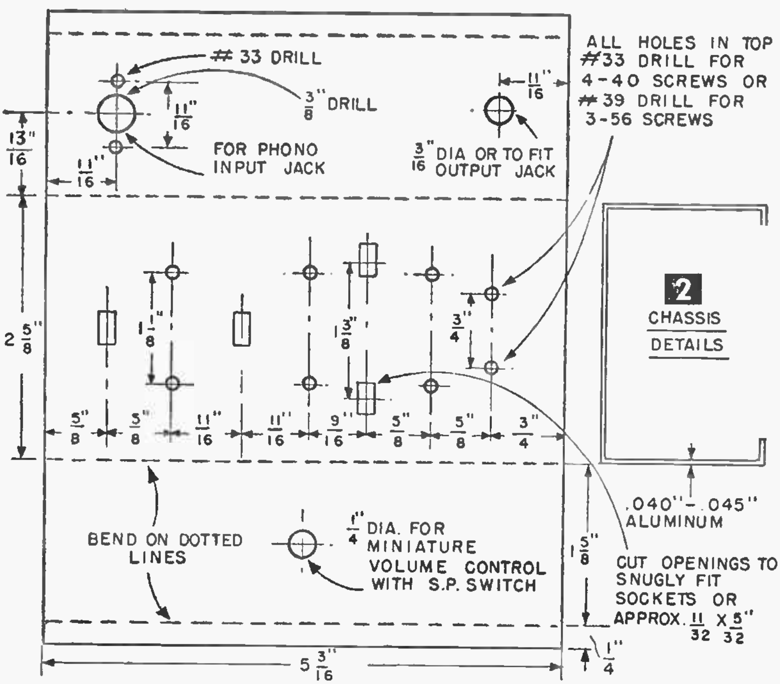
1 This amplifier converts a transistor earphone radio receiver to loudspeaker operation. After testing, it will be mounted in the enclosure for a 6 in. speaker shown at right in photo.

TRANSISTOR experimenters who have built a radio for earphone reception soon find that they would like an amplifier to which the radio can be connected for loudspeaker operation. The amplifier shown here (Fig. 1) was designed especially for this purpose and will provide excellent volume with a 6 in. or larger speaker having a 3-4 ohm voice coil. The total cost of building the amplifier will be around $18.00, including $8.85 for the coupling transformers.

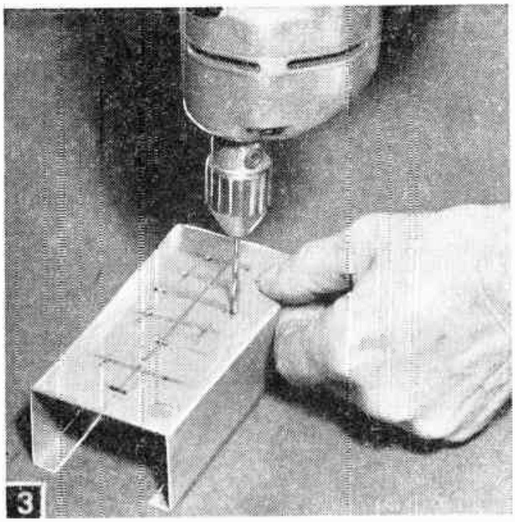
Four transistors are used in a transformer coupled circuit for maximum gain. If you wish you can substitute Raytheon CK722 transistors for the G.E. 2N 107 transistors used in the original amplifier, or you can obtain somewhat greater gain by using CK721 in the first two stages and CK-722 in the push-pull output. While several of the other PNP types should work out about as well, do not use the NPN transistors, such as the Sylvania 2N35, since their battery polarity *must* be reversed from that shown in the diagrams or they will be ruined. Transistors require very close matching between stages and also between the output and the speaker if distortion is to be avoided. Transformers provide the best method of matching impedances.

Shape the chassis from sheet aluminum (Fig. 2). Note that the volume control and switch are placed on the front of the chassis and the two jacks at the back. While this is suitable when amplifier is used on the bench for experimental purposes, switch and jacks can all be located on one side for more convenience if you prefer to mount chassis in speaker cabinet or baffle.

Lay out top chassis holes and drill, starting the socket holes as a marked rectangular area and finishing with a small file (Fig. 3). Sockets offer a decided advantage over soldering leads directly to terminals by avoiding damage from the heat of soldering, and permitting you to change transistors around in the circuit when testing a new unit in order to obtain minimum distortion and best gain. Each socket has a locking ring which is pushed down over the lower end of the socket to hold it firmly in place. The other holes are made with a #33 drill to take 4-40 screws which, with



2 CHASSIS DETAILS



3

Drilling the top holes in the sheet aluminum chassis. Lay out socket openings to size with a pencil, then drill and file to shape them to fit socket snugly.

nuts on the bottom side, are used to secure the transformers and the battery clip. If you prefer to use 2-56 or 3-56 binder head screws about 3/16 in. long, for neater mounting of these miniature parts, use a smaller drill.

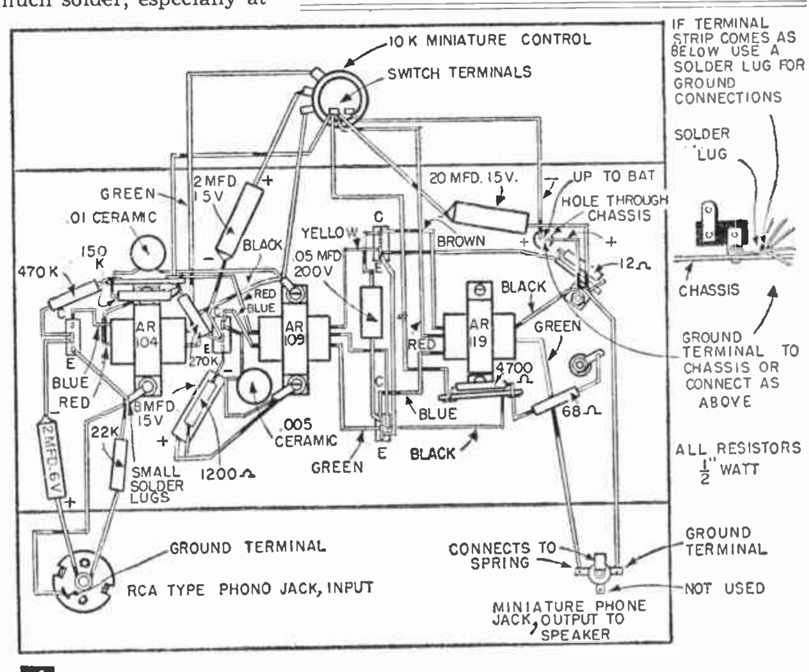
Assemble the parts, soldering all connections (Fig. 4). Use a small soldering pencil such as the Ungar type for most soldering at terminals. Where the heat is not sufficient to thoroughly flow the solder, as at larger terminals or where several wires connect, use a soldering gun or small iron. Avoid using too much solder, especially at transistor socket terminals, since it takes only a bit of rosin-core solder to make a perfect joint on clean metal and excess solder may run down and short-circuit to some other terminal or connection.

Be sure to select the correct values of resistors and capacitors as detailed in Figs. 4 and 6. Capacitors are marked for their values, and resistors use a color code which can easily be determined by checking a color code chart of RETMA standard color code values. When installing capacitors, make sure you observe the plus and minus ends of each electrolytic capacitor and place them in the circuit with relation to this polarity as given in the diagrams. When soldering to transistor socket terminals, which are closely

MATERIALS LIST— TRANSISTOR AUDIO AMPLIFIER

All parts except sheet aluminum available from Lafayette Radio, Dept. SM, 165-08 Liberty Avenue, Jamaica 33, N. Y.

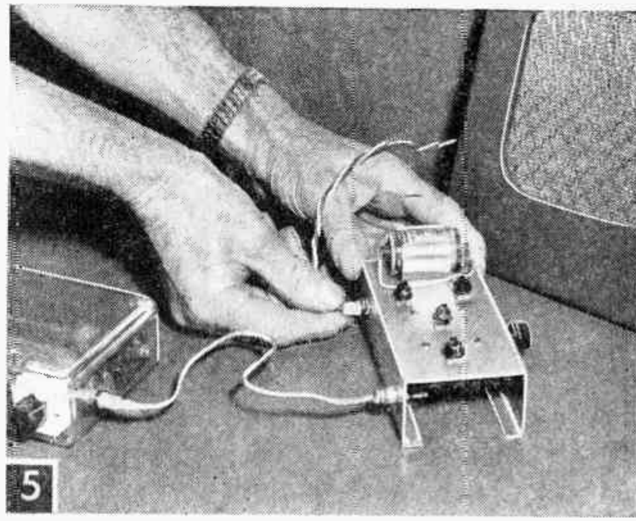
No.	Description
1 pc.	sheet aluminum .025-.030 x 1 1/8 x 2 7/8" (battery holder)
1 pc.	sheet aluminum .040-.045 x 5 3/16 x 6 3/8" (chassis)
4	transistors, G.E. 2N107 or Raytheon CK722 (99¢ each)
4	transistor sockets MS-275 (19¢ each)
1	RCA VS-300, 9 volt battery
2	battery terminal clips for VS-300 battery (1 plus, 1 minus)
1	miniature volume control with switch 10,000 ohms VC-28
1	miniature knob for 1/8" shaft MS-185
1	RCA-type phono jack MS-168 and plug MS-167 (13¢ per pair or KI-49, 10 pairs for 79¢)
1	miniature phone jack MS-282 and MS-281 plug
1	AR 104 input transformer
1	AR 109 driver transformer
1	AR 119 output transformer
1	20 mfd 15 volt Argonne capacitor
1	2 mfd 6 volt Argonne capacitor
1	2 mfd 15 volt Argonne capacitor
1	8 mfd 15 volt Argonne capacitor
1	.05 mfd 200 volt paper capacitor
1	.005 mfd disc capacitor
1	.01 mfd disc capacitor
1	470 K 1/2 watt resistor
1	150 K 1/2 watt resistor
1	270 K 1/2 watt resistor
1	1200 ohm 1/2 watt resistor
1	12 ohm 1/2 watt resistor
1	4700 ohm 1/2 watt resistor
1	68 ohm 1/2 watt resistor
1	22 K 1/2 watt resistor
2	two-terminal Bakelite mounting strips MS-232
1	one-terminal Bakelite mounting strips MS-231 (mounting foot should extend up for ground connections or otherwise use a solder lug under foot).
5	small solder lugs
	SPEAKER
1	6" speaker Utah or similar make
1	speaker enclosure or baffle SB-10 or similar type for 6" speaker
4 ft.	light plastic-covered 2-conductor cord
1	miniature phone plug MS-281
	4-40 screws and nuts for mounting parts, hook-up wire, solder, etc.



4 PICTORIAL DIAGRAM

spaced, first bend the terminals apart slightly so that there will be no danger of a short between them from soldered wires or leads. Leads should be only long enough to reach terminals.

Final assembly steps are to place the transistors in their sockets and fit the battery in its clip, which is bent from sheet aluminum and screwed to top of chassis (Fig. 5). Solder the snap-on clips to insulated leads that have been brought up from under the chassis through a drilled hole. Be sure to solder the clip that fits on the positive (plus) side of the battery to the lead that connects to the chassis as ground through the grounded terminal of the terminal strip. The other clip (negative or minus) connects to the other lead which goes to one side of the switch on the volume control. An error in battery polarity can result in ruined transistors.

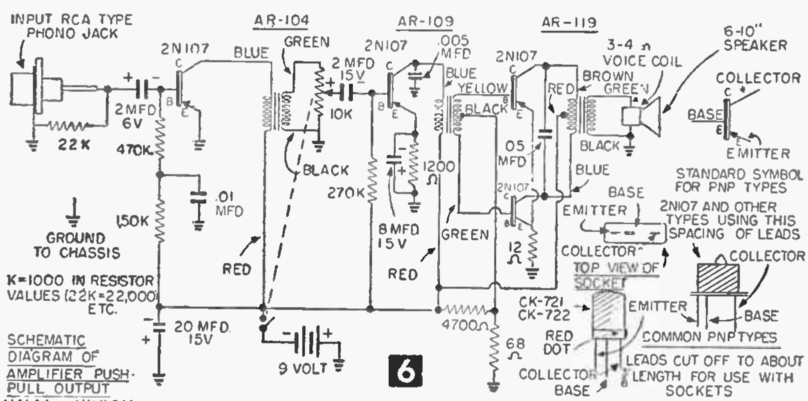


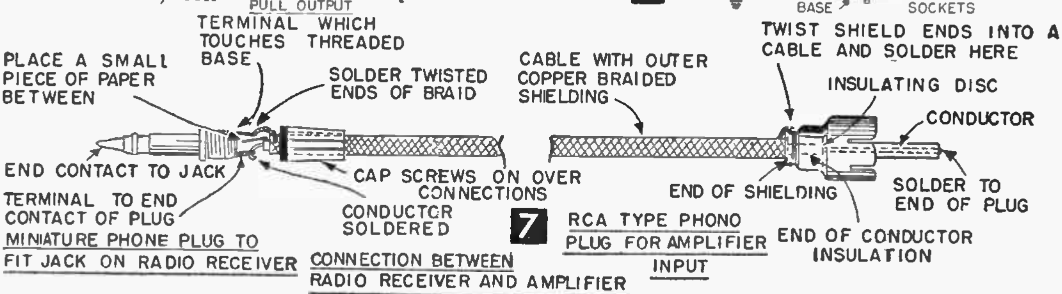
Connections between the radio and the amplifier and the amplifier and the speaker are made with plug-in cables. Shielded cable is used between radio and amplifier to avoid hum and other disturbances.

Before using, test the transistors in a transistor tester (see p. 128 of Vol. 4, No. 545, RADIO-TV EXPERIMENTER, available for 50¢) to save time you may consume looking for trouble in a circuit which lies directly in a defective transistor. A transistor should test with low leakage and a gain of at least 25 for the G.E. 2N107 or 22 for the Raytheon CK722, with a preference for transistors placed in some parts of a circuit that show a gain above these values.

Connect the radio to the amplifier (Figs. 5 and 7) with a piece of shielded cable with plug connections to fit the radio and amplifier jacks. This eliminates or reduces possible hum or stray pickup. Connect the amplifier to the speaker with ordinary rubber- or plastic-covered wire and a miniature phone plug.

To turn on the amplifier, rotate the volume control shaft clockwise until a click is heard, continue to turn to increase volume. With a speaker with a 3-4 ohm voice coil plugged into the output jack and the volume control fully advanced, you should hear a good hum when you touch a finger to the center terminal of the input jack. The hissing sound in the background is typical of transistors and cannot be helped. However, it will be reduced at lower volume levels or when a radio receiver is plugged into the input jack.





Combination Intercom-Radio Set

For party line service *and* music, you need only two or more crank-type telephones, an ac-dc receiver and hookup wire

By THOMAS A. BLANCHARD

THE quaint rural crank-type telephone is rapidly vanishing from the American scene. Interior decorators have been buying up these bits of Americana and converting them into costly antique conversation pieces such as Spice Cabinets, Pin-Up Lamps, Liqueur Chests, etc. Here, we have used one of these antique telephones as a novel radio cabinet while preserving its original function as an intercommunicating device. Two or more of these wall phones may be rewired as in Fig. 5 and used to provide party line service (Fig. 1) between the several floors of the home; or home to garage or barn.

Rural crank-type telephone houses radio. Youngster is listening to other member of family through intercom hook-up of old telephone.

Since most every home has a small table-model radio set of the ac-dc type that has been set aside because of a broken cabinet, missing knob, or a minor circuit defect, we will make use of such a set. If you do not have one of these radios you can pick up a traded-in set at your local appliance store for a couple of dollars. Readers who desire to put an old set into good working order will find complete data in Vol. 3 of Radio-TV Experimenter, No. 538, which is available for 50¢.

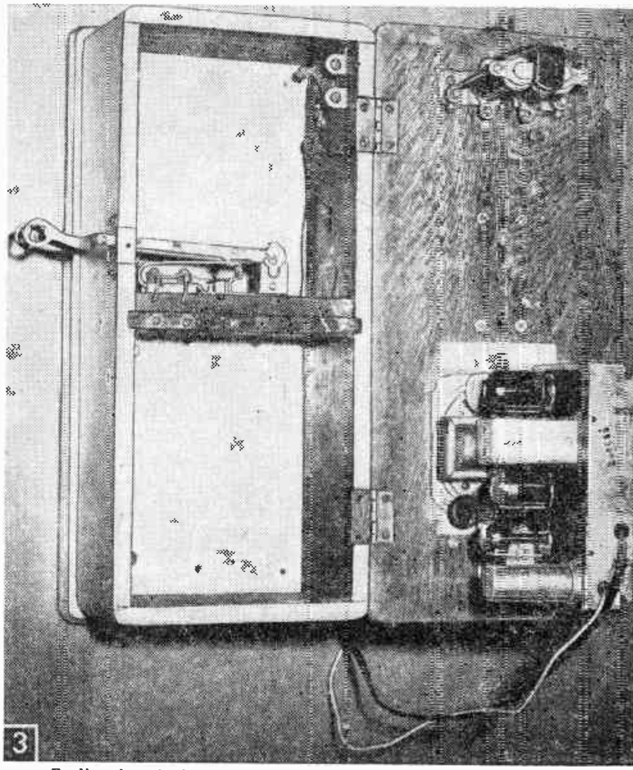
The wall telephone used was obtained from Telephone Repair & Supply Co., 1760 W. Lunt Ave., Chicago 26, Ill. The unit's supplier calls it their #4 magneto wall telephone with separate transmitter and receiver. Price is $7.00, plus postage (20 pounds). Since many of these phones have seen 50 years service, both cabinet and exposed metal parts (Fig. 2) require refinishing in most instances.

To refinish the cabinet remove the exterior metal parts, hinge screws from the door and wood screws hold-

Wooden telephone cabinet and metal parts in "as purchased" condition.

ing the back of the cabinet. Strip off the old finish with paint and varnish remover of the 15% phenol type. Do not use a powder-type caustic paint remover mixed with water because it may warp the solid oak cabinet. Using an old brush, flow the remover on the wood and wait about a minute for the old finish to wrinkle. Then lift off the varnish or paint with a putty knife. Repeat the treatment again, this time wiping off any of the old finish remaining with steel wool. Then rub the wood with a rag soaked with turpentine to neutralize any phenol remaining in the wood grain.

Radio Installation. Because of the thousand and one shapes of radio chassis in existence we can not cover the installation of each. However, the following suggestions will take care of any and all sets. The total interior space available is 4⅜ x 6½ x 16 in. A removable shelf (Fig. 2) divides the cabinet into two compartments. With the set shown, it was not necessary to remove this shelf. However, if the radio chassis will not fit into the lower compartment, remove all of the shelf except the small strip required to support the phone *hook switch*. In fact, all of the shelf may be removed by mounting the switch on a small metal bracket. Small table sets have the speaker mounted to the chassis. To fit within the phone box it is usually possible to leave the speaker intact. However, if you are posed with a mounting problem, remove the speaker from the chassis and extend the wires connecting speaker to set. In this way, the speaker can be mounted in the front, top or side of cabinet where it fits most conveniently.



Radio chassis is fastened to rear of telephone cabinet door.

If, as in our case, the set is small enough to mount directly on the cabinet door (Fig. 3), the old radio cabinet may be used as a template for drilling the tuning and volume control shafts holes and location of the large speaker opening. Place a sheet of paper over the front of the old radio cabinet, and trace position of openings. Then transfer the hole locations to the door of the phone cabinet. In our conversion, the speaker opening was made with a "fly cutter" set for a 3¼ in. dia. hole (Fig. 6). The round opening is optional since a square sawcut opening or series of ½ in. holes will serve just as well. The control shaft openings are drilled with a ½ in. wood bit. Because we have concealed the tuning and volume control knobs under the writing shelf (Fig. 4), it was also necessary to drill two ½ in. holes through the steel bracket supporting the shelf.

Now, check the chassis for fit. Do not be alarmed if you find that the control shafts are too short for attaching the original knobs. Any radio parts supplier can furnish "push on" knobs with an extended shank or ferrule. If the radio employed "push on" knobs merely replace with the extended type. On the other hand, if your set employed set-screw knobs a little extra work is required.

The round control shafts are ¼ in. dia. whereas the "push on" knobs are designed to fit a splined and slotted 7/32 dia. shaft. Since the new knobs are made of soft polystyrene plastic, simply ream out the knob ferrule with a ¼ inch drill. Insert the drill in a pin vise, or wrap a piece of cloth around the shank and twist by hand only. Heat generated by a power-driven drill will melt and distort the plastic. Because polystyrene has an elastic quality, these knobs will grip a smooth round shaft without the use of set-screws.

To allow for the displacement of heat generated by the radio tubes, a row of ¼ inch holes may be drilled in the top and bottom of the phone cabinet. The last remaining detail is the installation of the loop antenna if the radio was so equipped. If this unit will not fit into the cabinet even though the excess cardboard backing is trimmed off, replace it with a non-directional ferrite rod-type loop. This tiny antenna is available from most radio supply houses for about $1 complete with simple instructions for installing it.

We installed the radio chassis to the door of

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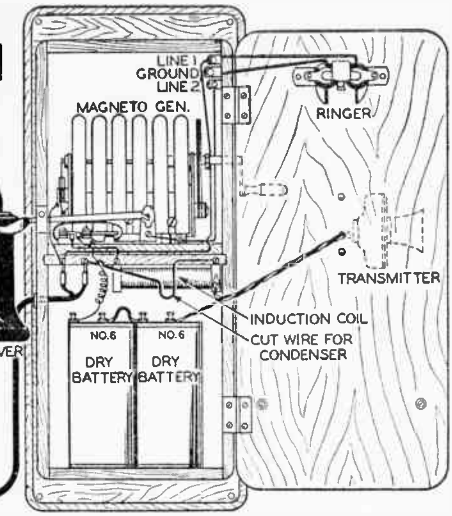
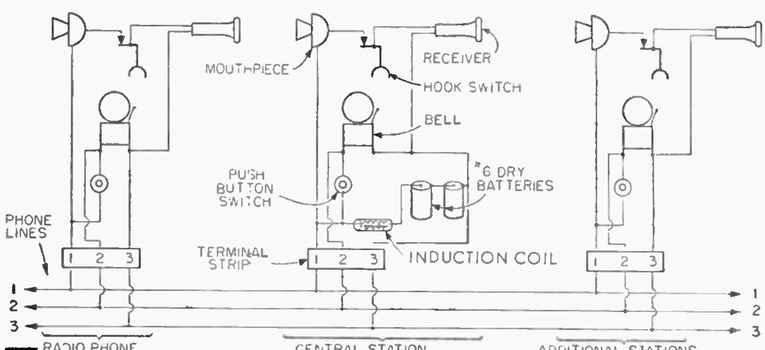


Original factory diagram of wall type magneto telephone. This was model 697 made by American Electric Co., Chicago. Rewire as shown in Fig. 5.



5 HOME PHONE SYSTEM HOOKUP

the phone cabinet with two #6 x ½ in. roundhead (*rh*) screws and washers. One screw in the unused speaker mounting hole, the other diagonally in the corner of the set chassis. Having checked alignment of radio chassis, remove it and set aside until cabinet is finished. There are several types of finishes that can be used, however each requires first filling the open-grained oak with paste wood filler. The cabinet may be given several coats of white shellac, and rubbed down with linseed oil and fine sandpaper. A limed-oak finish can be achieved by filling the oak with white paste-type wood filler. Follow with shellac as mentioned above. The cabinet may also be enameled in any desired color and decorated with decals.

While the cabinet finish is drying, clean the grease and rust from all metal parts with the phenol paint remover and steel wool. Follow by sanding or wire brush buffing before applying a new finish. Although the phenol solution will not remove the baked-on black enamel, it will remove all varnish and gum so that the parts can be painted with aluminum paint, black enamel, or gold if you wish. Radio supply shops stock General Cement's *Telephone Black* and *Chrome Paint*.

If you do not wish to use the telephone as an intercommunicating device, the various unwired parts may be reassembled on the cabinet. Should you wish to use two or more phones as an intercommunicating system, the following applies:

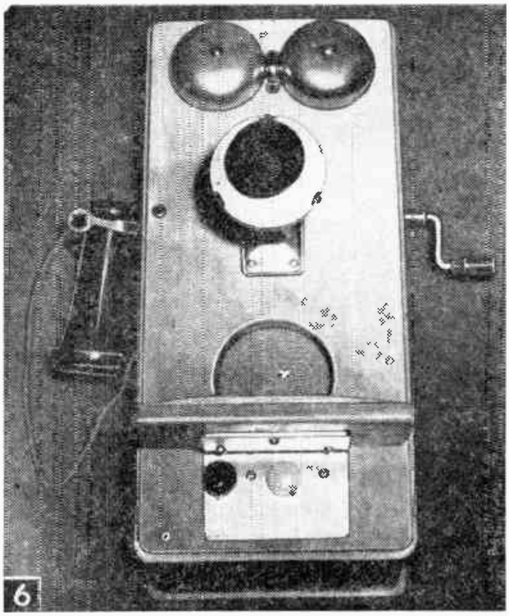
Wiring a Home Telephone System. The original rural telephone employed two electrical circuits (Fig. 5). For handling speech, two No. 6 dry cell batteries wired in series provided *talking current* to each phone. The 3 volts supplied by the batteries was not sufficient however, to ring the operator. Therefore, each phone was equipped with a hand-cranked magneto generator to provide the *ringing current*.

Many rural modernization jobs still required the magneto, and these units are removed from the old wall phones before they are offered to the public for sale. While the phone supplier includes the magneto crank for decorative use, he does not include a generator. For operating a phone system over short distances, the magneto is not necessary since the line resistance is low and the batteries can handle the ringing job quite well.

To put two or more telephones into operating condition, remove the old wiring and rewire with radio hookup wire, or plastic covered bell wire (Fig. 5). Each phone will require a 3-terminal, Jones-type barrier strip available from radio parts houses, and a door-bell push button. The push button may be installed over the hole formerly occupied by the generator hand crank.

Note in Fig. 5 that the central station unit includes an induction coil and dry cells. When three or more telephones are purchased, an induction coil will be furnished free if you ask for it. Other phones on your line require *no* coil or battery power. The central station can be located anywhere on the line . . . garage, basement, barn, etc. However, a central location on the line will prove most efficient. Phones may be inter-connected indoors by using two or three-conductor bell wire known as *thermostat wire*. While the phone system shown requires three lines, line 2 may be a ground return so that only two wires are used. In this instance, a water or steam pipe must be handy at each phone location. Scrape off any paint from the pipe and attach a radio ground strap with a wire long enough to connect to phone terminal 2.

The two wire hook-up greatly simplifies outdoor installations since two-wire twisted phone line is in plentiful supply in the surplus market.



Refinished cabinet showing radio control knobs beneath writing shelf. Knobs of different colors were used to distinguish between volume and tuning. Speaker grille is 4 x 4 in. piece of aluminum fly screening taped to cabinet.

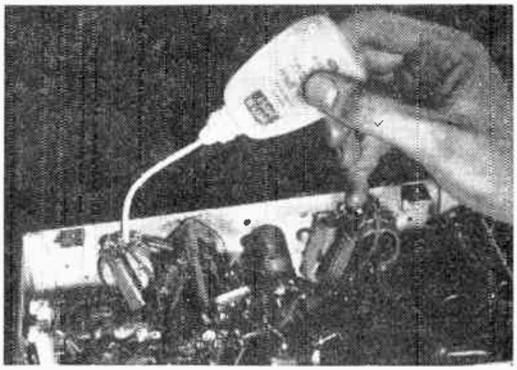
Moreover, for outdoor runs, TV lead-in wire is excellent and very inexpensive. When installing an outdoor line, it is important to provide lightning protection. Connect a TV arrestor across the line, and ground the center terminal to a water pipe. If a 3-wire line is used, connect the arrestor terminals to lines 1 and 3 and attach remaining ground terminal on arrestor to line 2. Then ground line 2 to earth via water pipe.

When several phones are installed on your home phone system, simple code ringing signals may be employed. Give each phone a number: 1, 2, 3, etc. To reach a certain phone, merely pulse the push switch the desired number of rings. Any phone on the line may be used to originate or receive a call.

If the telephone line involves a long run of wire, additional battery power may be required. Add additional dry cells in series if ringing current isn't adequate with two cells. After the line is installed, check each phone receiver for correct polarity. With receiver off hook, unscrew cap. The metal diaphragm should be securely held by the magnet both when phone hook is up and pulled down. If disc slides off receiver with hook up, the battery polarity is reversed at the receiver. Disconnect the cable at receiver terminal screws and reverse the connections. When each diaphragm is "sucked in" by the receiver magnet, when hook is up, polarity is correct.

Squeeze Bottle Dispenses Radio Chemicals

• Plastic squeeze bottles used for medicinal nose sprays make handy injectors of radio and TV control cleaning chemicals. Just remove the plug from the neck of the bottle, and pull off the spray tube attached to the inside of the plug. Wash out

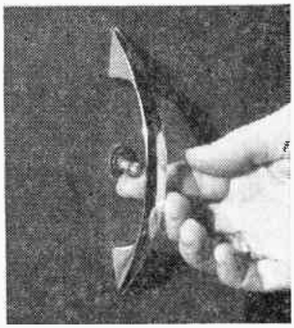


bottle, then enlarge the hole in the plug to accept the spray tube from the outside. Pour the cleaning fluid into the bottle and push the plug and spray tube back in place. Seal any leaks around the plug with service cement or any other cement that can be used to mend plastics.

The dispenser holds enough cleaner to clean several noisy controls without refilling. and the tiny hole in the center of the spray tube will let you squirt cleaner into tiny control openings easily.—John A. Comstock.

Toggle Switch Safety Guard

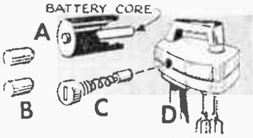
• An exposed toggle switch is not only open to damage to itself, but it can also be a source of injury if it is flicked on unexpectedly. To cut down on this hazard, fit an ordinary cabinet or drawer pull over the switch. This will take the brunt of



accidental blows, and you will have to reach under the arch to turn on the equipment.—Frank A. Javor.

Flashlight Battery Cores Sub for Brushes

• If worn-out brushes cause your electric food mixer or other small electric motors to lose power and

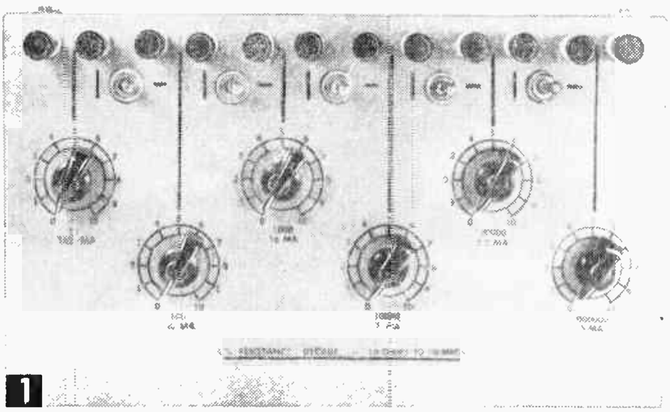


quit running, here's how you can avoid loss of usefulness while new brushes are being ordered. Remove the carbon core from a used flashlight battery (A), grind two pieces down to the desired size on an emery wheel (B) and insert in place of the worn-out brushes (C and D).—Glen A. Norberg.

Simplified All-Purpose Decades

Resistor and capacitor decades are quite useful in both servicing and experimental work, but often the units lack flexibility and are expensive. Here's a unit that's both flexible *and* inexpensive

By W. F. GEPHART



1 Front-panel view of a six-section, all-purpose resistance decade for experimental work.

UNLESS special features are incorporated in most resistor and capacitor decade units, they can only be used for one function at a time. Also, their accuracy and power capacity are sometimes insufficient for the use desired. One solution to these problems is to have several wide-range units, such as a 1% unit, a 1-watt (5% or 10%) unit, and a 2-watt (5% or 10%) unit.

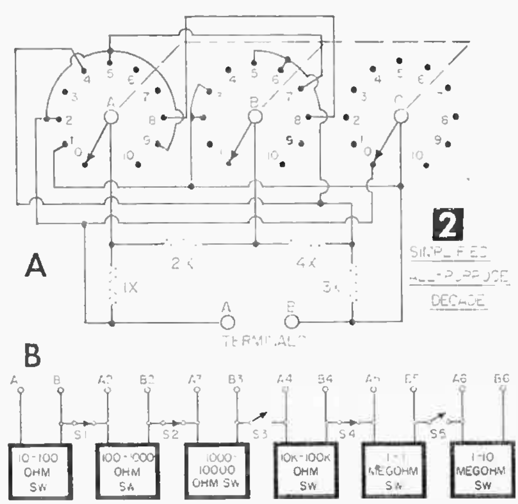
There are three general uses for decades: 1) In servicing work, to determine (by trial-and-error substitution) the value of parts to be replaced, where the original value cannot be determined. 2) In experimental work, to act as variable resistors or capacitors in circuits to determine optimum values by operating tests. 3) In measurements, to act as external bridge components or as comparison resistances or capacitances.

