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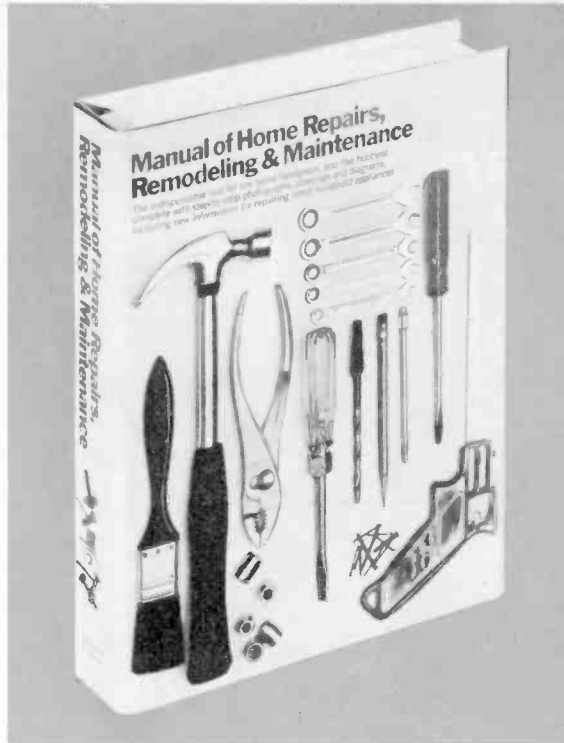
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You Can Make

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ELECTRONIC PROJECTS YOU CAN MAKE, FAWCETT BOOK #741 is published by Fawcett Publications, Inc., Greenwich, Connecticut. Editorial and Advertising Offices: 1515 Broadway, New York, New York 10036. General Offices: Fawcett Building, Greenwich, Connecticut 06830. Printed in U.S.A. Copyright © 1964, 1965, 1966 by Fawcett Publications, Inc.

Second Printing

Fawcett Publications, Inc., is a member of American Book Publishers Council, Inc.

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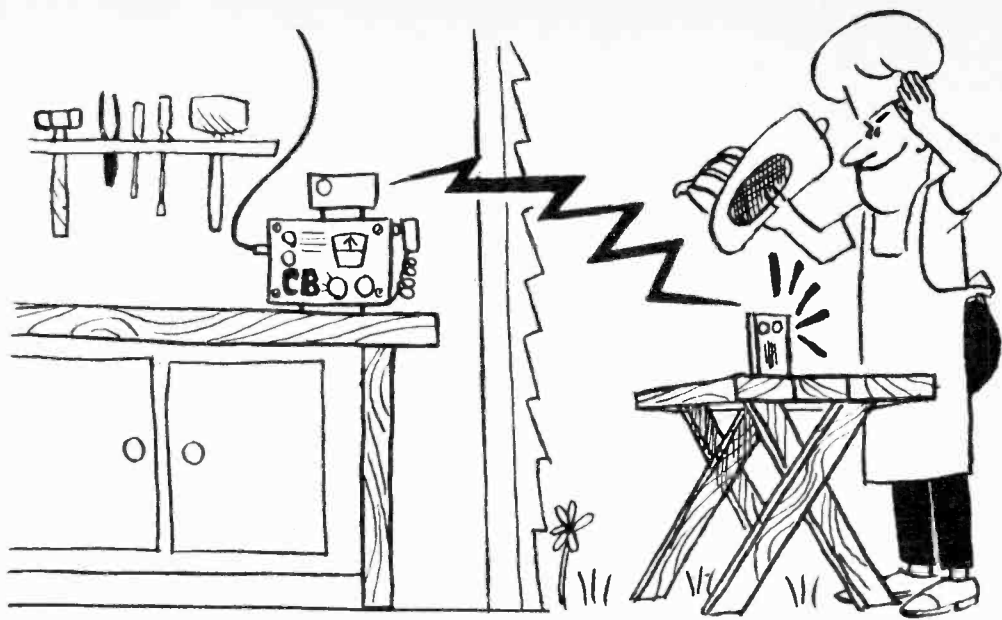
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CB PAGER

It puts the Citizens Band on any broadcast radio anywhere in your home!

By HERB FRIEDMAN, KB19457

SERIOUS Citizens Banders aren't known to be time wasters. They're quick to get messages across, then go on to other business. Seldom do they just sit and look at the rig, waiting for something to happen as would a short-wave listener.

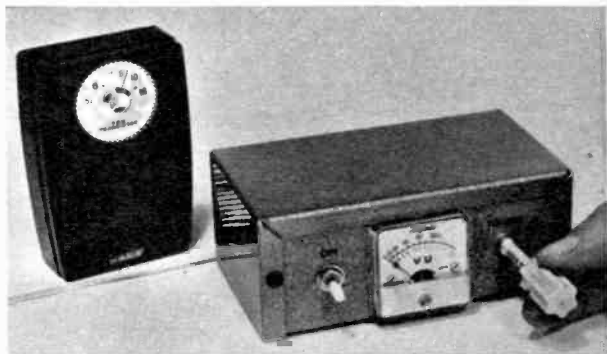
But sometimes they *must* sit around waiting for a prearranged call to come through or to monitor a channel. More often than not there are other things waiting to be done around the house that could be taken care of during these idle moments.

This means that if they can't be within reasonable earshot of the rig you must crank the gain up so high that when the call finally does come through it rattles windows halfway across town.

The best way to be sure of hearing an incoming call *away* from the rig is with our Pager. It's a device that rebroadcasts incoming CB calls to you through any broadcast radio. It works this way: the Pager is a low-power broadcast-band oscillator. The CB transceiver's speaker output is fed to the Pager to modulate its oscillator, which is tuned to broadcast the call from the rig on

an unused broadcast-band frequency.

To keep within FCC regulations and to insure privacy, the Pager's range is limited to about 100 ft. This is enough to cover the average home, backyard or your neighbor's home where you may be visiting. To keep distortion down the Pager has a built-in modulation meter. And the circuit is designed to



Pager is tuned to an unoccupied spot on the broadcast band by adjusting a front-panel-mounted coil. Radio becomes quiet when Pager is on frequency.

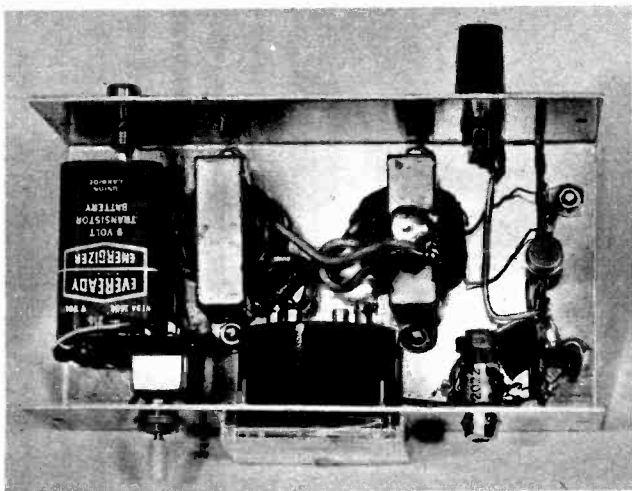
work from a flea-whisper signal.

Construction. All component values are critical and substitutions must not be made. The Pager operates at the legal input power limit of 100 milliwatts. Do not attempt to increase the power or you will destroy transistor Q1 and possibly oscillator coil T3.

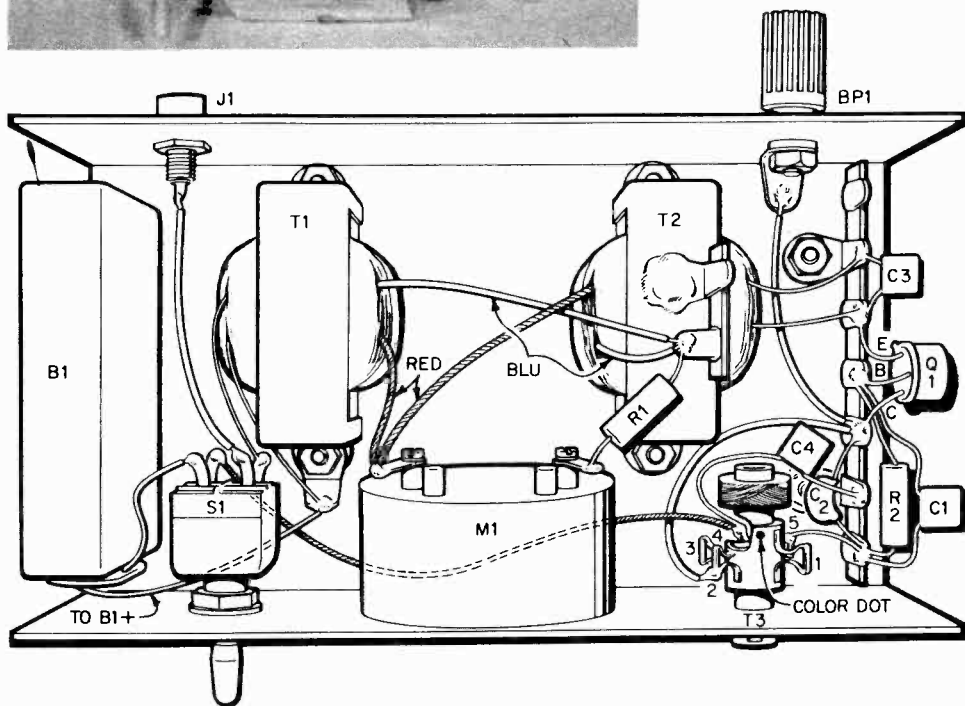
The circuit is built on the U-section of a 5¼ x 3 x 2½-in. Minibox. Modulation meter M1 is mounted dead center on the front panel (its hole can be cut with a standard 1½-in. chassis punch). To insure that

there's enough room for T1 and T2, mount the 7-lug terminal strip (at the right in the pictorial) as close to the right edge of the cabinet as possible.

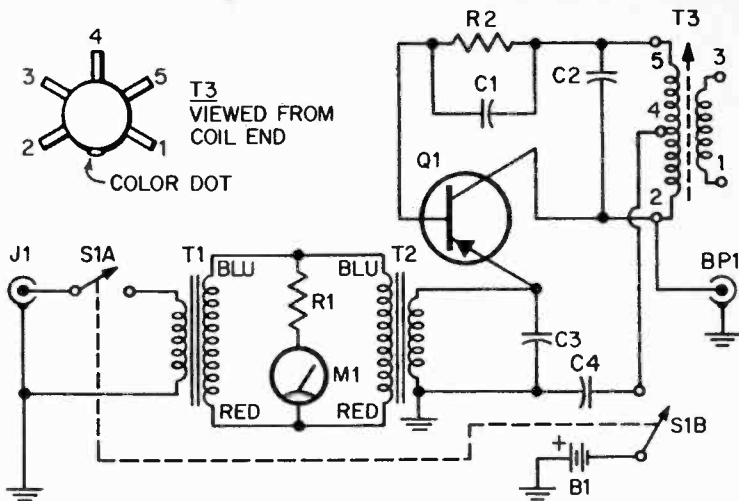
Since the components just fit into the cabinet, assemble the Pager in the following order. First (after all chassis holes are cut), mount the terminal strip at the right. Second, mount T3 on the front panel as shown, with the color dot facing up. Then connect all leads to T3. Connect the remaining components to the terminal strip before installing



Space is at a premium but you'll be able to fit everything in a 5¼ x 3 x 2½-in. Minibox if you proceed in this order: cut meter hole in center of cabinet; drill holes for switch, coil, transformers, terminal strip, binding post and jack; wire oscillator circuit on terminal strip at right, install coil, meter, transformers and other parts. Because of crowding around terminal strip at right and oscillator coil, use spaghetti on all leads. Heat sink Q1's leads to prevent heat damage to it when soldering.



Schematic of Pager. Incoming signal is stepped up by T1 to drive VU meter M1. (M1 indicates maximum safe modulation level.) Signal then is stepped down again by T2. T2's secondary is in Q1's emitter circuit so signal modulates RF carrier generated by Q1. When unit is turned off power is removed and signal from transceiver is prevented from being applied to T1 by open set of contacts of S1A.



PARTS LIST

B1—9 V battery (Burgess 2U6 or equiv. See text)
 BP1—5-way insulated binding post
 C1,C3,C4—.01 μ f, 75 V (or higher) ceramic disc capacitor
 C2—33 μ f, 500 V silvered mica capacitor (see text)
 J1—Phono jack
 M1—VU meter (Lafayette 99 R 5024)
 Q1—PNP (AM converter) transistor (Lafayette 19 R 4213)

R1—5,600 ohm, $\frac{1}{2}$ watt, 10% resistor
 R2—2,200 ohm, $\frac{1}{2}$ watt, 10% resistor
 S1—DPST toggle or slide switch
 T1,T2—Output transformer (50L6 tube); 3-4-ohm secondary (Lafayette 33 R 3701)
 T3—Transistor oscillator coil (J.W. Miller 2022, Allied 60 U 974)
 Misc.—K-tran alignment tool (Allied 50 U 015), $\frac{5}{8}$ x 3 x $2\frac{1}{8}$ -in. Minibox, battery clip

CB PAGER

Q1. Since Q1's leads must be short, heat sink each when soldering.

All capacitors except C2 can be ceramic discs rated at 75 V or higher. But C2 must be a silvered-mica type. The specified value of 33 μ f will produce an output between 1000 kc and 1600 kc. If you want to lower the output frequency, change C2 to 50 μ f. Install M1, then T1 and T2.

Battery B1 is a standard transistor-radio size. In intermittent service it will last several months. If you plan to use the Pager constantly, install a larger 9-V battery and mount it on the outside rear of the cabinet.

Tuneup. Connect an antenna no longer than 10 ft. to BP1. Temporarily connect the Pager via J1 to the voice-coil lugs on your transceiver's speaker. Make sure that if one of the voice-coil leads is grounded the ground lead from J1 is connected to this lug.

With the transceiver *off* and S1 *on*, place a radio near the Pager's antenna and tune the radio to a quiet spot between 1000 and 1600

kc. Then adjust T3's slug with the special alignment tool specified in the Parts List until you pick up the signal in the radio. You'll know the carrier's there by a sudden quieting of the radio.

Next, set S1 to *off*, turn the transceiver on and tune in an active channel. Turn the transceiver's volume way down and then turn S1 *on*. Slowly advance the transceiver's volume until M1 indicates 100 per cent modulation on speech *peaks*. If all is well you will hear the CB signal from the radio with very little distortion. If the sound is distorted move the radio away from the Pager's antenna.

Since the transceiver's output during normal listening is several times that required to modulate the Pager, both Q1 and M1 could be damaged if the Pager is left *on* during normal transceiver operation. Always make certain S1 is set to *off* before you turn up the transceiver's volume.

The level of the signal to the Pager should be adjusted on a moderate-level signal from the CB rig. If adjusted on a strong signal the weak signals hardly will be heard. If adjusted on a weak signal, a strong signal will cause overload and distortion.

At camp, school or home, would-be disc jockeys have it made with this closed-circuit wireless broadcaster.

THE entertainment you want when you want it. That takes a lot of patient dial-twisting these days. In fact, you may never be able to locate the station that plays *your* kind of music and with few commercials. But before you and your friends give up radio as an entertainment medium, have you ever thought about operating a station with your *own* programs?

We don't mean a 50-kilowatter. What we have in mind is a low-cost, low-power radio station. With such a setup you can broadcast your newest records, deliver hardhitting commercials and give your own inaccurate weather forecasts. It's the chance to show what a witty disc jockey you could be if only somebody would discover you and give you a break.

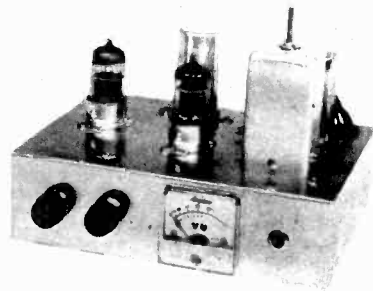
With our low-power broadcast station you can do all this and more. It has inputs for a microphone and record player (or tape), mixing controls and a modulation-level meter. Just turn it on, pick a clear spot on the broadcast band and you're on the air!

Because the FCC frowns on unlicensed broadcast stations, and since a licensed station costs a pile of dough, our rig was designed for limited range. Its low power is perfectly legal and you won't get into trouble with the FCC. You won't be heard all over town—in fact, you won't even be heard at the other end of the block. But in your own apartment building, your neighbor's house, at camp or in a college dorm, you'll be top dog on the band.

Our station actually is a deluxe version of the old wireless microphone. But instead of having an antenna wire hanging out of the back, our rig uses the AC power line that it's plugged into to carry the signal. And with good conditions the range may exceed that of the wireless mike of old.

Our station doesn't produce the usual barely-readable signal like many wireless mikes. It has extra power-supply filtering for low hum, and its low-distortion mike and phono preamps make its signal sound as if it is coming from a commercial station.

build your own



BROADCAST STATION

By AL TOLER



The station will fit on a 5x7x2-in. aluminum chassis. Parts layout and wiring are critical; therefore, we urge you to duplicate our layout. After the chassis has been drilled, mount VU meter M1. Space is at a premium and it might be difficult to install M1 after other components are mounted. Coil L1 should be mounted last to protect its slug-adjustment screw, which protrudes a considerable distance outside the can. Pay special attention to the values we specify for components associated with V2; do not make changes or substitutions.