In the first usage, reasonable power capacity is most important; in the second usage, power capacity and accuracy are both important; and in the third usage, accuracy is of greatest importance. The overall solution would be to have a decade of both high-power capacity and high accuracy, such as a 2-watt 1% unit.

Another problem, particularly in the first two usages, is the need for multiple units. For example, in an experimental circuit, it might be desirable to vary both the cathode resistance and plate resistance simultaneously to determine best operating point. Since these circuits must be isolated, the usual single-decade unit cannot be used for both functions simultaneously, and two conventional-type units would be required.

Using conventional designs, such usage would require a 0-10 megohm, 1%, 2-watt decade (for measurements, grid and cathode resistor substitution), and a 10,000-ohm to 1-megohm, 10%, 2-watt unit for plate resistances. If 1-ohm steps were used on the 1% unit, and 10,000-ohm steps on the 10% unit, these two units would require nine switches, 70 1% resistors and 20 10% resistors. All of this would represent a substantial cost.

This decade unit system (Fig. 1) can meet requirements at substantially less cost than conventional units, and can be altered (from a tolerance or current capacity standpoint) economically, since it only uses four resistors per decade section instead of the conventional ten. The switches are more expensive, but in the 1% and 5% tolerance ranges, this is offset by the savings in resistor costs. For example, a conventional single-decade section of 1-watt, 1% resistors would cost approximately $6.70 (resistors and switch), while the cost of a similar unit under this plan would be $4.50. In the 5% type, relative costs are about equal, and the conventional type would be somewhat cheaper in the 10% type. However, if a conventional unit is made on a 10% tolerance basis, and it is decided



2 SIMPLIFIED ALL-PURPOSE DECADE

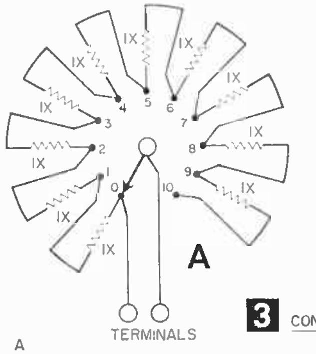
Table A—Maximum Current Capacity of Various Resistors

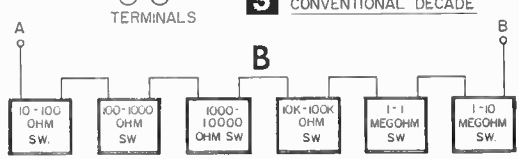
Ohms	Resistor	Maximum ½-watt	Milliampere 1-watt	Capacity 2-watt
10	(1X)	225	318	550
20	(2X)	160	225	318
30	(3X)	130	183	258
40	(4X)	112	160	225
100	(1X)	72	100	142
200	(2X)	50	72	100
300	(3X)	41	58	82
400	(4X)	35	50	72
1000	(1X)	22	32	45
2000	(2X)	16	22	32
3000	(3X)	13	18	26
4000	(4X)	11	16	22
10,000	(1X)	7	10	14
20,000	(2X)	5	7	10
30,000	(3X)	4	5.8	8.2
40,000	(4X)	3.6	5	7
.1 meg	(1X)	2.2	3.2	4.5
.2 meg	(2X)	1.6	2.2	3.2
.3 meg	(3X)	1.3	1.8	2.6
.4 meg	(4X)	1.1	1.6	2.2
1 meg	(1X)	.7	1.0	1.4
2 meg	(2X)	.5	.7	1.0
3 meg	(3X)	.4	.6	.8
4 meg	(4X)	.35	.5	.7

to convert it to 1% tolerance, the total cost (original plus conversion) would be $8.20, while the total cost of converting this type section from 10% to 1% would be $5.65. A comparison of Fig. 2A and 3A shows the savings in resistors.

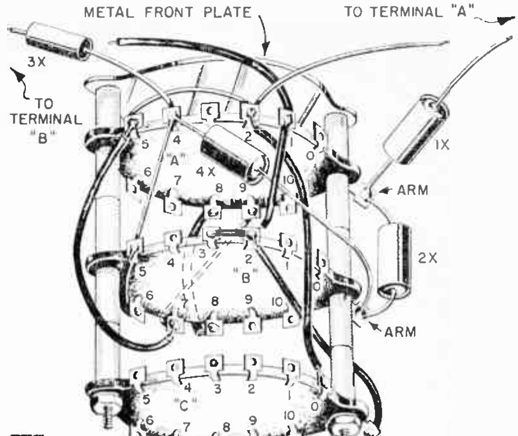
Further savings can be effected with this type unit in connection with wattage capacity. The current that can be carried by a decade section is limited to the current capacity of the resistors and, for a given wattage, the higher the resistance, the less the current capacity. In the conventional decade where all resistors are of the same value, each resistor must be of sufficient wattage to carry the peak current desired. In this unit, where resistors are of different size (and therefore different current capacity), and where they are not all in the circuit except on one range, varying wattage sizes can be used to get high current capacity.

Table A shows the current capacity of ½-, 1- and 2-watt resistors used in this decade system. Notice that by using a 1X ½-watt, a 2X 1-watt, a 3X 2-watt and a 4X 2-watt, the entire section would have the equivalent of a 2-watt capacity even though some of the resistors in it were less than 2-





3 CONVENTIONAL DECADE



4

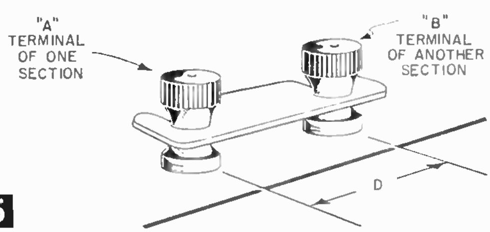
Table B—Switch Wiring Instructions

Abbreviations: (S)—Solder; (NS)—Do Not Solder; A3—Contact #3 on switch wafer "A", etc.

Step	Connection
1	R2X to A-arm (S) and to B-arm (NS)
2	one end of R1X to A-arm (S)
3	R4X to B-arm (S) and to A4 (NS)
4	one end of R3X to A4 (NS)
5	jumper from A4 (S) to B5 (S) and B6 (S)
6	jumper from A1 (NS) to B2 (NS) and B3 (S)
7	wire long enough to go to Terminal "B" to A1 (S)
8	jumper from B2 (S) to C-arm (S)
9	jumper from A9 (S) to B7 (S) to A5 (S) to A2 (NS)
10	jumper from CO (S) to A2 (NS)
11	wire long enough to reach Terminal "A" to A2 (S)
12	jumper from A8 (S) to B8 (S)

watt. In the 5% tolerance type, a conventional decade system would require ten 2-watt resistors costing $4; in this system, equal results can be secured with one ½-watt, one 1-watt and two 2-watt resistors at a cost of $1.30.

In planning a decade, it is best to analyze minimum requirements and build accordingly, since conversion to higher accuracy or current capacity can be done economically later. If the primary usage is for measurement purposes, 1% resistors should be used, but initial cost might be reduced by limiting the number of decade sections originally included. For example, the original unit might be for 100-100,000 ohms (three sections), and later expanded to greater and lesser resistances. Of course, the original housing should be large enough for ultimate requirements, and the layout should permit orderly expansion. If the primary usage is for servicing work, 10% tolerance sections would be sufficient, but current capacity should be fairly high.



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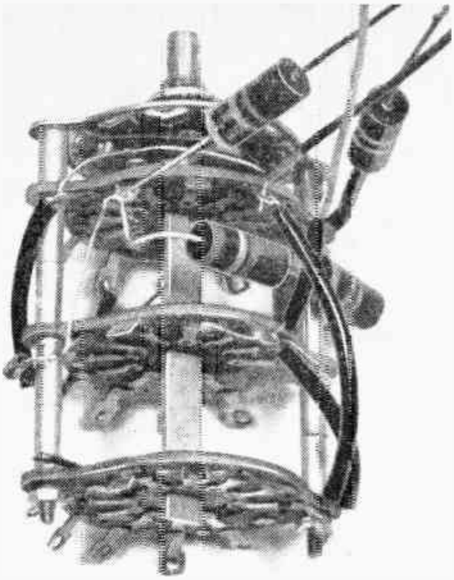


6 Switch wired (see Fig. 4) and ready for installation.

MATERIALS LIST—ALL-PURPOSE DECADE
(For each decade section)

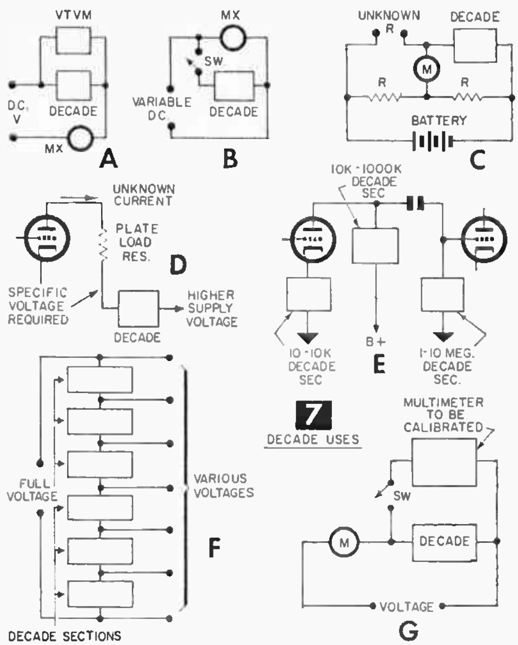
No. Req.	Description
1	rotary switch; 2 poles with 11 positions & 1 pole with 1 position (Mallory 1331L, Centralab 1009, etc.—see text)
1	1X resistor) "X" = ohm step of decade section, i.e. 10-ohm,
1	2X resistor) 1000-ohm, etc. Tolerance and wattage optional.
1	3X resistor) For wattage, also see Table A.
1	4X resistor)
2	binding posts
1	SPST toggle switch (optional)
1	pointer knob
1	0-10 dial plate (Optional—Mallory Type 380)

This decade design also permits the use of any section or sections of the unit independent of the other sections. Figure 2B shows how the sections are coupled together with switches (or "jumper" bars) with separate binding posts for each section. In this way, a 10-ohm to 10-megohm unit, for example, could be divided into a 10- to 10,000-ohm unit (with 10-ohm steps) for cathode resistances, a 10,000- to 100,000-ohm unit (in 10,000-ohm steps) for plate resistances, and a 1- to 10-megohm unit (in 1-megohm steps) for grid resistances. This arrangement is shown in Fig. 2B, and its application is shown in Fig. 7E. With the conventional decade, three separate units would be required, since sections cannot be isolated (see Fig. 3B).

Jumper bars can be used instead of switches for dividing the sections if desired. These are small strips of aluminum cut as shown in Fig. 4, and are used to connect the adjacent binding posts of each section. The distance "D" must be the same as the center-to-center distance between the binding posts, and should be the same between all sections. All bars should be in place when the entire unit is used, and appropriate bars removed to isolate sections.

Figure 1 shows the panel view of a 10-ohm to 10-megohm unit. Layout is not too important, except that the binding posts should be in one line and spaced evenly if jumper bars are to be used. It is desirable to have both binding posts and resistance switches in a line for ease of operation.

Most of the wiring of the decade sections should be done on the switch before it is fastened to the panel. Figure 6 shows a decade switch completely wired. While the diagram for it (Fig. 2A) seems complicated, each switch can be wired in the 12 steps outlined in Table B. After this pre-wiring, attach the switches to the panel and



7 DECADE USES

make connections to the binding posts (and toggle switches, if used).

If a low-range (less than 1-ohm) section is used, special low-resistance switches should be used, and all wiring done with No. 14 or No. 16 wire. In wiring high ranges (over 1-megohm) no wires, even though insulated, should touch, to prevent leakage resistance from affecting results. Other than this, no particular care is required in wiring.

You can reduce costs by using surplus parts wherever possible. In my unit, spring-type binding posts and toggle switches were cheaper than screw-type binding posts alone, since the items were surplus stock, so they were used. The decade switches were made by buying surplus switches (with three wafers, each suitable only for the "C" section) and buying two, new, large switches to get sufficient 11-contact wafers. Surplus 1% resistors can often be purchased for less than standard 5% units. Technical Apparatus Builders ("TAB"), 111 Liberty Street, New York 6, N. Y., has an excellent supply of 1% resistors at a reasonable price.

Decade Uses. Figure 7 shows a number of uses for decades other than for servicing work. In Fig. 7A, the decade is used to determine the current range of an unknown meter. The decade is adjusted to give full-scale reading on the unknown meter, the voltage across the decade measured, and the current determined by Ohm's Law. The same set-up can be used to determine the series dropping resistor required to convert a milliammeter to a voltmeter of desired range by applying the desired voltage, adjusting the decade for full-scale meter reading, and noting the resistance.

The internal resistance of a meter can be found as shown in Fig. 7B. The switch is opened and the voltage adjusted to give full-scale meter reading; the switch is then closed and the decade adjusted to give exactly half-scale reading, at which time the decade resistance will equal the meter resistance.

In Fig. 7C, the decade is used, with two external 1% resistors, to form a Wheatstone Bridge. The two other resistors should be of equal value (approximately 1000 ohms), and a zero-center meter used.

Often when the exact current being drawn by a tube is unknown, and a plate voltage dropping resistor is required, the decade can be used as shown in Fig. 7D.

Figure 7E (and Fig. 2B) show how this type of decade can be used as three variable resistances in determining resistance values for experimental circuits, and Fig. 7F shows how the unit (or part of it, depending on how many jumper bars or switches are closed) can be used as a voltage divider.

Figure 7G shows how the decade can be used to calibrate a multimeter or VTVM, using an external milliammeter of any value. In this case, the decade and/or voltage is adjusted to various current values, the voltage drop across the decade calculated by Ohm's Law, and the voltmeter calibrated accordingly.

In the above uses, 1% tolerance should be available in cases A, B, C and G. Care should be exercised in connection with peak current in all cases, but particularly in cases D, E, and F.

Specific dimensions have not been mentioned, since they will depend on the number of sections included in the unit, the type and size switches used, etc. If 30° indexing switches are used, Mallory Type 390 Dial Plates ("Off" and "1-10") may be used instead of making dials with decals as shown.

Generally speaking, the principles covered above (except usages) also apply to capacitor decades, except that voltage rating must be considered instead of wattage.

Desk lamp mike stand

Record that tall story using the desk lamp reflector to increase the range of your hand mike

A MICROPHONE stand for hand mikes (such as those that come with less expensive tape recorders) can be improvised from a flexible neck desk lamp with its cord removed (or at least disconnected), a plug to fit the lamp's socket, and a 1/8 x 3/8 in. metal strip. Bend the metal strip to the size necessary for the mike in question, and use as shown. To pick up faint sounds attach the lamp's bowl-type reflector to the lamp's socket to "funnel" or focus the sound into the mike. Face the mike toward the inside of the reflector.—ANDY VENA.

Keeping Tube Numbers Readable

• After tubes used in experimental circuits have been handled for some time, the type numbers on the glass envelope wear away and are almost impossible to read. To prevent this and keep numbers readable indefinitely, apply clear fingernail polish to the numerals when tubes are new. If the numbers on older tubes are illegible, apply ammonia with a piece of cotton and let it dry to bring numbers out clearly.—JOHN A. COMSTOCK.

Grommet Is Pilot-Light Bumper

• In some electronics gear, pilot bulbs are placed in locations that make them especially vulnerable to breakage. To prevent such breakage, slip a snug-fitting rubber grommet over the bulb's glass envelope as shown. The grommet will serve as a bumper to ward off damaging blows.—J.A.C.

1

Strong TV signals may cause rapid and slow rolling of picture by triggering the vertical synchro on your TV set.

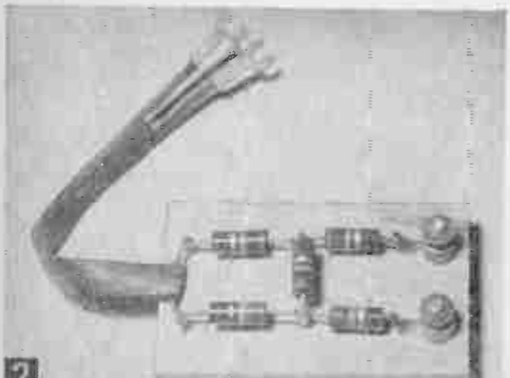
H-Pads Stabilize Rolling TV Pictures

THE combination of the modern ultra-sensitive cascode tuner in TV sets made during the past few years, plus the greatly increased operating power of TV stations, may make the housetop antenna deliver too strong a signal.

The result is that the TV picture may roll (Fig. 1), blacken and pull to the right of the screen between "station breaks" or when the picture contrast control is advanced. These conditions can, of course, also be caused by defective components in the vertical synchro section of your receiver. But, where the trouble is due to your antenna delivering too strong a signal, what happens is that the vertical circuitry loses its stability and cannot lock the picture in frame.

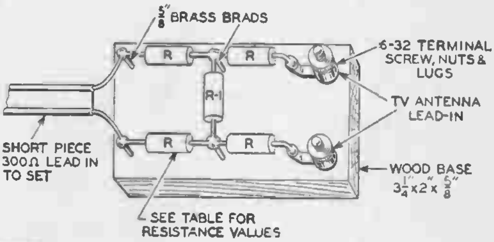
To eliminate this triggering action of strong TV signals, you can insert a simple resistance network between your set and the TV antenna. Because of the arrangement of the resistors (Figs. 2 and 3), this picture stabilizer is known as an "H-Pad."

In simple language the H-Pad is a picture volume control which reduces the R.F. signal delivered to the set's tuner input by the antenna.

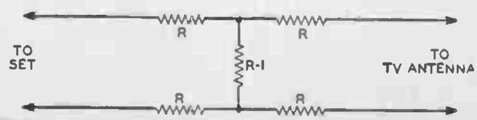


2

Simple H-Pads may be assembled on a small wood baseboard and connected in series with TV antenna.



3 PICTORIAL



4 SCHEMATIC

The strength of the signal reaching your TV receiver is expressed in decibels, which are convenient units for measuring intensity logarithmically (you hear, by the way, in proportion to the logarithm of the intensity rather than in direct linear response to it). The H-pad resistor combinations, which you will use to reduce the signal strength, are proportional to the degree of reduction (attenuation) of signal strength required. Thus, where the vertical circuit is only triggered infrequently by a slow roll, a 5-*db* (decibel) H-Pad may be all that you need. This unit has low series resistance and high shorting resistance. On the other hand, if your pictures are double or triple-triggered as evidenced by rapid rolling, up to 30-*db* attenuation may be required. Here the series resistors are high and the shunt or shorting resistor low. Table A indicates various resistor values needed to provide various degrees of attenuation.

For most vertical sync problems a 20-*db* stabilizer should prove about right. The unit shown in Fig. 2 was assembled on a ⅝ x 2 x 3¼-in. block of wood. Holes were drilled and countersunk in one end for two 1⅛-in. *fh* 6-32 machine screw binding posts.

Drive four ⅝-in. long brass brads into the block, leaving 3/16 in. of the nail exposed. Then cut off excess portions of the resistor pigtail leads and carefully solder resistors to the brad heads in a neat and rigid arrangement as shown in Fig. 2. A short length of 300-ohm TV lead-in wire allows the H-Pad to be attached to the set's antenna terminals, while the antenna itself is attached to the binding posts.

TABLE A—H-PAD RESISTOR VALUES

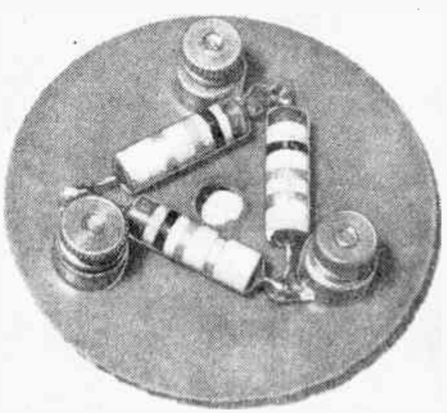
Attenuation	Resistors R	Resistor R-1
30 db	150 ohms	22 ohms
25 db	150 ohms	33- 36 ohms*
20 db	120 ohms	56- 62 ohms*
15 db	120 ohms	120 ohms
10 db	82 ohms	220 ohms
5 db	47 ohms	470-510 ohms*

*Use the larger value if available. Otherwise substitute smaller resistance value which all dealers stock.

The resistors for any of the six H-Pads listed may be as small as ¼-watt size. If you prefer not to experiment with your own homemade H-Pads, you can purchase printed circuit H-Pads from the larger TV supply houses (see pages 73-74). Centralab Division, for instance, makes 10, 20, 30, and 40-db attenuators.

Centralab also has a tap switch unit containing all four printed circuits to allow change-over from 10 to 40 *db* by turning a switch knob. Usually one H-Pad is sufficient, but if it reduces the signal of more distant stations normally received, it should be switched out of the antenna lead-in when set is tuned to the distant stations that do not cause picture roll.—T. A. BLANCHARD.

Two Sets-One Antenna *with this* TV COUPLER



1

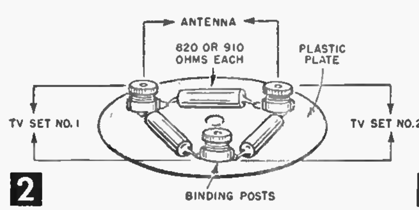
TWO TV receivers will operate efficiently off the same rooftop antenna by using this simple resistance bridge coupler. To assemble it, all you need are three 820 or 910 ohm composition resistors, three 6-32 x ⅝ in. machine screws and six matching nuts.

Arrange the resistors in a triangle on a small round or square piece of fiber or plastic (Fig. 1). For a neater appearance you can enclose them in a small plastic cosmetics box.

Connect the antenna lead-in to any adjacent pair of binding posts, running another piece of lead-in to TV set #1, and a third lead to set #2 (see Figs. 2 and 3). Since the resistance network is balanced, any pair of terminals work equally well as antenna input or TV coupling.

Resistors may be rated as little as ¼-watt, and the choice of values is dependent upon availability. The 910 ohm size is ideal for flat, oval or round 300 ohm lead-in. If this size is not available, use the more popular 820 ohm units. The latter resistance also happens to provide a perfect match for the new 270 ohm foam rubber round lead-in now becoming popular.

Some early TV sets were designed with an unbalanced 72 ohm input. Fair to good results may be obtained if one of the sets attached to coupler uses a 72 ohm co-ax lead-in from set to coupler, but line from antenna to coupler must be the modern 270 or 300 ohm impedance type.—T.A.B.



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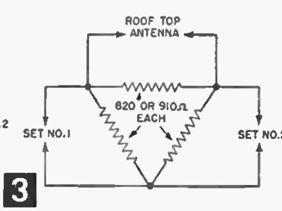


3

Pocket-Size Transistorlab

The turn of a switch demonstrates any of three unique functions of transistors and solar cells: radio, radiated energy control or solar-electronic switch

By THOMAS A. BLANCHARD

1

The 3-in-1 Transistorlab with switch in A-position functions as a solar-powered radio, here being activated by the beam of a flashlight.

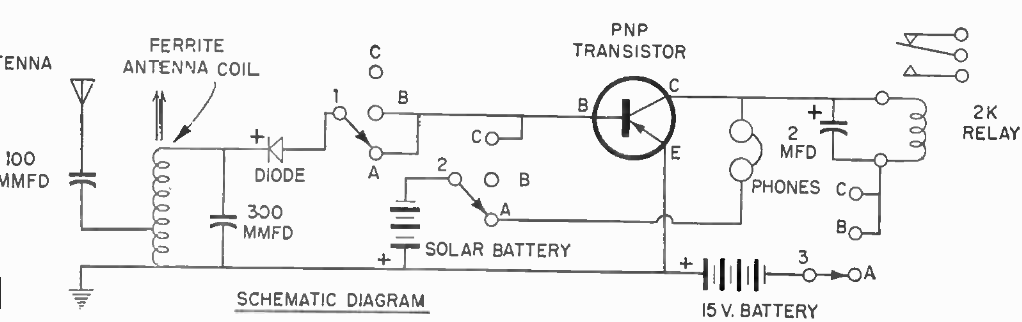
TUCK this 3-in-1 *Transistorlab* in your pocket, and you have ready for instant use a solar-powered pocket radio, a radiated energy control or a solar-electronic switch. An inexpensive rotary switch enables you to change from one application to another immediately for use in your own experiments or as a demonstration unit for school or club.

All components fit nicely into a plastic trinket box measuring 1¼ x 3¼ x 4¼ in. which was picked up at the notions counter in a dime store (Figs. 1 and 4). A 3/16 x 1½-in. slot was cut in the plastic box and the solar cell mounted in place with a strip of self-stick masking tape (Figs. 3 and 4). So long as wiring is correct (Figs. 2 and 3), and relay armature tension adjustment set so it can pick up on 1 milliampere, you can make any physical layout changes that may be necessary to suit housing you select. Note that none of the D-contacts on the switch are used, and only those indicated in the A, B, and C positions are wired, the others being idle. The control has been wired for an RCA 2N109 transistor. Other PNP transistors, such as the CK722 and 2N107 will also work but the high beta 2N109 is less critical and gives more consistent results.

When the rotary switch is in the A-position, the Transistorlab switch sets up the circuit so that RF signals from the air are tuned by the ferrite antenna coil, rectified by the diode detector, then amplified by a direct-coupled PNP transistor amplifier, powered by the inexpensive International Rectifier 3.2v., 2ma. silicon solar battery.

A subminiature jack provides plug-in connection for a miniature magnetic, high-resistance earphone. Many experimenters run afoul by trying to use less expensive crystal phones in transistor circuits. These can be used in conjunction with a shunt resistor, but results are too poor to bother with them in this case.

When the switch is moved to B-position, the circuit disengages the solar battery and substitutes the sensitive Sigma Model 4F relay for the earphone. It also connects the miniature 411E



2

SCHEMATIC DIAGRAM

hearing-aid battery into the amplifier circuit. With a suitable antenna and ground attached to terminals the Transistorlab will now demonstrate how energy radiated by more powerful or nearby local stations can be made to operate other electrical circuits.

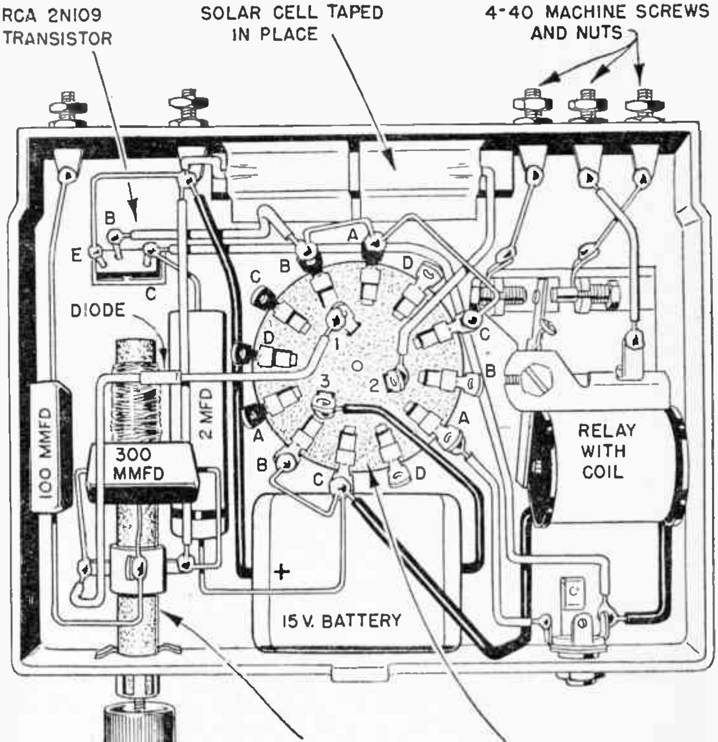
Having the antenna coil knob tuned to a loud radio station beforehand, you will discover that when the antenna is attached to its post, the relay contacts close. Tuning away from the station will cause the contacts to release.

As a mere idea of applying radiated energy to a more practical purpose, consider the chicken farmer who could rely on his strong local radio station going on the air in the early morning to automatically turn on the lights in the hen houses. Or, this same radiated energy could be used to turn off street lights or billboards. This is especially interesting since many radio stations are allowed to broadcast only from sunrise to sunset, since they are on channels assigned to larger stations with "clear channel" night-time rights.

When daytime stations sign off, the circuit of the radiated energy control draws very little current. Only when a signal reaches the diode detector circuit does any appreciable current flow from the transistor's *emitter* to *collector*. Another use for this radio carrier operated relay is as a Conelrad air raid warning service.

Finally, with the selector switch in C-position we have a form of electronic switch that is "triggered" by light striking the solar battery which has now been cut into the circuit to replace the RF tuner. Here a stronger current than the previous radiated voltage is applied to the *base* of the transistor. A small current flowing in the *base* circuit causes a much larger current to flow in the *emitter-collector* circuit of transistor.

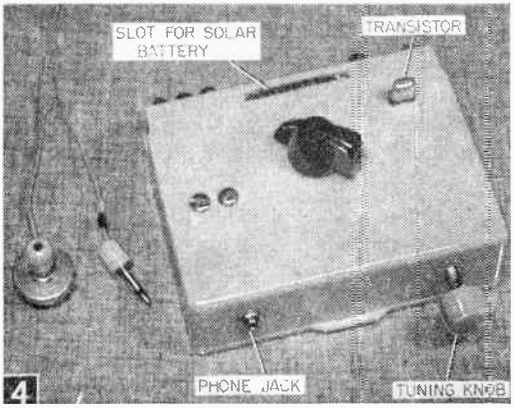
When sun or artificial light (except neon or fluorescent) strikes the solar cell, it becomes active and the relay circuit closes. The effect of a beam of light is like that of the well known photoelectric controls with the outstanding feature of the transistor being in evidence—its ability to work on as little as 9 v. as compared to vacuum tubes requiring from 90 to 150 for satisfactory results.



3 PICTORIAL DIAGRAM

MATERIALS LIST—TRANSISTORLAB

No. Req.	Description
1	1¼ x 3¼ x 4¼" or larger plastic box
1	ferrite antenna coil (loopstick, Miller No. 2002)
1	general purpose germanium diode, 1N34 or equiv.
1	RCA 2N109 transistor
1	transistor socket
1	subminiature phone jack
1	Sigma #4F sensitive plate circuit relay with 2,000 ohm coil
1	2 mfd 25v. electrolytic capacitor
1	300 mmfd mica capacitor @ 300v.
1	100 mmfd mica capacitor @ 300v.
1	solar cell strip No. MS-420 (Lafayette Radio, 165-SM Liberty Ave., Jamaica 33, N. Y.)
1	Mallory #3234J (non-shorting) rotary switch; 3-poles, 4-positions
1	15-volt #411E midget battery
5	4-40 machine screws ⅜" long for terminals
10	4-40 nuts
5	soldering lugs
	hook-up wire and knob



Transistorlab fits easily in a 1¼ x 3¼ x 4¼-in. plastic box.

Howard Souther's Stereophile Heaven showing at far end of room two professional Ampex tape machines and one Magnecorder, used for duplicating and for various sound effects. Control console is at center of photograph.

IF you decided you wanted the best stereo sound available—and were not worried about the cost—you might wind up with a dream system that looks like the one shown here.

The control console in the center of the array shown above was constructed over a period of a year in spare time. The rest of the equipment consists of standard professional components, except that the tape machines are housed in a specially constructed cabinet (top right in photo) to allow easy working from a standing position. Actually, the control console is two consoles in one, for the left and right channels are separate and symmetrical each side of center. Two meters in the center of the instrument panel measure the power level of right and left sound while the two outside meters measure limiting, or compression action for recording or dubbing operations. The limiting amplifiers achieve highest levels of sound without overload and system hiss.

Three microphones, inputs for right and left respectively, can be mixed by the control knobs on the first row of the console, along with stereo AM-FM radio, disc or sound from two stereo tape machines. The monaural central tape deck is used for single track sound effects available from an extensive tape library. Key switches located over each mixer pot allow flexibility in operation by actually doubling the number of inputs, 20 in all, although only 10 can be mixed or recorded at one time, five on the right and five on the left.

Directly over the mixer knobs on the first row are remote push-button controls for two of the tape machines. These allow one-man operation of even the most complex mixing or recording set-ups.

Located each side of the remote control cluster are "program equalizers," which act like tone controls on a high-quality amplifier, but allow more accurate settings.

The system of loudspeakers consists of two Electro-Voice Cardial Klipsch systems on the extreme sides, and three diminutive E-V Stereons, the odd one of which is placed on top of the control console center. The two outside Stereons, playing only stereo-significant sounds above 300 *cps*, are simply in parallel across the two Cardinal loudspeaker systems. The other Stereon receives "mixed" sounds which actually constitute a reformed third channel in the center. To insure proper reconstitution of this third, or "phantom" channel, a small square control box at the extreme right side of the meter panel allows reversal of phasing through a special transformer. This is necessary because many records and tapes are non-uniform in this respect. When properly phased,, this third channel gives much better stereo effect, and permits the listener to move about the room without rebalancing channels. This third channel also prevents violent shifting of the playing instruments from one place in the orchestra to another, and "locks-in" the soloist when he sings or plays centrally.