Coil L1 must be modified, as shown in the diagrams on the third page of this article, to work in the station's oscillator circuit. The modification is not difficult but must be done with care to avoid damaging the delicate coil wires.

First, remove the single screw which holds the coil assembly in the can. If your coil is supplied with a rivet instead of a screw, use a 1/4-in. drill to remove the rivet's head. Then punch the rivet through the can with a nail or a center punch. Carefully slide the coil assembly out of the can. The slug remains attached to the can, so don't move the coil to the side when taking it out. Slide it straight down.

Note that the coil has a terminal board at the bottom and that the color-coded leads are attached to only four of the five terminals. The remaining terminal is the junction for two 100-mmf capacitors.

Remove the capacitor going to the green-lead lug by clipping its leads (don't try to unsolder it). Then cut out the 100K resistor and remove the blue lead. Cut off the green lead and attach it to the terminal that was the junction of the two capacitors. Install the coil in the can again. Disregard the instructions supplied with L1 and connect it as shown.

Install C3 so it can be removed easily. If you want to use the station for baby-sitting purposes only, eliminate J2, R5, R6, R7, C5 and M1 and connect R4's wiper directly to pin 7 on V1B.

Make certain that C8 is connected to the contact on S1 that goes to T1. It should *not* connect to the line side of S1. Twist the leads going to switch S1 and to neon lamp NL1. Use shielded wire to connect J2 to R5.

Checkout

Turn on power by rotating R5 until the

Phone Tapping for Everyone



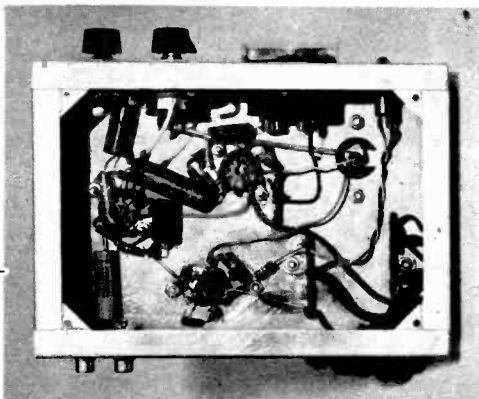
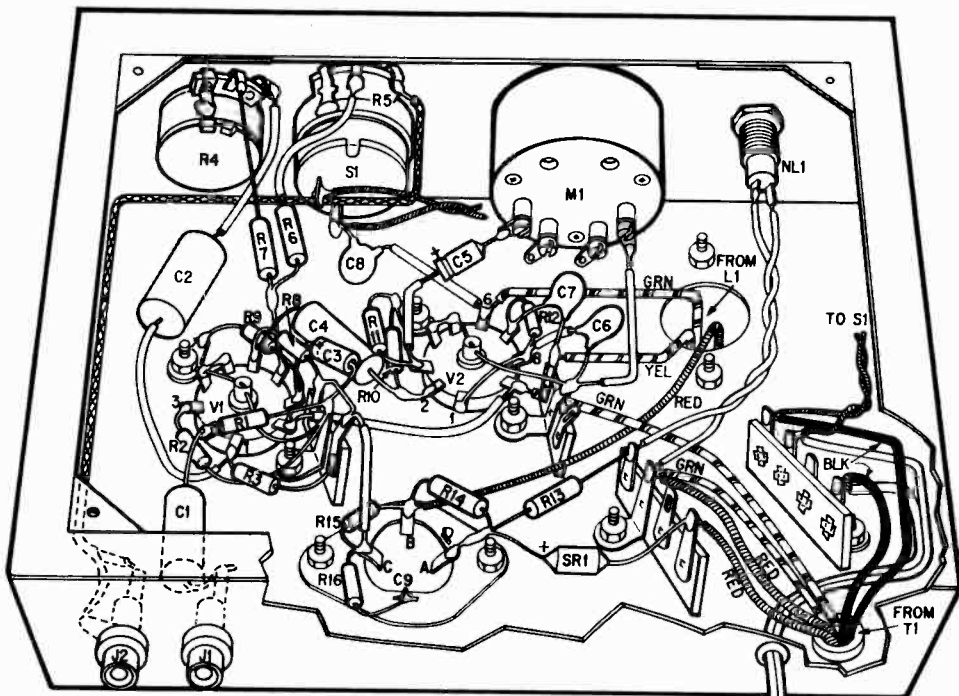
YOU don't have to be President to want to tap a telephone. Lots of private citizens find it useful to record conversations. And, so long as it is their own phone, they'll find it easy to do—and perfectly legal.

Two ways are available for you to record phone calls. The first method requires that you apply to the phone company for a beeper which warns callers of the recording. The phone company favors the beeper partly because it gets them involved and they can try to dissuade you, or at least make sure *their* equipment is not damaged.

An even easier way is to use a pickup coil fastened to the handset or placed under the base of your phone. Since no wires have to be connected, the phone company is none the wiser and their equipment obviously doesn't get pranged.

You can find pickup coils at Radio Shack and Lafayette stores and the latter offers them by mail for \$1.10 to \$7.80. Many tape recorder manufacturers sell telephone pickups as accessories for the models that they market.

What's that about legality? So long as you don't do anything with the tapes that is embarrassing or harmful to someone else and don't reveal the contents to third persons, you're okay with the feds. ●

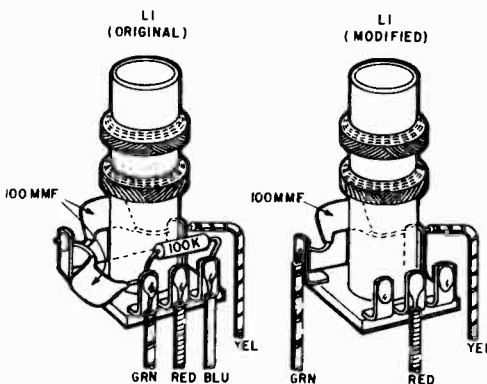


There's plenty of room for all parts in the chassis we selected. All leads should be short and direct to keep hum and distortion low and to assure proper oscillator (V2) operation. Braid on shielded lead from J2 to R5 is grounded at J2 only. Twist AC lead to S1 and position it near the chassis.

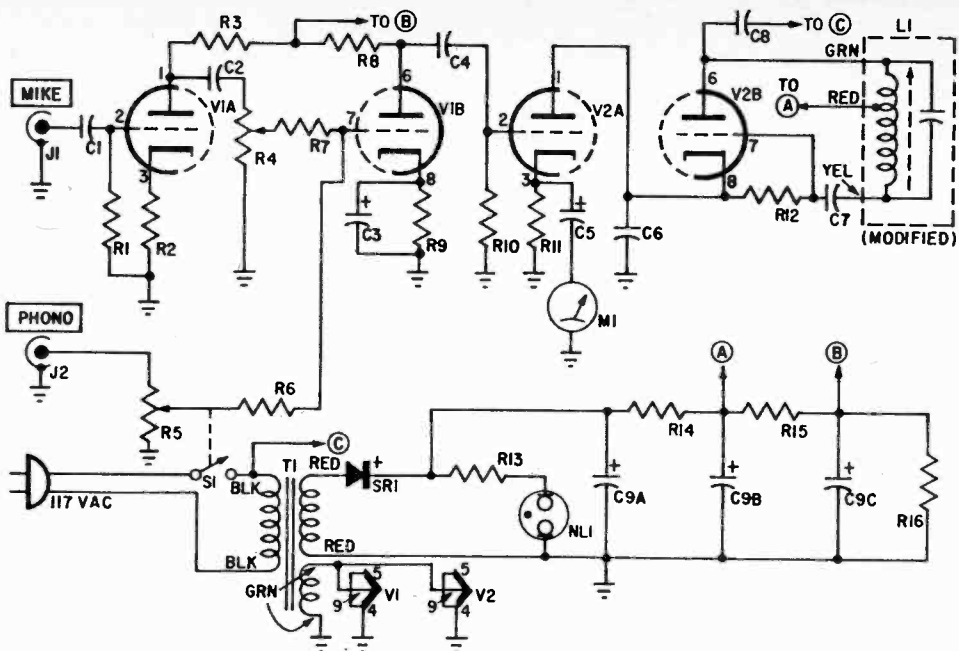
BROADCAST STATION

power switch clicks. Allow the unit to warm up for a few minutes, then turn on an AC or AC/DC radio plugged into the same circuit and tune the radio to a spot where there is no station. Adjust L1's slug until you pick up the signal on the receiver. The radio will get quiet and the background noise will disappear. Check to make certain the rig is not interfering with a commercial station. If the receiver is physically too close to your station you may pick up two signals, one on the high end of the dial and one on the low end. The low-end signal usually is false; it will not be received when the radio is moved to another room. (It is possible that the high-end signal is false, although this is rare.)

Connect a mike to J1 and plug a record player with a crystal or ceramic cartridge



Coil L1 as it appears when removed from can, at left. Modify it by removing 100 mmf capacitor, 100 K resistor, blue lead; also move the green lead.



Mike signal is amplified by V1A and fed via R4 to V1B and further amplified. The signal continues to V2A which, because it is connected between Hartley oscillator V2B and ground, modulates the oscillator.

PARTS LIST

- | | | |
|---------------------------------|------------------------------------|-----------------------------------|
| Capacitors: | Miller No. 522, Allied Radio stock | potentiometer |
| C1—.01 mf, 400 V tubular | No. 61 G 005, \$2.97 plus postage. | R6, R7—470,000 R11, R15—2,200 |
| C2—.02 mf, 400 V tubular | (Not listed in catalog) | R12—22,000 R13—220,000 |
| C3, C5—30 mf, 15 V electrolytic | M1—VU meter (Lafayette 99 G | R14—1,200 R16—270,000 |
| C4—.05 mf, 400 V tubular | 5024) | S1—SPST switch on R5 |
| C6, C8—330 mmf, 500 V disc | NLI—NE-2 neon lamp and holder | S1—Silicon rectifier: 500 ma, 400 |
| C7—.001 mf, 500 V ceramic disc | Resistors: ½ watt, 10% unless | PIV or higher |
| C9A, B, C—20/20/20 mf, 250 V | otherwise stated. Values in ohms. | T1—Power transformer: second- |
| J1, J2—Phono jack | R1—1 megohm R2, R9—1,500 | aries; 125 V @ 15 ma, 6.3 V @ |
| L1—Phono oscillator coil: J. W. | R3, R8, R10—100,000 | 0.6 A Lafayette 33 G 7502. |
| | R4, R5—250,000 ohm audio-taper | V1—12AY7 tube V2—12AX7A tube |

in J2. (You would also connect a tape deck output to J2). If your record player has a magnetic cartridge, plug it in J1 and connect a 22K-ohm resistor from J1 to ground.

Adjust volume controls R4 and R5 until M1 indicates between 60 and 85 per cent modulation. (Don't try to push the modulation any higher or you will produce a distorted signal.) Move the radio away to check the station's range. If the range is only a few feet, reverse the station's plug.

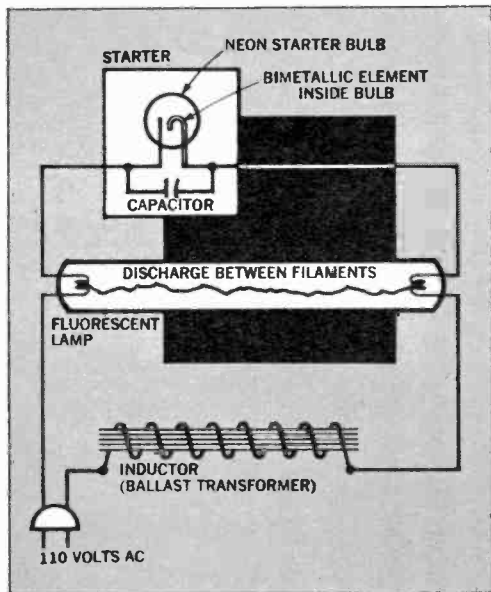
Since power lines have considerable losses at broadcast frequencies the station's operating range will depend on the type of house wiring (metal-clad BX or insulated Romex) and the equipment connected to the line, such as lights, heaters or motors. The range also will depend on power-line transformers. If you are on one side of a distribution transformer and your neighbor is on the other, he won't be able to pick up your signal.

If the operating range is too restricted by power-line problems, it can be extended by converting the station to wireless operation. To do this, install an insulated binding post on the chassis, disconnect C8 from S1 and connect C8 to the binding post. Then connect a 50-in. length of wire to the binding post. If the station's frequency changes when the wire antenna is approached, change C8's value to 50 mmf. If you find the mike or phono signal has too much bass, remove C3.

Service Hints

If L1's slug does not lower the output frequency sufficiently, increase the value of C8 by 50 mmf. If L1's adjustment can't raise the output frequency sufficiently, lower the value of C8 by 50 mmf. If the sound is distorted severely and M1 doesn't indicate, or just barely wiggles, check C5's polarity. Be sure the positive end connects to pin 3 of V2A.

Fluorescent Starter Guide



PROBABLY the most misunderstood part of a fluorescent lighting fixture is the mysterious metal can that starts it. Actually, the starter is just a neon bulb and capacitor. But its values must be matched with the lamp if you are to avoid poor performance and shortened tube life.

Inside the fluorescent tube is argon gas mixed with a droplet of mercury. In the presence of a spark, this mixture glows and produces light.

The lamp has filaments at either end connected to pins. When electricity flows into the circuit (see diagram) the neon bulb lights up and heats a bimetallic element which bends and closes a circuit. That, in turn, brings a shot of high voltage from the ballast transformer that also is applied to the fila-

ments. The high voltage between filaments causes the gas to ionize (become conductive) and start glowing. The starter then switches itself off.

Selection of the right starter is confusing because FS codes follow no particular pattern. For example, type FS2 works fine with a 20-watt lamp and it can also be used on a 14 or 15 watt tube. But don't try putting an FS4 or FS40 (which are both for 40 watters) in place of the FS2 starter because this change can cause problems.

A starter that is too big is apt to destroy the filaments. On the other hand, an undersize starter fires before sufficient voltage is built up and won't be able to turn on the lamp. Fluorescent lamps should go on within 7 sec.

No-blink starters do away with the blinking that often takes place at the end of a lamp's life. You can get either manual or automatic switches with this type. With the manual one you have to push a red button (in the bottom) after replacing a lamp.

Some new starters have the wattage printed along with the FS code. If you can't find this type just read the wattage off the lamp and our chart will give you the right starter.

Since starter life is limited and they're not very expensive, it's a good idea to keep spares on hand. At the first sign of trouble (especially a delay in lighting), replace the starter. ●

FLUORESCENT STARTER GUIDE

FS NUMBER	LAMP SIZE IN WATTS	STARTER SWITCH TYPE
FS2	14, 15, 20	Standard
FS4	30, 40	Standard
FS4-NA	40	No-blink automatic
FS5	4, 6, 8	Standard
FS12	32 Circline	Standard
FS20	15, 20	No-blink manual
FS25	22 Circline, 25	Standard
FS30	30	No-blink manual
FS40	40	No-blink manual
FS85	85, 90, 100	Standard
FS85-NA	85, 90, 100	No-blink automatic
FS85-NA4	85, 90, 100	No-blink automatic
FS85-4	85, 90, 100	Standard
FS400	40	No-blink manual
FS850	85, 90, 100	Standard
FS40/400	40	No-blink manual

Build Your Own Robot Telephone Answerer

By Myles Marks



NOT long ago the people who had gadgets to answer their phones were likely to be doctors or lawyers. But now everybody seems to want an automatic phone answerer and the devices are on the way to becoming almost as popular as digital clocks.

You can go and spend a big wad of money for one of these little marvels but for the do-it-yourselfer there's a better way.

For about \$45 you can build our Robot Telephone Answerer that will (in conjunction with a tape recorder) answer callers with a greeting and then make a tape of the caller's message. Your pre-recorded greeting can take up to 30 seconds of tape time and the caller's message can run as long as a minute. Then, when you return home, the tape recorder plays back all the messages left for you.

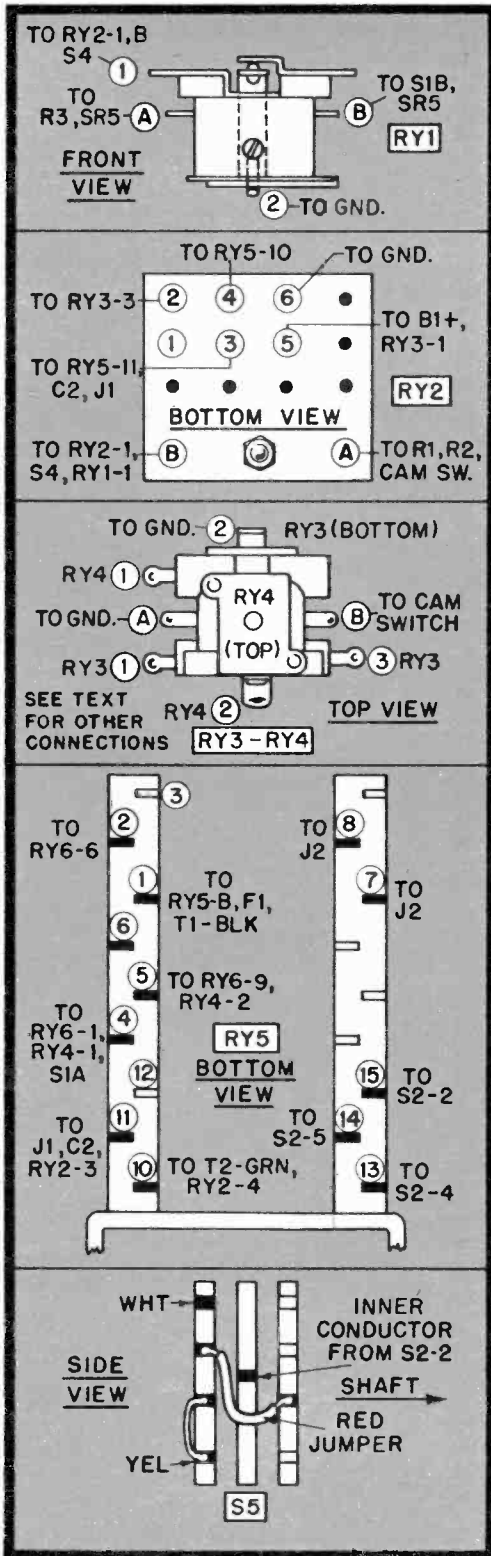
The Robot can be built in a 12x7x4-in.