A transcription turntable for playing stereo phonograph records completes this reproduced music paradise, but as tapes for purest sound are generally employed, it is kept rolled away in a closet. Not shown in the photograph is a long lounge directly opposite the control console where Howard Souther, General Merchandise Manager for Electro-Voice, luxuriates in 3-D Sound at its finest.

What would it take to duplicate Souther's custom-made set-up? "A real love for well reproduced music, a year's spare-time," says Souther, "and more money than I care to admit!"

The Jim-Jam Box

By ROBERT GANNON

FROM old components lying idle in your scrap box, or for a total of a little over $6 for new parts, you can easily construct a "Jim-Jam Box." Essentially nothing more than three elementary blinker circuits, a Jim-Jam Box, with three (or more) neon lights flashing intermittently, easily simulates anything from a Geiger counter to a miniature, electronic brain.

Circuit consists of a trio of resistors, capacitors and neon lights, wired in parallel and powered by a 90-*v* battery (see Fig. 2). By varying the values of the components, the lamps can be set to flash at a variety of speeds, in sequence or at random.

Container for the Jim-Jam is a 4-in. meter case. A small piece of sheet metal is fitted from the inside to the front of the case with two machine screws, and the lights—held in place by close-fitting grommets—protrude through three holes in the plate.

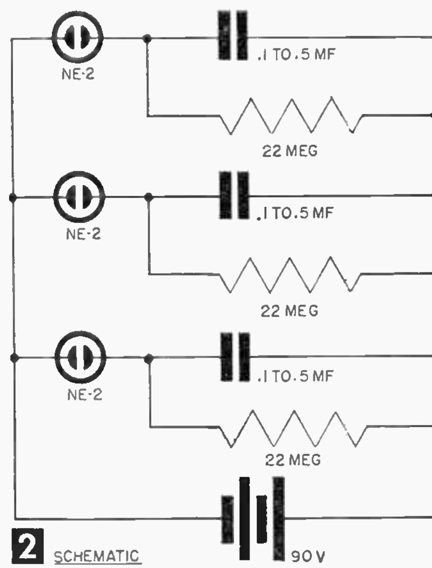
The back, metal or opaque plastic, is attached with sheet metal screws or machine bolts screwed into threaded holes. (A small threading tap costs about 85¢ at most hardware stores.)

To construct, solder three ¼- or ½-watt resistors of about 22 megohms to three capacitors of from .1 to .5 microfarads, and of whatever voltage rating you have on hand (600 *v.* is fine).

Tape the three resistor/capacitor pairs together (see Fig. 3) and solder the lamps in place. Use spaghetti for insulation. Then carefully push the three lights through the holes in the face-plate. Cushion the components by wedging them lightly against the bottom front of the box with some crumpled newspaper. The battery slides into place easily with just a bit of jiggling.

With the back screwed in place, your Jim-Jam Box is ready for a half-year of thaumaturgic blinking—on a single battery. Yes, that's all it does—sits there and blinks. But it's surprising how this mystifies, moves and even amazes your guests.

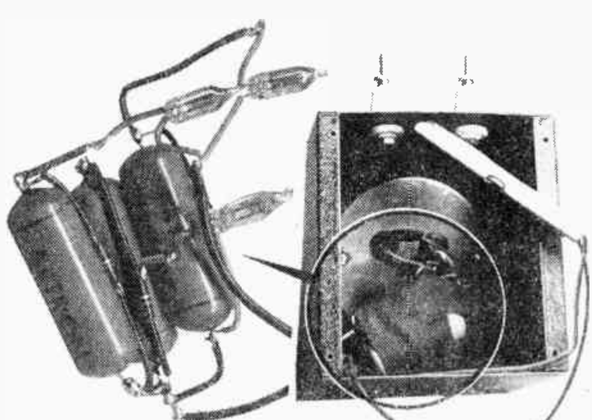
A completed Jim-Jam Box.



2 SCHEMATIC

MATERIALS LIST—JIM-JAM BOX

No. Req'd	Size and Description
1	4 x 4 x 4¼" meter case
3	NE-2 neon glow lamps
3	½-watt, 22-Meg resistors
3	.1 to .5 mfd., 600-v tubular capacitors
3	½" grommets (center hole to fit NE-2)
1	90-v battery (R.C.A. VS090, Eveready 490 or Burgess N60)
	Misc. screws, bolts, wire, spaghetti, solder, etc.



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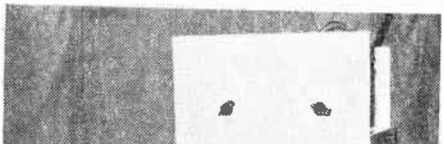
Components are tucked in place, and a wadded pad of newspaper holds them tightly against case front. The two terminals serve no useful function; they come with the meter case. At left in photo are components soldered in place before protective tape is applied.

Antenna-Coupler and Low-Pass Filter

Novice hams, if you want to combine some of the odd "outboard" pieces of apparatus around your station into a single unit this device will do it! It combines a flexible antenna coupler with an efficient low-pass filter, both designed for the low-powered transmitter operating at plate inputs of less than 150 watts

By RALPH SCHACHAT (W1GIF) and MARTIN GLICKSMAN

THIS antenna-coupler and low-pass filter can be constructed in an evening or two from readily obtainable parts. The two variable capacitors needed can be of almost any value and can be easily salvaged from a couple of discarded receivers. The chassis used is an inexpensive "store-bought" model with a small piece of Masonite attached as a front panel. Most of the coils for the antenna-coupler come prewound; the proper lengths are simply cut off to form the correct size coils.




1 Ham at rig, coupler-filter upper right

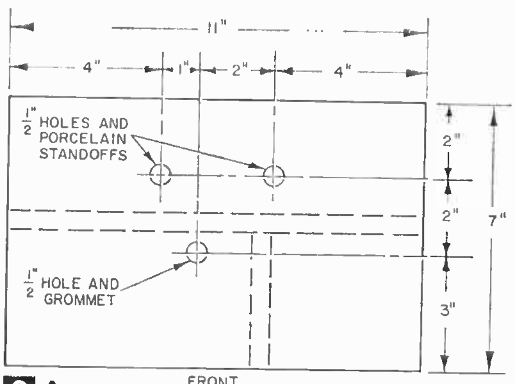
The low-pass filter portion consists of a series of five coils and four high-voltage capacitors built into three isolated chambers (see Fig. 3). The filter circuit serves to attenuate interfering harmonics by by-passing them off to ground. In Fig. 3, coils of insulated #12 wire are shown, but bare wire is satisfactory and easier to handle. Hence, all directions are given for bare wire. If insulated wire is preferred, then all measurements must be accordingly adjusted to allow for the thickness of the insulation.

Construction. Obtain a stock chassis measuring 3 x 7 x 11 in. and fasten a piece of Masonite 8½ in. high by 11 in. to its front with screws and nuts. Fasten a strip of aluminum, 2½ in. wide by 7½ in. high to the rear of the chassis (Figure 4). One SO-239 coaxial socket (S2) is fastened to the top of this strip of aluminum by drilling a hole slightly larger than the socket (about ⅝ in.) and fastening the socket in place with small screws and nuts.

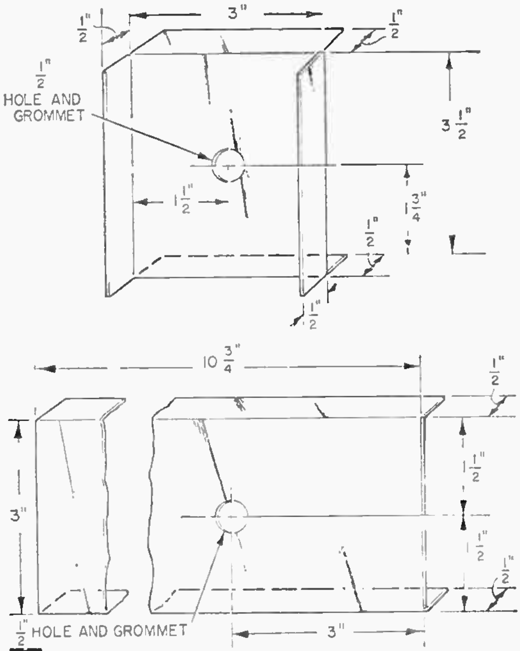
A second coaxial socket (S1) is similarly installed in the center of the rear side of the chassis. Note that if twin-lead cable is to be used instead of coaxial cable, the S2 socket and the aluminum strip are not needed, since the twin-lead cable terminates in small clips (A2, A3) which are hooked directly to coil L7.

Three ½-in. holes are drilled in the chassis (see Fig. 2A) and fitted with rubber grommets. Two porcelain stand-off insulators are then mounted in these holes.

Now make two aluminum dividers from



2A CHASSIS



2 B ALUMINUM DIVIDERS

flat pieces of aluminum stock (see Fig. 2B). Scribe the flat pieces of aluminum along the sides to be bent, bend the aluminum and drill and fit with rubber grommets two ½-in. holes as shown. These dividers are then fastened in place under the chassis with machine screws and nuts as shown in Figs. 2A (dotted lines) and 3.

The two variable capacitors (C5, C6) are mounted as shown in Fig. 4. One of these is a two-gang capacitor (C6) and must have both gangs of the same value. The other (C5) can be a one-gang capacitor. (A two-gang unit was used because it was available, but one gang was not used in the circuit.) The small mica trimmer capacitors often found on such variable capacitors should be removed if present. They will be found on either side of both stator sections. Remove by unscrewing the adjustment screw and discarding it, along with the mica spacer. The remaining adjustable plate may then be wrung-off with a pair of long-nose pliers.

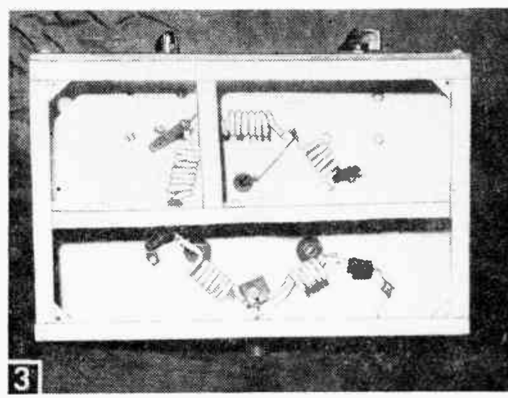
Coils L1 to L5 are made by winding #12 bare around a ½ in. form at a spacing of 8 turns per in. Coils L1 and L5 have 5 turns; L2 and L4 have 7 turns; and L3 has 8½ turns. The large coil (L7) can be made by winding 24 turns of #14 bare wire around a 2½-in. form, using a spacing of 8 turns per in. It is far easier and more convenient, however, to cut a 24-turn section from a commercial coil such as Barker and Williamson Type 3906 "Air Inductor." In either case, an extra 1 or 2 in. of wire should be left on each end of the coil to serve as leads.

The small coil (L6) can be made similarly by winding 9 turns of #14 bare wire around a 2-in. form at a spacing of 8 turns per in. Likewise, cutting a 9-turn section from a commercial coil is preferable. Long leads of about 6 in. should be left at each end of this coil.

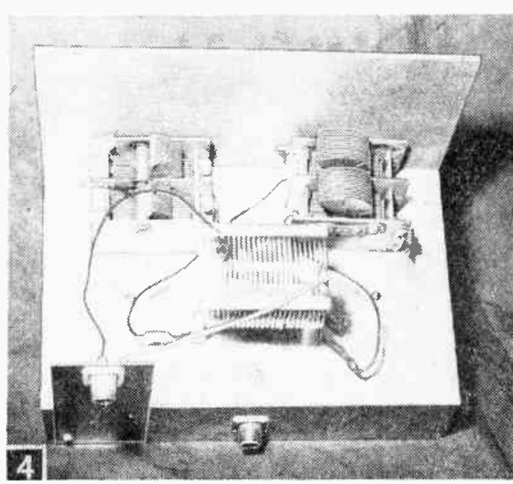
Carefully center the small coil (L6) within the large coil (L7) so that the long 6-in. leads of the small coil come out conveniently between the turns of the outer coil. The leads are covered with spaghetti to avoid shorting of the coils, and the inner coil is fastened in position by gluing small spacer strips of Bakelite (or other rigid, non-conductive plastic material) between the inner and outer coils. The small Bakelite strips can be cut from a large piece of Bakelite with a bandsaw or hacksaw. Duco cement, or preferably a commercial coil cement is used to glue the plastic in place.

The two leads of the large coil (L7) are fastened to the porcelain stand-off insulators and the excess wire is clipped off (see Fig. 4).

One lead of the small coil (L6) is run through the ½-in. hole in the chassis to the low-pass filter section. The other lead is soldered to the hot terminal of variable capacitor C5. The wiring is then completed as shown in the wiring diagram,



3 Bottom view of unit.



4 Top view of unit.

MATERIALS LIST—COUPLER-FILTER

No. Req'd.	Description
1	chassis, 3 x 7 x 11"
1	Masonite panel 8½ x 11"
1	aluminum strip, 4 x 10¾"
1	aluminum strip, 4 x 4"
2	capacitors, 46mmfd (C1, C4)—Mica—Allied Catalog #74-L-335
2	capacitors, 154 mmfd (C2, C3)—Ceramic—Allied Catalog #11-L-052
1	Barker & Williamson Coil—(L6—Radio Shack Catalog #21-520)
1	Barker & Williamson Coil—(L7—Radio Shack Catalog #21-097)
2	Alligator clips—(A1, A4—Radio Shack Catalog #32-774)
1	variable capacitor—(C5—1-gang—Allied Catalog #61-H-009)
1	variable capacitor—(C6—2-gang—Allied Catalog #61-H-059)
6	#12 bare wire (L1 to L5)
24	#14 bare wire, or 2 Barker and Williamson Type 3906 "Air Induction" (L6, L7)
3	coaxial cable, RG59U—Allied Catalog #47-W-552
6 strips	Bakelite, about ¼ x 3/16 x 1½"
2	porcelain stand-off insulators, about 1" high
2	knobs, to fit variable capacitor shafts
1	porcelain electric light socket
1	electric light bulb, 15 watts
1	No. 40 pilot bulb and miniature screw-base socket
	Miscellaneous nuts, screws, grommets, solder, etc.
	If Coaxial Cable is used:
1	aluminum strip, 2½ x 7½"
2	coaxial sockets, SO-239 (S1, S2)—Allied Catalog #40-H-352
	coaxial cable, RG59U
	If Twin-Lead Cable is used:
1	coaxial socket, SO-239 (S1)
5	Polarized connectors, Mosley, Type 321—Mosley Electronic Catalog #321
2	No. 40 pilot bulbs and miniature screw-bare sockets
	Twin-lead cable, 300 ohms, to dipole antenna—Allied Catalog #49-T-385

Fig. 5. An aluminum cover plate can be fastened over the bottom if desired. Both the transmitter and the coupler chassis should be individually grounded before operation. The coupler and transmitter are connected to each other with a short piece of coaxial cable having a PL-259 plug on each end. The antenna can be connected by coaxial cable or by a form of balanced line, such as twin-lead cable. The general operation of this particular antenna coupler is particularly suited to balanced line installation. However, coaxial cable can be used, and directions will be given for the use of both types of transmission lines.

Ordinary TV 300-ohm twin-lead cable serves as an excellent transmission line between a low-power transmitter and antenna and has been found to work very well with this coupler.

The setting of the clips depends greatly upon the impedance of the antenna feed system at the point of connection. It is suggested that clips 2 and 3 be set closely together near the center to begin, and capacitor C6 adjusted to resonance. Then clips 2 and 3 should be moved outward, meanwhile adjusting C6, until best antenna current is obtained. Naturally the transmitter is turned off when clips 2 and 3 are being adjusted; otherwise, the user may get an unpleasant shock. If the clips are set too far out to begin with, the shunt impedance of the feed line may "kill the Q" of the circuit, and no tuning effect will be observed. This would be most disconcerting to one not acquainted with an antenna-system's whims.

(While the use of a lamp bulb as a dummy load is excellent practice for tuning a transmitter and testing its operation, the impedance of an actual antenna would approach the impedance of a 15-watt lamp, or about 1000 ohms, slightly inductive, only by the luckiest happenstance. Actually, it would probably be best for the new ham to practice tuning-up on the lamp, as suggested below, until he knows perfectly what each adjustment is for. Then it would be better if he proceeded as above when tuning the "live" antenna. Most such systems would probably have a *much* lower impedance than the lamp.)

Coaxial cable is reported to lose less power by radiation from the transmission line, but the difference between coaxial cable and twin-lead is small, with properly operating equipment.

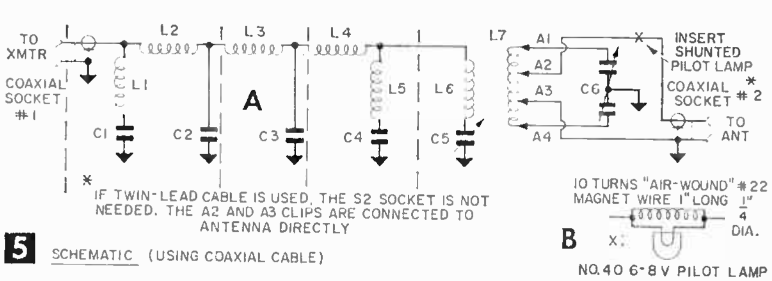
The antenna used to test the coupler was a 5-band dipole commercial trap antenna designed for use on 10-, 15-, 20-, 40-, 80-meter bands.

Transmission with Coaxial Cable. 1) Connect a dummy antenna lamp bulb to the antenna socket (S2). A 15-watt bulb was used for an AT-1 transmitter; for transmitters operating with higher power, use higher wattage bulbs. The dummy antenna is made by connecting a PL-259 plug to a porcelain electric bulb socket by means of two separate insulated wires as in Fig. 6. The proper size bulb is screwed into the porcelain socket and the PL-259 plug is plugged into the antenna socket (S2) of the coupler unit.

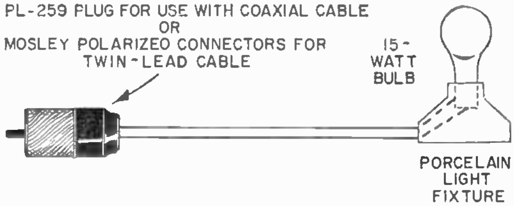
2) Alligator clips A1 and A4 are set at the ends of coil L7. Clips A2 and A3 are then set in about 1 or 2 turns from each end of the coil for 80-meter operation, and about 4 or 5 turns for 40-meter operation.

3) The transmitter is tuned up in the usual way and variable capacitors C5 and C6 are adjusted until the bulb lights to its maximum brilliance and the transmitter loads properly. A good "dip" must be obtained when the transmitter amplifier coil is tuned through resonance. The light bulb should glow with a good brilliance.

4) When the proper "dip" and bulb brilliance has been obtained, the dummy antenna is re-



5 SCHEMATIC (USING COAXIAL CABLE)



6 DUMMY ANTENNA

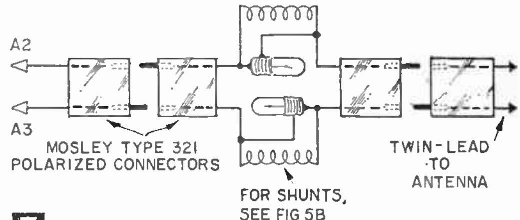
placed by the transmitting antenna. C5 and C6 are readjusted somewhat for "dip" and good loading. If poor loading or no "dip" is obtained, A2 and A3 are readjusted by changing their positions, and the transmitter is retuned as above. However, in order to indicate actual flow of RF current *in the antenna circuit itself* (imperative to proper transmitter adjustment) insert at point X in the schematic Fig. 5 a shunted pilot-lamp, No. 40, 6-8 *v* in series with the antenna feed line itself as shown in Fig. 5B.

Sometimes the beginner can *think* he has his antenna system tuned properly by meter when actually all of the RF output is being dissipated in the residual resistance of the tuner. However the glowing lamp in the feeder leaves little doubt that the "soup is going up the stack," as intended. This adds miniscule cost but great convenience to the coupler unit. Also, the power used in the lamp may be considered negligible (the lamp can be unscrewed after tuning if desired).

Transmission with Twin-Lead Cable. 1) The transmitter is tuned in the same way with the dummy antenna.

2) The dummy antenna is then removed, and replaced by a simple twin-bulb unit (Fig. 7) shunted as in Fig. 5B.

3) Clips A2 and A3 are adjusted to a proper position on coil L7. Capacitors C5 and C6 are adjusted until both bulbs light up with maximum and almost equal brilliance. This indicates that both sides of the antenna are loading equally. Although this may sound tricky or complicated,



7 "TWIN-BULB" UNIT

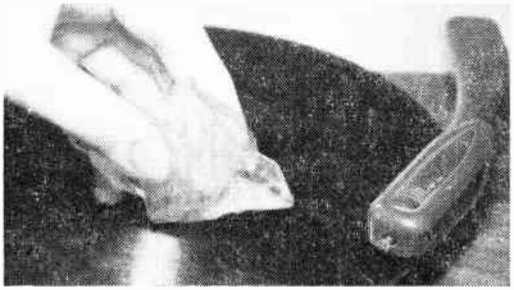
it will be found to be a neat and relatively easy procedure.

4) The twin-bulb unit is removed and the transmitting antenna is plugged in. Usually, no further adjustments need be made as long as the transmitter "dips" and loads properly and the shunted pilot lamp glows.

Here, then, is a simple, easily built unit that will deliver the full power of the transmitter to the antenna in such a way that good balance between the "legs" of the dipole will be obtained. In addition you need have no qualms about operating during "TV hours" no matter how close your antenna is to your neighbor's TV antenna.

"The next sound you hear will be that of a startled mountain goat."

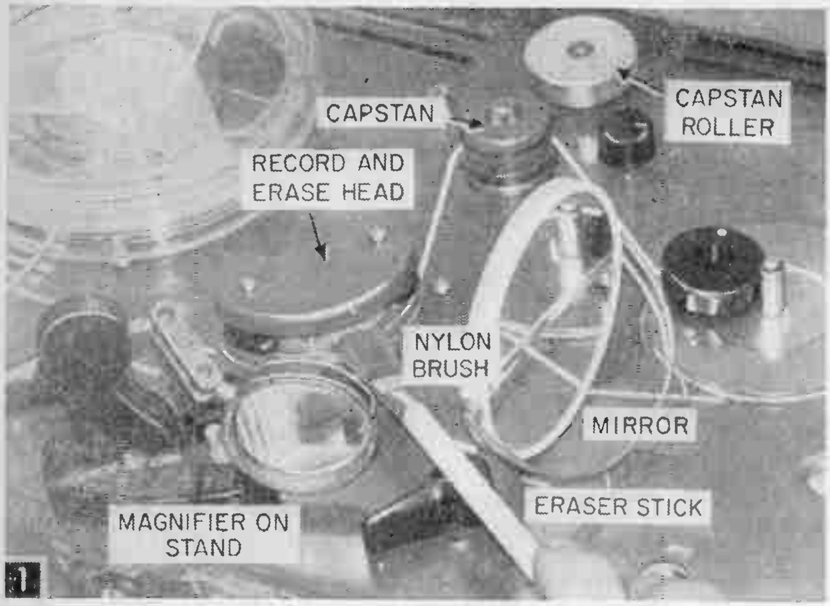
Charged Plastic Dusts Platter



• If the grooves of your hi-fi phonograph records are filled with dust, here's how to remove it the harmless electrostatic way: Take a piece of Saran plastic wrap and crumple it in your fingers while holding it about an inch above the surface of the revolving platter. The static electricity produced by crumpling the plastic will attract the dust particles and hold them. If you watch very closely, you'll actually be able to see them jump from the platter to the charged wad of plastic.—J.A.C.

Tape Recorder Upkeep

By JAMES A. McROBERTS



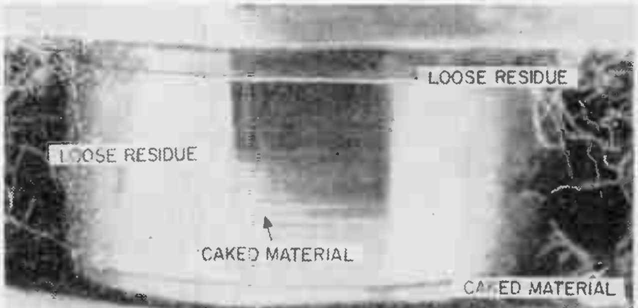
Top-chassis view of typical tape recorder showing use of brush, magnifier and mirror to clean heads.

Many thousand hours of nearly flawless service are engineered into even the least expensive tape recorder. Here's your part in getting every one of these hours from your machine

IN every tape recorder, a tape transport mechanism *transports* (pulls) a tape from a *supply* reel past a magnetic recording-reproduce head (or heads) and winds it on a *takeup* reel. An electronic amplifier (or amplifiers), with associated record-reproduce heads and accessories are also essential in tape recording, the electronic accessories to include a volume control, recording level indicator, and an erase oscillator driving an erase-head winding.

A combined group of mechanical-electronic equipment accessories (controlled by the function switch) switch the amplifier, the heads, the erase oscillator, and also change tape direction and speed. Your owner's manual covers the placement of the heads, controls and other parts with specific lubrication instructions and other data applicable to your particular recorder. Those are specific instructions. With them, you'll also need a general schedule of inspection and lubrication. Lubrication should be performed every 500 hours of service, additional operations every 1000 hours. (Some work is on an *as-needed* basis and is so mentioned below.)

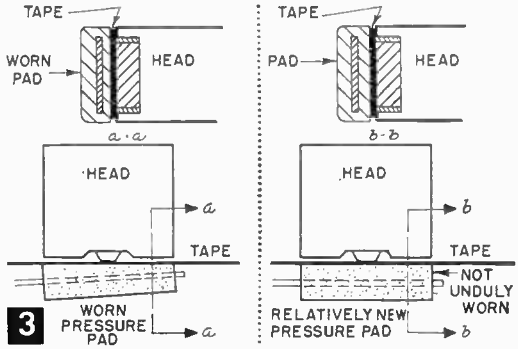
Mechanical Maintenance Schedule: 1) Clean the recording, reproduce (playback), and erase heads. Use a magnifying glass and mirror to reflect light on the



Business part of head showing erase lamination on left with record-playback lamination on right. Above, microphotograph of dirty head.

heads (See Fig. 1). A nylon brush on a typewriter eraser stick is an excellent tool for removing loose residue from the head structures. Loosen caked material with a lint-free rag moistened with rubbing alcohol or carbon tetrachloride wrapped around a wooden or plastic toothpick. Remove excess liquid with another clean rag.

Do not use metallic tools on the head laminations, or bring magnetized objects near them. Metallic objects scratch or dent the laminations, and can magnetically short-circuit them; magnetized bodies could magnetize the head, requiring an unnecessary demagnetization. Do not use a pipe cleaner on the laminations. Use a nylon brush, a stiff bristle brush or a narrow toothbrush. Wipe the brush clean on a clean rag before the final brushing.



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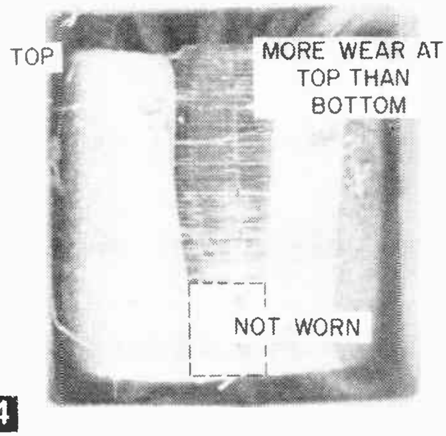

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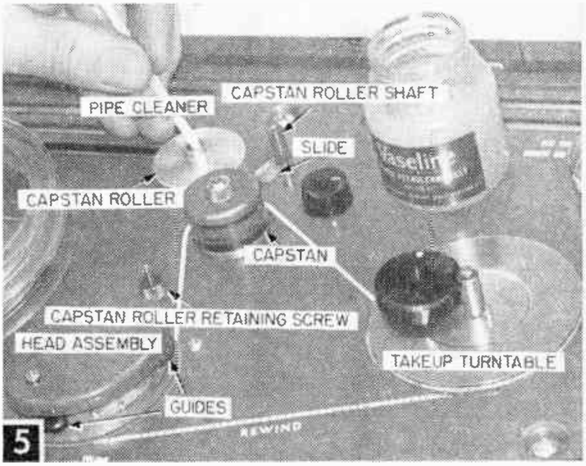
Badly worn single erase head.



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Lubrication of capstan roller with petroleum jelly.

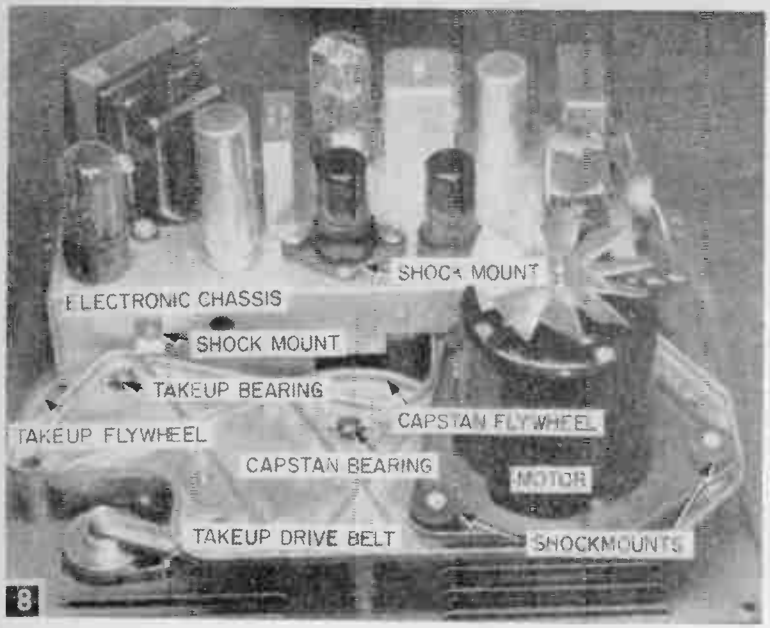
2) Inspect heads for uneven wear during cleaning. The cause of the uneven wear in Fig. 4 was uneven pressure of the tape against the head, the greater pressure being exerted at the top of the laminations (tape guides are employed in some recorders, pressure pads are used in other equipment).

To correct the cause of such uneven wear, the entire head structure can be rocked in some instruments to provide paralleled alignment of tape and the head structure. Most manufacturers of tape recorders which have pressure pads supply pads already mounted on arms for easy replacement. Try to detect excessive wear so that you may place an order well in advance for renewal pads. A reserve set is a good investment in continuous performance. If you can't purchase the pad-arm assemblies, then you must remove the old pads and cement on new ones.

3) Inspect pressure pads; replace if worn badly (see Fig. 3). Rocking the head to make the tape parallel must be done cautiously, however, since in some instruments the head can be moved sidewise (at an angle to the vertical in direction of tape travel). This is the azimuth adjustment which should *not* be touched if the high frequencies (the *ss's* and the *zz's*) reproduce satisfactorily. If such an adjustment is provided, and the high frequencies reproduce unsatisfactorily, make the azimuth adjustment by rocking the head sidewise so that the laminations gap is at right angles to the tape. Work carefully, preferably with the set-up shown in Fig. 1 (magnifying glass and mirror).

Remove old pads with a razor blade, scrape old adhesive from the pad arms. Replace with a new pad using adhesive (such as Duco cement) *sparingly*. Check parallelism of new pad with the head structure. Check spring tension of all pads against a piece of tape in the recording position. The pull on the tape—with tape taut from supply reel through the heads—should be about 2 oz. (half the weight of a ¼ lb. stick of butter). Loosen or tighten springs on the pressure pads, or adjust the brake on the supply drum as indicated by your inspection and "feel."

4) Inspect the capstan and roller. Test with a length of tape between these units. The pull for slippage of the tape should be about 2 lbs., approximately the weight of one qt. of water or milk. Rotate the capstan and roller manually through one revolution while making this check to see if the pull is uniform. Non-uniform pull



Underside rear view of typical tape recorder chassis.

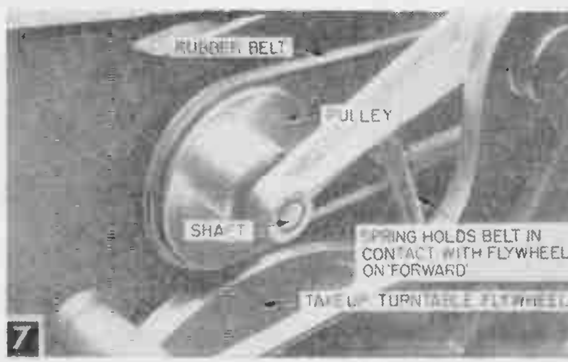
vide proper tension so that spillage does not occur.

Rubber friction drive may be accomplished by a belt in contact with a flywheel held by a spring (see Fig. 7), or by rubber-tired wheels driving the take-up reel. The cause of insufficient friction can be found by manual operation (power plug disconnected, function switch on Forward). The rewind is almost always another friction device operating at a higher speed. Inspect by manual movement of the motor drive pulley or belt (power plug disconnected, function switch in the Rewind position). Flats and reduced diameter are the principal troubles.

usually means a flat on either the capstan or the roller. Replacement is the only remedy. The cause of this defect is failure to push the movable member free when the recorder is left idle. Always separate these parts when your recorder is not in use.