Minibox. First thing to do is drill all the holes in the ends of the main section. This includes small clearance holes on the front of the cabinet for miniature switches S1, S2, S3 and S4. These correspond to On/Off, Line/Record, Tone (push button for the beep maker) and Start (push button) functions.

In addition holes for the microphone and the remote start jacks from the tape recorder should be drilled. The Record/Play switch (S5) is also installed on the front.

On the rear of the cabinet you will later install a phono jack for the phone lines as well as potentiometer R4.

Most of the parts are mounted on a 10 $\frac{3}{4}$ x6 $\frac{1}{2}$ -in. piece of perfboard in which there's a 4 $\frac{1}{4}$ x5-in. cutout for the tape-loop mechanism. After cutting the board, lay it in the box and mark six spots (in the corners and middle) for the mounting-screw holes. Drill the mounting



holes in the board and in the box. (The board is mounted with 3/4-in. spacers—sleeves—to keep wiring on the underside from shorting to the box.)

Next, mount the parts on the board as shown in the pictorial. Our view of the underside of the board shows the wiring to the parts, which are mounted on the top of the board. The photo shows the location of the parts on the top. If you use different relays from those in the Parts List, follow the schematic, rather than the pictorial, when wiring.

The tape-loop mechanism should be installed where shown to reduce hum and so that switch S5 (it comes connected to the tape-loop mechanism with short leads) will reach the end panel. The tape-loop mechanism is designed to be powered by a 9-volt transistor battery (for the amplifier) and a 1½-volt D cell (for the motor and erase head). In our circuit, there's a built-in power supply for the amplifier but the motor requires a D cell.

Before mounting the tape-loop mechanism on the main section of the Mini-box, it first must be modified. Underneath it is a cam-driven leaf switch. As wired, the switch controls a tone generator which records a beep on the tape. Unsolder the wires then solder longer wires to each leaf-switch contact.

Use shielded wire to connect S2 to J3 and to lugs, 13, 14, and 15 on relay RY5. Ground the shield (braid) only where shown in the pictorial to prevent hum. Potentiometer R4 in our model is a screwdriver-adjust type with a locking nut; however, you may use a conventional pot. Transformer T1 is a 6.3-volt filament type. If yours has a center-tap lead, cut it short and tape it.

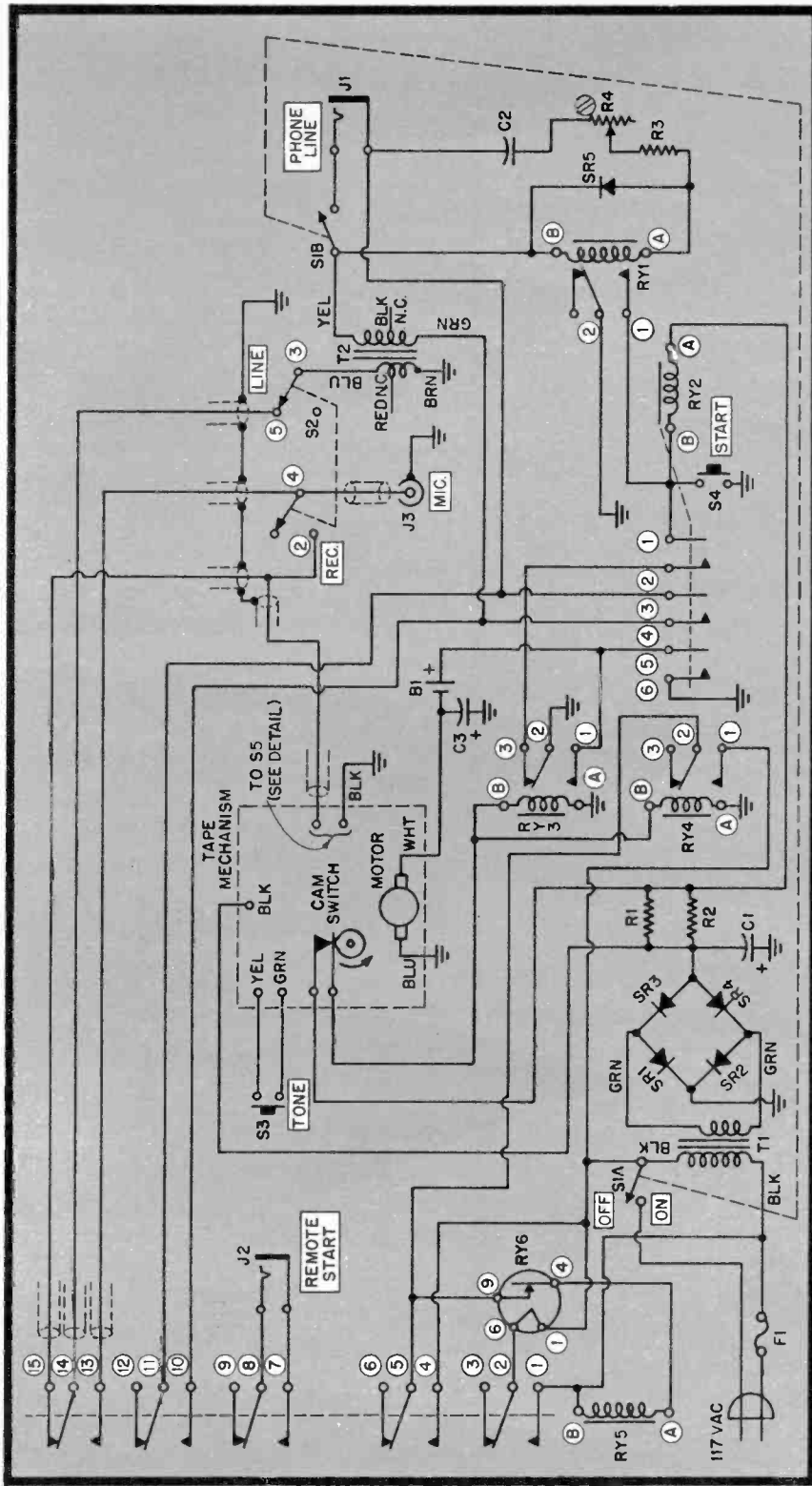
A few words about the relays in case you have trouble getting the types specified and wish to make substitutions.

Relay RY1 has a 2,500-ohm coil with a 5-ma (60 milliwatt) pull-in.

Relay RY2 is used as a 3PST although a 4PDT is specified in the Parts List. Any 6-volt (DC) 30-ohm coil relay with the necessary contacts can be used.

Relays RY3 and RY4 (SPDT) are

CONNECTIONS are many but relay wiring is easy because of ample working room. Wafer switch comes with tape mechanism.



RELAY RY5 has a total of 18 contacts (3 for each pole) but only 15 are needed as indicated at the extreme left of the schematic. Dotted lines near the relays mean that the contacts are mechanically linked but electrically isolated. In the same way, switch S1 is electrically divided, with one set of contacts for AC power and the other for phone lines.

Robot Telephone Answerer

stacked because a DPDT relay with the desired coil characteristics is not readily available. Don't forget to insulate the wiper lug (2) of RY4 with tape because there's a 117-volt shock hazard on it.

On relay RY3 terminals A and 2 should be grounded while B is connected to terminal B on RY4 and the cam switch on the tape mechanism. Terminal 1 goes to point 5 on RY2 and the positive battery terminal while terminal 3 goes to point 2 on RY2.

In like manner on relay RY4, terminal A is grounded and B goes to B on RY3. Terminal 1 is connected to S1A/T1 (blk), point 1 on RY6 and point 4 on RY5. Terminal 2 of this relay should go to point 5 on RY5 and point 9 on RY6. Terminal 3 gets no connection.

Relay RY5 is a 6PDT type with a 115-volt AC coil. Only five poles are used. This value coil was chosen to reduce the load on the power supply and the amount of filtering required.

Relay RY6, a time-delay type, looks like a nine-pin tube. It was chosen so you can easily change the length of time allotted the caller by simply plugging in a different relay. However, a 60-second limit is the longest time possible.

After you complete the wiring, all that remains is the final adjustments.

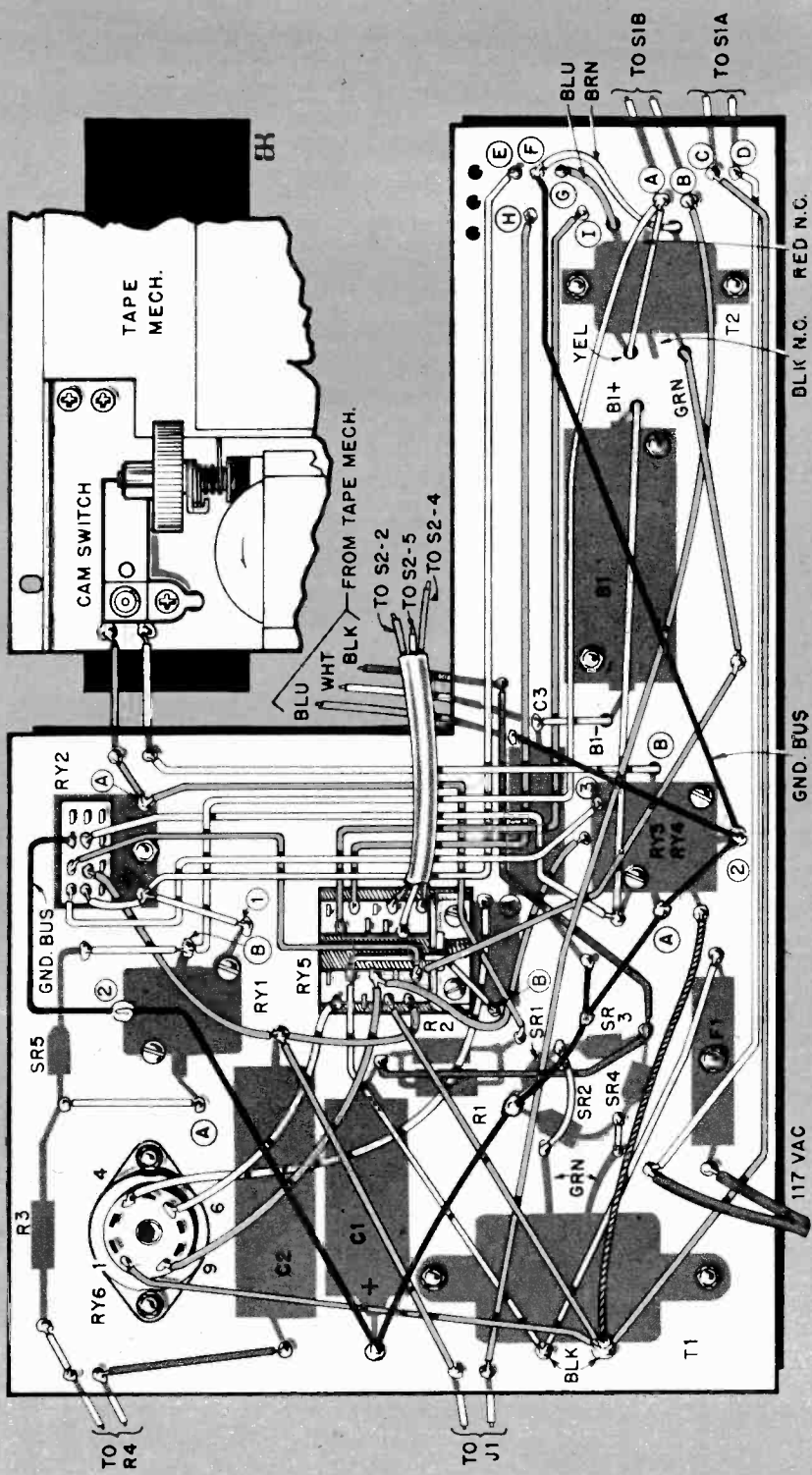
First thing to do is match the length of the tape loop to the timing of the cam switch. Remove RY6 for this operation so the answerer will recycle immediately and not after the time delay. Cycle the tape-loop mechanism twice by applying AC power with S1 and then press S4. When the loop stops, carefully mark the outside of the tape with a felt-tip pen at the center of the record/playback head.

Cycle the answerer again with S4. When the tape loop stops, note that the mark you put on the tape is not in the same spot. Do not move the tape. Make another mark on the tape at the center of the record/playback head. Remove the tape between the two marks. This will be a tedious job and may require several tries before the correct amount of tape is removed. Always cut the tape at the left mark and remove tape to the right (where it is fed to the head).

PARTS LIST

- B1—1½-volt battery (D size)
- C1—1,000 to 2,000 mf, 10-volt electrolytic capacitor
- C2—2 mf, 100-volt capacitor
- C3—100 mf, 15-volt electrolytic capacitor
- F1—1-amp fuse
- J1—Phone jack
- J2—Subminiature phone jack
- J3—Miniature phone jack (to match tape recorder microphone plug)
- R1, R2—33-ohm, 1-watt, 10% resistor
- R3—12,000-ohm, 1-watt, 10% resistor
- R4—10,000-ohm potentiometer (see text)
- RY1—SPDT relay; 2,500-ohm, 5-ma coil (Potter & Brumfield RS5D. Allied Electronics Corp., 2400 W. Wash. Blvd., Chicago, Ill. 60612. Stock No. 886-1277, \$5.15 plus postage.)
- RY2—4PDT relay; 6-volt DC, 40-ohm coil. (Magnecraft W77CSX-1. Allied Electronics No. 850-2225, \$9.27 plus postage.)
- RY3, RY4—SPDT relay; 6-volt DC, 440-ohm coil (Calectro D1-98. Olson Electronics, 260 S. Forge St., Akron, Ohio 44327. Stock No. SW-616B, \$3.95 plus postage.)
- RY5—6PDT relay, 115-volt AC coil (Hart-Advance 12-AC-115-6C-10 or Magnecraft W-67-AC-SX-15 which is available from Lafayette by special mail order for \$9.08 plus postage—not in catalog)
- RY6—Normally-closed thermal time-delay relay. Miniature 9-pin, 30-second, 115 volt. (Amperite 115C30T, Lafayette 33 E 35874)
- S1—DPST miniature toggle switch
- S2—DPST miniature toggle switch
- S3, S4—Normally-open miniature push-button switch
- SR1 SR4—Silicon rectifier; minimum ratings: 750 ma., 25 PIV
- SR5—Silicon rectifier; minimum ratings: 100 ma., 100 PIV
- T1—Filament transformer; primary: 117 V, secondary: 6.3 V (Lafayette 33 E 37029)
- T2—Transistor transformer; primary and secondary: 500 ohm, center tapped (Lafayette 33 E 85531)
- Misc.—Continuous-loop tape mechanism (Burststein-Applebee, 3199 Mercier St., Kansas City, Mo. 64111. Stock No. 18A1509. \$3.95 plus postage.), fuse holder, battery holder, 9-pin miniature tube socket, 12x7x4-in. Minibox, perforated circuit board, ¼-in. spacers, wire, solder, etc.

Next, record the message to be played to the caller. Plug a medium- to low-impedance microphone into J3, turn switch S5 (connected to the tape-loop mechanism) fully counterclockwise, and set S2 to record. Press S4, wait a couple of seconds and speak into the microphone. Limit the message to about 25 seconds, and, at the end say, "Wait for the tone before speaking." Wait a couple of seconds and press S3. Hold it until the tape-loop mechanism stops.



TELEPHONE-ANSWERER wiring is run on the bottom side of the perf board after all major parts are in place. Use wires of several different colors in this area so that checking of connections is easy. Most of this work involves hooking wires between contact points on the six relays. However, none of the wire runs are very critical. What does matter is good solder joints.

Robot Telephone Answerer

There is now a beep tone at the end of your message that tells the caller to start talking.