5) Lubricate capstan and roller sparingly with clear petroleum jelly every 1000 hours of use. Figure 5 shows a roller being lubricated with a pipe cleaner. The sliding part may require similar lubrication. Use all lubricants sparingly—none must get on the *rubber* or on the *surface that contacts the tape.*

6) Inspect the take-up reel drive. Tape spillage will occur if friction here is inadequate (see Fig. 6). A spring drive may be employed; spillage of the spring compensates for the different speeds required. You can compress the spring with a pair of pliers, or open it, to pro-



Belt type friction drive assembly. Other type drive is accomplished by contact between rubber wheels and take-up reel.

Tape spillage due to insufficient drive of take-up spindle. Too much tension would break the tape.

7) Lubricate on schedule all bearings (such as the pulley bearing of Fig. 7) every 1000 hours of use with clear petroleum jelly from the top of a broom straw. Petroleum jelly is also a satisfactory lubricant for sliding parts with the exception of the high-speed bearing on the motor and some rewind pulleys. Here, several drops of #30 or #40 S.A.E. automobile engine oil should be applied with a straw or a narrow loop of thin wire.

It is extremely important that you do not *over*-lubricate; particular care should be taken to keep lubricants away from rubber parts. Clean rubber belts with a cloth moistened in rubbing alcohol every 1000 hours (use alcohol sparingly, it also attacks rubber).

You will find that some tape-recorder motors have built-in lubrication of their bearings and do not require lubrication.

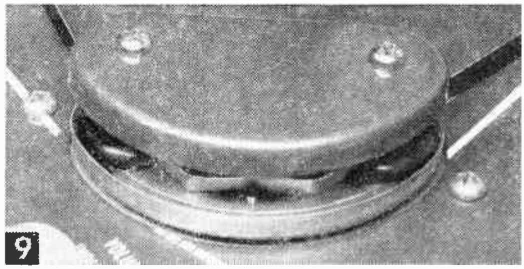
Figure 8 is a back, or upside-down view of a typical recorder chassis. The take-up reel and capstan reel bearings should be lubricated every 1000 hours with heavy motor oil or petroleum jelly. The supply reel bearing, behind the motor, will need lubricant at the same time.

8) Check the chassis-support bolts and shock-mounting rubbers of the electronic chassis (background of Fig. 8) by moving the parts they hold or shock-mount. Shock-mounted parts should give slightly, other parts should hold rigid. Replace rubbers or tighten bolts as required.

Electronic Maintenance Schedule. For the most part, electronic or electrical maintenance is far easier than mechanical. Some of this maintenance has been discussed under the care of the heads and their laminations already.

Every 1000 hours of use, test the tubes of your recorder at some reliable radio-TV store. Tubes should be checked every 1000 hours of operation (or at least once a year), because weak tubes that still play reasonably well may not draw the proper amount of current. Failure to draw rated current can cause a voltage rise which can damage other components. Also tubes with incipient short circuits can be detected before they damage or destroy other components.

1) If possible, test tubes for "quality" on a mutual-conductance type checker. Ask the salesman or serviceman to check for partial short-circuits also. This latter test is doubly advisable if the hum level of the instrument has increased since you bought it. Replace all tubes found to be unsatisfactory.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The time when heads must be demagnetized is hastened if tape is left in contact with the recording, erase, or playback heads when the machine is not in use.

2) A high background hiss level or noise level can be due to residual head magnetism (in the process of making a tape recording, we magnetize the tape, and magnetized tape will magnetize anything also capable of being magnetized with which it comes in contact). The amount of such secondary magnetization is a function of the intensity of the original magnetization of the tape and the time it is in contact with the heads.

When heads have accumulated enough residual magnetism to cause a high hiss, they must be demagnetized by subjecting them to a very strong alternating magnetic field for a few seconds, then slowly reducing this field to zero. Plans for a demagnetizer coil you can use for this purpose will be found on page 77 of *Science Experimenter* (No. 557), Vol. 1, a handbook available from SCIENCE AND MECHANICS for 50¢.

DXing "LIVE"

By C. M. STANBURY II

WHETHER you listen to standard, shortwave or TV broadcast stations, the news you get, the drama you hear comes to you secondhand. It has been cut, rearranged and sometimes distorted beyond recognition by the scriptwriter. Are you tired of it? Are you tired of the clichés and tired stereotypes that pass for reality? I was—and I did something about it.

Three-fourths of the radio spectrum is allocated to utility radio services such as aeronautical, marine and public safety, and it is here that the listener has his only chance to hear real people living real lives. The words transmitted by these stations come from no script. They come from life itself!

The most interesting, exciting listening is heard on emergency services such as the police and coast guard. Here, by knowing how and where to listen, you may hear men under pressure voicing the spine-tingling words of emergency.

But suppose you are a crime or mystery fan, then the frequencies assigned to law enforcement agencies may become your favorite bands. Here you will find realism that no magazine or book could ever bring you. Public safety radio services operate on both medium-wave and VHF (see Table B). Medium-wave is best for distant reception. See "One-Tube VHF Receiver," p. 45, on VHF reception. The first police band lies just above the standard broadcast band, starting at 1610 and going up to 1760 *kc*. In addition, a few such stations operate between 2300 and 2500 *kc*.

Major stumbling block to police listening is the use of coded number signals. All use a few of these, for example "ten-four," which means

TABLE A—THE PHONETIC ALPHABET

A Alpha	N November
B Bravo	O Oscar
C Charley	P Papa
D Delta	Q Quebec
E Echo	R Romeo
F Foxtrot	S Sierro
G Golf	T Tango
H Hotel	U Uniform
I India	V Victor
J Juliet	W Whiskey
K Kilo	X X-ray
L Lima	Y Yankee
M Mike	Z Zulu

TABLE B—THE POLICE BANDS
Range in Megacycles

1.61	to	1.75
2.3	to	2.5
31.14	to	32
33	to	33.12
37	to	37.44
37.88	to	38
39	to	40
42	to	42.96
44.60	to	47.68
153.74	to	154.47
154.62	to	156.24
158.7	to	159.48
166	to	173
454	to	456

POLICE STATIONS USING LITTLE CODING

KCA692 Newton, Mass.	1714 kc
New Hampshire State Police	1682 kc
KSA536 Milwaukee, Wis.	2450 kc
KCA281 Revere, Mass.	1714 kc
Ohio State Patrol	1730 kc
KQA387 Cincinnati, Ohio	1706 kc

that the contact is concluded. However some stations, such as KMA367 (of *Dragnet* fame) in Los Angeles, use almost nothing but code while others, like KCA962 in Newton, Mass., use a bare minimum of coding. Table B lists some of the police transmitters which will probably provide your best listening.

There is one disadvantage which cannot be overcome in police monitoring. The DXer can only hear one side of the picture: the viewpoint of the police dispatcher. Because of this, the Coast Guard distress frequencies 2760 and 2182 *kc* will sometimes prove more interesting and revealing. Balanced against this is the increase of both interference and dull traffic on these frequencies—2760 *kc* doubles as a general calling channel for Coast Guard stations. All contacts are made here (except on the Great Lakes) and then transferred to another frequency. The frequency 2182 *kc* is even worse for this since it is the international calling frequency for all ships. Table C lists the frequencies as well as the manner in which they are utilized by Coast Guard and distress traffic.

It comes down to a matter of patience—wherever you listen on the public safety and emergency channels, there will be the routine and matter-of-fact. Reality would not be reality without it—but only reality provides the compensating moments of spine-tingling actuality. Those with the least patience, will probably want to monitor the police frequencies. If you have a good deal of patience, the distress channels are for you.

Now, a few hints on identifying stations. On the Coast Guard channels, this is simple. These stations use their call letters or location on each transmission. Further, the letters are given phonetically, so there can be no error (see Table A). The headquarters station in each area is assigned a three-letter call sign—NMD, for example, at Cleveland. Other stations in the district add one or two digits to the HQ call, as NMD47, Buffalo. However, non-coast guard vessels in distress will merely call by location, for example, "Coast Guard Norfolk." Table C gives call and location of all CG district headquarters stations. Coast Guard vessels use four-letter calls.

Identifying police transmitters is touch-and-go. Some frequently identify; others, every hour; and, a few seldom announce their call or location. Police calls generally consist of three letters followed by three digits. They are not given phonetically. A complete registry of public safety systems in the U. S. can be obtained from Communications Engineering Book Co., Monterrey, Mass., for $4.

One can monitor a local broadcast station and when a disaster or search is reported tune to the appropriate CG or police frequency, but by then the action is already completed.

A note of caution: It is a federal offense to reveal the transmission of any utility station. So don't phone a scoop to your local paper. The wire services monitor the utilities so they'll have the story already anyway—but you are absolutely free to listen for your own entertainment.

TABLE C—
THE COAST GUARD CHANNELS

Frequency in kilocycles	Service
2182	Distress. Calling, particularly on Great Lakes
2662	General traffic
2670	Calling and distress
2678	General traffic
2686	General traffic
2694	General traffic
2702	General traffic

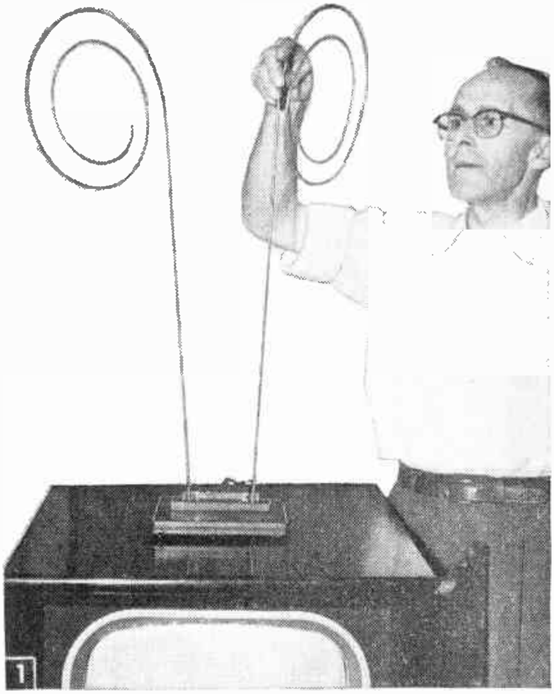
COAST GUARD DISTRICT HEADQUARTERS

NMA	Miami, Florida
NMB	Charleston, S. C.
NMC	San Francisco, Cal.
NMD	Cleveland, Ohio
NMF	Boston, Mass.
NMG	New Orleans, La.
NMH	Washington, D. C.
NMJ	Ketchikan, Alaska
NMK	Cape May, N. Y.
NML	St. Louis, Mo.
NMN	Norfolk, Va.
NMO	Honolulu, Hawaii
NMP	Chicago, Ill.
NMQ	Long Beach, Cal.
NMR	San Juan, P. R.
NMV	Jacksonville, Fla.
NMW	Seattle, Wash.
NMX	Baltimore, Md.
NMY	New York, N. Y.
NOY	Galveston, Tex.

Homemade Television Antenna

By HAROLD P. STRAND

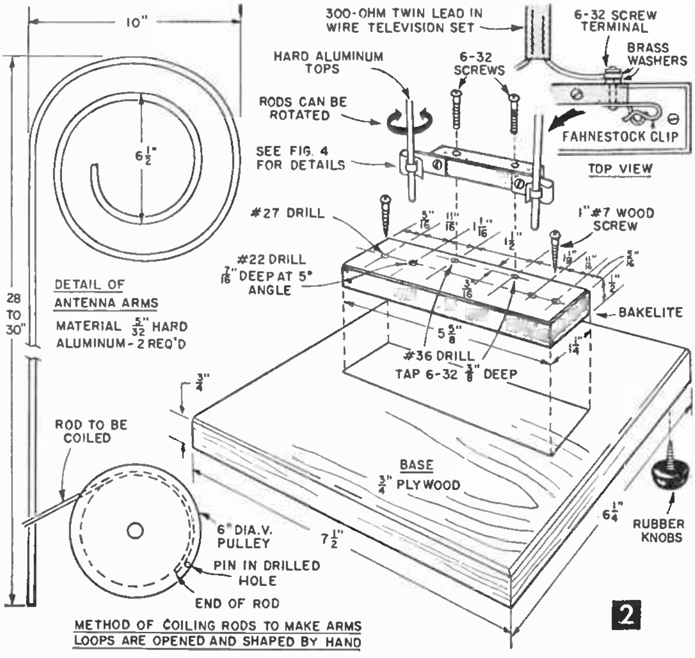
Save your money and improve your TV set's reception with this inexpensive, effective antenna



Each arm of this indoor television antenna can be rotated to bring the coiled sections in the best position for station reception.

AN INSIDE antenna usually works well for television reception from stations up to 25 miles or so away. After experimenting with the familiar "rabbit ears" form of interior antenna, I found that this homemade design definitely improved reception under certain local conditions. The aluminum rods coiled at the top ends (Fig. 1) are so attached to the base that they can be rotated, and this helps to clear up ghost images and improve the picture. These coils can be moved to be at right angles to each other, formed as a V or used in a flat plane, and the entire unit can also be rotated on the cabinet for further adjustment.

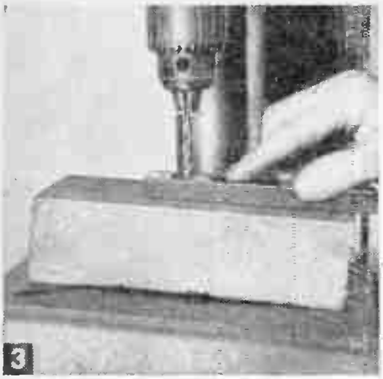
Each rod represents a 6-foot antenna arm, but when coiled, the total height is only about 2 feet 4 inches. A short piece of 300-ohm lead-in wire connects the terminals at the base of the antenna to the antenna posts of the television set.



For the ¾-inch birch plywood base, select some smooth grain stock and cut the piece to size (Fig. 2). Smooth the edges and slightly round the corners on a sanding disc. Then apply walnut or mahogany oil stain, allow it to dry for about 10 minutes, and then wipe off all surplus stain. After three or four hours apply two or more coats of shellac, lightly rubbing down each well-dried coat with fine steel wool. Finally, apply wax and rub briskly with a dry cloth for a pleasing soft finish.

As an insulated support for the lower ends of the rods, cut a piece of ½-inch thick Bakelite to size and drill the required holes (Fig. 2). Bore the two holes for the rods on about a 5° slant (Fig. 3).

Figure 4 shows the terminal strip made from a second piece of Bakelite. The lead-in wire attaches to the nut terminals



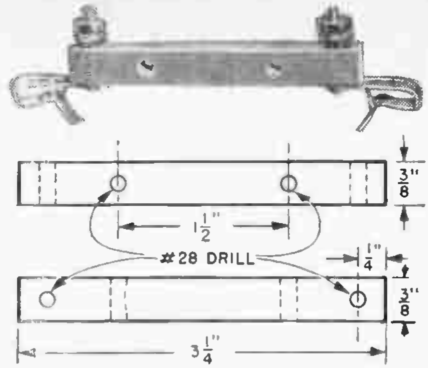
3

By tipping the drill press table the two holes drilled for the ends of the arms are given a 5° slant or you can hand drill by shimming up one end of the piece to get the right slant.

MATERIALS LIST—TV ANTENNA

1 pc ¾" birch or pine plywood 6¼ x 7½"
1 pc paper base Bakelite ½ x 1¼ x 5⅝"
1 pc paper base Bakelite ⅜ x ⅜ x 3¼"
2 Fahnestock clips
2 pcs hard aluminum rod 5/32" diameter x 72" long
4 rubber drive-in base knobs (rubber tack bumpers)
2 #7 rh wood screws 1" long
2 6-32 rh machine screws (brass) ⅞" long
4 brass 6-32 nuts
4 brass washers
2 6-32 rh brass machine screws ¾" long
About 3 feet twin lead-in wire, stain and shellac

SOURCES OF SUPPLY: For Bakelite, try Forest Products Co., 196 Broadway, Cambridge, Mass. Fahnestock Clips, lead-in wire and rubber base knobs may be obtained from Allied Radio, Dept. 10, 100 N. Western Ave., Chicago, Ill. For aluminum rod, metal supply or products company, see your classified telephone directory.



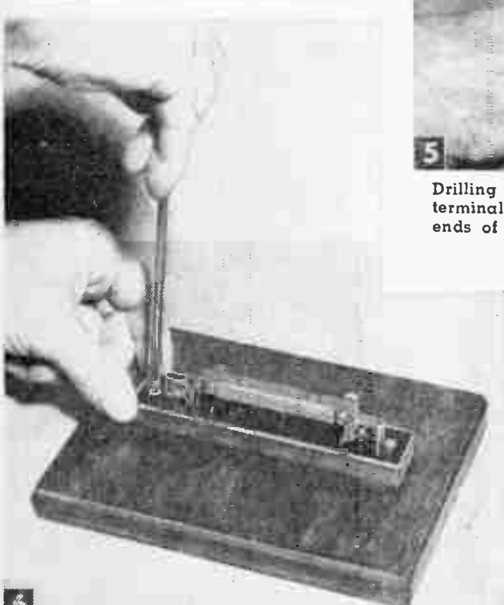
4 TERMINAL STRIP - 1 REQ. BAKELITE

Completed terminal strip equipped with two Fahnestock clips and terminals for lead-in wire connections (Fig. 2).

5

Drilling holes for 6-32 screws which attach terminal strip to base piece. Note that ends of antenna arms are put in position to line up the parts.

and the ends of the rods go down in the spring loops of the clips (Fig. 2) to make good contact and also serve to hold the rods in position. You may need to bend the loops out slightly in order to fit the 5/32-inch dia. rods. To make sure clips are placed right on Bakelite so the rods will pass through the loops and enter the holes in the bottom Bakelite piece, use a short piece of rod stock as a guide at each end to insure proper alignment before drilling the holes for the 6-32 screws that secure the clips. The terminal strip attaches to the lower piece with two 6-32 screws (Fig. 5 shows how the holes are spotted for the screws). With the ends of the rods through the loops of the clips and also pressed down in the lower Bakelite piece, use two small C clamps to hold the top piece in position for drilling (Fig. 5). Drill and then tap the holes for 6-32, and then screw terminal strip to base piece. Next screw the assembly to the plywood base with two 1-inch #7 *rh* wood screws (Fig. 2) to accomplish this.

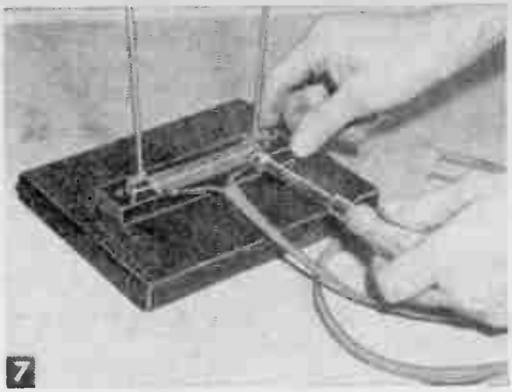


6

Roundhead wood screws fasten the Bakelite base piece to the wood base, through holes bored in the ends of the Bakelite.

Making Antenna Arms

The 5/32-in. dia. aluminum rod stock is of the hard 17ST4 type. You'll need to get two 6-foot pieces from a local dealer in metal and metal products (look under these classifications in the yellow pages of your classified phone directory). Bend the coiled ends around a 6-inch dia. V pulley as shown in Fig. 2. A small hole was bored in the pulley to receive a steel pin, under which the end of the rod is placed to hold it. The pulley is then turned by hand and the rod carefully



7

Connecting a short piece of twin lead-in wire to the terminals. The other end connects to the television set terminals.

wrapped around to form the coil. The stock springs out when released to some extent and you can then apply some hand forming to get the neat coils shown.

Before fitting the finished coiled rods into the base section, slightly round the ends of the rods so that they enter the Fahnestock clips easily when the lever is pressed, and press them down firmly in the slanting holes in the base piece. This construction allows the rods to be turned while the spring clips still hod them firmly in place.

Figure 7 shows how the short length of lead-in wire is attached to the terminals. After connecting the other end of the wire to the set terminals, you are then ready to try out the new antenna. If you wish, you can attach four rubber base knobs or felt to the antenna base to protect the surface of your TV set.

Transistor Set for Code Practice

1

This transistor code practice outfit will operate for days on a single penlite battery. It is easily modified for 2-way use.

FOR those interested in mastering the International or Morse codes, an audio-tone oscillator is essential. Prior to transistors, two types of code practice circuits were popular. One was the vacuum tube *feedback* oscillator; the other was the neon-glow *relaxation* oscillator. The relaxation circuit was the simplest, but required a minimum of 60-volt *dc* to fire the neon lamp. The feedback circuit required a minimum of 22½-volt *dc* plate voltage, plus a 1½ to 6-volt filament or heater supply, depending upon the tube employed.

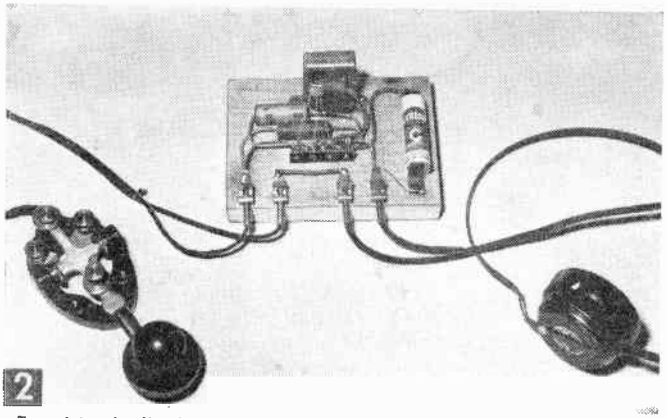
The circuit of this transistorized feedback oscillator has the simplicity of the neon-glow, the signal strength of the vacuum tube, and requires only one or two penlite cells for weeks of service. It may be used for solo practice, or two may send and receive with the same unit.

Following a simple breadboard design, the components are arranged on a 5 x 3½ x ⅝-in. baseboard (Fig. 2). The four Fahnestock clips attached to the base with ½-in. wood screws serve as terminals for attaching key and phones. The 4-lug tie strip secured near the baseboard center serves as a solder tie-point for capacitors, resistor and hookup leads; it also provides a simple mounting for the P-N-P junction transistor.

The feedback inductance is the primary side of most audio output transformers. This is the transformer between the output tube of a radio set and its PM speaker, and you can salvage one from a junked radio, or buy a new one, purchased usually for less than $1. Those advertised as 50L6 types are ideal, but any single plate-type output trans-

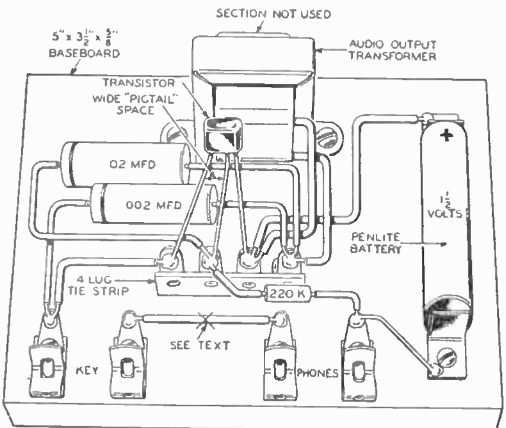
MATERIALS LIST—
CODE PRACTICE SET

1 5 x 3½ x ⅝" wood baseboard
1 P-N-P junction transistor, CK-722 (Raytheon) or RR-38
1 audio output transformer, 2500 to 10,000-ohm tube load
1 220K (220,000) ohm, ½-watt composition resistor
1 .002 mfd. paper capacitor (working voltage unimportant)
1 .02 mfd. paper capacitor (working voltage unimportant)
4 Fahnestock clips
1 transmitting key
1 pair, magnetic headphones, about 2000 ohms (do not use crystal type)
1 4-lug tie strip
Miscellaneous, ½-in. rh wood screws, hook-up wire, penlite batteries



2

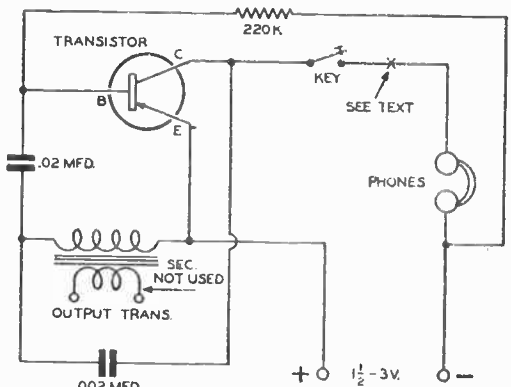
Transistor feedback oscillator requires no switch, since penlite cell is simply removed from base clips when unit is idle. Transformer may be eliminated when used for dual practice.



3 PICTORIAL DIAGRAM

Then, with key and magnetic phones connected, the transistor audio oscillator is ready for use. The headphones you use should be rated at about 2000 ohms or so (crystal headphones will not work in this circuit). For a stronger signal, use two penlite cells in series, which will then deliver 3 instead of 1½ volts to the circuit.

If you want to learn the code (Table A) with someone else, connect another key and phone in series, break the lead marked "X" in Fig. 3, and you have a two-way system. Remember, however, that when one person is sending, the other must hold down his key to provide circuit continuity. Some keys have a built-in knife switch for this purpose.



4 SCHEMATIC DIAGRAM

former with a 2500 to 10,000-ohm rating will do.

Disregarding the two plain enameled voice coil secondary leads, connect the insulated primary leads (usually red and blue colored) at the tie-points as shown in Figs. 3 and 4.

Note that two small angle brackets (fashioned from spring brass, copper or tin) are screwed down to the base to secure a single penlite cell.

TABLE A—INTERNATIONAL MORSE CODE

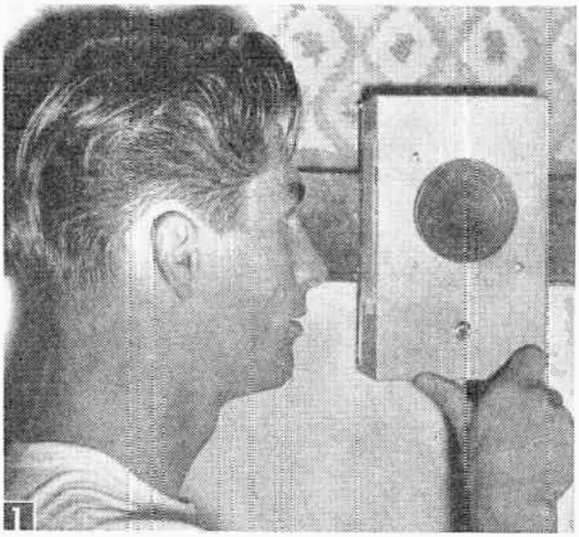
A	•-	J	•---	S	•••	2	••---
B	-•••	K	-•-	T	-	3	•••--
C	-•-•	L	•-••	U	••-	4	••••-
D	-••	M	--	V	•••-	5	•••••
E	•	N	-•	W	•--	6	-••••
F	••-•	O	---	X	-••-	7	--•••
G	--•	P	•--•	Y	-•--	8	---••
H	••••	Q	--•-	Z	--••	9	----•
I	••	R	•-•	1	•----	0	-----

PERIOD •-•-•-
COMMA --••--
? MARK ••--••

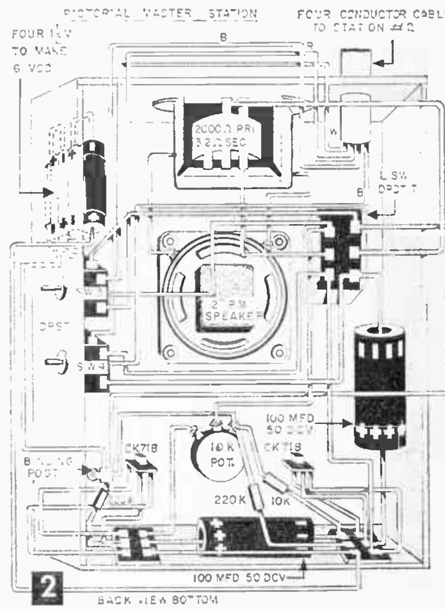
If this transistor oscillator is built expressly for two-way transmission, the audio output transformer can be eliminated by installing clips for the second pair of phones where the primary leads are terminated. Thus the second pair of phones serves both as reproducers and oscillator coil. You then insert the additional key at "X" in Fig. 4.—THOMAS A. BLANCHARD.

Transistorized Intercom

For less than $15 you can build this small but rugged two-station intercom and get surprising clarity and volume from room to room



A few parts—most of them from your scrap box—and a few hours of time and you have your intercom. Here the author is calling to the Master Station.

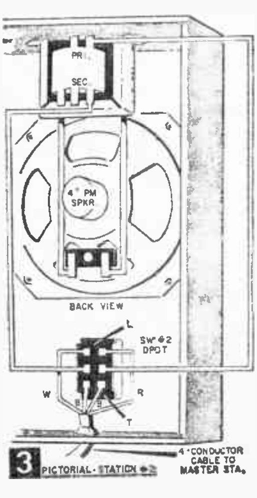


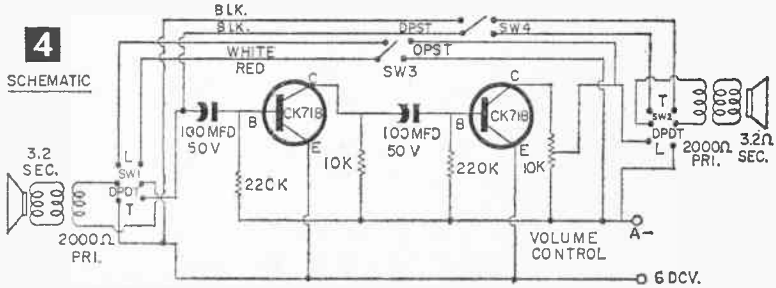
By DONALD S. PEARSON

THIS project is based on the Transistor Amplifier project given on p. 34 of the *Radio-TV Experimenter*, Vol. 6 (75¢). By changing a few of the original parts, and using the same circuit and adding a few extra parts and switches, this unit can be made to serve not only as the amplifier, but as an intercom as well.

The schematic for the complete unit is given in Fig. 4, pictorial wiring diagrams in Figs. 2 and 3. Use a cigar box as the master station, mounting the transformer and speaker as near the top center as space will allow. The DPDT switch #1 on this station can be mounted to the right of the transformer and there will then be room enough to mount the three penlite batteries to the transformer's left.

You can mount the Cinch-Jones barrier-type terminal strip on the bottom of the box. Note the long leads on the transistor sockets. Leads are soldered to the sockets first; the transistors are inserted when all the wiring is completed to eliminate the chance of overheating and ruining them.





To operate, SW1 must be on L, SW2 must be on T. SW3 and SW4 must be on the closed position. This is the necessary procedure for the Number Two station to call the Number One or Master Station. To call No. 2 station from the Master Station SW1 must be on T, SW2 must be on L. SW3 must be on the open position. SW4 must also be on the open position. Four-conductor cable is used between stations. A buzzer may be added if desired.

MATERIALS LIST—TRANSISTORIZED INTERCOM

No. Req.	Description
1	binding post (see Fig. 2)
2	2" or 4" PM speakers
2	output transformers, 2000-ohm Pri. 3.2-ohm Sec.
2	CK722 or CK718 transistors
2	electrolytic capacitors—100 mfd, 50 v dc
2	220K, ½-watt resistors
1	10K, ½-watt resistors
4	DPDT toggle switches
1	10K potentiometer
1	pointer knob for pot
2	Cinch Jones barrier type terminal, 3 or 6 term
2	transistor sockets (optional)
2	cigar boxes (or equiv. in size)
3-4	Penlite batteries

Long leads permit moving them to a more convenient position, depending upon the space in the box.

I used a 2-in. PM speaker in the Master Station. This was done because it was handy at the time of construction. It also left more room in the box in which to work. A 4-in. speaker will fit, and will probably give better results. Since they both cost about the same, the size speaker to use is optional.

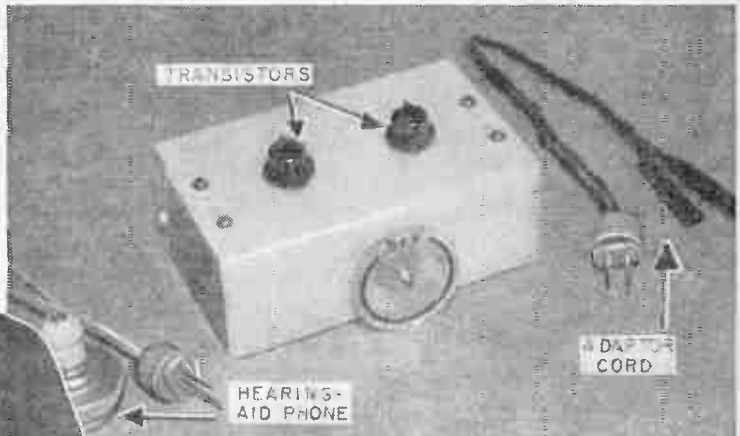
It is possible that a more simple switching arrangement could be devised, but the switches I used were handy at the time. If switches #3 and #4 are not used, an intermittent "bleep" will develop when the intercom is in use. The "T" position on switches #1 and #2, both enter the input side of the amplifier. When the master station is on the "T" position and the #2 station is on the "L" position, part of the signal would go through the amplifier, while the remaining portion of the signal would go out the "T" wires of the #2 station. With switches #3 and #4 at these points, however, the circuit is broken, thus allowing the entire signal to be amplified.

Because of the distance between the two stations (in my case, about 100 ft.), 4½ *v* are used, instead of the 1½ *v* used in the original transistor amplifier. (The batteries will become weak with use and cause a crackle or a mushy sound in the speaker. When this happens, replace the batteries.)

The box for the #2 station is also a cigar box. This can be made smaller if space is your problem. Both stations are mounted on the wall by means of four wood screws through the cover or lid of the box. Contact paper can be used to cover both boxes to give them a neater appearance.

"I said save the short-wave set!"

Vestpocket Transistor Amplifier



Testing an ordinary standard size magnetic earphone for use as a microphone with the transistor amplifier. Photo above shows how transistors are placed on outside top of case.

By THOMAS A. BLANCHARD

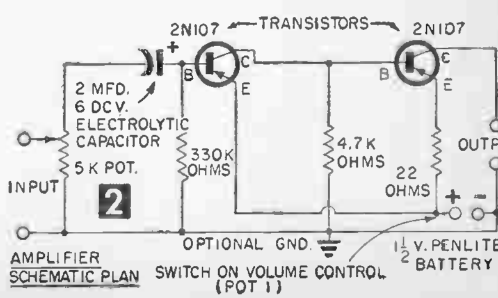
WHILE primarily intended to serve as an electronic novelty, this tiny transistor amplifier certainly is *not* to be classified as a toylike gadget. It may be used to amplify crystal radios, provide private listening with a record player, function as a detectophone, or even as an electronic stethoscope for tracking down vibrations in machinery, motors or engines.

The direct-coupled circuit requires the very minimum of components—all of which are quite inexpensive (see Materials List). A single penlite AA size 1½-volt cell powers the amplifier and the entire unit is housed in a 1 x 2 x 3-in. plastic box.

Make a battery clamp from a strip of 1/32 x 3/8-in. aluminum to fasten the battery to one of the 3-in. box sides as in Fig. 3. Then arrange the amplifier components to fit the remaining space. Because ordinary phone jacks require too much space, the "Input" and "Output" connections terminate at miniature jack strips which match miniature 2-pin plugs designed for hearing-aid size earphones. Drill four 3/32-in. holes spaced 3/16 in. apart at each end of the box for the jack strips. The two outer holes are for mounting the connectors with 2-56 by 3/8-in. *rh* machine screws. Remaining two center holes allow passage of plug pins through the box to the phosphor bronze contacts.

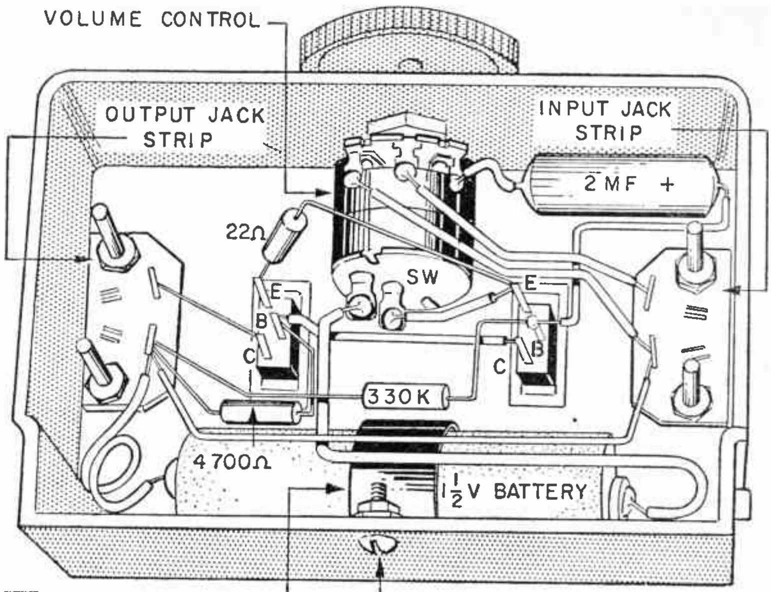
The volume control is the conventional subminiature type and measures just 5/8 in. diameter. A 1/4-in. hole drilled in the front of the box provides for its mounting. The control has a resistance of 5000 ohms and incorporates a power switch for turning battery power on and off as well as controlling the input signal. It has a 1/8-in. dia. shaft, 7/32 in. long and is slotted for either a decorative push-on knob or 5/8-in. dia. knurled set-screw knob for 1/8-in. shafts.

The entire amplifier hook-up will require only a few inches of wire since the pigtail leads on the 1/2-watt resistors and 2 mfd. 6 v. electrolytic capacitor provide their own connecting leads. Because of limited space in practically any transistor circuit, #22 solid tinned hook-up wire is best. Leads that require insulating may be covered with plastic radio "spaghetti." Two short lengths of conventional stranded, plastic insulated wire are used for the leads from amplifier to bat-



tery. Solder these leads directly to the penlite cell (Fig. 3). The battery brass cap is *positive* and zinc case *negative.* Battery life in this circuit is remarkable so that in normal use, replacement will be infrequent.

A word about mounting the transistor sockets: These tiny Bakelite units require a rectangular hole opening of 5/32 x 11/32 in. To avoid making them too large, first drill two 9/64-in. holes side by side. Then use a 1/8-in. sq. modelmakers file to shape the rectangular openings in the plastic. Because plastic files down quite rapidly, check the hole size with a transistor socket after each few file strokes.



3

Using the Amplifier. Since all transistors are low impedance devices, this fact must be kept in mind when using the amplifier. A high impedance crystal microphone or phono pickup *cannot* be connected directly to the input. Nor can a crystal-type earphone be attached directly to the output of a transistor amplifier.

However, any 1- or 2000-ohm, magnetic earphone can be used either as a receiver or mike. While the amplifier was designed for use with a miniature 2000-ohm phone, large phones may be used with the simple adaptor cord shown in Fig. 1. Attach a miniature phone plug to one end of a short cord and to the other end attach two clips salvaged from an old octal wafer tube socket. Cover these clips with plastic spaghetti. Conventional phone tips can then be attached to the clips and the cord plugged into the amplifier. This method may be used for all other applications you may have in mind, such as using a PM speaker as a dynamic microphone.

Any PM speaker may be used. The matching transformer would have its 3 or 4-ohm winding attached to the speaker voice coil lugs. The transformer's 250 to 500-ohm winding would be connected into the input of the amplifier. Now to use the speaker as a speaker, just shift the pin plug to the output jacks and attach the output of a crystal radio, magnetic phono pickup, earphone mike, etc., to the input jacks.

A crystal phono pickup may be used with the amplifier in some instances without a matching transformer, but usually such will be required. An old fashioned magnetic pickup or modern magnetic types require no transformer coupling. Incidentally, a needle soldered to the diaphragm of an old magnetic earphone makes a good phono pickup.

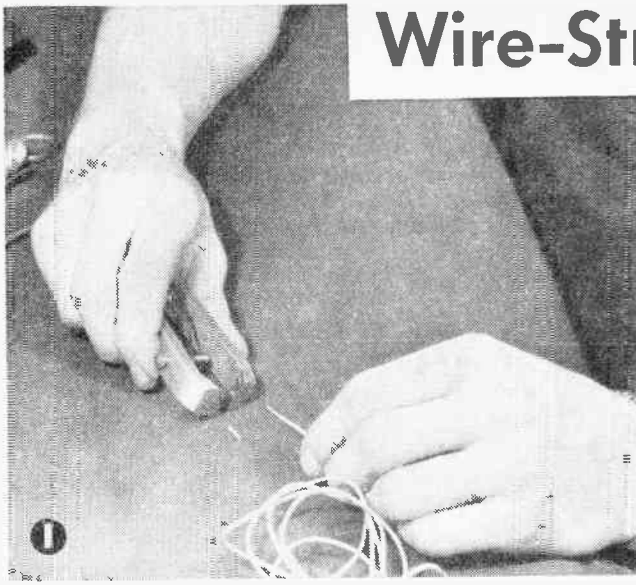
Using the amplifier as a stethoscope, a standard size 1000 or 2000-ohm earphone is connected to the amplifier input, and a hearing-aid phone connected to output jack. Unscrew the large earphone cap and place the receiver on your chest. The exposed diaphragm provides a more effective pickup than with the cap on the receiver. Try placing the rubber eraser end of a lead pencil against the diaphragm, and pointed end in contact with any motor driven device. The result will be similar to that of an industrial stethoscope.

If you own a pair of magnetic phones, the existing tinsel cord may be removed from them and set aside. Each phone may be fitted with new cords and miniature pin plugs. Thus one phone will serve as a mike; the other as a receiver. When finished experimenting with the phones, the original cord may be replaced and phone set will again be as good as new.

MATERIALS LIST—VESTPOCKET TRANSISTOR AMPLIFIER

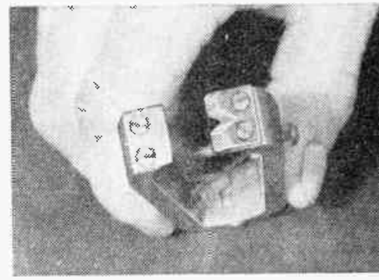
No. Req.	Size and Description
1	small plastic (or metal) box, approx. 1" x 2" x 3"
2	miniature 2-pin phone plugs
2	miniature matching jack strips for above
2	P-N-P transistors, GE 2N107 (or CK-722 types)
2	molded Bakelite transistor sockets for above
1	2 mfd., 6v. miniature electrolytic capacitor
1	sub-miniature 5K volume control/switch
1	knob for control
1	22-ohm. ½-watt composition resistor
1	4.7K, ½-watt composition resistor
1	330K, ½-watt composition resistor
1	type AA penlite battery, 1½v.
4	2-56 by 3/8" rh machine screws and nuts
1	4-40 by ¼" rh machine screws and nuts

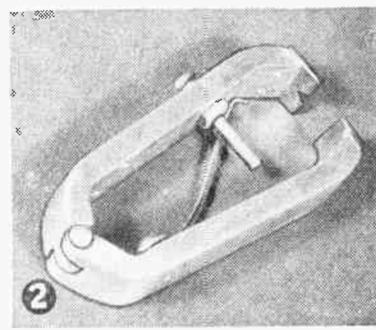
NOTE: To connect a high impedance crystal mike or pickup to amplifier, Lafayette Radio Transformer #AR-100 may be used. To use a PM speaker as such, or as a mike, use #AR-122, or #AR-119. Parts available from Lafayette Radio, 165-SM Liberty Ave., Jamaica 33, N. Y.



Wire-Stripping Tool

By HAROLD P. STRAND





THIS tool quickly strips insulation from all kinds of insulated wire in one twist of the tool and a light pull. End piece is then pulled off with the tool (Fig. 1). First an adjustment screw must be set, using a test piece of wire, to allow cutters to sever insulation without cutting strands of copper. The screw acts as a stop.

Tool accommodates all sizes of wire from about #10 down to the smallest common wire size. One of the hardened tool steel blades has a V cut and the other a straight edge (Fig. 2), both being ground to a sharp cutting edge. When sides of tool are pressed together, straight edge goes under V edge, with a snug but free fit, thus trimming around the wire insulation with one complete turn of the tool. Piano wire spring returns the side pieces to an open position when pressure is released. While the hinge joint shown was made in a small bench milling machine (Fig. 4), it can also be made with hand tools.

MATERIALS LIST—WIRE-STRIPPING TOOL

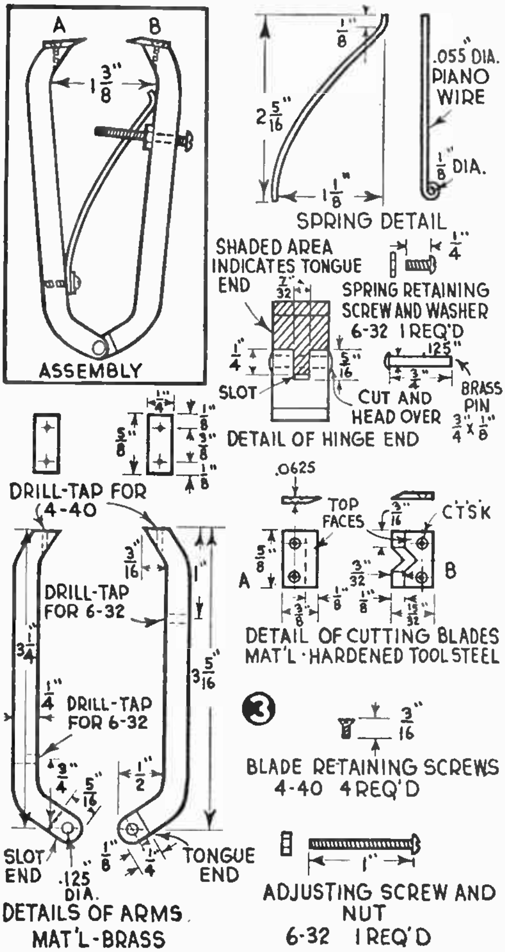
2 pcs.	brass bar stock ¼" x ⅝" x 6" (cut to length after bending)
1 pc.	tool steel .0625" x ⅜" x ⅝"
1 pc.	tool steel .0625" x 15/32" x ⅝"
1	brass low-head rivet or pin ¾" x .125"
1	6-32 rh machine screw 1" long
1	6-32 hex. nut
1	6-32 rh machine screw ¼" long and washer to fit same
1 pc.	.055" dia. piano wire about 3" long
4	4-40 fh machine screws 3/16" long

Fig. 3 gives a good idea of design and placement of parts. Fig. 2 shows the tool in its normal open position; spring, made from .055 in. piano wire opens side frames about 1⅜ in. at the top, as shown in drawing. Bend 2 pieces of ⅝x¼ in. brass to shape and dimensions given. Start with pieces about 6 in. long to facilitate bending operation. Use a heavy vise with brass jaw protectors and a fairly heavy hammer. To avoid marking stock use a small piece of brass under the hammer blow. After shaping, cut pieces to length; leave hinge ends a little long, until tongue and slot have been cut, after which ends can be dressed down to a good fit.

Finish pieces to a smooth surface, with fine abrasive cloth or a power sanding wheel, rounding all edges slightly. Drill and tap two 6-32 holes in the pieces, one for a spring retaining screw, the other for the adjusting screw. At the top ends, drill and tap 2 holes in each piece for 4-40 screws to hold cutting blades in place.

After fitting hinge joint with a fine file so it works smoothly without side play, drill hole for hinge pin, using a .125 in. dia. drill. This pin is a low-head brass pin or rivet which fits snugly in the drilled hole without causing joint to bind; use a little oil to get a free-working hinge. In riveting over the pin, don't drive joint together too tightly.

Shape an eye in one end of the .055 piano wire, using a pair of round-nose pliers, then bend to shape. Make blades of tool steel .0625 in. thick. Cut them out on a metal-cutting band saw or by hand with a hacksaw, and file to final shape and size. Make V cut on a power grinding wheel of fine grit. Grind underside of straight edge piece off to a sharp bevel and likewise grind top side of the other blade. Before final grinding of cutting edges, however, drill holes for the screws. Use flathead 4-40 machine screws, coun-



tersunk. With blades in a final finish condition, grind edges to a knife sharpness on a fine grit wheel. Harden blades with a Bunsen burner (Fig. 5) by heating to a cherry red, then plunging in cold water. Clean up one flat surface with

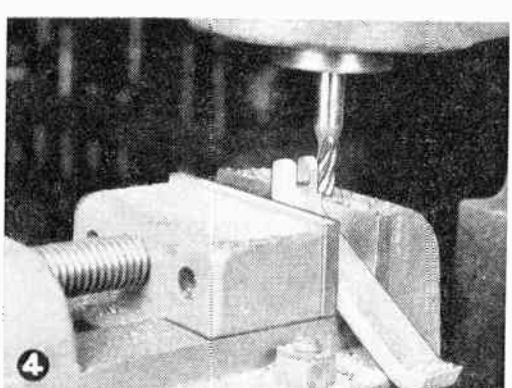


Fig. 4. Making hinge joint in a milling machine.

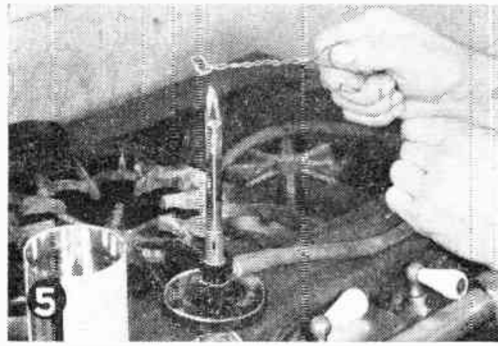


Fig. 5. Hardening cutting blades in a Bunsen burner (see text).

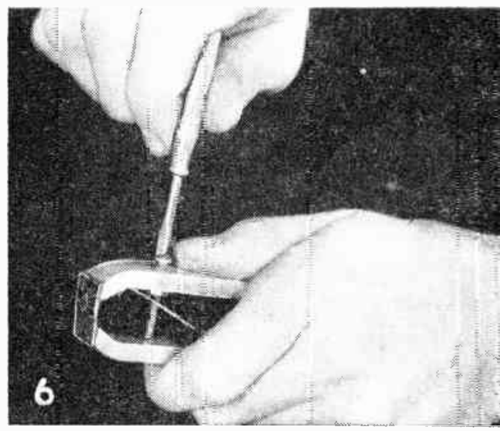


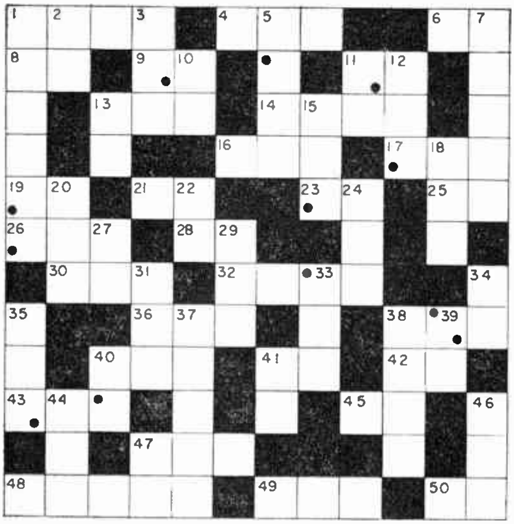
Fig. 6. Adjusting stop position of completed tool.

fine abrasive cloth and then place piece back in flame. When you note a straw color, quickly remove it and again place it in water. This draws the temper a little, so the steel will not be too brittle to work with.

Fig. 6 shows the completed tool with adjusting screw being tested. You may need to file down the end of one of the side frames so straight edge will just fit under the V edge after all blade screws have been tightened. Or a piece of .001 or .002 in. shim stock under one blade may give you the perfect alignment. Here is where accuracy in making hinge joint and in bending side sections counts. If poorly made, the blades will not make contact with each other properly, over their entire length.

You can also use this tool in radio chassis wiring for wire cutting ordinary #24 to #18 hook-up wire. If made properly, it will double for a pair of diagonal wire cutters or pliers. Place wire to be cut out of V groove, but between the cutting edges; wire will snip off just as nicely as with the diagonals; in this way one tool is used in place of two. This tool also trims short wires already attached at opposite ends, such as in re-connecting work or wiring changes. You will find the tool handy for using in very small spaces, where it will do a perfect job.

RADIO-TV CROSS NUMERAL PUZZLE



By JOHN A. COMSTOCK

CLUES

ACROSS

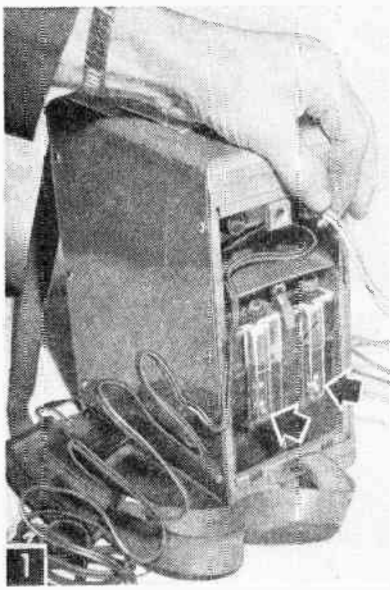
1) The year in which Lee deForest invented the "audion," a triode tube.
4) Mid-frequency of television channel 13.
6) Power consumed by a 175-watt television set operated for 12 hours.
8) Full-wave rectifier tube with electrical characteristics identical to those of the 5Y3.
9) Separation in megacycles between TV picture and sound carrier frequencies.
11) Fast tape recorder speed.
13) Output ripple frequency of full-wave, three-phase rectifier.
14) A current value of 1752 milliamperes converted to amperes.
16) The third harmonic of an 80-kilocycle signal.
17) A 20-cycle signal converted to kilocycles.
19) A capacitance of 2×10^{-2} microfarads expressed in conventional notation.
21) Upper frequency limit of TV channel 6 in megacycles (mid-frequency 85-mc.).
23) Five milliwatts expressed in watts.
25) The power that can be dissipated by two 200-ohm, 25-watt resistors, series connected.
26) Factor by which microhenries must be multiplied to convert to millihenries.
28) Voltage dropped when 2 amperes flows through a 26-ohm impedance.
30) Common AM superheterodyne IF frequency.
32) Oscillator frequency of a superhet having an IF of 456 *kc* tuned to a signal at 1144 kilocycles.
36) Output frequency of a generator having 10 poles and an armature speed of 1200 *rpm*.
38) Resistance of 15 ohms in parallel with 35 ohms.
40) Signal frequency received by a superhet with an IF of 456 *kc* and the local oscillator tuned to 1066 kilocycles.
41) The coefficient of coupling between two coils having values of .2 and .8 henries when mutual inductance is .1 henry.
42) The frequency 5,500 kilocycles converted to megacycles.
43) Total resistance of a 4-ohm, a 7-ohm and a 14-ohm resistance parallel connected.
45) The ripple frequency of a ½-wave single-phase rectifier.
47) Applied voltage across a series circuit of two resistors when voltage dropped across each component is 100 volts.
48) Upper frequency limit in megacycles of the shf band (lower limit 3,000 mc).
49) The wattage dissipated by a circuit drawing 3 amperes at 200 volts.
50) Number of degrees voltage lags current in a purely capacitive *ac* circuit.

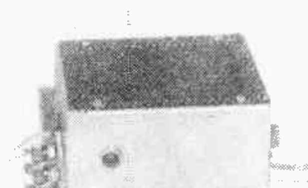
DOWN

1) Velocity in miles per second of a 500 *kc* signal.
2) Total resistance of two resistors of 35 and 55 ohms, series connected.
3) The wattage equivalent of one horsepower.
5) The peak value of a sine wave is found by multiplying the effective value by this factor.
7) Wavelength in meters of the lower limit of the vlf band (upper limit 30,000 meters).
10) Voltage dropped across a series *dc* circuit when the applied potential is 50 volts.
11) The frequency swing in FM transmission that corresponds to 100% AM modulation.
12) The frequency 520,000 cycles per second expressed in kilocycles.
13) Television frame rate.
15) The frequency 7×10^{-2} kilocycles expressed in conventional notation.
18) The unknown of the following voltage ratio: 1 is to 25 as 10 is to ——.
20) Lower frequency limit of television channel 12 in megacycles.
22) Highest approximate amplifier efficiency obtainable with class "C" operation.
24) International distress frequency.
25) Amount of voltage that will send a current of 5 amperes through a 10-ohm resistance.
27) The inductance .015-millihenries converted to microhenries.
29) Difference frequency in kilocycles produced by mixing a 1,000-*kc* signal with a 790-*kc* signal.
31) Impedance of an *ac* circuit when the current drawn is 1 ampere, applied voltage 511 volts.
33) Capacitance in microfarads of a capacitor having a reactance of 531,000 ohms at a frequency of 60 cps.
34) Amount of resistance in which a voltage of 35 volts will maintain a current flow of 1 ampere.
35) Total impedance of an *ac* circuit when reactance is 220 ohms, resistance 250 ohms.
37) Number of zeros represented by green in the resistor color code.
38) Wavelength in meters of a radio wave having a period of .005 second.
39) Current flow in an *ac* circuit when applied voltage is 20 volts, total impedance 400 ohms.
40) Power dissipated by a resistor of 200 ohms in series with a 5-microfarad capacitor across an *ac* voltage of 60 volts, 120 cycles per second.
41) Conductance of a circuit when current flow is 6 amperes, applied voltage 24 volts.
44) Percentage AM modulation that gives the greatest service-area coverage.
46) Amount of power expended when a current of 100 amperes is driven by a potential of 100 volts.
47) Secondary voltage of a transformer which has a primary voltage of 100 volts, primary turns 200, and secondary turns 40.

For answers, see Page 127.

Strobe-Flash Battery Charger





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Plugging the lead wire from the compact battery charger, shown at the right, into a built-in receptacle on the photo-flash unit. The three tiny balls floating in the electrolyte of each cell (identified by arrows above) are near the bottom, indicating the need for recharging. When balls float up to surface of electrolyte, battery is fully charged.

THE air turns blue when some photographer discovers weak batteries in his strobe flash unit have ruined a fine series of shots.

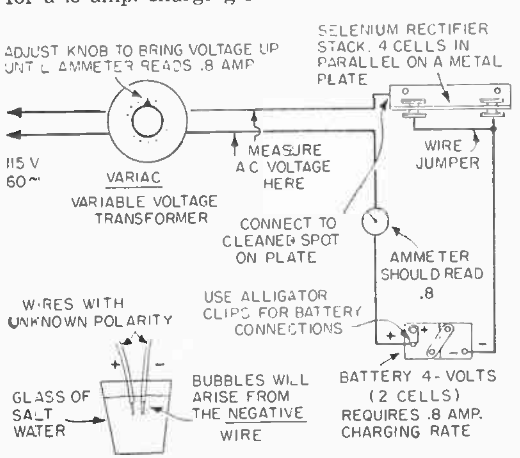
For strobe light flash units will operate even when the batteries are too weak to insure complete synchronization of the flash exposure.

One good way to avoid such wasted shots is to keep your strobe-flash batteries up to snuff with this charger. You can build it for about $10, less than the cost of a comparable commercially-built charger.

Although this charger was designed and built for a .8 amp. charging rate for use with a 4-volt battery in a Dormitzer Synctron flash unit, it could be redesigned for charging batteries of a different size. You can tell at a glance what the voltage of the storage battery in your unit is by counting the number of cells. Each cell is rated at 2 volts and since they are connected in series, merely multiply the cell voltage by the number of cells.

The recharging rate of the battery can be obtained from the manufacturer if it is not noted in the instructions you received with the unit. The value of .8 amperes is the same as 800 milliamperes, which is a more common term in electronics.

To find the correct a-c voltage that the charger transformer must deliver from its secondary in order to provide a .8 *amp.* d-c charging rate, make the test set-up shown in Fig. 2. A variable voltage transformer or Variac, which may be borrowed from a friend in the radio or electrical field, is connected with an ammeter in the test charger circuit. Start with 0 volts and gradually bring the voltage up until the ammeter reads .8 am-

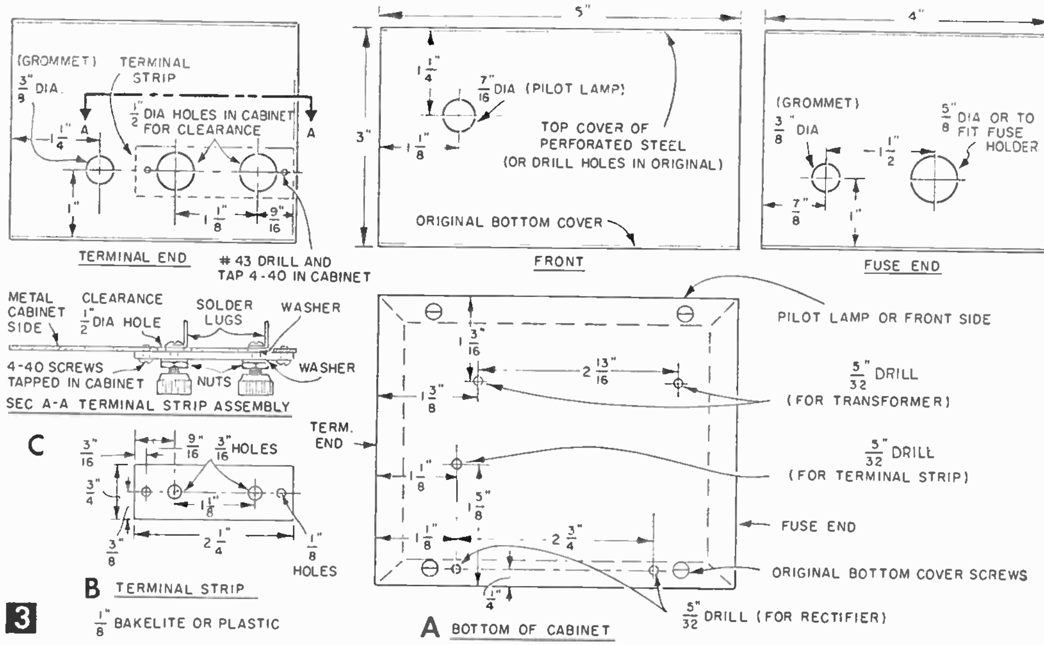


2 TEST CIRCUIT FOR MEASURING A.C. VOLTAGE REQUIRED FOR A GIVEN D C CURRENT TO BATTERY

MATERIALS LIST—STROBE-CHARGER

No. Req.	Size and Description
1	3 x 4 x5" aluminum cabinet, hammertone finish, Type 29811 ICA
1	6.3 volts, 2 amp. filament transformer Merit P 2945
1	selenium rectifier, 1800 ma. D.C. Federal type 1018 (If the above rectifier is not available, purchase 4 International CIH rectifier plates of 250 ma each, Allied catalog #4A825, and assemble as in Fig. 8.)
1	fuse holder, panel type, Littelfuse type 342001 with 1½ amp. fuse
1	pilot light assembly Dialco type 432, Series 510 with 6.3 volt lamp
6 ft	flat rubber lamp cord
1	attachment plug cap
2	rubber or bakelite grommets for ⅜" hole
2	insulated thumb nuts (from old B battery)
1	⅛ x ¾ x 2¼" clear plastic or bakelite
2	8–32 R.H. screws ¾" long
2	8–32 nuts and 4 washers
2	solder lugs for #8 screw (Allied Cat. #44N607)
2	4–40 R.H. screws ¼" long
8 ft	#18 flexible insulated wire
1	special male plug to fit charging receptacle on battery unit (Order from manufacturer of flash equipment.)
2	Mueller test clips type Pee-Wee 45 with rubber insulators
1	2-terminal, Bakelite tie-point terminal strip
1	piece perforated steel 4⅞ x 3⅞" (cut from old television back or other cabinet enclosure)
	Miscellaneous screws, nuts, etc., for mounting parts

Above materials available from any well-stocked electronic supply house, such as Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

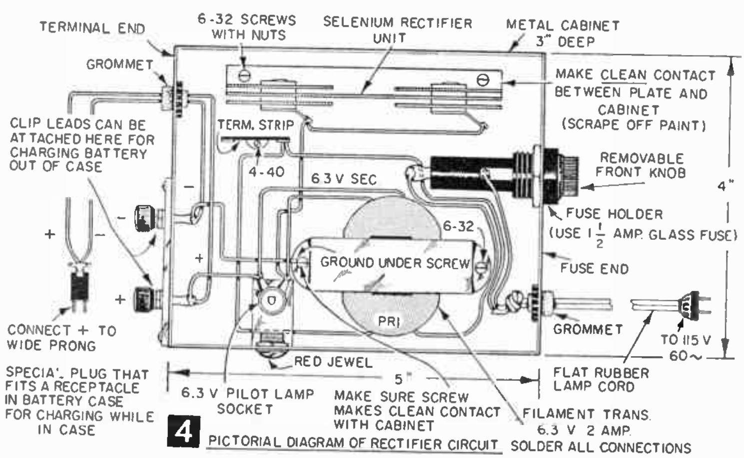


3

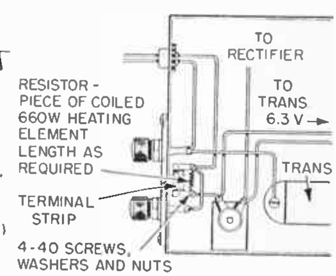
peres. Next, measure the voltage on the load side of the transformer with an a-c voltmeter having a range of to 0-10 volts to find the value required for a permanent transformer. In our case this was found to be 6.2 volts. If your flash outfit has a battery of the type described you will not have to make the above test. However, the method described is useful for determining the necessary voltage for other battery and rectifier combinations. See the Materials List for the components needed to make a 4 volt, .8 *amp.* charger. If the Federal rectifier is not available, use 4 International rectifiers as in Fig. 6.

Fig. 1 shows the new charger being connected to the battery in the carrying case, through a special plug that is attached to the wires coming from the charger, and which fits in a receptacle provided by the manufacturer for the purpose. Note that in this type battery, three small balls are used in each cell to indicate the condition of the battery. When all three are at the top, the battery is fully charged. As it goes down, the balls start to fall and when they are all at the bottom, the battery is discharged. It is well to start a recharge when the first ball has fallen and continue 2-3 hours after it has risen to the top.