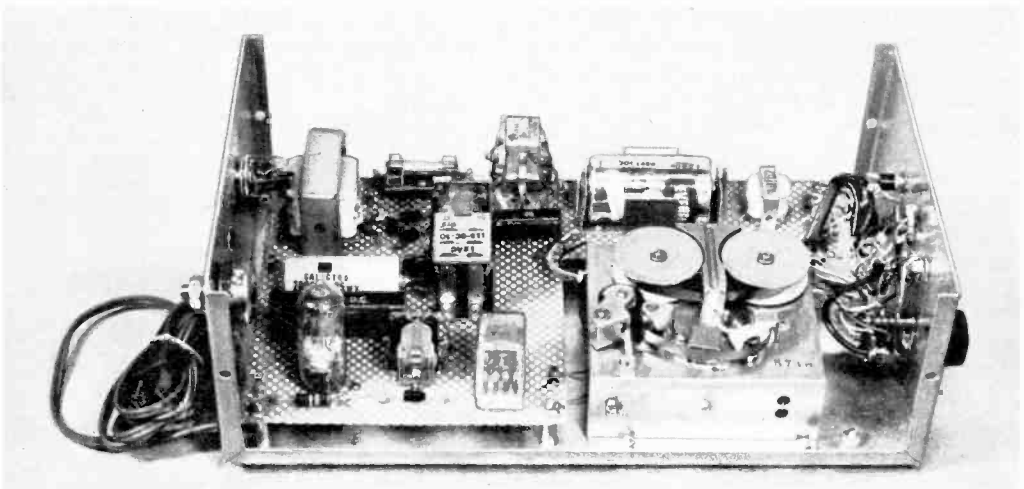
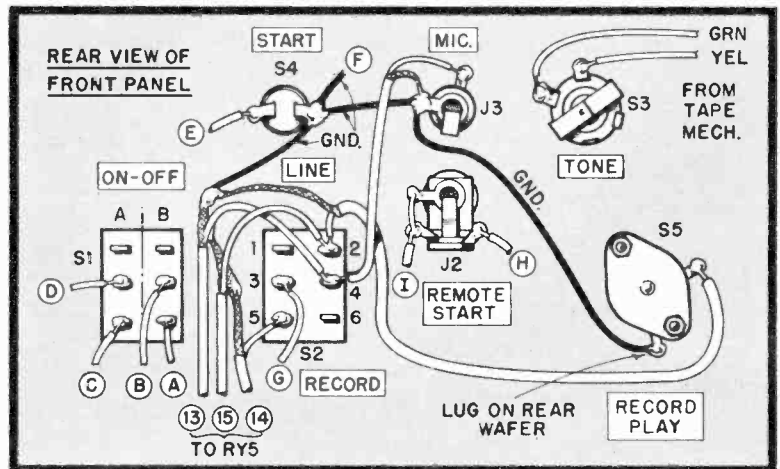
To check the recording, turn S5 fully clockwise and leave S2 in the *record* position. You'll hear the message, although slightly distorted, from the microphone. If the message is satisfactory, the answerer can now be connected to the phone line (red and green wires).

Connect a shielded patch cord from J3 to the AUX input of an external tape recorder that will be used to record the *incoming* messages. Finally, connect *remote-start* jack J2 to the remote-start jack on the external tape recorder. Plug RY6 in its socket and set S2 to *line*. Have someone call you and adjust R4 until the answerer answers just after the phone rings. Lock R4. If it's necessary to adjust the output level of the tape-loop mechanism, do so with the trimmer

potentiometer located underneath it.

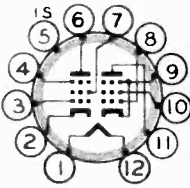
The checks completed, you can leave the answerer permanently connected to the phone lines (you may want to ask your phone company to install a special coupling device between their phone and your answerer).

One final comment about RY6. Although 30 seconds is plenty long enough for a caller to leave name, phone number and a short message, the time can be increased to 60 seconds. Beyond this time however, the answerer will not be able to answer calls back-to-back because of recycle time that is required between calls. ●



ALL PARTS fit nicely in 12x7x4-in. Minibox. Battery powers tape-mechanism motor.

The COMPACT BCer



- 1-Compactron Circuit
- Big-Speaker Sound

By HOMER L. DAVIDSON

BACK in the early days of radio everyone wore earphones and sat around a table while Dad carefully adjusted the catwhisker for best reception. Time passed and eventually a tube was used as a detector. Not long after that more tubes were added for amplification and some sets came to have more tubes than a cat has lives.

But the all-American five design trimmed the number of tubes somewhat. Today some cut-to-the-bone superhets have only three tubes, thanks to clever bottles that pack everything from diodes to pentodes into one envelope. Think the rise and fall in tube count has ended here? Not by a long shot.

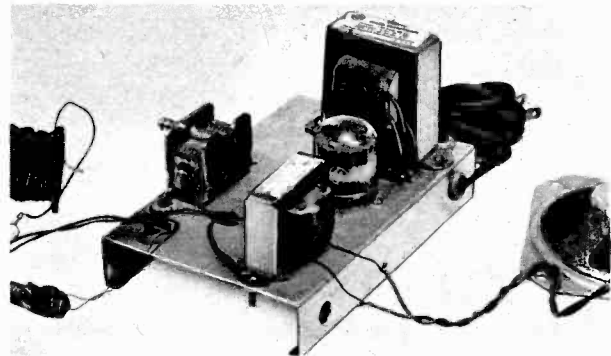
The Compact BCer has only one tube but in terms of performance it's a mighty far cry from that one-tube job of 30 or more years ago. The BCer's sensitivity and tone will surprise you. Secret of its simplicity and performance with only one bottle is a Compactron. It's a dual pentode job, one section of which is a hot regenerative detector. The other section is a power pentode that can deliver up to 2 watts of audio to the speaker.

And there aren't many other parts in the BCer—all together there are 11 capacitors and eight resistors. All components are standard, there is only one simple coil to wind

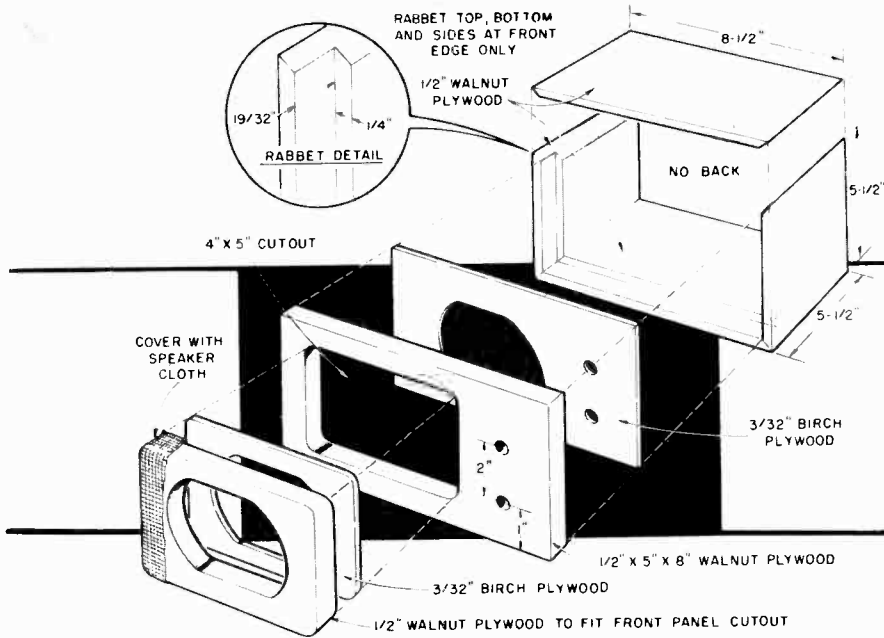
and the circuit is transformer-powered to eliminate the shock hazard associated with AC/DC sets. You'll find the Compact BCer a snap to get together and it will make a wonderful one-evening project.

Construction

The BCer fits on a standard $6\frac{1}{8} \times 4 \times 1$ -inch aluminum chassis. Follow as closely as possible our layout shown in the photo and pictorial. Don't worry about mounting the



Completed radio ready for installation. If you build cabinet we show here, mount speaker first and attach loopstick near back of the cabinet.

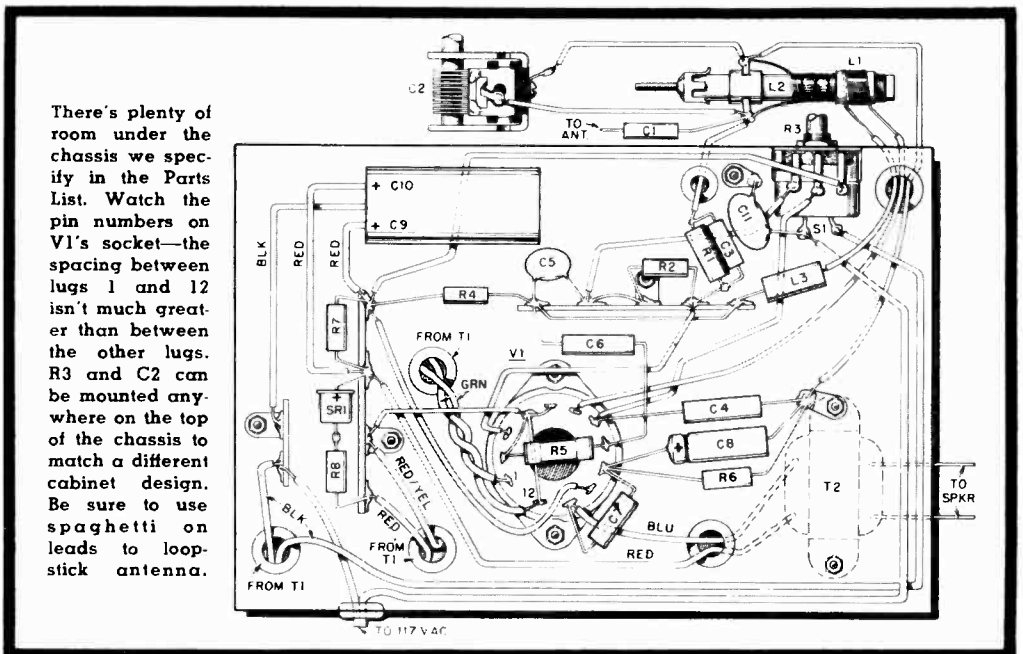


Use this wooden cabinet and you'll get excellent tone. Front panel construction can be simplified by using a piece of $\frac{3}{8}$ -inch plywood instead of the arrangement shown. Leave the back off the cabinet to provide for ventilation.

speaker at this time. It and the loopstick antenna can be attached to the cabinet after the chassis is installed.

Take your time when wiring V1's socket. There are a lot of connections to it and it's easy to short something. L1, the detector's feedback coil, should be wound over the bot-

tom end of the loopstick's coil. First, wrap a turn or two of tape over the loopstick's coil, then wind 35 turns of No. 36 enameled wire on the tape. The width of the coil should be about $\frac{5}{16}$ inch. After L1 has been wound, wrap a turn or two of tape over it to keep it from unwinding. L1's leads should be covered



There's plenty of room under the chassis we specify in the Parts List. Watch the pin numbers on V1's socket—the spacing between lugs 1 and 12 isn't much greater than between the other lugs. R3 and C2 can be mounted anywhere on the top of the chassis to match a different cabinet design. Be sure to use spaghetti on leads to loopstick antenna.

PARTS LIST

Capacitors: 500 V ceramic disc unless otherwise indicated

C1—.005 mf, 400 V tubular
C2—10-365 mmf variable (Lafayette MS-214 or equiv.)

C3—100 mmf
C4—.1 mf, 400 V tubular
C5—250 mmf C6—.01 mf
C7—.005 mf

C8—50 mf, 25 V electrolytic
C9, C10—50/50 mf, 150 V electrolytic C11—.05 mf
L1—35 turns No. 36 enameled wire wound over L2 (see text)
L2—Loopstick antenna (Lafa-

yette MS-11 or equiv.)
L3—10 microhenry RF choke (J. W. Miller 4612 or equiv.)

Resistors: 1/2-watt, 10% unless otherwise indicated

R1—5.6 megohms
R2—15 megohms
R3—200,000 ohm linear-taper potentiometer with switch
R4, R5—1 megohm
R6—68 ohms
R7—1,500 ohms, 1 watt
R8—33 ohms
S1—SPST switch on R3
SR1—Silicon diode, 750 ma, 400

PIV (Lafayette SP-196 or equiv.)

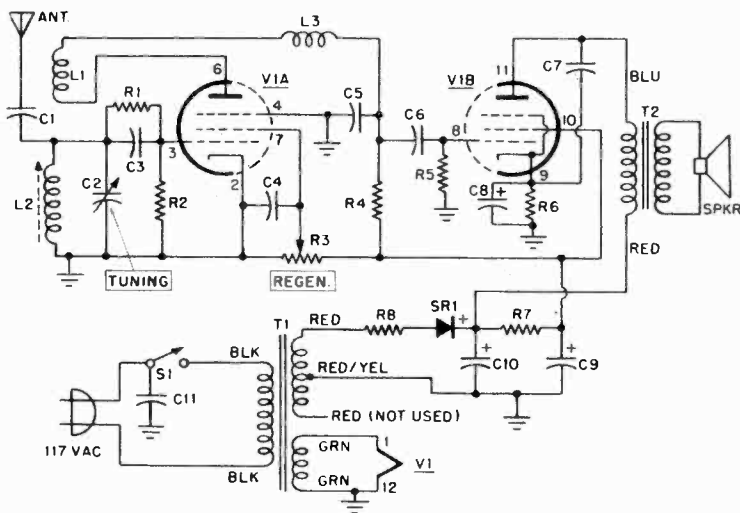
T1—Power transformer: primary, 117 VAC; secondaries, 250 V @ 25 ma and 6.3 V @ 1 A. (Stancor PS8416 or Allied 62 G 008)

T2—Output transformer: primary, 2,000 ohms; secondary, 4 ohms; 5 watts (Stancor A3876 or Allied 62 G 065)

V1—6AL11 tube

Misc.—Speaker, 6 1/8 x 4 x 1-inch aluminum chassis (Bud CB-1620)

V1A is a regenerative detector. Regeneration is controlled by the amount of B+ applied to V1A's screen grid (pin 7) by R3. Feedback is achieved by winding L1 over L2. V1B, a power pentode, delivers up to 2 watts to speaker.



The COMPACT BCer

with spaghetti, and should be about 8 inches long to reach the connection points under the chassis.

If your cabinet design is different from ours, don't worry about mounting tuning capacitor C2 on the chassis. Put it wherever you like but don't forget to run a wire from its frame to the chassis. If there's a trimmer on the side of the capacitor you use for C2, open it all the way. It is necessary to use the size transformer specified for T1 to provide current for V1's heater (900 ma). Be sure to cut short and tape one of T1's red leads.

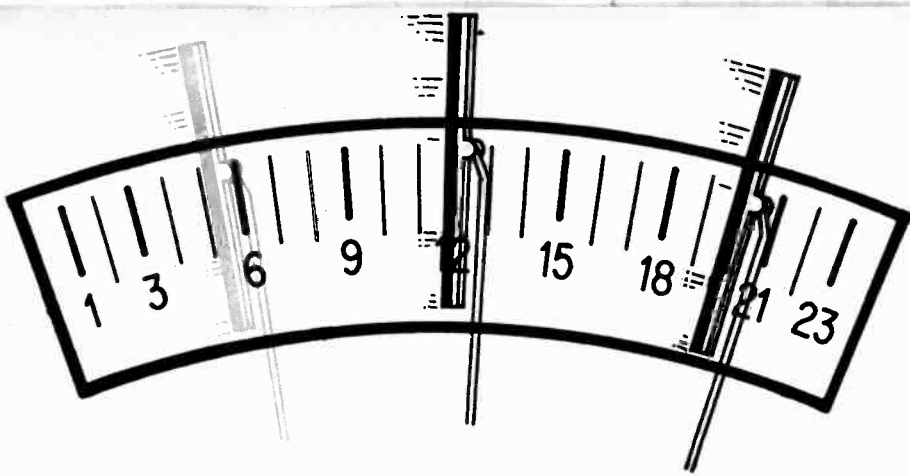
Tune-Up and Adjustment

After you've double-checked your wiring, plug in the tube, turn on power and slowly turn regeneration control R3 clockwise. Eventually you will hear a squeal or rushing

sound. If you don't hear this with R3 full clockwise, reverse the connections of L1's leads.

To calibrate the dial, open C2 to a point corresponding to that of the tuning capacitor in another radio tuned to a station whose frequency you know. Advance R3 until the BCer squeals, then back off R3 a bit. Without touching the antenna lug on the loopstick, adjust the loopstick's slug until the same station comes in loud and clear. If necessary, readjust L1's slug if a station is missing at either end of the dial.

To find and tune in a station, turn R3 almost full clockwise and turn C2 slowly. When you hear a squeal, it means there's a station at that point; then back off R3. You'll get the knack of this quickly. A 10- or 15-foot antenna will be adequate for local stations. For distant stations use a longer outdoor antenna and a good ground.



CB BAND SWEEPER



Flip a switch, sit back and your transceiver will be tuned automatically and continuously from the low to the high end of the band. It's the easy way to listen in on every CB channel.

By R. L. WINKLEPLECK

CITIZENS BANDERS have come up with a new form of the twist that doesn't have a trace of hip action. Every bit as frantic, their version involves a fast back and forth twisting of the wrist as they turn their transceiver's channel-selector knob to hear who's on each channel and what they're talking about. A cure hasn't been found yet but the twisting can be greatly reduced by the CB Band Sweeper.