Fig. 2 illustrates a set-up of a battery removed from the case and with an ammeter in the circuit to check the charging rate. Connections for this job are made to the two terminal posts and leads with alligator clips are employed. The meter reads about .9 amperes which is close enough to specifications of .8 amperes, since it would not be possible to always maintain exactly the same line voltage and fluctuations in line voltage would cause some variation in charging rate, as an expected fact. The use of these clip leads is conven-



4 PICTORIAL DIAGRAM OF RECTIFIER CIRCUIT SOLDER ALL CONNECTIONS



SEE FIG. 4 FOR CONNECTION WITHOUT RESISTOR 5

IF LINE VOLTAGE IS NORMALLY HIGH (120-125 VOLTS) CHARGING RATE CAN BE DROPPED TO .8-.9 AMPERES WITH A BUILT-IN RESISTOR IN THE CHARGING CIRCUIT. USE AN AMMETER TO DETERMINE THE REQUIRED AMOUNT OF RESISTANCE ient for charging a spare battery, but of course the meter would not be ordinarily used.

Start construction by drilling the required holes in the cabinet sides and bottom as detailed in Fig. 3A. Make the terminal strip as in Fig. 3B and assemble to the cabinet sides as in Fig. 3C sec. A-A with two 4-40 *rh* screws. Remove the bottom from the cabinet sides when fastening the transformer, rectifier and Jones terminal strip in their positions on the bottom of the cabinet with 8-32 screws as in Fig. 4. Scrape off the paint on the transformer and rectifier bases and cabinet and make up the screws tight so these parts will make a good ground connection. Use #18 insulated wire for all hookup connections and be sure to solder at all points of attachment. Assemble the fuse holder and pilot lamp socket to the cabinet sides and continue with the hookup wiring. Two grommets are used where wires leave the cabinet and these can be of rubber or *Bakelite* with screw-on rings.

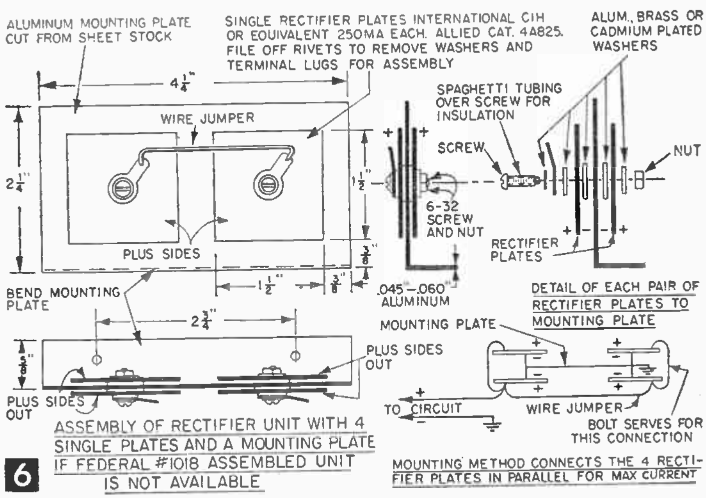
To provide ventilation and an escape for the heat generated in the cabinet, the original cover was substituted with a piece of perforated steel cut from what was formerly the back screen of an old television set. Any other perforated metal could be used instead. If desired, you can use the original cover by drilling six ½-in. holes in it.

If the battery is removed from the flash outfit and the special charging plug cannot be used as in Fig. 1, two leads with battery clips attached can be connected to the binding posts on the terminal strip as in Fig. 7. To replace a fuse, unscrew the front knob of the fuse holder and remove it so the glass fuse holder can be replaced.

As a rule when the battery has lost its charge, an overnight charging will fully restore the charge. However, when the battery has reached a certain age or had considerable use, it may not be possible to recharge it to the proper full condition. One or two of the charge indicating balls (Fig. 1) may rise but no amount of charging will effect the rise of all of them, or in some cases all the balls will rise, but in use the battery will be quickly depleted or fails to hold the charge. In either case it indicates that the battery is reaching the end of its life and may not be dependable.

In some areas where the line voltage is somewhat high (about 120 volts) the charging rate from the rectifier may also be on the high side.

This condition can be quickly determined with an ammeter connected in series with one of the charging leads as in Fig. 2. While a charging current of 1 to 1.5 amperes may not do any harm, and will certainly recharge the battery quicker, it is well to try and keep within the specified charging rate of .8 to .9 amperes if possible. Where the high condition is found, a series resistance can be connected in series between one of the terminal posts inside the cabinet and the wires that connect thereto, as in Fig. 5. A piece of coiled *Nichrome* 660-watt heater element about a half inch long, mounted in chassis terminal strip as shown, can be used for a convenient dropping resistance. With the ammeter in the line, cut this coiled wire to a length that will produce the desired current into the battery. You could also use a 25 w, 3 ohm adjustable resistor, mounted inside the case for a variable resistance.—HAROLD P. STRAND



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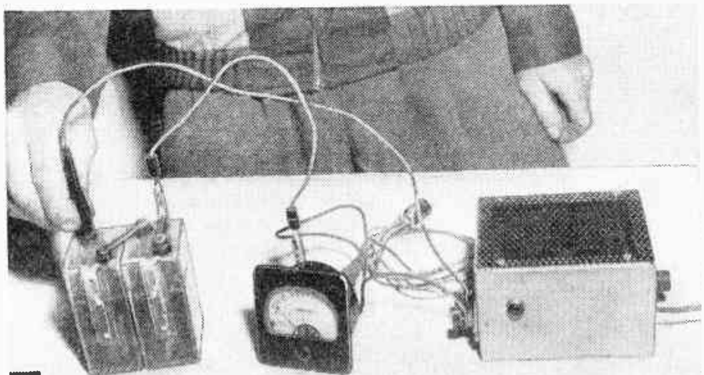

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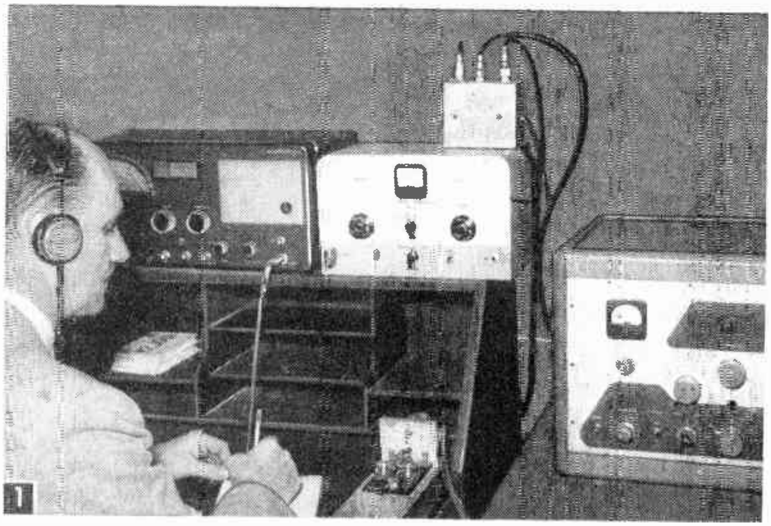
When charging a spare photo-flash battery or one removed from the case, leads with battery clips attached are connected to terminal posts on side of charger case. The ammeter shown is connected in series with one lead to check the charging rate which in this test is indicated as .9 amps. The meter is not ordinarily used.



A flick of the switch (on wood block above key) and you go from transmitting to receiving—or vice versa. If switch is located on a microphone, "push-to-talk" operation is possible with any transmitter from ½ watt to 1 kilowatt.

How to Use An Antenna-Changeover Relay

A boon to any amateur, a multipurpose, interchangeable "antenna-changeover relay" can be easily and cheaply constructed

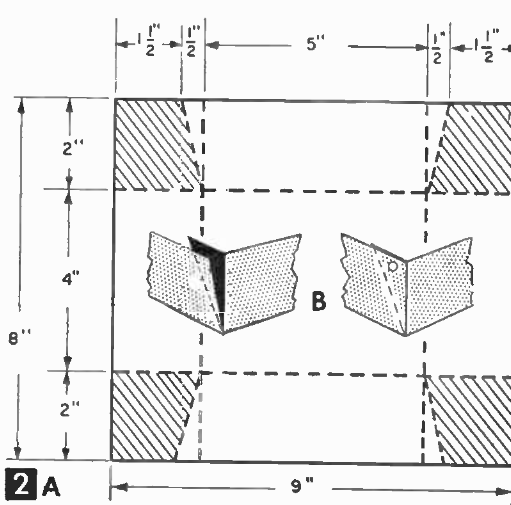
By RALPH E. SCHACHAT (W1GIF) and MARTIN GLICKSMAN

THIS unit automatically switches antenna to receiver or transmitter at the proper time; absorbs excessive received signal while transmitting, so that excess power will not be picked up (and possibly burn out components in the front end of receiver); allows just enough signal to be picked up from the transmitter so that transmission can be easily monitored; works equally well with high-power or low-power transmitters and serves both phone and CW operations. Relay is extremely flexible and interchangeable and can be transferred from one transmitter to another in less than a minute by simply changing two plugs; it minimizes the possibility of TV interference since it is totally enclosed in a grounded case.

Construction. Case for unit is a 2 x 4 x 5-in., #20 gage aluminum box. Take a flat 8 x 9-in. sheet of aluminum and scribe or score it as shown in Fig. 2A. Cut out shaded corner areas with a tin snips or a hack-saw and bend sheet along the scribed lines to form a box, with each flap forming a tight corner (Fig. 2B). Drill a $\frac{9}{64}$-in. hole in each corner, about ¼-in. on-center from the top and side of the box and fasten sides and flaps with 6-32 machine screws and nuts.

The cover of the box-case (Fig. 3) is made simply by cutting corners out square, and bending sides over at right angles to form a lip of about ¼ in. Use the box itself to work out the inside circumference of the cover. Fasten cover on two sides with ordinary sheet metal screws.

Select position for coaxial sockets (S1, S2, S3) so that each socket can be connected to the appropriate relay terminal (R1-A, R1-B, R1-C) with the shortest length of wire (see Fig. 5). Place the relay in the center of the case and mark positions of the sockets on the front panel of the box. Since the relay posts are not equidistant from each other, neither will the coaxial sockets be equally



2A

spaced from each other. When positions of the sockets have been selected, place a block of wood behind box wall and drill holes with an ordinary brace-and-bit. Select a bit slightly larger than the sockets, about ⅝ in., so as to allow clearance for their insertion. After sockets are inserted, mark mounting holes and drill and fasten sockets in place with small machine screws, lock washers and nuts. Drill a ⅜-in. hole on the right side of case for a rubber grommet through which power cord is passed.

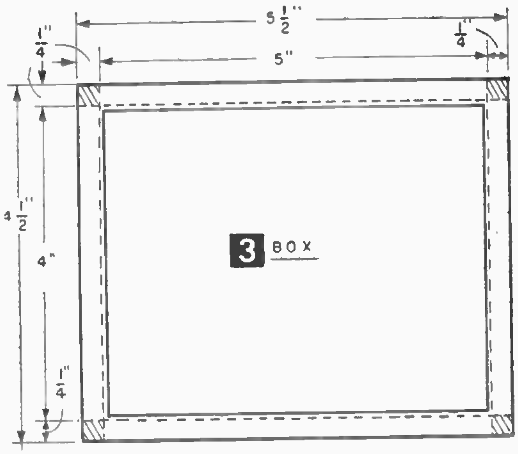
Assembly of Relay Unit. Next, bolt the relay (R1) to the bottom center of the case with 6-32 machine screws and nuts. The relay is capable of handling up to 1 kilowatt of RF power, and has "wiping action" contacts.

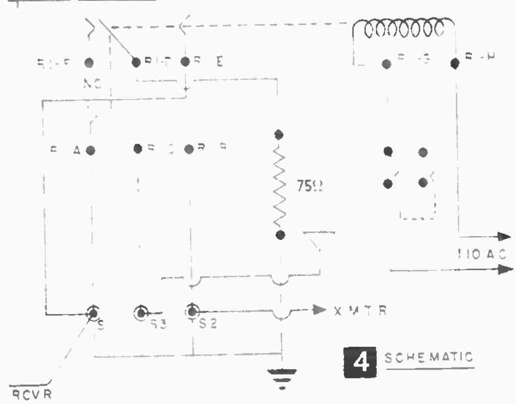
Connect the inner conductor of each socket to the appropriate post on the relay (see Fig. 5). Each socket, the relay (R1-D) and the case are individually grounded by means of a ground "bus" of #12 or #14 wire. A 1-in. screw extending out of the case at one corner is used to connect these components to a good outside ground. The 75-ohm, 1-watt carbon resistor between relay position R1-D and ground matches the characteristic impedance (75 ohms) of the RG-59-U coaxial cable used and gives more uniform quenching of signal pick-up over a wider range of operating frequencies. If a transmission line of another impedance value is used, substitute a corresponding 1-watt carbon resistor of the correct value.

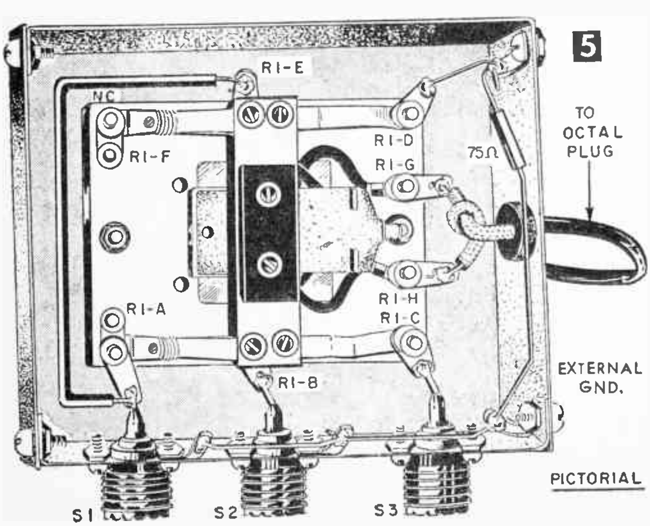
Connect the receiver socket connection (S1) to the relay post (R1-E) with a length of hook-up wire about 6 in. long. This will permit a weak, but adequate, signal to be picked up when transmitting, allowing you to monitor your transmitted signal. If too much pick-up is obtained with this wire as short as possible, use shielded wire, grounding the shield to the case.

If you must conserve cash, eliminate the antenna (S3) or receiver (S1) socket and connect the coaxial cable directly to the relay posts (R1-C or R1-A). This will reduce the flexibility of the set-up, however, and should only be considered if absolutely necessary.

An octal plug connects the relay to the transmitter which contains the switch and supplies the power. An octal plug is recommended because some transmitters, such as the Heath DX-100, have an octal socket built into the set so that no alteration is necessary. Any convenient prongs can be used of course, but if the transmitter is a DX-100, then prongs 2 and 4 must be used in order to conform with the existing internal wiring.



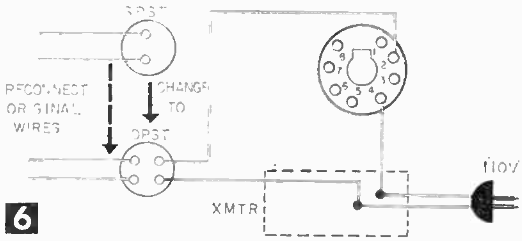




PLASTIC CORE INSULATES INNER CONDUCTOR FROM OUTER SHELL

MATERIALS LIST—CHANGEOVER RELAY

No. Req.	Description
1 pc	8 x 14", #10 gage aluminum
3	amphenol sockets type SO-239 (S1, S2, S3)
1	relay, type 400, Advance Electric and Relay Co. (R1)
1	DPST switch (to match SPST plate switch in transmitter)
1'	bare #14 wire
1'	standard hook-up wire
1	standard octal socket (Cinch-Jones No. 8EB or No. 8EC)
1	standard octal plug (Cinch-Jones 8-contact plug No. 8PB, with #16F cap)
1	75-ohm, 1-watt carbon resistor (see text)



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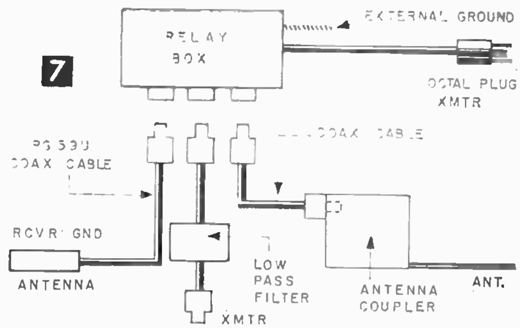


7

Modification of Transmitter. Many transmitters, such as the Heath AT-1, must be altered slightly to use this unit by replacing their SPST plate switch with a DPST switch. Reconnect the wires from the SPST switch within the transmitter to one side of the DPST switch and connect the other side of the DPST switch in series with the 110 *ac* drawn from the power supply plug and two prongs of the octal socket.

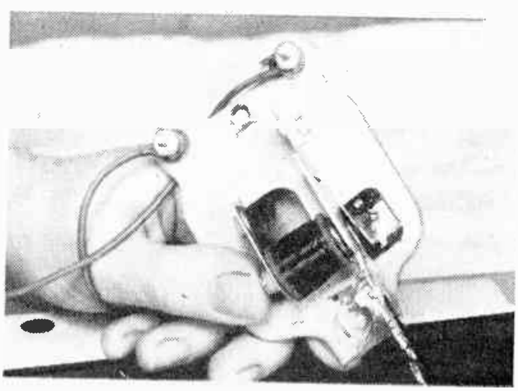
A remote switch can be added to suit the convenience of the operator. This can be attached to the microphone, to a hand-rest with the sending key on the edge of the operating table, or at any other convenient location. Wire such a remote switch in parallel with the regular plate switch so that the transmitter will be turned on by either switch.

To adapt the relay for use with other transmitters, mount an octal socket in any convenient place in the rear of transmitter's chassis and install a DPST switch in place of the SPST switch, reconnecting the original wire to one side of the DPST switch (Fig. 6). The two contacts on the other side of the DPST switch are then connected, with one contact going to terminal 2 of the octal plug, the other going to one side of the 110-*v* line. Connect the other side of the 110-*v* line to terminal 4 of the octal plug. Terminals 2 and 4 were chosen for the sake of convenience. Any others can be used as long as the corresponding plug-socket terminals are used.

Testing and Operation. With all plugs connected as in Fig. 7, turn on the receiver and the filament supply of the transmitter. The receiver should work normally. For the initial test, tune it exactly to the transmitter's operating frequency. Flip the transmitter's plate switch and tune up the transmitter in the usual way. When the plate switch is thrown on, the relay should click over to the antenna position and the receiver should cut out. Now, as the transmitter is operated, the receiver should give out a pleasant, medium-level monitor signal so that you can hear if your CW signal is clear and crisp or whether it has clicks or chirps. Similarly, by allowing someone else to talk into the microphone of a phone rig, you can easily monitor voice.

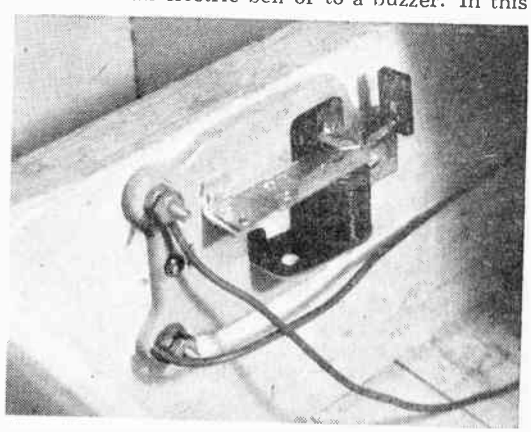
Stippling Machine from Bell

IF THE clapper of a bell is removed and replaced with a nib which may be soldered into position, a very efficient electric stippling machine may be had. After being used 10 or 15 minutes, this machine will be found capable of covering a large area at high speed. It must be held just the right distance from the surface to be inked and just the right amount of ink must be used. A little experience will determine these points.—R. F. Y.



Buzzer Makes Secret Lock

HERE the small bolt of an especially made lock for a drawer is soldered directly to the armature of an electric bell or to a buzzer. In this case, the current is led directly into the coil and the vibrating system is cut out. When current flows through the coil, the armature will be pulled down and thus release the bolt.—R. F. Y.



The Easiest and the Hardest

Have you picked up Spanish language radio broadcasts and wondered where they originated? Here's how you can find out

By C. M. STANBURY II

IT is fairly easy to tune Latin American stations on the broadcast band. An experienced listener who knows how to identify these stations will tell you that this is the easiest of foreign DX (distant reception). They are not too distant, and it is easy to learn the small amount of Spanish needed for this type of reception. Most stations have frequent commercials which provide easily obtainable program data for your report.

There is no time, during the hours of darkness, when south of the border stations are absent from your dial. During the evening, CMHQ, Santa Clara, Cuba, consistently holds down the 640 kc spot in eastern North America, while in the west such stations as TGJ (880) Guatemala, HJKC (840) Bogota, Colombia, and YSS (655) San Salvador are nightly visitors. Even more powerful are the Mexican border stations. These broadcast in English on relatively clear channels. At least two of them, XEG (1050) and XERF (1570), operate all night.

For best reception the DXer should tune the 2½ hours following sunset. This is especially true during an ionospheric disturbance. (Such disturbances, believed to be associated with sunspots, cause a drop in signal strength. The severity of such blackouts depends upon how near a station is to the pole. Reception from northern stations will be almost impossible, middle latitude stations will be weak, but semi-tropical stations will not be hampered.)

With all this good hunting you will want to know how best to spot your quarry. There is, of course, the obvious and easy matter of language. If while tuning you hear Spanish, chances are pretty good your DX search has paid off. Once your station is zeroed in, you are ready to identify it and obtain enough program data for your report. This is easy. Many well-known American products are advertised south of the border. (Table C will give you help among these lines.) Table B shows the Spanish pronunciation of every letter in the alphabet. With it and a little practice, you should have little trouble interpret-

TABLE A—STATIONS TO START WITH

FREQ.	CALL	LOCATION	SLOGAN AND ADDRESS (*denotes good verifier)
585	TIJC	San Jose, Costa Rica	Radiopolis
590	CMW	Habana, Cuba	Circuito CNC, O No. 216, Vedado*
625	TIDCR	San Jose, Costa Rica	La Voz de la Victor, Apto. 225*
640	CMHQ	Santa Clara, Cuba	Circuito CMQ, Radiocentro, Vedado, Habana*
650	YVQO	Puerto La Cruz Venezuela	Ondas Portenas, Apto. 482*
655	YSS	San Salvador, El Salvador	Radio Nacional, Teatro Nacional
660	CMCU	Habana, Cuba	R. Garcia Serra, Paseo de Marti 260
670	CMHG	Santa Clara, Cuba	Relay of CMBC 690 kc
675	YNDS	Managua, Nicaragua	Union Radio
690	CMBC	Habana, Cuba	Radio Progreso or R. Nacional, Av. Menocal 105
700	YVMH	Maracaibo, Venezuela	R. Popular, Apto. 247*
730	CMCA	Habana, Cuba	Radio Mambi, Paseo de Marti 107
760	CMCD	Habana, Cuba	Radio Voz de la Hora, Calle 25, No. 113
770	CMDC	Holguin, Cuba	R. Oriente, Aguilera 511, Santiago*
770	HJDK	Medellin, Colombia	La Voz de Antioquia, Maracaibo 46-70*
790	CMCH	Habana, Cuba	R. Cadena Habana, San Jose 104
820	HJED	Cali, Colombia	La Voz de Rio Cauca or Ca Ra Col (fair verifier)
830	CMBZ	Habana, Cuba	R. Salas, San Rafael 108, 2°piso (fair verifier)
840	HJKC	Bogota, Colombia	Ca Ra Col, Calle 53, No. 46-80*
880	TGJ	Guatemala, Guatemala	Radio Neuvo Mundo, 6a Av., 10-45, Z1. Strong on Pacific Coast*
910	CMCF	Habana, Cuba	Union Radio, La Rampa, 23 e Emganta
935	YNW	Managua, Nicaragua	Radio Mundial, 5a Calle N.O.
998	YVOB	San Cristobal, Venezuela	La Voz del Tachira, Apto. 37*
1015	HOU44	Panama, Panama	Radio Reloj. Best early AMs*
1020	HJAQ	Cartagena, Colombia	Radio Miramar*
1060	CMCX	Habana, Cuba	La Emisora Amiga, Edif. Odontologico, L y 23, Vedado
1075	YSEB	San Salvador, E. S.	La Voz de Latino-America, Calle Los Planes Km. 4
1120	YVMF	Maracaibo, Venezuela	Ondas del Lago, Apto. 261 (fair verifier)
1160	CMJK	Camaguey, Cuba	La Voz del Camagueyana, Finlay No. 4*
1175	TIQ	Puerto Limon, C. R.	Radio Casino, Apto. 287*
1198	CMDD	Bayamo, Cuba	Relay of CMDC, 770 kc.
1200	CMK	Habana, Cuba	Radio Deportes, manzena de Gomez 508

ing calls. But there is also another way of identifying your catch. Foreign broadcasters tend to use their slogans as often as their call letters. Such slogans are not hard to interpret. Most of the Spanish words used resemble English words, for example, *Radio Nacional* and *Radio Central*. Others make use of place or well known names such as *La Voz de Cali,* and *Radio Bolivar.*

Table A lists 32 stations to start with and includes slogans. White's Radio Log (see page 161 of this handbook) contains all Puerto Rican and the most widely heard Mexican and Cuban stations. These stations announce their call letters as frequently as American stations. Finally, a government publication, *Broadcasting Stations of The World: Part III* (Catalog No.: Pr. 34.659:957/-Pt. 3) lists all foreign stations alphabetically both by call and slogan. It can be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. for $1.25.

Now that you know how to hear it, you will want to verify all this DX. And this is where things get tough because of the language barrier. While many stations have someone on their staff who can read English, many out-of-the-way stations do not. Reporting in Spanish tends to convince the Latin that you are genuinely interested in his station. For those who don't write in Spanish, one solution is a Spanish report form. The National Radio Club, 325 Shirley Ave., Buffalo 15, N. Y., provides its membership with such forms at cost. Dues are $4 a year and include a subscription to DX *News.*

TABLE B
SPANISH PRONUNCIATION OF CALL LETTERS

A	ah
B	bay
C	say or thay
D	day
E	ay
F	ay-fay
G	hay or gay
H	ah-chay
I	ee
J	hoa-tah
K	kah
L	ayl-yay
M	ay-may
N	ay-nay
O	oh
P	pay
Q	koo
R	erray or ay-ray
S	ay-say
T	tay
U	oo (as in tool)
V	vay
W	dahblah-oo or dahblah-vay
X	ay-kees
Y	yay
Z	zay-tah or thay-dah

In writing to Latin stations, try to tell what you heard in Spanish. This is not too difficult. List the time and the item heard. Translations for most of the program data will be found in Table C.

An ordinary radio receiver will not bring in nearly as many stations as a specialized receiver —one with crystal selectivity. The latter is desirable, especially for receiving stations that broadcast between the ordinary frequencies (for example, 725 *kc* instead of 720 or 730).

Different makes of crystals vary slightly in their operation. However, the following procedure generally applies. Set the crystal selectivity control at the first stop and the phasing control in the center position. Carefully tune the dial until you are on the carrier frequency. There are three

TABLE C—SPANISH WORDS AND EXPRESSIONS FOR REPORTING

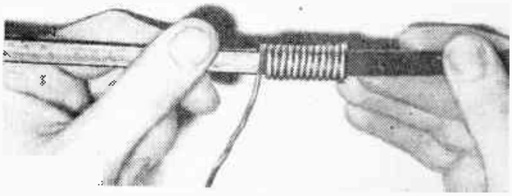
station identification: anuncio de la estación
program: programa
announcement of the correct time: anuncio de la hora correcta
to: a
advertised............: propaganda de............
a march: marcha
classical music: musica clasica
popular music: musica popular
guitar music: musica guitarr
dance music: musica de baile
duet: duo
trio: trio
chimes: ritmo de las campanas
solo vocal by man (woman): solo vocal por hombra (dama)
singing commercials: anuncios comerciales cantados
beer: cerveza
slow: despacio
fast: ligero
cigar: cigarro
mass: misa
political speech: habla politica
and: y

SAMPLE LISTING OF PROGRAM DATA

10.00 a 10.15 pm—programa de musica popular
10.00 y 10.15—anuncio de la estación y ritmo de las companas
10.05—propaganda de Pepsi Cola
10.10—propaganda de Cerveza Crystal.

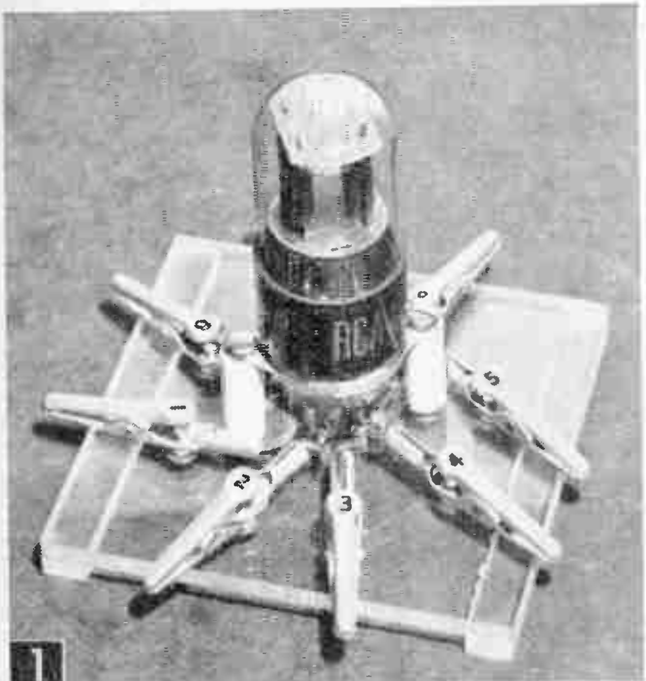
ways of accomplishing the latter: 1) Watch the S-meter; it will peak at the desired frequency; 2) Listen until only a soft swishing sound is audible; or 3) You can turn on the BFO (beat frequency oscillator); after it produces a whistling sound, set the beat frequency control in the center (at 0), and tune back and forth until the BFO's pitch drops to zero. Turn off the BFO. Now adjust the phasing until the heterodyne is least annoying. It is often necessary, when using the crystal, to switch from AVC to manual. A strong station on a nearby frequency tends to block the AVC. Finally some crystals, even in first position, tend to cut the sidebands off too sharply. The effect will be similar to an unmodulated carrier. On occasion it will be necessary to tune slightly away from the carrier frequency in the direction having the least interference. Following this, you will probably have to reset the phasing control.

Solder Improves TV Reception

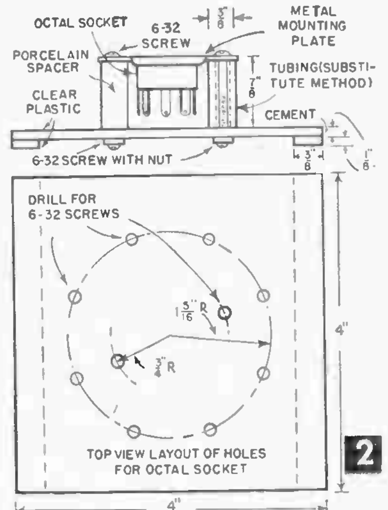


• When a TV ribbon lead-in appears to be unbalanced, don't wrap aluminum foil around the line—after a while it will become torn and crumpled and have to be renewed. Instead, close-wrap wire solder around the line as shown. It will last indefinitely and be easy to slide up and down the line to improve TV reception.—J.A.C.

Alligator Clipette for Experimenters



1 Short wires soldered to clips and to socket terminals complete the project.



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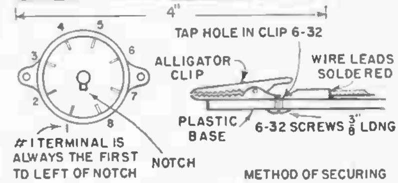


SOCKET TERMINALS AS SEEN FROM UNDERNEATH **3**

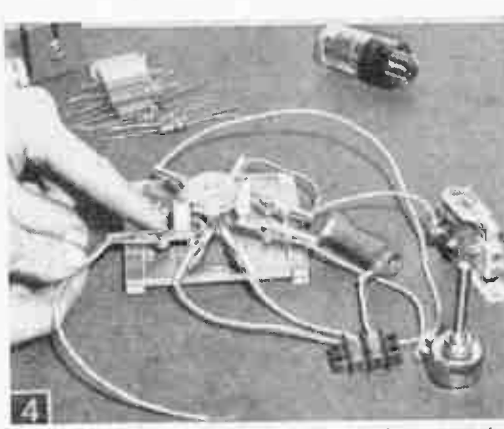
ELIMINATE the slow and tedious job of soldering and unsoldering connections at socket terminals in "breadboard" set-ups by using an alligator clip socket unit for each tube in the circuit (Figs. 1 and 4). Wires and various components can be directly connected to the sockets without the use of solder, and they can be just as quickly disconnected for changes in the circuit. The unit illustrated here is for an 8-pin or octal socket, but similar units can be made up for 7-pin and 9-pin sockets.