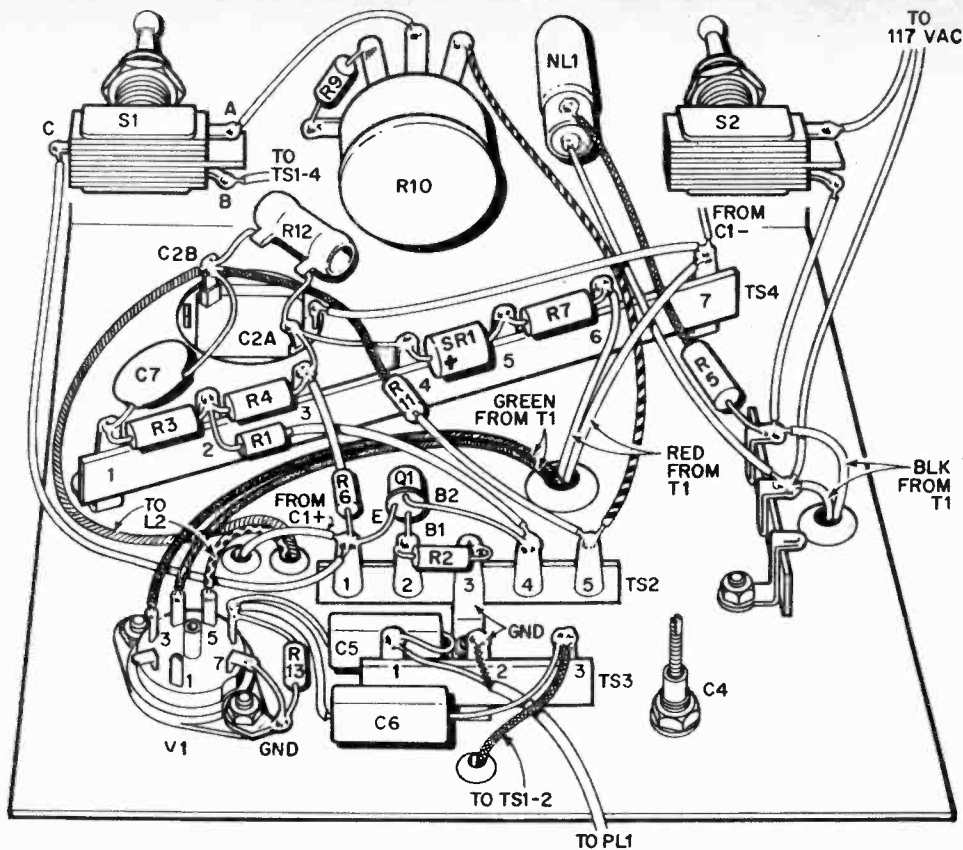
The Sweeper is an electronic tuning adaptor that you plug into one of the receive crystal sockets in your rig. The frequency of the Sweeper's oscillator changes constantly to tune the rig automatically from the low to the high end of the band. In about 1½ minutes you listen briefly to every channel—1, 2, 3, etc. up to channel 23. Then the receiver jumps back to channel 1 and the cycle repeats. Without effort on your part, you can

listen in on a portion of every conversation on the band. When you hear something of more than passing interest you just flip the mode switch from *auto* to *manual* and tune in the channel manually on the Sweeper.

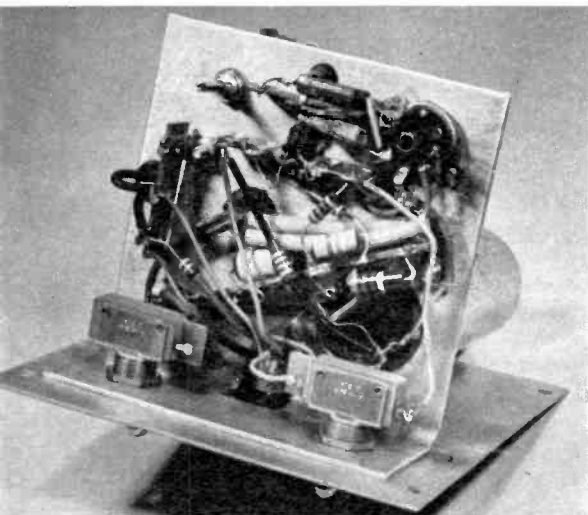
Construction. To be on the safe side, duplicate the layout of our model, which is built in a 4 x 5 x 6-in. aluminum utility box. The components are mounted on an L-shaped chassis, made of scrap aluminum, which is held to the front panel by S1 and S2.

Since the RF oscillator (V1) operates around 27 mc, placement of parts associated with it is critical and can affect its operating frequency. However, the wide range of frequency adjustment provided by piston capacitor C4 permits you to compensate for some minor changes in layout. Short and direct leads and good grounds are a must.

Coils L1 and L2 are made from a single



CB BAND SWEEPER



Our Model's $3\frac{3}{4}$ x 4-in. chassis is made from a $5\frac{1}{4}$ x 4-in. piece of scrap aluminum. It is held to the cabinet's front panel by S1, S2. R9 (pictorial) connects to ground strap on R10's mounting bushing.

Barker and Williamson Miniductor coil form. Unwind a turn from one end for a connecting lead and leave five turns intact for L1. Cut the next wire and unwind a half turn in each direction for the inner leads of L1 and L2.

Leave three more turns for L2, then unwind one more turn for L2's final lead. Cut away the remainder of the coil stock. The plastic supports can be cut with a hot razor blade. Note that the four plastic wire supports are used to space L1 and L2 exactly one turn apart. Mount the two-coil assembly on terminal strip TS1 and use additional terminal strips where shown for other components.

A short length of RG59/U coax should be used to connect the Sweeper to the transceiver. On one end of the cable install a plug made from an old CB crystal to match the crystal socket in your rig. The plug must be polarized; that is, the shield of the coax from the Sweeper must go to the grounded side of the crystal socket in the transceiver.

Adjustment and Calibration. After the wiring is completed and checked, a few preliminary tests should be made. Turn on

power and let the Sweeper warm up. Using a VTVM, measure the voltage at pin No. 5 of V1. It should be 140 to 150 volts. If V1 is oscillating there should be a slight negative voltage on pin 6. If V1 is not oscillating reverse L2's leads.

Set S1 *manual* and measure the voltage across D1 to see whether it can be varied by R10 from approximately 2.5 to 7 volts. Then set S1 to *auto* and check to see that the sweep oscillator (Q1) is supplying a varying 3- to 6-volt sawtooth voltage to D1.

If all is satisfactory, put the Sweeper's plug into a receive crystal socket in your transceiver. Set the transceiver's channel-selector switch to the appropriate position and put S1 in the *manual* position. R10 should be at about half rotation.

Set another nearby rig to one of the center channels, such as 11 or 12, and put it in the transmit mode. Slowly adjust C4 until you pick up the signal.

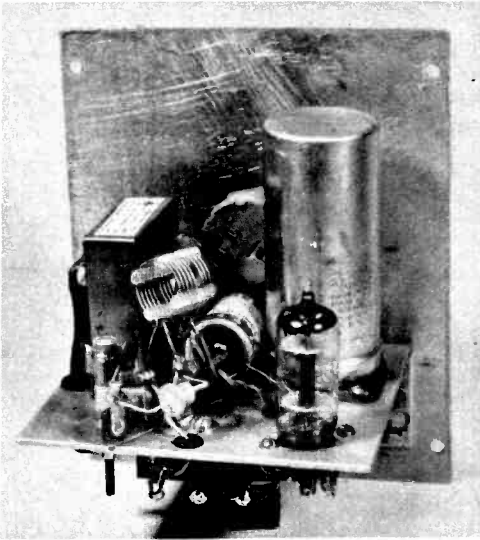
During this adjustment you may find a couple of settings of C4 where the S-meter will deflect but you won't hear the signal. This means the Sweeper's oscillator is operating at your rig's IF frequency (or a harmonic

of it). Ignore this. Or you may pick up high- or low-end-of-the-band channels. Ignore these, too, since if the Sweeper is centered on them, it won't sweep across the entire band.

Continue to adjust C4 carefully and slowly until you finally locate the channel on which the second rig is transmitting. There will be two points where this signal can be found. Note the quality and strength of each and continue adjusting C4 until you tune in the *strongest* signal. Alignment is now completed.

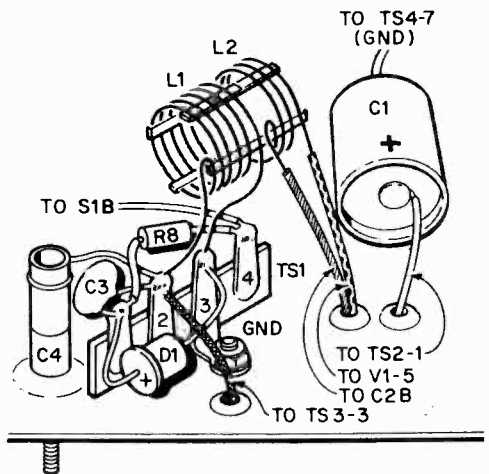
It should now be possible to tune from one end of the band to the other with R10. When S1 is in the *auto* position, the Sweeper should tune from the low to the high end of the band in about 1½ minutes. This should be long enough for you to tell what's going on on every channel and to spot the vacant ones. The sweep can be speeded up by making either R6 or C1 smaller. If either component is increased in value, the sweep will be slower.

How it Works. The Sweeper's RF oscillator is a modified Armstrong. It replaces the crystal-controlled oscillator in the rig and supplies the local oscillator signal to produce the IF signal. To make the oscillator sweep



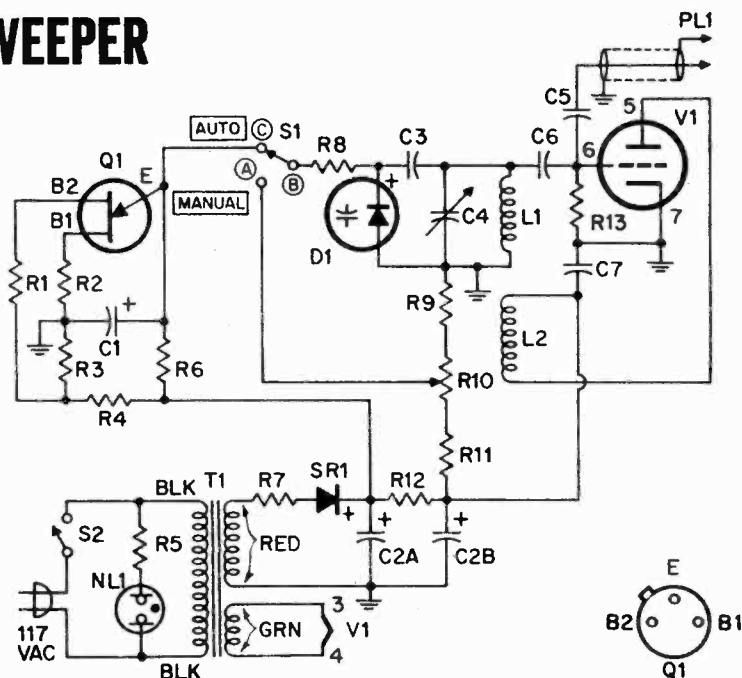
Rear view of Sweeper. Note the way coils L1 and L2 are mounted. Potentiometer R10 should be mounted on front panel before transformer and electrolytic capacitor can be installed on the chassis.

Detailed sketch shows what coils look like and how they're mounted. Since parts on terminal strip TS1 are in RF-oscillator circuit, position them where shown and keep the leads short.



CB BAND SWEEPER

Sawtooth voltage generator consists of unijunction transistor Q1, C1, R6 and associated components. When S1 is in auto position, sawtooth voltage developed across C1 is applied to varactor diode D1, causing its capacitance to change. Since D1 is part of RF oscillator's (V1) tuned circuit (D1, C4, L1), it changes operating frequency of RF oscillator in step with the sawtooth voltage. Output of Sweeper is fed to mixer stage in CB transceiver via crystal socket, causing receiver to tune from the low to the high end of band. To calibrate R10's dial, have a friend use another rig to transmit on each channel while you tune in and mark dial.



back and forth so the set tunes from channel 1 to 23, a capacitance diode (D1, a varactor) is connected in parallel with L1 (D1, C4 and L1 form the oscillator's tuned circuit). A varactor is a special silicon diode that can be used as a capacitor. The capacitance between its leads is a function of the reverse-bias voltage across it. When a varying voltage is applied to D1, D1's capacitance changes in step with the voltage. This changes the RF oscillator's frequency, which causes the transceiver to tune from the low to the high end of the band. (The transceiver also can be tuned manually with R10, which varies D1's voltage from about 2.5 to 7 volts.)

The varying voltage which is applied to D1 is produced by a unijunction-transistor relaxation oscillator. After power is turned on, capacitor C1 begins to charge slowly through R6. When the voltage across C1 (and D1) reaches about 6 volts (the rig will be tuned to channel 23), the emitter-base (B1) junction of Q1 conducts, causing C1 to discharge through R2 to ground. This abruptly reduces the charge on C1 (and the voltage across D1) to about 3 volts. This tunes the transceiver back to channel 1. The charge/discharge cycle repeats continuously.

PARTS LIST

- C1—200 μ f, 15 V electrolytic capacitor
- C2A, C2B—40/40 μ f, 150 V electrolytic
- C3—.001 μ f, 500 V ceramic disc capacitor
- C4—5-50 μ f piston-type trimmer capacitor
JFD VC55C (Newark Electronics Corp., 223
W. Madison St., Chicago, Ill. 60606. Stock
No. 19F1949; \$1.95 plus postage.)
- C5—68 μ f, 500 V silvered mica capacitor
- C6—100 μ f, 500 V silvered mica capacitor
- C7—.01 μ f, 500 V ceramic disc capacitor
- D1—3-30 μ f voltage-variable capacitor (Inter-
national Rectifier Corp. Semicap No. 6.8
SC20. Newark Electronics Corp. Stock No.
21F999 \$1.10 plus postage)
- L1—Coil: 5 turns Barker & Williamson No.
3007 Miniductor (Lafayette 40 R 1616)
- L2—Coil: 3 turns Barker & Williamson No.
3007 Miniductor. (part of L1)
- NL1—NE51H neon lamp
- PL1—Plug made of discarded CB crystal
- Q1—2N2160 Unijunction transistor (GE)
- Resistors: $\frac{1}{2}$ watt 10% except R3, R10, R12
- R1—470,000 ohms
- R2—39 ohms
- R3—8,200 ohms, 1 watt
- R4—47,000 ohms
- R5—100,000 ohms
- R6—8.2 megohms
- R7—22 ohms
- R8—2.2 megohms
- R9—680 ohms
- R10—1,000 ohm wirewound potentiometer
- R11—33,000 ohms
- R12—2,000 ohms, 5 watt wirewound
- R13—47,000 ohms
- S1—SPDT toggle switch
- S2—SPST toggle switch
- SR1—Silicon rectifier: 500 ma, 400 PIV
- T1—Power transformer; secondaries: 125 V @
15 ma, 6.3 V @ 0.6 A (Lafayette 33 R 3405)
- V1—6C4 tube



A Shortwave Converter

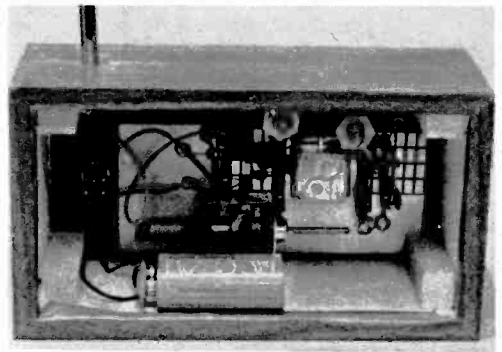
You Can Build

By Herb Cohen

CONVERTER wiring is eased with copper pc board and Mini Mounts. Battery, antenna and switch are secured to cabinet walls.

TIME WAS when anyone who wanted to join the shortwave-listening ranks simply picked up a budget-price converter. On shoestring savings, a rookie listener could try the international delicacies of music, language and commentary via his converter and a broadcast receiver. Later, he could spend a hundred bucks to pull down a communications rig.

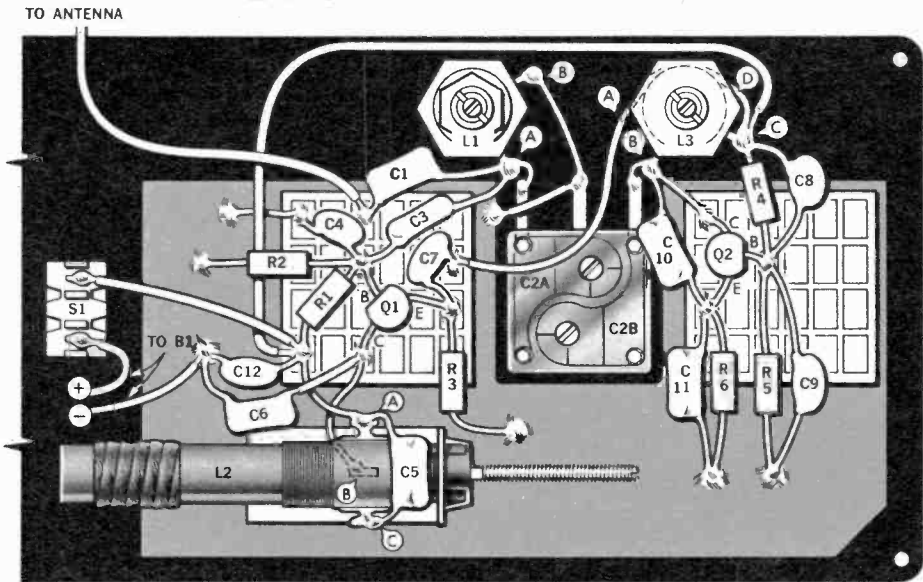
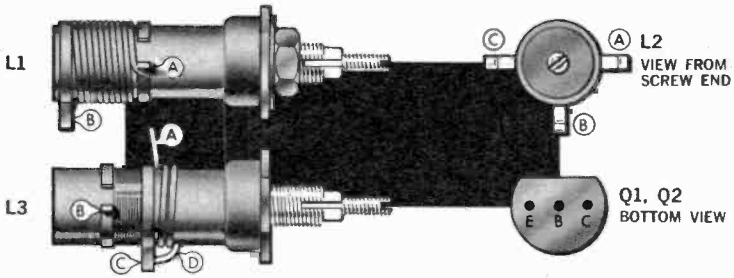
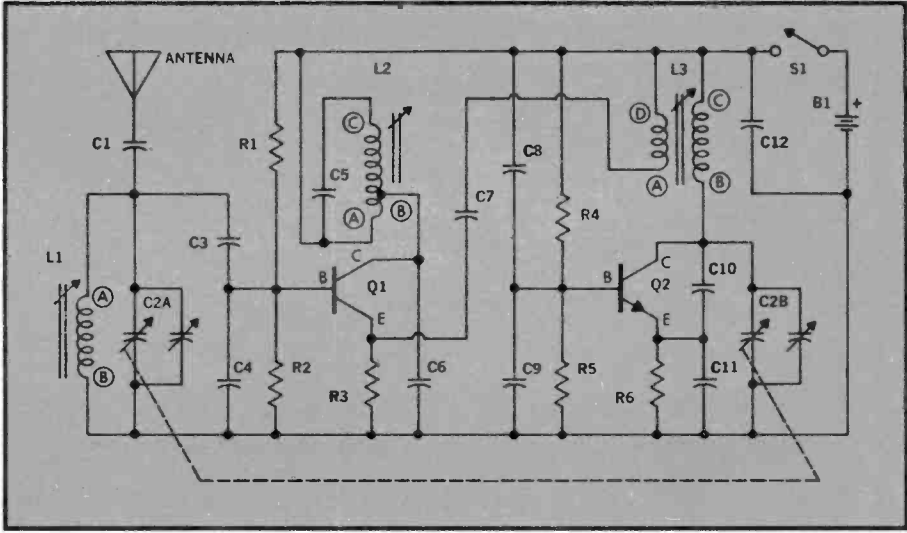
Today, converters have disappeared from the sales shelves. But it's not difficult to build one yourself. Our converter employs a simple circuit that



tunes shortwave stations and then uses the added circuits and speaker of an AM radio to deliver audio.

Perhaps the best part is that you don't have to fiddle with the insides of an expensive family radio. Our converter uses inductive coupling to eliminate connecting wires. Simply place it atop any AM radio and turn it on. Its signal is radiated to the antenna of the AM rig.

The shortwave section that our converter tunes is the 9- to 15-megahertz band. It covers a whole host of stations,



Shortwave Converter

including all types of foreign broadcasts, international telephone and one of the most active amateur bands going.

Parts should tally up to about \$15. This is well below the tags on those factory jobs of a few years back. And performance levels from our two-transistor circuit rank with the best of the old-time rigs.

In all, there are 27 components but don't let the number scare you. We've eliminated a bit of the raw labor in this project through the use of a clever soldering device called Mini Mounts.

The Mini Mounts we used have 24 solder squares each. They also have adhesive backs. This means that instead of drilling holes and mounting terminal strips you merely stick on a Mini Mount board and solder in the parts. (You'll find Mini Mounts in electronics stores from coast-to-coast at the Calctro component rack.)

A copper-clad printed circuit board was used at the mounting base for our Mini Mounts. It serves nicely as the ground or common terminal. Before mounting, however, you have other work to do.

Fashion a small wooden cabinet out of plywood that measures 2 x 3 x 6 in. on the inside. Glue will do for this construction and later you can either varnish the cabinet or add some veneer. Components should be mounted on the inside front cover of the cabinet. (If you shy away from woodworking, this project will fit nicely in a 2 x 2 $\frac{7}{8}$ x 2 $\frac{5}{8}$ -in. phenolic instrument case.)

Now mount the tuning capacitor on the front cover—you'll have to drill a small clearance hole. A square opening is cut in the copper pc board (to clear the capacitor) before it can be glued to the cover. Then you can peel off the adhesive backing on the Mini Mounts and place one at each side of the capacitor on the copper board.

Probably the most intricate detail of the entire building procedure is coil-winding. Make sure to wind the coils in the center of standard coil forms. L1 takes nine turns of No. 24 enameled copper wire, close-wound. L3 takes 16

Foreign SW Stations

Country	Frequency (mbz)	Time (EST)
Australia	11.840	6:30- 7:15 p.m.
Austria	9.770	6:00- 7:00 p.m.
Canada	9.625	2:15- 2:45 a.m.
	11.945	6:00- 6:30 p.m.
China (Peking)	9.780	10:00-11:00 p.m.
	11.695	7:00-12:00 p.m.
China (Taipei)	11.825	9:00-11:00 p.m.
Cuba	11.840	8:00-10:00 p.m.
Czechoslovakia	9.630	10:00-11:00 p.m.
Ecuador	9.605	8:10-12:00 p.m.
Great Britain	9.510	7:30-10:30 p.m.
Holland	11.730	9:00-10:20 p.m.
Hungary	11.910	8:00-10:30 p.m.
India	11.710	5:45- 7:00 p.m.
Israel	9.625	4:30- 5:00 p.m.
Italy	11.810	8:00- 8:30 p.m.
Japan	9.505	2:00- 2:15 a.m.
Liberia	11.950	1:30- 2:15 a.m.
Norway	9.645	12:00-12:30 a.m.
Portugal	11.935	9:00- 9:45 p.m.
Romania	9.570	8:30- 9:30 p.m.
Sweden	9.645	12:15-12:45 a.m.
Switzerland	11.715	8:30- 9:30 p.m.
U.A.R. (Egypt)	9.475	9:00-10:00 p.m.
U.S.S.R.	11.920	7:00-10:30 p.m.
Voice of America	9.530	11:00- 2:30 a.m.

Other Broadcasts

Type	Frequency (mbz)	Time (EST)
Amateur-20 meter band	14.000-14.350	dusk to dawn
International Telephone	12.000-12.500	dusk to dawn
WWV and other Time Stations	10.000, 15.000	dusk to dawn

PARTS LIST

Resistors: All resistors are $\frac{1}{2}$ watt, 10% tolerance.

R1,R4—68,000 ohms

R2,R5—10,000 ohms

R3—2200 ohms

R6—1,000 ohms

C1—33 mmf mica capacitor

C2—Variable capacitor, Calctro A1-234

C3,C4,C11—100 mmf mica capacitor

C5—47 mmf mica capacitor

C6—270 mmf mica capacitor

C7,C9,C12—.01 mf disc capacitor

C8—.005 mf disc capacitor

C10—10 mmf mica capacitor

Q1,Q2—HEP S0002 NPN silicon transistor

L1,L3—Standard coil forms, Lafayette

34 E 89515 or equiv. (see text for coil-winding details)

L2—Ferrite antenna coil, Calctro D1-841

S1—SPST miniature on/off switch

A1—Whip-stick antenna, Calctro J4-850

Misc.—2 Mini Mounts, Calctro J4-785; pc board, Lafayette 19P71043; plastic instrument case (optional), Calctro H4727; 9-volt battery and connecting clip; wire, solder, lumber (see text), hardware, etc.

Shortwave Converter

turns of No. 32 enameled wire, also close-wound. In addition L3 gets two turns of No. 24 wire just above the metal coil clip. Solder one end to the coil clip and leave the other end free for now.

You can turn the L3 mounting strip into a bracket by putting a bend in its middle. This later can be secured in place on the pc board with epoxy.

Before you mount the coils, complete the wiring around the Mini Mounts. A tip: keep leads as short as possible.

Finally mount and wire the coils, antenna and switch. Then you'll be ready for calibration.

In order to get our converter to perform properly you have to peak-tune some of the components. First adjust the trimmers on the back of the variable capacitor for full mesh or maximum capacity. Next pull out the antenna and turn the capacitor knob almost fully counterclockwise. This is the low-frequency end of the dial. Turn on your AM radio and put it near the converter.

Set the AM dial to 1400 kilohertz. A whistle can be heard at 9.275 mhz, which is close to the low end of the converter's band. To find this frequency, adjust L3 until the whistle is heard on the receiver.

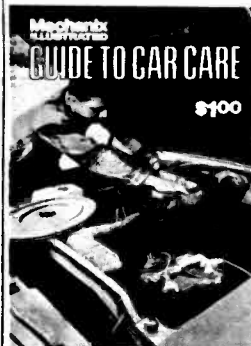
Now tune the AM receiver to 1600 khz and slowly turn the converter tuning capacitor until a whistle is heard. This should be at 10.275 mhz. Move the converter away from the AM radio until the whistle starts to fade. Adjust L1 and L2 for maximum signal. You can now mark this spot on your dial.

Continue to rotate the converter's dial clockwise. Another whistle should be heard at 12.330 mhz and again at 14.385 mhz. This last whistle should be close to the high end of the tuning dial.

Move the converter away from the receiver until the signal starts to fade and adjust the trimmer on C2A for maximum signal. If this whistle fails to appear on the dial, turn to a point slightly before the high end of the dial and adjust the trimmer on C2B until the whistle appears. Then tune the trimmer on C2A for maximum.

Once this has been completed, go back to the 10.255 mhz point on the dial and readjust the core of L1 for maximum again. Recheck the high end and your converter is ready for action.

We have included a listing of the international broadcasts for the frequency range covered by the converter. For some you may have to hunt through a maze of hash and false signals, but be patient. You'll soon learn that the rewards are worth the trouble. ●



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Tape Compressor

By WALT HENRY TAPING the monthly meeting of the debating club isn't just a matter of setting the recorder's level control when the first member starts speaking. Reason is, the discussion may get quite heated before you realize it. Then others, trying to emphasize their point, begin to move closer to the table and mike. Several people start talking at once, then suddenly everyone's shouting. By this time the record-level indicator's needle is pinned.

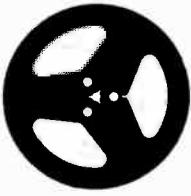
Or, after setting the recorder's level control for one person you discover some other members speak softly. When you play the tape back you find it's difficult to hear them. One solution is to get the moderator to adjust the record-level control constantly. But this would distract him and is not a particularly fast or reliable way to maintain a constant-level signal.

Our tape compressor is like having an extra hand there to ride gain all the time. You connect the mike to the compressor and feed its output to the recorder's mike input. Next, you make a test tape of the quietest speaker sitting a normal distance from the mike. While you do this you set the recorder's level control for optimum record level.

Then you start talking loudly and simultaneously increase the compression to pull the record-level indicator's needle back into the safe area. You're all set for the great debate. And no matter who speaks, you can rest assured that the meek will be heard and the loudmouths will be gagged. The compressor also can be used with a PA system. This will permit the speaker to move away from the mike or shout until the rafters ring. The sound level in the room always will be the same.

Or suppose you want to record a fading short-wave program. The compressor will put a constant-level signal on the tape. The same is true if you want to tape the Citizens Band or Aircraft Band. A strong signal that comes blasting through will come out of the compressor no louder than weak or moderate-level signals. Your gain-riding days are over.

There are several other applications for the compressor. For example, it can be used between your mike and a CB or ham transmitter to produce a modulating signal whose amplitude remains constant regardless of changes in the level of your voice. This means more talk power, which makes your signal sound as though your RF is much greater than it actually is.



Our compressor has all the features of commercial models. The compression is variable from zero to a maximum of about 26db. The noise level is

-60db. A preamp stage

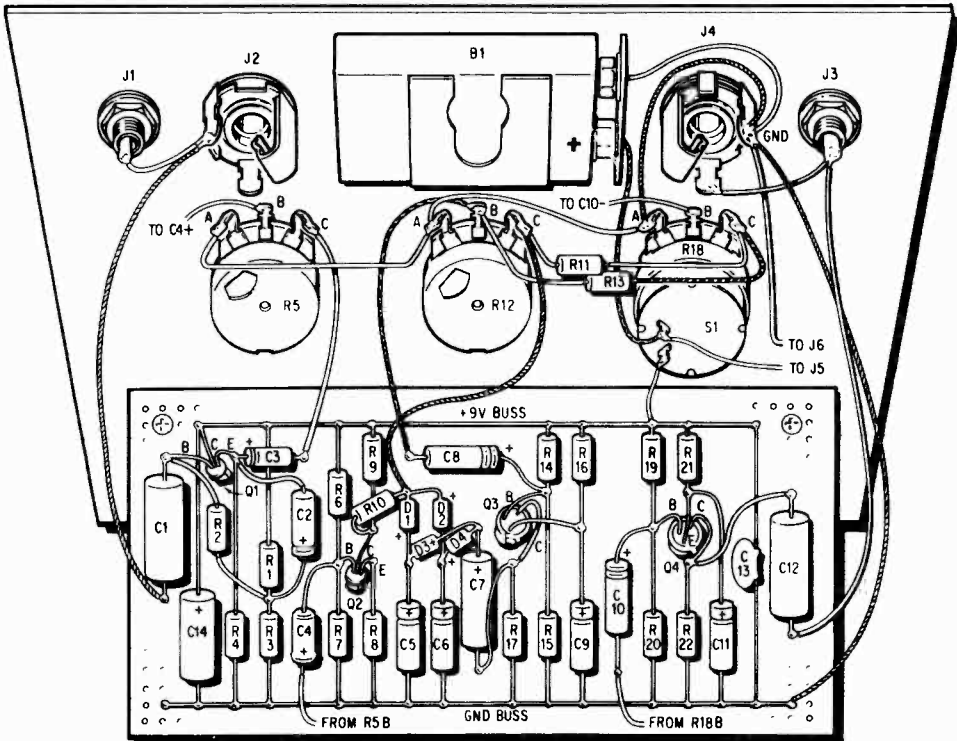
and a gain control enable the compressor to be used with almost any program source. There's plenty of gain (25db) which means a dynamic mike can be used with it. The compressor will handle inputs up to 5 V peak-to-peak (1.77 V rms).

The circuit has a fast attack time (time required for the compressor to reduce the level of a strong signal). The hold (decay) time required for the gain to return to maximum after the input signal is removed is

Fig. 1—Inside the compressor. First thing to do is mount all parts on a 3 x 5¼-in. piece of perforated board, as shown, using flea clips for tie points. Then install other parts on 5 x 7-in. chassis cover plate. Use two small angle brackets to attach circuit board to panel about 3¼ in. from the edge near J2 and J4. Mount jacks J5 and J6 underneath the circuit board. Note that several ground leads are tied together and connected to the ground lug on J4.

PARTS LIST

- B1—9 V battery (Burgess 2MN6 or equiv.)
 C1, C12—.47 μ f, 200 V tubular capacitor
 C2, C8, C10—30 μ f, 15 V electrolytic capacitor
 C3, C4—5 μ f, 15 V electrolytic capacitor
 C5, C6, C9, C11—50 μ f, 15 V electrolytic capacitor
 C7—100 μ f, 10 V electrolytic capacitor
 C13—.02 μ f, 500 V ceramic disc capacitor
 C14—150 μ f, 15 V electrolytic capacitor
 C15, C16—.015 μ f, 500 V ceramic disc capacitor
 D1, D2—1N914 diode D3, D4—1N270 diode
 J1, J3—Phono jack J2, J4—Phone jack
 J5, J6—Insulated tip jack (H.H. Smith type 241 or equiv.)
 Q1, Q2—2N3393 transistor (GE)
 Q3, Q4—2N414 transistor (GE, RCA)
 Resistors: ½ watt, 10% unless otherwise indicated
 R1—22,000 ohms R2, R3, R15—56,000 ohms
 R4, R9—2,200 ohms
 R5—10,000 ohm, linear taper potentiometer
 R6, R20—120,000 ohms R7—15,000 ohms
 R8—120 ohms R10, R22—3,300 ohms
 R11—8,200 ohms
 R12, R18—50,000 ohm, linear taper potentiometer (SPST switch on R18)
 R13, R17, R21—1,000 ohms
 R14—22,000 ohms
 R16—560 ohms R19—33,000 ohms
 R23, R24—10,000 ohms
 S1—SPST switch on R18
 Misc.—Perforated board, flea clips, 5 x 7 x 3-in. aluminum chassis (Premier ACH-428GH), 5 x 7-in. aluminum chassis bottom plate (Premier ABP-423GH).



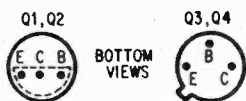
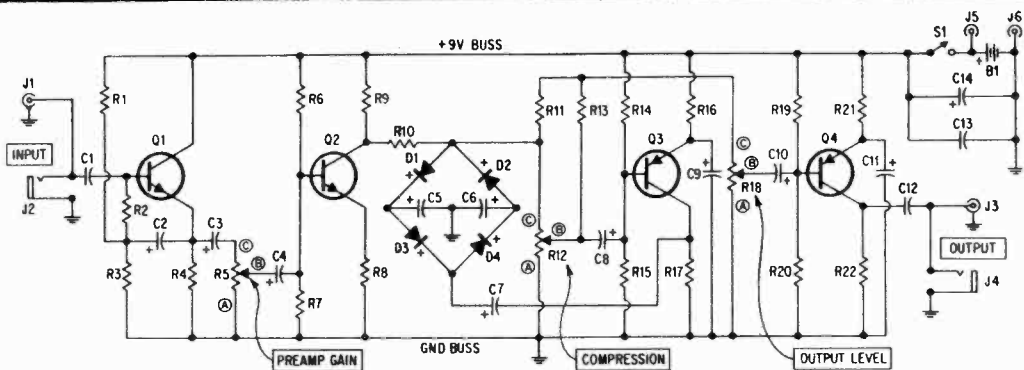


Fig. 2—Q1, a bootstrapped emitter-follower, gives compressor an input impedance of 250,000 ohms. Incoming signal is amplified by Q2 and fed via R10, R12 and C8 to Q3. Q3 amplifies signal and feeds it back via C7 to rectifier diodes D3 and D4. DC is applied to D1 and D2 causing them to attenuate, or compress, signal fed via R11, R18 and C10 to the output transistor, Q4.

about one second. The compressor does not clip or limit the audio signal—it reproduces it without distortion.