First step in making unit is to attach the two bottom strips to the clear plastic base with an acrylic plastic cement (Fig. 2). Apply sufficient cement to the surfaces to be joined to soften the plastic, press the pieces in place and lightly clamp for a few hours. Drill the holes as in Fig. 2. Then remove the original terminal screws in the clips and tap the holes for 6-32 threads. Use screws 3/8-in. long to hold clips in position on base (Fig. 3). Pieces of *Bakelite* or fiber tubing cut to size can be substituted for the porcelain spacers (Fig. 2).

Number clips in counterclockwise fashion so that, when viewed from underneath, numbering corresponds to socket-terminal numbering running clockwise from the first terminal to the left of the center slot (Fig. 3). This is the standard arrangement in all schematic diagrams. Short pieces of #20 insulated wire can be used to connect terminals in consecutive order to the clips.—HAROLD P. STRAND.

MATERIALS LIST—ALLIGATOR CLIPETTE
(For octal socket)

No.	Description
1	clear Lucite or Plexiglas 1/8 x 4 x 4", base
2	clear Lucite or Plexiglas 1/8 x 3/8 x 4", feet
1	octal socket attached to steel mounting plate
2	porcelain spacers 3/8 O.D. x 7/8" with 6-32 threaded holes
8	Mueller alligator clips with screw terminals
6 in.	#20 insulated wire
8	6-32 rh screws 3/8" long
4	6-32 rh screws (for porcelain spacers) or
2	6-32 rh screws 1 1/8" long with nuts (if tubing is used as spacers)

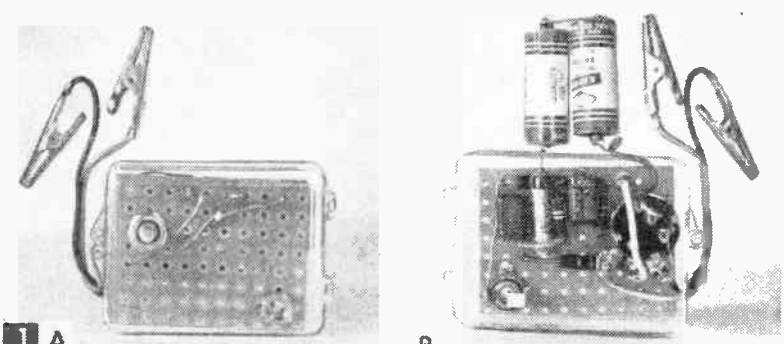


4 Trying out the alligator clip socket unit in an experimental circuit. Radio beginners will find the unit very handy when making various receivers.

The PIGGY-BACK

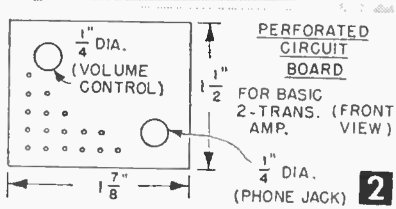
The term piggy-back may recall for you the days when you hitched an occasional ride on your Dad's back, or it may remind you of a practice in the transportation industry. As used here, however, it refers to the units used with a basic piece of miniature, transistorized electronic equipment built so that it may become any one of a number of different electronic devices simply by attaching a different piggy-back

By FORREST H. FRANTZ, SR.



1 A B

The basic two-transistor amplifier with clip-type input leads for general-purpose use (A). Volume control knob has been omitted in this photo to show simplified wiring more clearly. Piggy-back units are built on plastic case halves. In B, the basic amplifier is shown with an inexpensive flashlight battery power supply.



2

THE basic unit used in this project is a two-transistor, high-gain, audio amplifier constructed on one-half of a 1 x 1⅝ x 2⅛-in. plastic box. For general-purpose amplifier applications, this basic unit can be used with a blank piggy-back as the other half of the case. Any of the other piggy-backs described in this article may be used in place of the blank half case.

One of the piggy-backs is a microphone which—with the basic amplifier—may be used as a hearing aid device, as an "eavesdropper," as a very novel but simple vest-pocket musical instrument, as a power amplifier driver and in numerous other practical and novel applications.

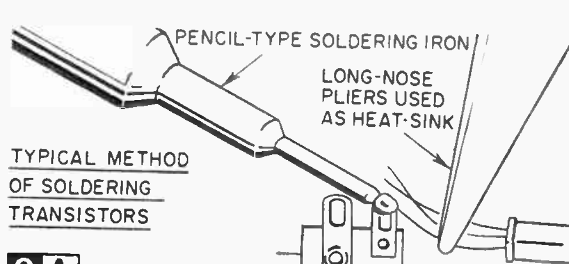
Another is a simple radio tuner-detector. A crystal unit is described in detail and a circuit for a regenerative transistor detector is presented for the hobbyist who wants a hotter radio and enjoys doing his own package designing.

Another piggy-back unit does not attach to the back of the basic amplifier. It is a loudspeaker unit that is the same size as the basic amplifier with a piggy-back (1 x 1⅝ x 2⅛ in.). It may be used attached side-by-side to a basic unit piggy-back combination, or it may be used with a piggy-back combination unattached for remote placement. This speaker unit may be used as a general-purpose speaker for other equipment, too. A second larger speaker unit is also described, and either of these speakers may be used for the variety of applications to be discussed. Additionally, a circuit for an extra amplifier stage that may be built into the basic amplifier to beef up the output will be described.

Finally, a number of circuit ideas for additional piggy-backs and accessories that will extend the application of your piggy-back equipment even further will be presented.

Cost. Is all of this equipment expensive? The answer is no. The piggy-back approach allows you to build circuits in basic easy-to-handle and easy-to-use sections. Components for all of the sections together do not cost as much as the parts for some single-application construction projects, yet you have a multitude of circuits that can be combined in many ways to equal many single-application projects.

To be more specific, the basic amplifier unit costs less than $5; the deluxe microphone piggy-back costs about $7; and two less expensive alternatives about $2. The crystal radio piggy-back



TYPICAL METHOD OF SOLDERING TRANSISTORS

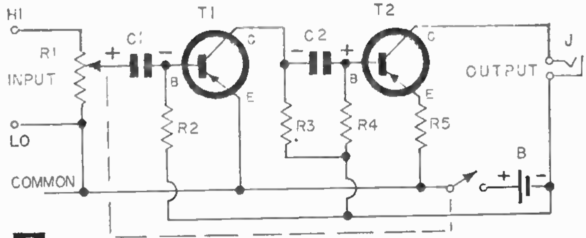
2A

costs less than $3, and the small loudspeaker unit costs a little over $2.

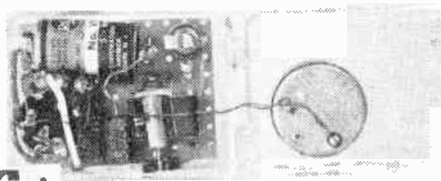
THE BASIC PIGGY-BACK AMPLIFIER UNIT

The basic piggy-back amplifier unit uses two PNP transistors—the inexpensive Raytheon CK722's. Texas Instrument 2N367/300 or General Electric 2N107 transistors may be used in place of the CK722's without any circuit or parts value changes. These transistor types are inexpensive, experimenter-grade transistors. The amplifier has its own volume control and will operate from a self-contained battery supply. You may use any voltage from 3 to 6 *v* for the battery supply. You can obtain 3 *v* from two small penlite cells (type N). This voltage is adequate for headphone operation, but you'll want 4½ to 6 *v* to operate a loudspeaker. The RCA VS310 battery is recommended for use with the amplifier because it provides 5½ *v* (enough for loudspeaker operation), and it's small enough to allow any of the piggy-backs to be attached without crowding. The battery operating cost is higher when this small battery is used, but for some applications, the compactness is worth it.

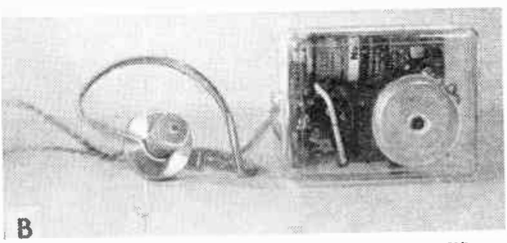
For the technically inclined, it is interesting to note that operating current is about 2 *ma* when a 5½-*v* battery is used with a 2000-ohm earphone in the output jack. The amplifier gain of the original model with a 2000-ohm earphone connected was 51 decibels. In terms of voltage gain, that's 320; the signal into the amplifier is magnified 320 times!



3 2 TRANSISTOR AMPLIFIER SCHEMATIC



4 A



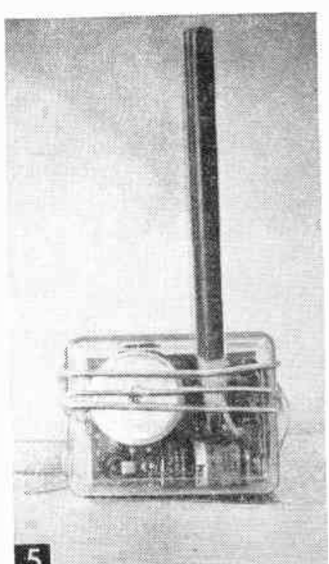
B

Back and front views of basic two-transistor amplifier with deluxe microphone piggy-back using 2000-ohm headphone (B).

To construct the amplifier (Fig. 1), cut and drill a piece of the miniature perforated Bakelite circuit board (see Materials List) as shown in Fig. 2. Make a matching set of holes for the phone jack and volume control in one half of the plastic case by making pilot holes with a heated ice pick and then reaming holes out to size with a taper reamer.

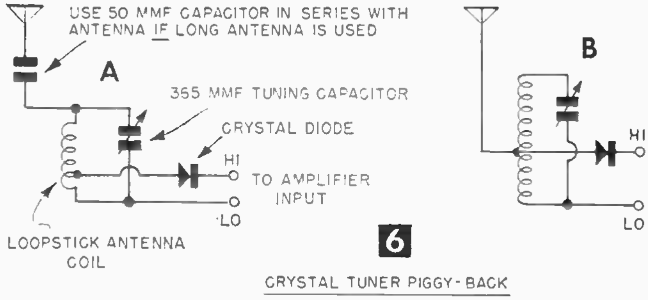
Saw the volume control shaft to a length of ⅜ in. with a hacksaw (clamp the end of the shaft to be discarded in a vise). Fasten the volume control and the phone jack on the perforated circuit board temporarily and wire the circuit (see Figs. 1 and 3 and also Fig 15). Go over each connection on the circuit diagram with a red pencil to avoid wiring mistakes. Connections are made by pushing leads that connect through a common perforation on the wiring board. They're soldered on the side of the board that you see in Fig. 1A, and excess lead lengths are clipped off. The lead from the extreme left center of the board passing close to the volume control hex nut connects to the emitter of transistor T1. The other prominent lead is made up of a number of leads that return to the negative side of the battery. (When you're using PNP transistors, the minus battery terminal is similar to the B-plus terminal in tube circuits.)

I used two type N penlite cells (Ray-O-Vac No. 716) in series in my amplifier for initial testing, since they're so inexpensive. And I brought a pair of input leads terminated with Mueller Mini-Gator clips out through a hole in the side of the plastic case for quick experimental connections and general purpose amplifier use. You'll find these leads particularly handy in trying some of the experiments and applications discussed later. But solder them in the circuit so they can be disconnected easily for the installation of piggy-

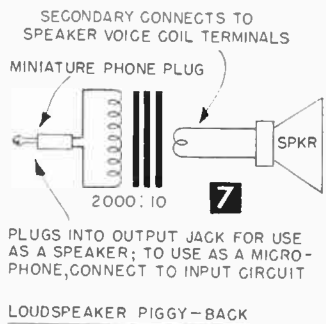


5

The microphone piggy-back and amplifier becomes a musical instrument with the addition of a pencil and rubber bands.



Physically, the Crystal Tuner Piggy-Back shown schematically above in Fig. 6 looks as below in Fig. 8, case open (A), closed (B).



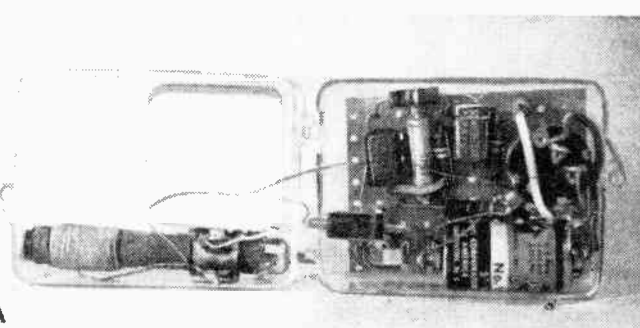
backs. When you've completed the wiring and obtained a satisfactory test of the amplifier, you're ready to remove the volume control and phone jack hex nuts and refasten them with the wiring board in the case. You may have to "dent" the inside of the case with a heated ice pick to accommodate protruding connections before you can fasten the wiring board in place. Fasten the volume control knob to complete the job.

MICROPHONE PIGGY-BACKS

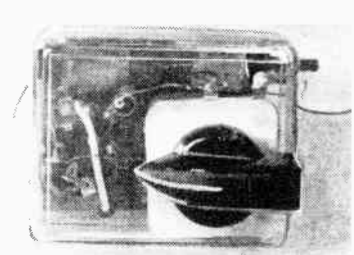
By adding a microphone piggy-back to the basic amplifier unit, you obtain a very compact instrument with many application possibilities. It can be used as a remote communication unit, a microphone and preamplifier for a public address system, a musical instrument pick-up and preamplifier, a gas leak detector, a vibration and rattle locator, and even as a small public address system and complete musical instrument (with the loudspeaker units to be described later). As a toy for children, it may be used as an eavesdropper with a long earphone cord that can be used to listen to birds, animals, and insects as well as human beings. Children will enjoy using the unit as a hearing aid for Blind Man's Bluff and other games. Hams will find the unit extremely useful as a speech amplifier for miniature and mobile transmitters.

The deluxe microphone piggy-back unit uses a Shure MC11 microphone. This microphone is only 1 in. in dia. Drill a 3/16-in. hole in the plastic case half on which you're going to mount it, and fasten the microphone to the plastic case with a small amount of metal-to-plastic cement. Don't allow any of the cement to get into the small sound hole opening on the front of the microphone. In the original unit the hole in the plastic case half is ½ in. from the side and top of the rectangular border formed by the recessed front of the case, but the position isn't critical as long as you mount the microphone so it will not interfere with other components when the case is closed.

Use insulated magnet wire (#28) to connect the microphone to the input circuit of the amplifier. The microphone terminal common to the microphone case connects to the low end terminal of the volume control. Leave the leads long enough to permit the case to be opened without placing a stress on them. Twist them together to minimize the chance of signal feedback from the output circuit (see Fig. 4, in which is also shown the compact 5½-v VS310 battery wired into the circuit as the power supply).



8 A



B

Crystal radio tuner piggy-back attached to basic two-transistor amplifier.

A simple vest-pocket musical instrument can be made from this combination by placing several rubber bands around the assembled amplifier-microphone case. Put different amounts of tension on each of the rubber bands by placing a wedge between the case and the rubber bands. The rubber bands should pass over and near the microphone opening (see Fig. 5). My wedge was a sharpened pencil. In addition to varying the tension on the rubber bands, the wedge spaces them far enough from the case so they can be plucked readily. This vest pocket musical instrument will drive the larger loudspeaker unit (to be described later) directly and with reasonable volume. If the smaller speaker unit is used, equip it with the 3-transistor amplifier described in a later section.

The Shure MC-11 microphone costs about $7. It's a versatile, rugged unit, and in my estimation constitutes a good investment for the experimenter. However, some experimenters do not wish to invest this amount of money in a single component. There are less expensive alternatives, one of which is to use the small loudspeaker unit described later and shown in Fig. 10. This unit is not as compact as the deluxe microphone unit and cannot be mounted as a piggy-back, but you can attach it side-by-side to the amplifier unit equipped with a blank back. Use small machine screws and nuts. Circuit arrangement is shown in Fig. 7.

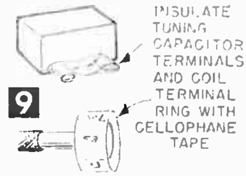
Another alternative is to use a magnetic earphone as a microphone. The Lafayette MS-367 which costs just a little more than $1 can be used for this purpose. It is small enough to be fitted on a piggy-back just as the MC-11 was, and the leads are connected in the same way.

If you resort to either of these alternatives, you'll get reasonable performance, but not equal to that of the deluxe unit.

TUNER-DETECTOR PIGGY-BACKS

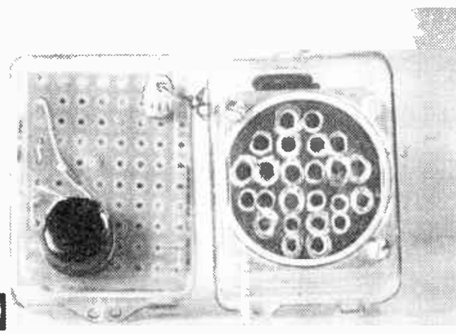
It's quite simple to add a radio piggy-back to your amplifier unit. For those who are undertaking their first project, I'll describe a simple crystal radio piggy-back in some detail. I'll also present a regenerative transistor detector unit which you can build later with a small amount of modification to the original crystal unit. Or, if you wish, you may build the transistor unit immediately. I didn't build the transistor detector as a piggy-back unit, but I've used and tested the circuit in other transistor equipment. The crystal detector, while extremely simple and straightforward, lacks the sensitivity and selectivity of the transistor regenerative type detector. You'll need a moderately good antenna and ground with the crystal detector and amplifier combination, but the requirements will be relaxed considerably if you use the regenerative detector-amplifier combination.

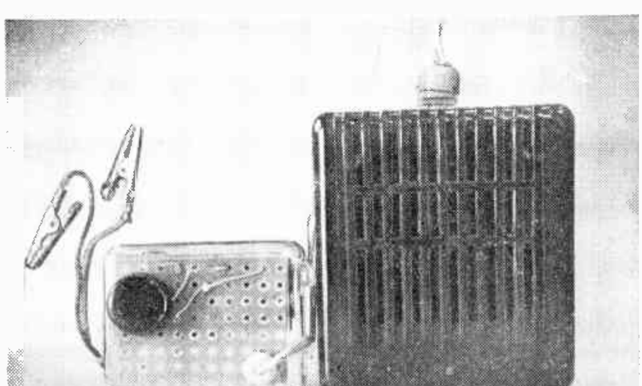
The crystal detector unit circuit is shown in Fig. 6. Two alternatives are shown. Try both of them and use the one you prefer. Figure 8 shows the construction and wiring of the amplifier unit according to the circuit of Fig. 6A. The tuning capacitor shaft hole is a 3/8-in. dia. hole located 1/2 in. from the top and side of the rectangular border formed by the recessed front. Note that the location of this hole is the same as that for the deluxe microphone unit. Place the capacitor in the plastic case. If it doesn't fit tightly into the corner of the case, enlarge the hole with a reamer till it does. Then locate the two mounting screw hole positions for the capacitor by placing the capacitor in the position it will occupy in the plastic case half and marking them off directly.

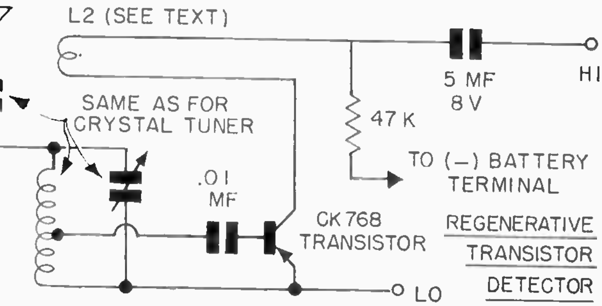


INSULATION PRECAUTIONS FOR CRYSTAL TUNER-DETECTOR PIGGY-BACK

Cut off the antenna loop coil connecting lugs as close to the coil as possible without damaging the coil lead connections. The center for the hole on the side of the plastic case half through which the antenna coil adjusting screw protrudes is located midway between the front and the hinge side of the case along the line formed by the indentation in the plastic between the corner and the hinge. The hole should be between 1/8 in. and 7/32 in. dia., as required, to secure a good fit. Wire the circuit with the components out of the case, checking as you proceed to be sure that you're allowing for proper lead length and fit. Bend the tuning capacitor terminals forward so they'll fit against the front of the plastic case when the capacitor is installed. Insulate these terminals by fastening a piece of cellophane tape to the


10
Front view of basic amplifier, with crystal radio piggy-back, attached to small loudspeaker unit.


11
Front view of basic amplifier connected to large loudspeaker unit.



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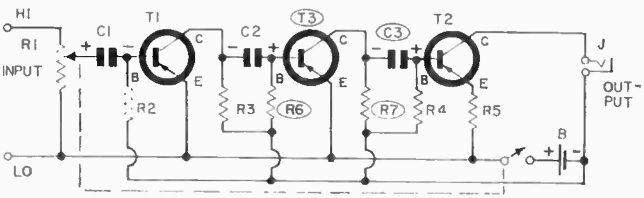


13

PARTS NOT CIRCLED - SAME AS FIG. 3
3 TRANSISTOR AMPLIFIER SCHEMATIC

NOTE
CHANGE OF POSITION OF R4 (SEE FIG. 3)

capacitor as shown in Fig. 9. As an added insulating precaution, run a piece of cellophane tape around the coil terminal ring. The assembly may then be mounted in the plastic case half and attached and connected to the amplifier unit. You won't be able to open the case all the way because of the protruding antenna coil adjusting screw. When you close the case, jockey the crystal diode to a position where it can't short-circuit to other components and connections. Use spaghetti insulation on the crystal diode leads.

Tune the antenna slug so you can cover the broadcast frequency range with your antenna and ground connected. On strong local stations you can drive the large loudspeaker unit shown in Fig. 11 directly. Or you can drive the small loudspeaker unit (Fig. 10) with the modified basic amplifier described later. The modified basic amplifier has an extra transistor stage. More distant weak stations can be received if an earphone is used.

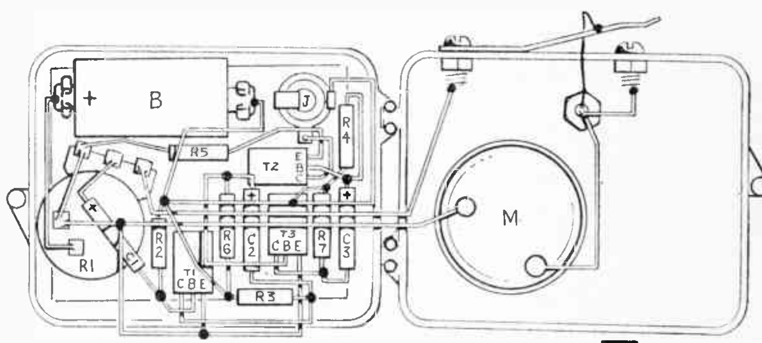
The circuit for conversion to the transistorized regenerative detector is shown in Fig. 12. Simply disconnect the diode from the coil tap terminal and connect the transistor in the circuit. The tickler winding L2 is made by winding 10 to 20 turns of #28 insulated magnet wire at the top of L2. The feedback due to L2 may make the received signal stronger or weaker. Try interchanging the L2 coil connections. Use the set of connections which gives the strongest signal or makes the set squeal. If the set squeals, remove turns from the L2 winding till the squealing stops.

Although the detector can be made more sensitive by providing it with a variable regeneration control so that the set can always be operated just below the oscillation point, the space allowances and the added complexity make it difficult to realize in this set. However, it can be done and the adventuresome experimenter may wish to try it.

With the regenerative detector-amplifier combination you won't have any difficulty in realizing headphone reception with only a few feet of antenna on local radio stations. You can expect satisfactory loudspeaker reception with a longer antenna.

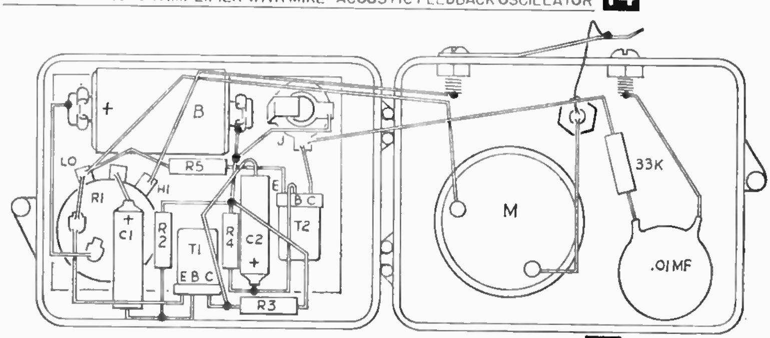
A higher grade transistor will improve the performance of the regenerative tuner considerably. The RCA 2N412 is a high Beta unit with a high

The basic amplifier converted to a three-transistor amplifier, together with a modified microphone, acoustic feedback, code-practice piggy-back.



THREE TRANSISTOR AMPLIFIER WITH MIKE-ACOUSTIC FEEDBACK OSCILLATOR 14

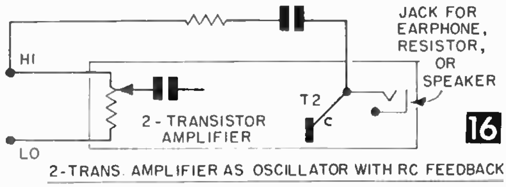
The basic two-transistor amplifier with electronic feedback, code practice and microphone piggy-back.

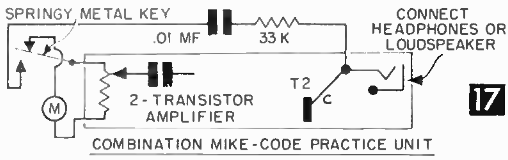


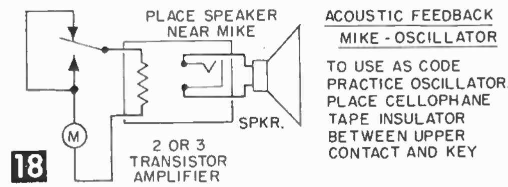
TWO TRANSISTOR AMPLIFIER WITH MIKE-ACOUSTIC FEEDBACK OSCILLATOR 15 cut-off frequency. This unit may be substituted directly for the CK768 transistor, but this substitution may require a decrease in the number of turns on the regeneration coil.

LOUDSPEAKER UNITS FOR THE PIGGY-BACK AMPLIFIER

The loudspeaker units for the piggy-back amplifier have been referred to frequently in preceding sections because they have a wide variety of uses and because they enhance the value of your piggy-back equipment considerably. One of these units is the extremely small speaker and output transformer combination mounted in a piggy-back size case which is shown with the amplifier unit in Fig. 10. The dia. of this speaker is 1½ in. Because of the small size of this speaker, the change from electrical to sound energy is not accomplished as efficiently as it would be with a larger loudspeaker. The second loudspeaker consists of a larger (2½-in. dia.) loudspeaker—and output transformer—mounted in a ready-made baffle case. This unit (Fig. 11) has a much higher electrical to sound transformation efficiency and can be used connected directly to the basic amplifier unit with good results.







To make the small loudspeaker unit, place the speaker in the case centered relative to the top and bottom of the case (see Fig. 10). Mark the mounting hole locations on the case with an ice pick or scriber, remove the speaker from the case and with a heated ice pick make the mounting and sound opening holes. I didn't measure off the sound opening holes. If you desire a neater appearance, you can measure them off. Otherwise you can guess them in quickly as I did and then use a small cloth grille.

The output transformer fits partially under the loudspeaker magnet frame. It is held in place by pressure between the speaker magnet frame and the transformer on one side and a rubber grommet between the transformer and the plastic case on the other side. Pass a piece of cellophane tape from the magnet over the top of the transformer frame and grommet for additional support. You can increase the tone quality and the volume available from the speaker by cutting out a soft cardboard washer to fit around the front of the speaker rim. This washer will fill the space between the plastic case and the speaker rim which would otherwise exist because the rounded edges of the case prevent the speaker rim from fitting against the front of the case. The secondary (green) leads from the output transformer connect to the loudspeaker voice coil terminals; the primary (red) leads connect to the plug (see Fig. 7).

The loudspeaker unit shown in Fig. 11 utilizes a larger loudspeaker and a ready-made case and can be built with less effort than the small loudspeaker unit. To assemble, remove the four screws that hold the baffle-case back in place and remove the back. Place the speaker in the baffle box and place the output transformer between the speaker magnet frame and the edge of the baffle box. Place a paper or cardboard shim sufficiently thick to hold the transformer in place between the transformer and the speaker.

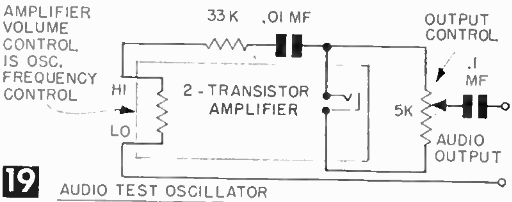
Next, solder the secondary transformer leads (green) to the speaker voice coil terminals and the primary (red) leads to the terminals at the top of the baffle box.

Finally, place the back on the baffle box and fasten the four screws. The speaker fits tight between baffle box and back and the pressure holds it in place.

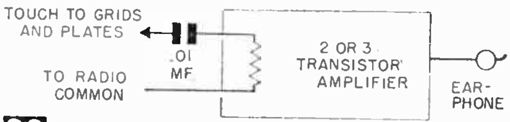
ADDING A THIRD TRANSISTOR TO THE BASIC AMPLIFIER

The amplification of the basic amplifier unit may be increased considerably by adding a third transistor amplifier stage. The extra stage increased the amplification of the original model from 320 to about 10,000. The large increase in amplification makes it possible to drive a loudspeaker with considerably smaller signals at the amplifier input terminals. With the crystal radio piggy-back, for example, the extra transistor amplifier stage will substantially increase the number of radio stations you can receive at reasonable speaker volume. And, with the deluxe microphone piggy-back, the earphone volume is equivalent to that of hearing aids costing from $40 to $100.

The new three-transistor amplifier circuit is shown in Fig. 13. Figure 14 shows parts placement. Compare these Figs. with Figs. 1, 3 and 15. Note that transistors T1 and T2 are still in the output and input stages, and that the new transistor T3 becomes the middle amplifier stage. The only parts required for the modification are transistor T3, resistors R6, R7, and capacitor C3 (see Materials List). They cost less than $2. The physical position of transistor T2 and resistor R4 has been changed in the amplifier. Transistor T3



19 AUDIO TEST OSCILLATOR



20 ARRANGEMENT FOR AUDIO SIGNAL TRACING

occupies approximately the same physical position as T2 occupied before modification. The change can be made in a few minutes if these steps are followed:

1) Remove the volume control knob and the volume control and output jack hex nuts. Remove the amplifier from the case.

2) Remove the 220K resistor R4 from the circuit board and replace it with 270K resistor R6.

3) Disconnect the base of transistor T2 from the junction of C2 and R4. *Don't* disconnect the emitter and collector leads. Bend these leads as required to change T2's position to that shown in Fig. 14.

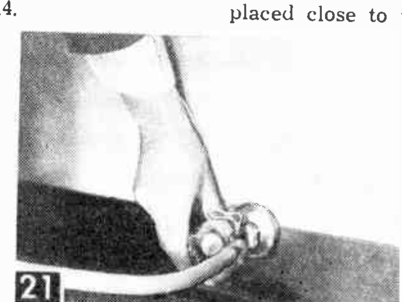
4) Wire transistor T3 into the circuit. Note that the connection end of T3 is toward the upper edge of the circuit board. Run the emitter and base leads through perforations to the front of the board. Connect the emitter to the common (battery plus) bus and the base to the junction of C2 and R6.

5) Mount and connect C3 and R7. The collector of T3 connects to the junction of C3 and R7.

6) Mount and connect R4. Connect the base of T2 to the junction of C3 and R4.

7) Bend component leads as required to minimize the possibility of short circuits. Fasten the amplifier in the case.

The added transistor stage increases the current requirements of the amplifier slightly. If the amplifier is used for prolonged periods, (as a hearing aid, say) you'll find it economical to use two size N penlite batteries in series. The gain will be reduced slightly due to the lower voltage.



The three-transistor amplifier with microphone piggy-back and earphone is used here to detect a small gas leak. The hiss of escaping gas is picked up and amplified.

MODIFICATION, ACCESSORY, AND APPLICATION IDEAS

Your piggy-back equipment has many more uses than those described in conjunction with the construction. In some instances, small modifications are required, and in some instances simple accessories are required for these additional applications. All of the applications and circuits that have or will be described have been tried and tested. (You'll probably discover many more.) You can rest assured that they will work provided your wiring is correct, your connections are electrically reliable and your battery and parts are good.

Code Practice Oscillator. The basic two-transistor amplifier can be made to oscillate at audio frequency by connecting the collector of transistor T2 to the high side of the volume control through a capacitor and resistor (as shown in Fig. 17) with an output load connected. This arrangement provides the feedback required to produce oscillation. The output load may be headphones, the small loudspeaker unit, the large loudspeaker unit, or a 3K to 10K resistor.