An output stage (Q4) and an *output level* control (R18) permit you to adjust the level of the output signal to match it to the input of any tape recorder, amplifier or transmitter. Since the current drain is only about 10 ma, the battery will last a long time. As a bonus we've included a four-component circuit (Fig. 4) that will turn the compressor into a 1,000-cps oscillator for checking audio equipment.

Construction

Circuit layout is fairly critical; therefore, try to duplicate ours. All components except for the input, output and battery-test jacks, the controls, R11 and R13 are mounted on a 3 x 5 3/4-in. piece of perforated circuit board on which flea clips are used as tie points. Note in Fig. 1 that several ground wires must be attached to the ground lug on J4. This is important to keep hum and noise low.

Our compressor was built in a 5 x 7 x 3-in. aluminum chassis. The battery, circuit board, controls and jacks are mounted on the chassis' cover plate. The cabinet could be plastic or wood; however, we recommend that it be metal to shield the circuit to prevent pickup of hum and noise.

Note that we put jacks (J5 and J6, not shown in Fig. 1) on the front panel so that the battery voltage can be checked without

disassembling the unit. If you want to use a separate supply, any well filtered source of 6- to 9-V DC will do.

Checkout

After construction is finished, double check your wiring. Then, turn the *preamp-gain* (R5) and *compression* (R12) controls full counterclockwise and turn on power. Measure the DC voltage from the emitter of Q1 to ground. It should be between 3 and 6 V with a new battery. Next, measure the voltage on Q2's collector. It should be between 4 and 7 V. Measure the collector voltage on Q3 and Q4. It should be between 3 and 6 V. If any of these voltages do not fall within these ranges, they can be corrected by changing the values of R3, R6, R15 and R20, respectively.

Using the Compressor

As we said, the compressor will handle up to 5-V (peak-to-peak) input signals. However, with a signal this large R5 must be carefully set to prevent the input stage from being overloaded and to prevent distortion. (R5 has little effect on compression characteristics.) The preamp stage is simply a variable-gain amplifier which was included to boost low-level input signals to get full compression.

Here's the way to adjust the controls by making a test tape or with a pair of high-impedance phones plugged in J4. Turn R12 full counterclockwise. When the input signal

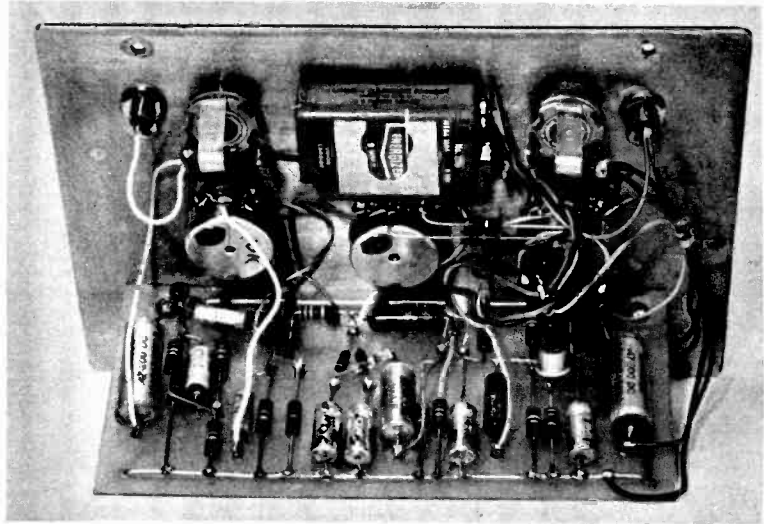
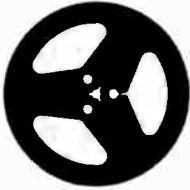


Fig. 3—Inside of compressor. Author's model is built on fiberglass board, but perforated board will be suitable. Because of high-gain stages, try to duplicate our layout. Buss wires at top and bottom of board facilitate connections to ground as well as to the 9-V supply.

is at its highest permissible level, increase R5 until the signal becomes slightly distorted. Then back off on R5 until the distortion disappears.

Once R5 is adjusted with a high-level input signal, it need not be changed again. Now, set R12 for the desired compression. (It may be necessary to readjust R18 when compression is changed.) When recording speech, R12 should normally be set full clockwise. Generally speaking, the compressor should not be used when recording music since loud and soft passages are an important part of musical expression.

To use the compressor as an oscillator set R12 full clockwise. Set R18 for the desired output level, and turn R5 clockwise until the circuit just begins to oscillate.

How It Works

Input stage Q1 is a bootstrapped emitter-follower which gives the compressor an input impedance in excess of 250,000 ohms. Pre-amp stage Q2 provides a voltage gain of about 20db so that low-level signals can be

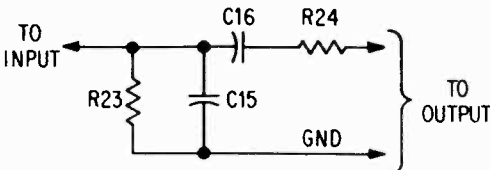


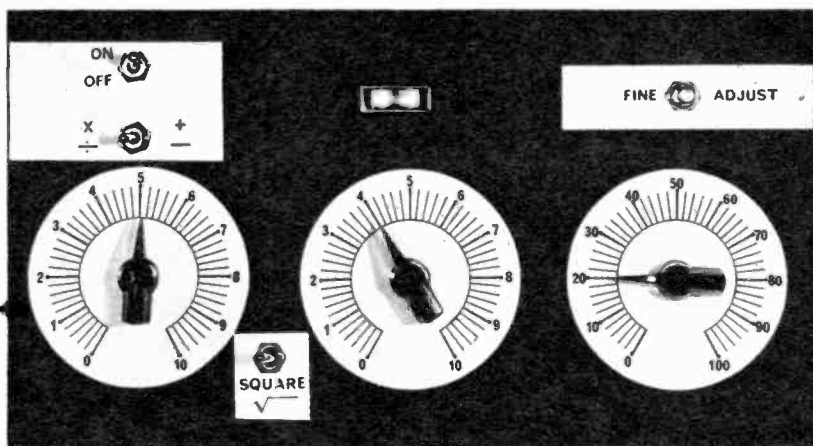
Fig. 4—Connect this Wien-bridge circuit from the input to the output and the compressor will be converted into a 1,000-cps audio oscillator.

compressed. Gain control R5 compensates for different input-signal levels.

The circuit that automatically controls compression is a push-pull diode attenuator which consists of D1-D4, C5 and C6. Since the resistance of diodes D1 and D2 depends on the DC current through them, they function as variable attenuators. Here's what happens: An input signal fed to Q2 appears at the junction of R10, D1 and D2 and the base of Q3.

Q3 amplifies a portion of the signal and feeds it to D3 and D4 where it is rectified and then filtered by C5 and C6. The DC is then fed to gain-control diodes D1 and D2. When the input-signal level increases the output of Q3 increases causing more DC to flow through diodes D1 and D2. D1 and D2 reduce the overall circuit gain (compress) by lowering the level of the signal to Q3 and to (via R11, R18 and C10) output transistor Q4. *Compression* control R12 permits you to vary compression up to about 26db.

The external plug-in oscillator circuit (Fig. 4) is simply a Wien-bridge network. When it is connected from the input to the output, the compressor becomes an audio oscillator. The part values shown produce approximately a 1,000-cps frequency. You can experiment with other values for different frequencies. If desired, the oscillator circuit can be built in. Simply connect R24 directly to J3. Use a SPST switch to connect the junction of R23, C15 and C16 to J1 and J2. Be sure to disconnect any other inputs when using the unit as an oscillator.



POT COMPUTER

Take the sweat out of math with switches, batteries and potentiometers.

By VERNON SIMMS

UNIVAC take note—here's a Samdiac. Expand those letters and you get subtracting, adding, multiplying, dividing, integrating, analog computer. Unlike its big brothers, Samdiac costs about \$8 to build. But don't count on it to do your math homework. It functions like a slide rule, therefore, answers are only approximate.

How It Works. The computer consists of two basic circuits. Take a look at Fig. 1 to see how it multiplies and divides. To multiply 5×5 , you set R1 to 5 on the dial. This is the center of its resistance range. Since the supply voltage is 10 V, the voltage from the arm of R1 to ground is 5 V. The 5 volts goes to R2. Since R2 also is set at its midpoint, the voltage is again divided. That is, 2.5 volts now appears from the arm of R2 to ground. This voltage is the answer to the problem; however, you have to shift the decimal point mentally.

To read out the answer, you would have to use a sensitive voltmeter, such as a VTVM. A less-sensitive voltmeter would draw excessive current from R1 and R2 and adversely affect accuracy. We get around this by adding a third potentiometer (R3) and a zero-center microammeter.

Note that R3 also is across a source of 10 V. When R3's arm is set to select 2.5 V, the voltage at the right side of the meter is exactly the same as the voltage at the left side. Since the meter merely indicates balance at zero, it draws little current from the circuit. You read the answer from R3's dial. To use the circuit for division, you set up the problem on R3 and R2 and read the answer from R1's dial.

Fig. 2 is the basic circuit for addition and subtraction. Instead of dividing voltages, the circuit adds them. Let's add 3 and 2. Note that R1 takes 2 V from one 10-V source and passes it to R2. R2 takes 3 V from its 10-V source. The two voltages are added and 5 V goes to the meter. The balance and indicator circuits work the same way as before.

In the practical circuit (Fig. 5) two 1.5-V batteries are the voltage sources. However the voltage relationships are exactly the same. Construction details are covered in the captions for Figs. 3 and 4.

Operation. Set S4 to square, $\sqrt{\quad}$ only for square and square root problems to be described later. Never press *fine-adjust* switch S2 until the problem has been set up.

● Multiplication. Let's say you want to

POT COMPUTER

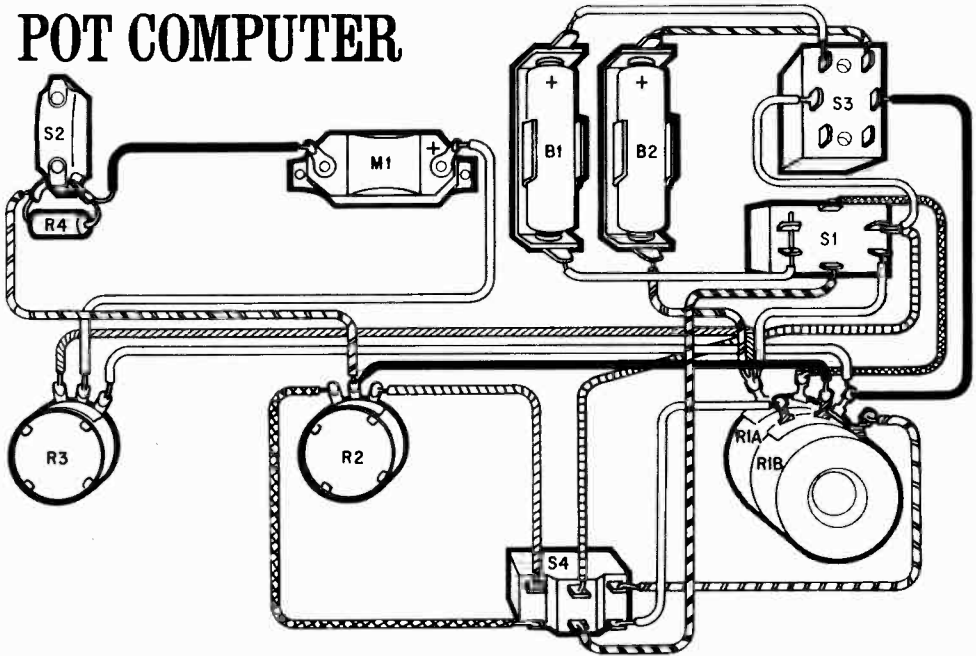


Fig. 3—Our computer is built on a 15 x 8 x ¼-in.-thick piece of plywood. Overall size is determined by diameter of dials for R1, R2 and R3. The location of batteries and switches is not important.

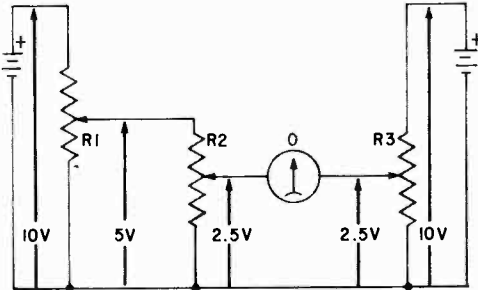


Fig. 1—Multiplication, division. R1 feeds part of 10 V to R2, which feeds part of voltage to M1. M1 zeros when voltages from R2 and R3 are equal.

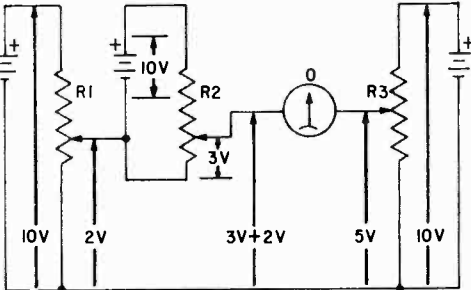


Fig. 2—Addition, subtraction. Part of voltage from R1 is connected in series with voltage from R2. M1 zeros when voltages from R2, R3 are equal.

multiply 5 x 8. Set S3 to *on* and set S1 to $\times \div$. After dialing the problem—R1 (left knob) to 5, R2 (middle knob) to 8—adjust R3 (right knob) until M1 indicates zero. Then press S2 and adjust R3 for zero again. Read the answer, 40, from R3's dial. With higher numbers you'll have to do some thinking to determine where the decimal place goes.

Accuracy is poor when *both* knobs which set up the problem are on numbers below 3. Accuracy improves when either knob is higher than 3 and is best when *both* knobs are higher than 3.

- **Division.** Set the right knob to the number to be divided (dividend) and the middle knob to the dividing number (divisor). Zero M1 with the left knob, read the answer (quotient) from its dial and determine the position of the decimal point. If it is impossible to zero M1 (for example, when you divide 80 by 5) shift the 80 on the right dial down to 8.

- **Addition.** Set S1 to $+ -$ and set up the problem on the left and middle dials. You read the answer on the third dial after M1 is

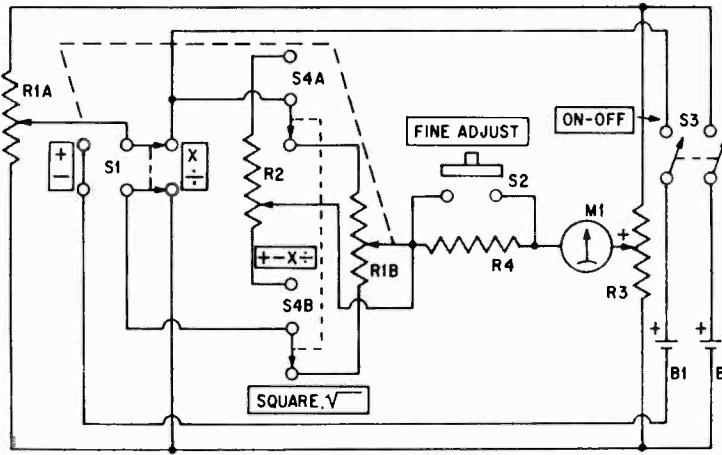


Fig. 5—Complete schematic of computer. To square or get the square root of a number, the left (R1) and middle (R2) potentiometers would have to be set to the same number. To make sure they are, we use another potentiometer, R1B (which is the same resistance as R2 and is mechanically coupled to R1A) instead of R2. When S4 is set to square/square root, R1B is connected in circuit instead of R2. Therefore, when left knob is set to, say, 6, R1A and R1B (the equivalent of R2) are both set to 6 automatically.

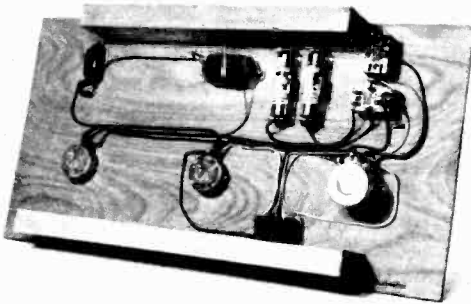


Fig. 4—Rear view of computer. The strip of wood at the top of the board should be higher than the strip at the bottom to tilt the board upward.