Figure 15 shows an arrangement for an earphone or loudspeaker code-practice oscillator incorporated piggy-back (schematic is shown in Fig. 16). The resistor is 33K and the capacitor is .01 mfd. Adjust the amplifier volume control for the tone you find most pleasing. The code practice oscillator may be built as a piggy-back with a key made from a small piece of metal, machine screws, and nuts. The microphone is connected through the upper contact as the amplifier input element when the key is up. When the key is depressed, the microphone is disconnected, and contact for the oscillator circuit is established.

A loudspeaker code-practice oscillator can utilize an even simpler scheme, with acoustic feedback from the loudspeaker to the microphone producing oscillation in this case. Circuit is shown in Figs. 14 and 18. A small piece of cellophane tape placed on the key under the upper contact prevents microphone circuit closure when the key is up. This arrangement will work with the two- or the three-transistor basic amplifier and either loudspeaker unit. The only requirement for oscillation is that the microphone be placed close to the loudspeaker.

Model RR Train Whistle and Paging System. The code oscillator-microphone piggy-back combination may be used as a model railroad or toy train whistle and paging system. Either of the code practice oscillator arrangements described above will work acceptably. The two-transistor amplifier with resistor-capacitor feedback is most convenient, although the paging volume of the three-transistor acoustic feedback arrangement is greater. The disadvantage of the acoustic feedback arrangement is that the speaker and microphone must be close together to produce a whistle but then must be separated to be used for paging.

Audio Oscillator. Figure 19 shows the circuit arrangement for a simple audio oscillator that can be used for amplifier testing. It can be built piggy-back. The frequency range is limited to a range of several hundred to several thousand cycles as a sine-wave audio oscillator, but it will operate at lower frequencies as a blocking oscillator. The volume control of the amplifier serves as the frequency control; the added potentiometer is the output level control.

Hum Locator and Telephone Pick-Up. The three-transistor amplifier may be used to pick up telephone conversations and reproduce them at loudspeaker volume with a telephone pick-up coil such as the Lafayette MS-16. Or you can use an unshielded headphone with the diaphragm removed for a telephone pick-up. This arrangement will also enable you to locate *ac* wiring by using the pickup as a 60-cycle hum locator. When the coil gets close to a 60-cycle house wiring circuit, it has a 60-cycle voltage induced in it. You'll get best results using a headphone for listening in the output circuit of the amplifier for the hum location function. The pick-up is connected to the amplifier in the same manner as the microphone.

Audio Signal Tracer. The basic amplifier may be used as a signal tracer for trouble-shooting audio amplifiers and the audio section of radios. The only additional component required is a 0.1 mfd. capacitor to isolate *dc* voltages from the amplifier volume control. The circuit arrangement is shown in Fig. 20.

To use the signal tracer for radio trouble-shooting, connect the input lead from the low side of the volume control to the common ground of the radio receiver. Tune the receiver to a strong local station's frequency and with the volume control all the way up, touch the tube grids and plates with the signal tracer "hi" lead in succession while listening for a signal in the earphone. If you don't hear a signal in the earphone when you contact the grid of the first audio stage, the trouble is in the RF, IF or detector portion of the radio ahead of the audio amplifier. If you do get a signal, the trouble's somewhere in the audio amplifier. It's between the last point in the circuit where you do hear a signal and the first point where you don't hear a signal.

To trace a signal in a phono amplifier or any other amplifier, provide an input signal to the amplifier and proceed with the signal tracer just as you would to signal trace a radio. The input signal can be derived from a phonograph turntable pickup and a record, a radio tuner or an audio oscillator.

MATERIALS LIST—BASIC 2-TRANSISTOR AMPLIFIER

Desig. (see Fig. 3)	Description
C1, C2	5 mfd. 8 v capacitors (PS8-5)*
R1	10K Vol. Control w/sw (VC-28)
R2	270K, 1/2 watt carbon resistor
R3	10K, 1/2 watt carbon resistor
R4	220K, 1/2 watt carbon resistor
R5	27 ohm, 1/2 watt carbon resistor
T1, T2	CK722 transistors (Raytheon, but see text)
J	miniature phone jack (MS-282)
B	battery (see text)
	plastic case (MS-156)
	perforated circuit board (MS-304)
	pair Mueller Mini-Gator clips

Microphone Piggy-Back

No. Req.	
1	Shure MC-11 microphone
15′	#28 insulated magnet wires (also used in other piggy-backs)
	Crystal Tuner Piggy-Back
1	loopstick antenna coil (MS-299)
1	50 mmf capacitor (see Fig. 7)
1	365 mmf tuning capacitor (MS-274)
1	crystal diode (GE 1N64)
	Regenerative Transistor Detector
1	5 mfd. 8 v capacitor
1	47K, 1/2 watt carbon resistor
1	.01 mfd. 75 v capacitor
1	CK768 transistor (Raytheon)
	Loudspeaker Piggy-Backs
1	miniature phone plug (MS-281)
1	speaker (SK-62 with MS-156 case for small unit, or an SK-66 with a TR-93 transformer and MS-315 baffle for the large unit; see Fig. 6).

3-Transistor Amplifier

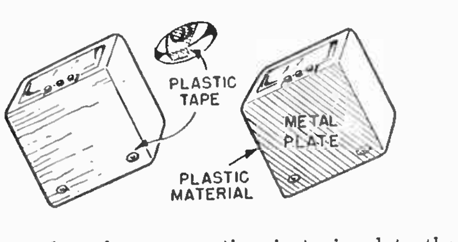
(Components needed in addition to those for 2-Transistor Basic Amplifier)

Desig. (see Fig. 13)	Description
C3	5 mfd. 8 v capacitor (PS8-5)
R6	270K, 1/2 watt carbon resistor
R7	10K, 1/2 watt carbon resistor
T3	CK722 transistor (Raytheon)

*All components listed by catalog number may be obtained from Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. Parts numbers, unless otherwise indicated, are Lafayette numbers.

Tape Insulates Radio-TV Screws

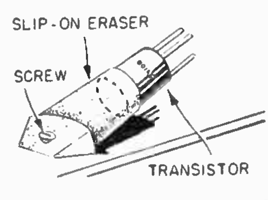
• The chassis of a transformerless *ac-dc* radio or TV can be a very deadly shock hazard, should the set be plugged into the outlet with the incorrect polarity. Often, the mounting screws found on the bottom of the cabinet are in direct contact with the "hot" chassis. Touching one of these screws and ground simultaneously can kill



you.

A simple safety precaution is to insulate the heads of the screws by covering them with plastic tape. If your set has a metal plate as a bottom cover, tape clear plastic material (available at hardware stores for a few cents a foot) over entire plate.—JOHN A. COMSTOCK.

Eraser Shock-Mounts Transistor



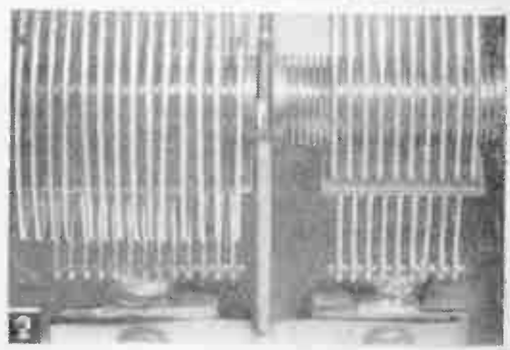
• A slip-on pencil eraser makes a good mount for some types of round case transistors that are not to be socket-mounted. Drill a small hole through the tip of the eraser, and mount it on the chassis with a small screw and nut. Eraser shock-mounting is especially desirable in portable gear subject to mechanical shocks.—JOHN A. COMSTOCK.

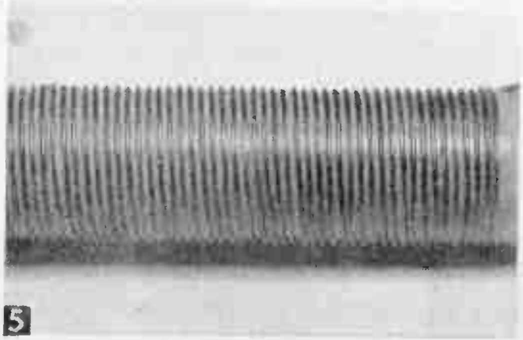
Electronics Picture Quiz

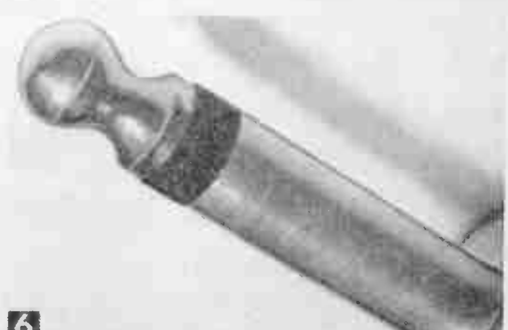
By JOHN A. COMSTOCK

Are you a whiz at picture quizzes? Here's one on electronics. All of the photos are of items commonly found on the electronic hobbyist's bench or in his box of spare parts. See if you can correctly identify and label them in the spaces provided. Study each picture carefully before filling in your answer. You'll find the solution on page 157.

1. ____________________ 4. ____________________
2. ____________________ 5. ____________________
3. ____________________ 6. ____________________







Line Voltage Corrector for Your TV Receiver

By HAROLD P. STRAND

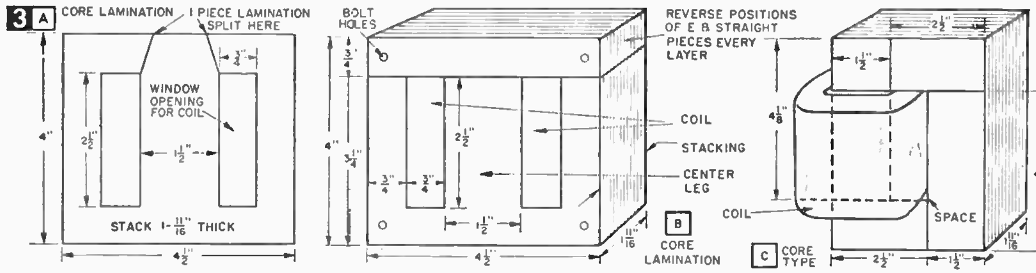
LOW line voltage from your electric company can cause all sorts of difficulty in your TV set. Since electric companies can't supply everybody with exactly the same voltage, outlying suburbs are most likely to be troubled with below-normal voltage, particularly during the evening hours when demand for electricity is high. If you're not satisfied with your TV picture, it doesn't fill out the screen or lacks brilliance, try connecting an *a-c* voltmeter to the wall receptacle to determine the line voltage. If I had done that myself, I would have saved considerable time and money.

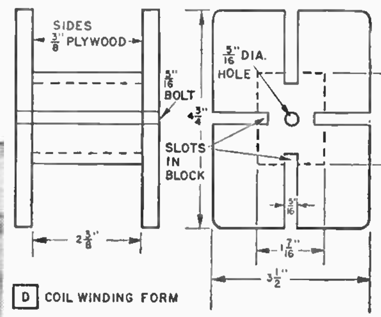
The picture on my set was not filling the screen, especially at the sides and was not up to its usual brilliance despite any adjustments of the brightness control. The picture kept slipping out of horizontal sync too. Something had to be done!

First, I replaced all the tubes in the video section, with very little improvement. Next, I removed the chassis and spent two evenings going over the complex circuit using instruments to check the connections and the components against the schematic. Still no luck! Some of the original condensers were bulging with sealing compound at the ends, so all of them were replaced with the latest type. You can imagine my

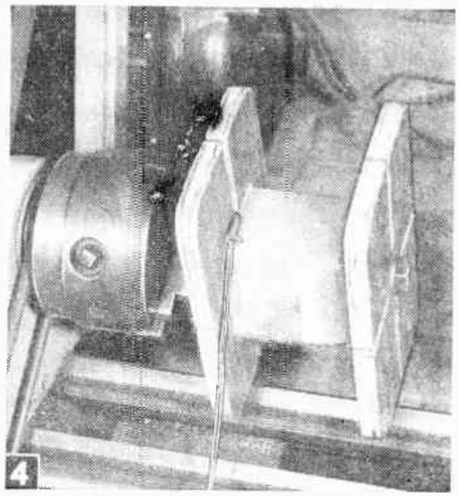
Picture wouldn't fill out screen when set was operating on 106 volts (A). Increased brilliance and full screen (B) improve picture after boosting line voltage to 112-115 volts.

Checking line voltage on meter built into booster. Voltage that's too low causes all sorts of trouble on your TV set.

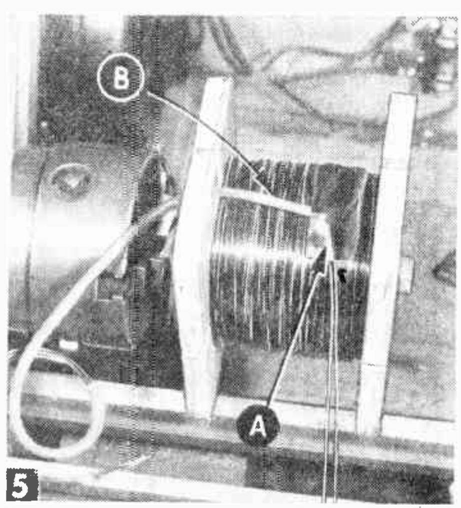




Core laminations (A) 1-piece shell lamination salvaged from used radio power transformer. (B) E-type laminations (C) Core-type lamination made by alternating straight strips of silicon transformer steel. Transformers built on this core will require larger mounting box. (D) Coil winding form.



Start winding through slot in narrow side of form. Turn counter records number of windings.



Bringing out loop tap at 247th turn. Slip sleeving over loop and separate lead from rest of windings with electrical tape, top and bottom. Continue winding over tap loops.

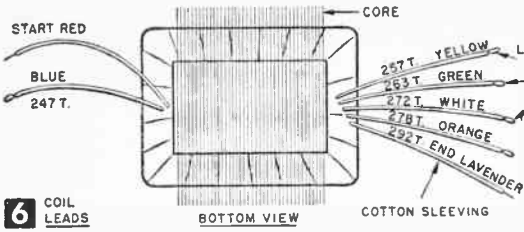
disappointment, when after assembling the set, the improvement was hard to find.

On an impulse, I got my voltmeter from the shop and plugged it into the outlet. I was getting exactly 106 volts! When I connected a *Variac* between the line outlet and the TV set and raised the voltage to 115 volts, the results were amazing. The picture assumed a brilliance it had never had before and it covered the screen with some to spare! You may find the same solution to your television difficulties.

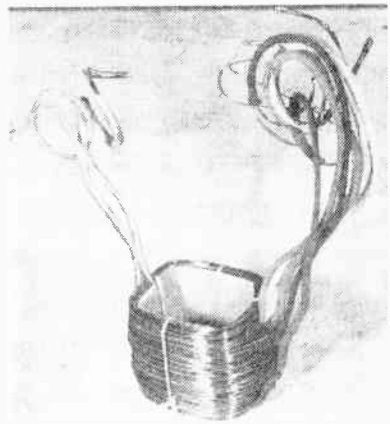
Instead of using the *Variac*, this line voltage booster which you can build yourself will step up line voltage and give you all the reception which your TV set can deliver. Basically it is an autotransformer with a number of taps controlled by a tap switch. The built-in voltmeter tells you at all times the exact voltage being delivered to your TV. I recommend setting the voltage at about 112 volts to allow for any upward line fluctuations. Most electric lines deliver voltage that varies only two to four volts although the general level may be low. No. 1 tap shows direct line voltage on the meter and allows you to check incoming voltage before making any corrections. Each additional tap boosts voltage about two or three volts. Most console TV sets draw about two amperes, well within transformer capacity.

To start building the transformer, you'll need the core taken from an old radio power transformer like an early Silver Marshall or any type close to specified core size (Fig. 4). The stacked E-type laminations measured 4½ x 4 in. outside with coil window openings of ¾x2½-in. with 1½-in. wide center leg and stacked 1¹¹⁄₁₆-in. high. If salvage cores are not available, you can cut 1½-in. wide strips out of regular 26-29-gage silicon transformer steel (Fig. 3C). Alternate stacks of four laminations were used in building the core; this same system for covering the joints should be used in rebuilding the core around the new coil.

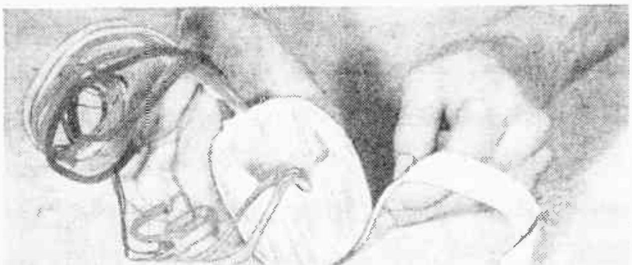
The new coil consists of 292 turns of either one #17 *Formex* wire or two #20 wires in parallel. Build a winding form first (Fig. 3D). Leads are brought out on the narrow sides of the form (Fig. 5) to avoid interference when coil is slipped onto the



6 COIL LEADS



7 Wound coil ready for taping and varnishing. Start and 247th turn comes out left side and 257 to 292nd turns come out right.

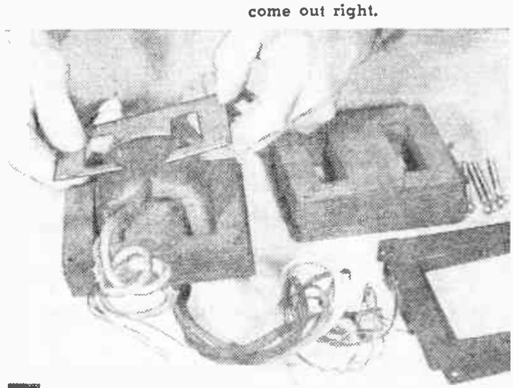


8 Wind cotton coil tape tightly through center opening, cutting strings that hold coil together as you come to them, and sew end.

core. Slots in the form allow you to pass strings through the coil and tie it tightly after winding. A 5/16-in. bolt holds the form together and is chucked in the lathe for winding. Cover the core with a piece of armature slot insulating paper secured with cellophane tape. The ends of the two #20 wires were passed through an 8 in. piece of cotton sleeving and started in to the form slot at one of the narrow sides. Wrap

MATERIALS LIST—VOLTAGE BOOSTER

1 metal cabinet, Insuline Corp., gray hammertone aluminum 9 x 5 x 6" #29801
1 panel meter, 3½" round, 0-150 volts A.C.
1 core from an old radio power transformer
1 power tap switch, Ohmite model #111, 6 taps, 10 amps.
1 toggle switch, S.P.S.T. 6 amps at 115 volts
1 power receptacle, Amprenol type 61-F1 two pole with plate
1 fuse holder, panel mounting, Buss HKP
1 fuse, Littelfuse 3 AG 5 amps, #312005
1 dial with knob, National HRS-3
1 piece cabinet back screen stock, 9 x 6"
7 ft. 2-wire #18 line cord
1 attachment plug cap
1 rubber grommet for 3/8" hole
4 rubber base knobs with 8-32 studs, nuts
About ¾ pound #17 Heavy Formex magnet wire, or double #20 wires. Coil tape, cotton sleeving in several colors, screws, nuts

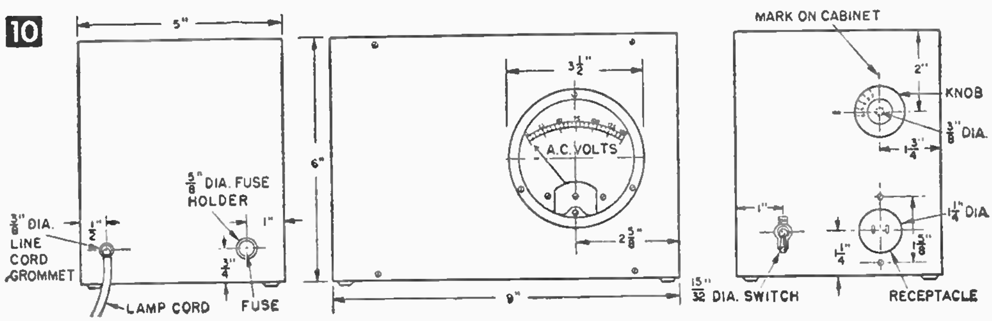


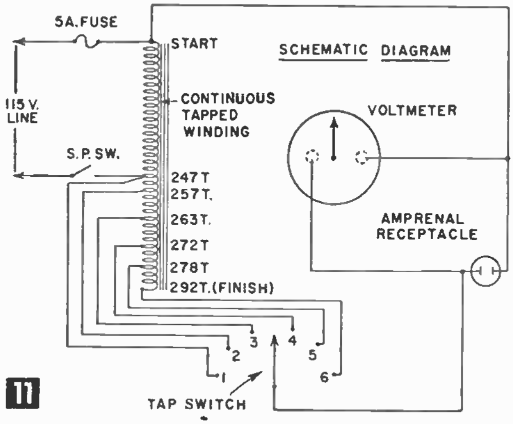
9 Assembling laminations. Reverse positions of laminations every fourth piece to cover butt joints.

the ends of the wires around the chuck jaws to keep them out of the way. The turn counter fixed to the lathe bed and driven by a rubber vacuum cleaner belt keeps track of the windings. You can, of course, wind the coil onto the form by hand evenly spacing the loops in tight layers.

Wind 247 turns before bringing out an 8 in. loop, also covered with sleeving. To identify the different loop leads, cover each with sleeving of

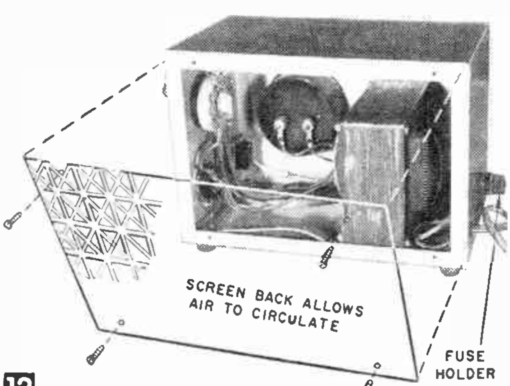
10





a different color noting the turns each represents as the winding progresses. At the loops, which will become taps, place a small piece of Scotch #33 insulating tape under the point where the wire is looped off and another piece on top of the spot, to properly insulate the crossing of wires. Also be sure to use a piece of sleeving over the ends brought out. Continue to wind over the previous work to the 257th turn, and bring out another loop. This 257th tap is brought out at the opposite narrow side of the form from the beginning and 247th tap. Continue to wind in the same way, bringing out taps at the 263, 272, 278, 285 and the end or 292 turns, all on the same form side as the 257th tap.

With the last winding on, you're ready to tie the coil with strings through the slots and remove it from the form (Fig. 7). The starting wire and 247th turn are at one of the narrow coil sides and the 257 to 292nd taps are at the other. Tape the entire coil with cotton coil tape as shown in Fig. 8. Sew the end of the tape before dipping the whole coil in air-drying insulation varnish, allowing it to soak for about five minutes. Hang it up to drain and allow it to dry overnight, or bake in an oven at about 150° F



Back side of booster assembly. Voltmeter is set off center to clear transformer. Back screen allows air to circulate around transformer. Note fuse holder at right lower corner.

for several hours to fully dry the varnish.

Assemble the core to the new coil (Fig. 9). Drive strips of fiber or Bakelite between the coil and center leg at both sides to wedge it tightly in place. Otherwise, an annoying hum may result. Attach the side frames and the transformer is finished. It will be necessary to square up the core with a light hammer, driving butt joints together.

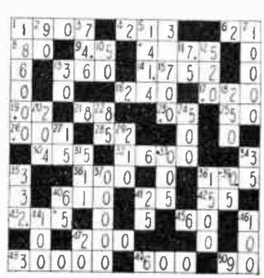
The grey enamelled aluminum cabinet has removable side panels and is laid out for the holes to mount parts according to Fig. 10. Cut the large holes with a Greenlee chassis punch, a hole saw or fly cutter. Instead of one of the panels, cut a piece of mesh screen stock to fit at the back. Mount the voltmeter, the toggle switch, flush receptacle, transformer and tap selector switch in the cabinet.

When all components are installed, you're ready to wire up connections according to the schematic diagram (Fig. 11). Insulation on the *Formex* wire is hard to scrape off, so be sure you get down to the bare copper before hooking it up. Use #18 flexible insulated wire for all hook-up connections aside from the transformer tap connections.

Step #1 on the tap switch shows the line voltage on the booster's meter and tells you if it is high enough (112-115 volts) to use without boosting. Other steps increase voltage and meter records just what these voltages are for top TV reception.

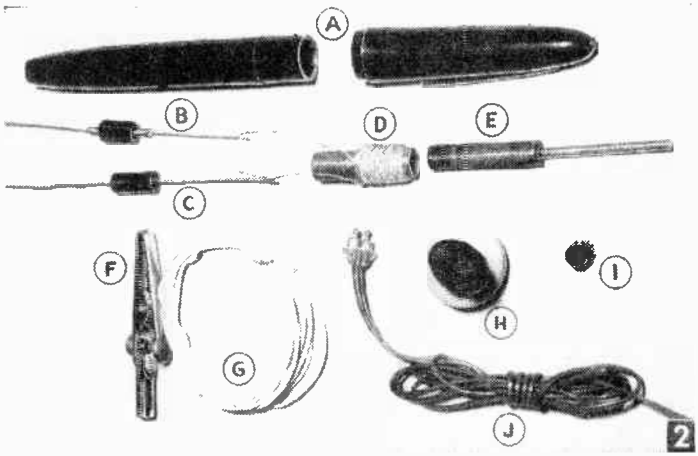
Bottle Plugs as Wire Grommets

• The plugs used in nasal spray plastic squeeze bottles make handy feed-through grommets. Pry out the plug from the bottle's neck with the blade of a sharp knife, then enlarge the opening in the plug with the sharp point of a heat soldering iron or an ice-pick. The inside spray tube makes a good piece of wire insulating spaghetti, too.



Answers to Cross Numeral Puzzle, Page 105.

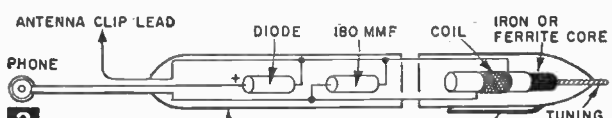
Built into a pen case, this little self-powered radio requires no outside antenna. Stations are received by attaching clip lead to telephone dial screen, or other metal.



Component layout—A. Pen cap and barrel. B. Diode detector. C. Ceramic fixed capacitor. D. Coil. E. Tuning slug and screw. F. Small alligator clip. G. Antenna lead. H. Earphone. I. Tuner knob. J. Earphone Cord.

Fountain Pen Radio

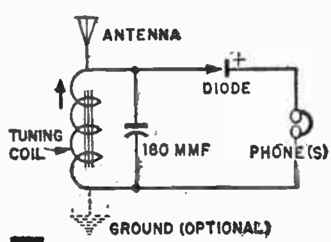
This "air-powered" set built in a pen-case will receive stations up to as far as 50 miles away



3 PICTORIAL PLAN

A DISCARDED ball point pen barrel holds this radio that not only makes a conversation piece, but really works—and works well! A tuning knob in the cap selects various local stations.

A crystal set, it uses a germanium diode detector and requires no operating power. A flexible clip lead attached to a phone dial finger stop, or other handy metallic object becomes an antenna for picking up local stations. X-type antennas may increase the set's range to 50 miles.



4 SCHEMATIC PLAN

The pointed plastic tip of a dime store pen carrying the ball point and capillary ink tube is discarded, leaving an open barrel. Drill 1/8-in. hole in the bottom of the barrel for the phone cord and flexible antenna lead.

Drill a 3/32-in. hole in the top of the pen cap to complete preparation of the pen barrel. The tuning coil is the next job. The coil shown in Fig. 2 consists of 12 ft Litz coil wire lattice-wound on a paper-base *Bakelite* tube 1/4 in. I.D. x 1 in. long. Leave coil leads long enough to be connected to the other components.

Duco or similar cement is applied to the outside of the coil before inserting it into the pen cap. The tuning slug is fitted with a #4-40 brass screw. Because the plastic is soft, the screw will cut its own threads when turned into the 3/32-in. hole in the cap. The screw moves the iron or ferrite core with the coil to tune in the stations.

Many inexpensive and surplus radio or TV I.F. transformers will yield a suitable slug and coil form to wind the Litz wire on. Or you can purchase a ferrite-tuned radio antenna coil and strip off its outer cardboard cover and trim the lugs to get it into the pen barrel.

The 180-*mmf* fixed ceramic capacitor and diode detector will fit nicely into the pen barrel when arranged as shown in Fig. 3. Be sure "pigtail" leads are covered with radio spaghetti or plastic *Scotch* tape so that leads do not short when inserted in pen.

The total cost of this novel radio is about $3, less the button type hearing aid receiver. A high resistance magnetic unit of this type costs about

MATERIALS LIST—FOUNTAIN PEN RADIO

1 cheapest grade ball point pen, or discarded fountain pen
1 tuning coil (available from Electro-Mite, Box 636, Springdale, Conn. for $1, or a complete kit except earphones for $3, postpaid)
1 small spool Litz wire (for homemade coil only)
1 short length insulated antenna lead wire (plastic stranded)
1 alligator clip (small)
1 germanium diode detector (CK705, 1N48 or 1N34)
1 high resistance hearing aid receiver, or standard size Alnico radio headphone (1000, 1500 or 2000 ohms)
1 180 mmf fixed ceramic capacitor for local stations between 1400 and 660 kc. Beyond 660 use 250 mmf, below 1400 kc use 75 mmf.

$8. However, a standard radio type *Alnico* headphone costs a fraction of this figure. Except for its size, it far outperforms a hearing aid receiver in volume. In either case, headphone leads and flexible antenna wire are fished through the 1/8-in. hole and soldered in place, along with the two flexible coil leads. The pen barrel is now slid up the cord to enclose the components and engage the cap.

The cap makes a tight friction fit over the barrel. While there is little danger of the radio pulling apart, a drop of cement may be applied inside the cap to permanently secure it to barrel.

Turning the #4-40 screw on the tuning core proved a little rough on the fingertips, so I squirted a generous amount of *Duco* cement into the plastic cap salvaged from a discarded lighter fluid can and attached it to the screw, allowing screw and knob to dry overnight.

Camera Flashgun From Toy Teakettle

BATTERY powered and hand held, this economical little flashgun can be used anywhere with any camera having a time, bulb or slow shutter speed. Exposure is made by the open lens-flash-shut lens method.

Obtain the parts given in the list of materials first. Then, cut out the bottom of the toy teakettle with a pocket knife and, with a pair of pliers, pull the remaining bottom metal out of the seam. Bend the teakettle handle to the shape shown in Fig. 2 and carefully remove the kettle spout. Force the automobile lamp socket into the spout hole and, with a midget flashbulb in the socket, adjust the socket in the hole so that the bulb is centered in the reflector. If the spout hole must be enlarged to do this, use a tapered wooden dowel to expand the hole just large enough for a snug fit with the lamp socket. Coat the inside and outside edges around the socket where it joins the kettle with household cement.

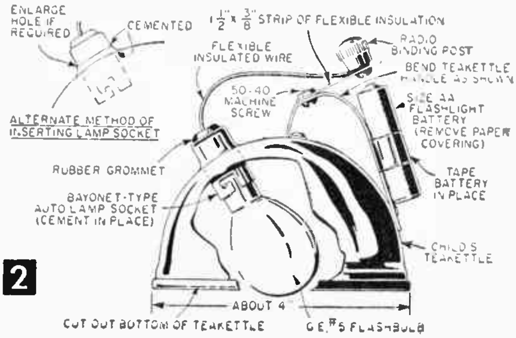
Now, remove the paper cover from an AA-size flashlight dry cell battery and tape to the teakettle handle as in Fig. 2. For the on-off switch, drill one end of a strip of flexible insulating material (see materials list) to take a radio binding post and the other end for a 5-40 machine screw. Because different makes of toy kettles will vary somewhat in size, determine the distance between the drilled holes by holding the insulating strip on the kettle handle so that the rd binding-post screw will make contact with thé battery center terminal when the binding post is pressed. Then cement and bolt the insulating strip to the kettle handle. Connect the wire from the lamp socket to the radio binding post and you're all set to take indoor, flashbulb-lighted pictures.—ARTHUR TRAUFFER.

1

To fire flashbulb, press binding post with thumb until binding-post screw contacts center terminal of flashlight cell.

MATERIALS LIST—
CAMERA FLASHGUN FROM TOY TEAKETTLE

No.	Description	Use
1	4" toy whistling teakettle (aluminum)	reflector
1	1/16 x 3/8 x 1 1/2" flexible insulating material (Plexiglas, Bakelite, Micarta or Fiber)	switch
1	8-32 Bakelite knob radio binding post	switch
1	size AA flashlight dry cell	battery
1	3/8 x 5-40 machine screw	switch
1 box	Midget flashbulbs (General Electric #5)	
1	single-point, bayonet-type automobile lamp socket to fit above bulbs	bulb socket
1 tube	household cement	



2

• When a rat-tail file breaks, don't throw it away—break it up into a number of 2-in. lengths and use them in your power drill to enlarge radio chassis holes. They cut very rapidly and are ideal for enlarging tube socket holes and for similar radio work.—J.A.C.