- PARTS LIST**
- B1, B2—1.5 V penlite cell
 - M1—Zero-center balance meter, $\pm 100 \mu\text{a}$. (Lafayette 99 R 5034 or equiv.)
 - R1A, R1B—50/500 ohm dual wirewound linear taper potentiometer. IRC-CTS WPK-50 (Lafayette 33 R 4453 and WM-500 (Lafayette 33 R 4526)
 - R2—500 ohm wirewound linear taper potentiometer
 - R3—5,000 ohm wirewound linear taper potentiometer
 - R4—47,000 ohm, $\frac{1}{2}$ watt, 10% resistor
 - S1, S4—DPDT toggle or slide switch
 - S2—SPST push-button switch
 - S3—DPST toggle or slide switch
 - Misc.—Battery holders, 2-in. pointer knob (Allied 44 U 176)

zeroed. When you find M1 cannot be zeroed when *both* knobs are set above 4 at the same time, shift the knobs down to the equivalent sub-divisions. For example, to add 9 and 8, place the left knob one-half division below 1, and the middle knob one division below 1.

● **Subtraction.** To subtract, reverse the adding process. The larger number is set with the right knob, the smaller number with the middle dial. The answer appears on the first knob's dial after it's used to zero M1.

● **Squaring and Square Roots.** Set S1 to $\times \div$ and S4 to square, $\sqrt{\quad}$. Turn the left knob to the number to be squared. Zero M1 with the right knob and read the answer on its dial. (The middle knob is not used.)

For square roots, turn the right knob to the number whose square root you want to determine. Next, turn the left knob until the meter is zeroed. Read the answer from its dial.

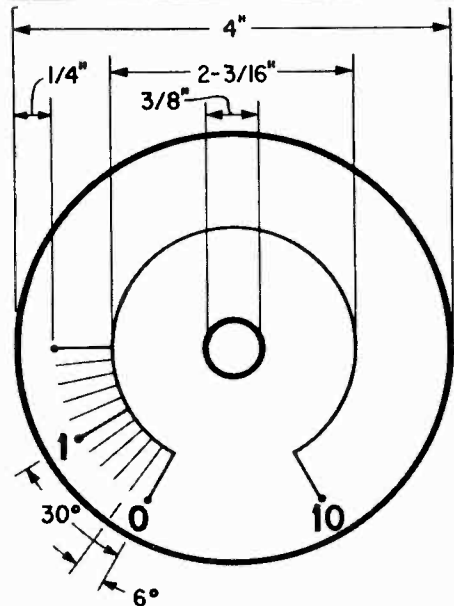


Fig. 6—Dial dimensions. Mark right dial 0-100.

A Super Battery Charger



FRUSTRATION is starting out (or rather, not starting) on a cold day with an auto battery that's pooped. You may huff, puff and swear but ultimately you're going to have to come to grips with the real problem—a juiceless battery.

The answer, of course is a battery charger. And if you have frequent battery trouble because of grim weather, cheapie purchases or little time for maintenance, you may need a *super* charger. We've done well with the \$29.95 Heathkit GP-21, a trickle charger.

Unlike conventional trickle chargers, which feed a minute bit of current to the battery (even after full charge is reached), the GP-21 shuts itself off at full charge. But it will come on again to restore any charge lost through internal leakage. To the consumer this shut-off feature means that the battery does not remain warm and lose its water.

Another great feature is the solid-state sensing circuit. It is a fail-safe mechanism that makes it almost impossible to damage the charger (or the car's electrical system) because of a reversed or shorted battery-clip connection.

This deluxe charger doesn't have an AC power switch; it is *on* all the time. Normally there is no voltage at the clips.

When it is connected to the battery, the sensing circuit measures the battery's voltage. If the measurement shows less than 13.4 volts, (which is the full-charge potential) our super charger will apply a charging current. The current is as high as 10 amps at a potential of 13.6 volts or lower. Exact current and voltage applied depend on the condition of your battery.

When a battery comes to full charge the charger stops pumping. Under no condition, including an unplugged AC line, will the battery discharge through the charger.

The GP-21 is an easy kit to build. We assembled ours in a little over two hours. You first install 19 parts on a 2 $\frac{3}{8}$ x1 $\frac{1}{4}$ -in. printed-circuit board.

This is followed by mounting a half dozen parts and the power transformer in the cabinet. The board is then mounted in the cabinet and several connections are made between cabinet-mounted parts and the board. You then make up the clip leads, connect them and assemble the cabinet. That's it.

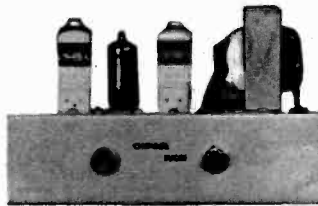
Our charger worked right off. When connected to the battery, which had been sitting for a cold week in the winter, the initial charge rate was 6 amps.

The GP-21 is protected by a circuit breaker. The front-panel pilot light remains on as long as the charger is plugged in the AC outlet.

Templates are included in the manual showing how to mount the charger on a wall. The GP-21 measures 9x5 $\frac{1}{2}$ x6 $\frac{3}{8}$ in. and weighs 11 $\frac{1}{4}$ lbs.—Bob Freed ●



COMPONENTS are few and easily identified and the recipe-type manual is a big help.



CB CHANNEL SLICER



By BERT MANN

Jam-packed channels are wide open when a rig has razor-sharp tuning.

WITH the new FCC rules crowding all communications between stations of different licenses (or calls) into only seven channels, CBers are likely to find the going rougher than ever. Getting a clear spot on the band will be like looking for a seat on the subway at rush hour.

One of the few good antidotes to the crowding malady will be a receiver with extremely sharp selectivity. Luckily, you don't have to throw out that budget transceiver and then spring for a high-price double-conversion job. Instead, keep the low-cost rig and merely add our CB Channel Slicer as an accessory. The Slicer makes adjacent-channel interference a thing of the past, giving you selectivity so sharp that you can separate two stations on the same channel if they are slightly off frequency.

In fact, if you're working a roundtable and everyone isn't in the center of the channel you'll have to trim the tuning each time a different station comes on.

The Slicer is a double-conversion adaptor which adds a 100-kc IF amplifier to transceivers whose IF is around 1,600 kc. The Slicer is not designed for transceivers with a

455-kc IF because the selectivity of these rigs is quite sharp, anyway.

The Slicer has an option. You can either cut a channel in two with 100-kc IF transformers or you can use 262-kc transformers. While not as sharp as 100 kc, selectivity still will be excellent. If an audio-frequency signal generator with a 100-kc output is not available do not use 100-kc transformers; alignment will be almost impossible without a generator. The 262-kc transformers are factory aligned and a reasonably good alignment job can be done by ear. Just adjust T1 as described later on, tune in a station and adjust T2 and T3 for maximum meter indication. Whichever you choose, construction is the same.

Since the 100-kc IF transformers are not stocked by many distributors, you will have to order them directly from Miller. To satisfy Miller's minimum-order requirement it will be necessary to order a complete set of transformers, consisting of oscillator transformer T1 and the two IF transformers, T2 and T3. Further ordering information appears at the end of the Parts List.

Because the power supplies of many trans-

CB CHANNEL SLICER

ceivers already may be overloaded with accessories, the Slicer has its own power supply—which means its operation is confined to base stations. It can't go mobile.

Construction. The Slicer fits easily on a 7x7x2-inch aluminum chassis. Component placement and values are critical so changes and substitutions should not be made.

IF transformers T2 and T3—whether 100 kc or 262 kc—are mounted with the adaptor plate supplied with them. The adaptor hole should be cut with a 1/8-inch chassis punch. Take care that you position them exactly as shown: pin 1 is color-coded green.

T2 and T3 are held in place by a U-clip (supplied with them) which fits through the adaptor plate and into the transformer cans. Using your thumb, first press one side of the clip into position and then the other. *Do not* try to force both sides of the clip in place at once. Note that T2 and T3 are *not* connected

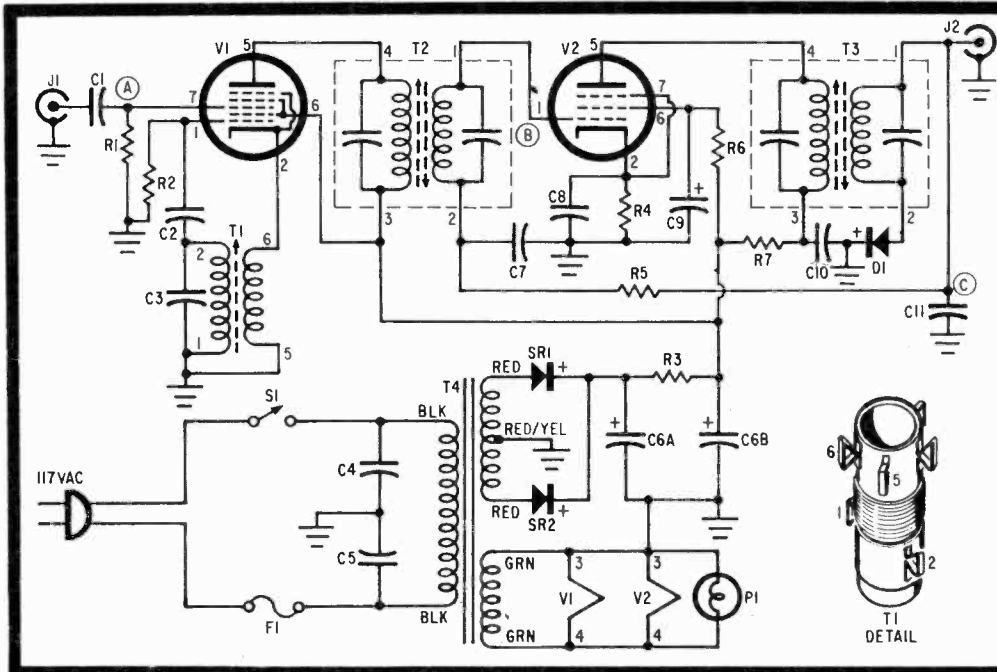
Capacitors: 600 V ceramic disc unless otherwise indicated
 C1—240 mmf C2—47 mmf
 C3—33 mmf (see text)
 C4, C5, C11—.005 mmf
 C6A, C6B—40/40 mf, 150 V electrolytic
 C7—.05 mf, 75 V or higher
 C8—.1 mf, 75 V or higher
 C9—20 mf, 150 V electrolytic
 C10—.1 mf
 D1—1N34A diode
 F1—1/2 A fuse and holder
 J1, J2—phono jack
 P1—6-V pilot lamp and holder
Resistors: 1/2-watt, 10%

PARTS LIST

R1—1 megohm
 R2, R6—22,000 ohms
 R3—470 ohms R4—100 ohms
 R5—2.2 megohms
 R7—1,000 ohms
 S1—SPST toggle switch
 SR1, SR2—Silicon diode: 50 ma, 500 PIV minimum ratings
 *T1—540-1,600 kc miniature adjustable oscillator coil (Miller 70-OSC.)
 *T2—IF transformer: 100 kc, Miller No. 1710; 262 kc, Miller No. 12H-1

*T3—IF transformer: 100 kc, Miller No. 1710; 262 kc, Miller No. 12H-2
 T4—Power transformer: 250 V center tapped @ 25 ma; 6.3 V @ 1 A (Stancor PS-8416 or equiv.)
 V1—6BE6 tube V2—6BJ6 tube
 *Available as a group only from J. W. Miller Co., 5917 S. Main St., Los Angeles, Calif. 90003. 1—No. 70-OSC and 2—No. 1710, \$5.34 plus postage. 1—No. 70-OSC, 1—No. 12H-1 and 1—No. 12H-2, \$4.62 plus postage.

Output (1,600 kc) of CB rig's IF strip is fed to pentagrid converter V1. Output of V1 (100 kc or 262 kc, depending on the value of C3) then goes to IF stage (100 kc or 262 kc) consisting of T2, V2 and T3. Circled letters are test and alignment points and are referred to in text. Watch the lug numbers on T1.



as specified in the instruction sheet supplied with them; use our connections.

Take extreme care when connecting oscillator transformer T1 since the Slicer will not work if just one set of leads to T1 is reversed. If you employ 262-kc IF transformers, use a 24 mmf capacitor for C3. [C3 in any case should be an NPO disc or tubular ceramic.]

Connecting the Channel Slicer. The Slicer is connected between the transceiver's last IF transformer and the detector circuit. The modification to the CB rig is shown in the schematic directly below. To facilitate future transceiver servicing, connections for the Slicer should be brought to phono jacks on the transceiver's rear apron.

The IF transformer lug to which a diode (semiconductor or tube element) is now connected, is connected to the Slicer's input (J1). Next, unsolder the components from the IF transformer lug that feeds the AVC/audio line. Twist the leads together and connect them to the Slicer's output (J2). Then ground the IF transformer terminal which fed the AVC/audio line.

The connecting cables between the transceiver and Slicer should be made with short lengths of RG58/U coaxial cable.

Alignment. In order to align the IF trans-

formers you must use the proper alignment tool. Attempts to use a screwdriver will damage the transformers. The 100-kc transformers require a hexagonal alignment tool whose parallel sides are 1/8-inch apart. The 262-kc transformers require a K-Tran alignment tool.

Temporarily disconnect the cable to the Slicer's input (J1). Connect a VTVM set to about -15 VDC to point C (C11) and connect an audio-frequency generator set to 100 kc to point B (pin 1 of V2). If you are using 262-kc transformers use an RF signal generator set to 262 kc.

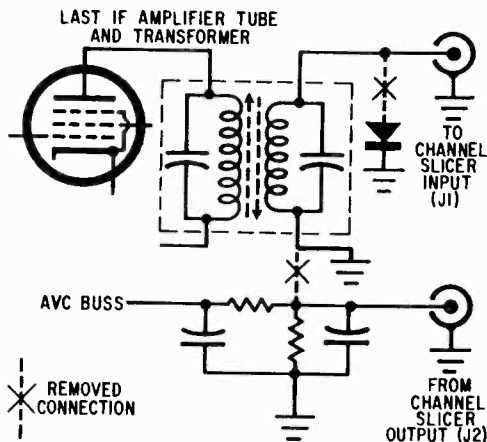
Adjust the generator's output for the lowest readable meter indication; if necessary, switch to a lower meter range. Turn T3's bottom slug full counterclockwise. Then slowly turn the slug clockwise until the meter peaks. There will be two peaks but the correct one is with the slug nearest full counterclockwise. Align T3's top slug the same way. Then repeat the procedure. As you adjust the slugs the meter may go off scale. Rather than change the meter's setting, reduce the generator's output. Connect the signal generator output to point A (pin 7 of V1) and repeat the procedure on T2.

Now connect an RF signal generator set to the transceiver's IF frequency to J1. Adjust T1's slug—starting from full counterclockwise—for maximum meter indication. Disconnect the generator and connect the transceiver's output cable to J1.

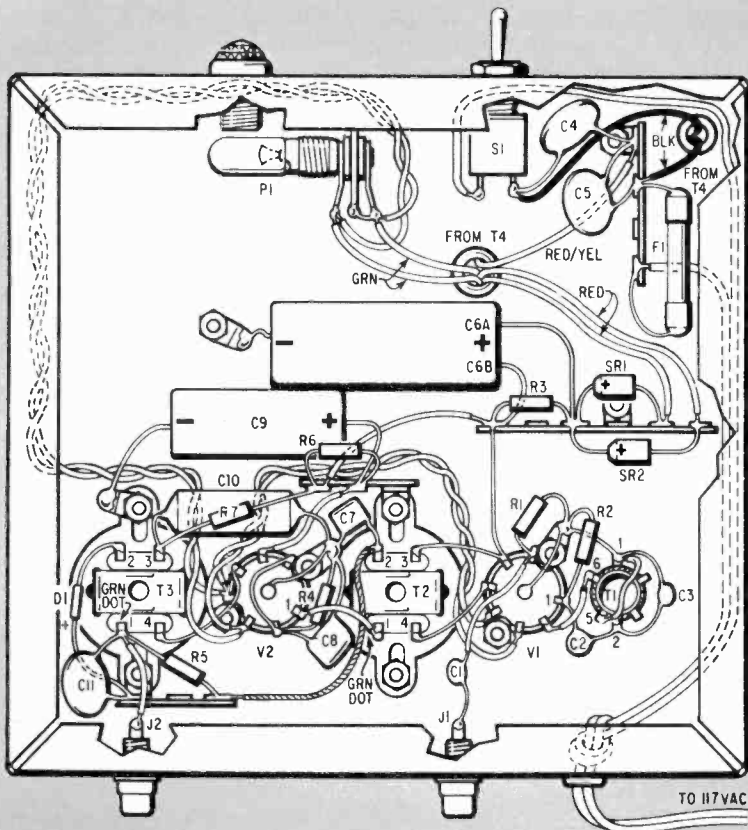
Tune in a station on, let's say, channel 10 to check dial calibration. If the calibration is off, turn the tuning knob so the channel 10 dial marking is directly under the pointer. Now adjust T1 so you receive channel 10 right on the nose. This will be the point of highest meter indication.

Finally, tune in a strong station and adjust the transceiver's last IF transformer for a maximum meter indication. Disconnect the VTVM and the Channel Slicer is ready to go.

Just so you don't think that something's wrong we'd better warn you of what reception will sound like with the Slicer. The volume will be about that of an unmodified transceiver but everything will sound unusually quiet. This is normal. The less IF bandwidth, the less noise. With 100-kc transformers tuning will be razor sharp. In fact, if you're tuned to the center of the channel and someone comes in 3 kc off frequency, it's quite likely you won't hear him. With 100-kc



Modification of CB rig. Disconnect top lead of secondary of last IF transformer and connect to phono jack on the rear of chassis. Disconnect bottom secondary lead and ground it; run all AVC line leads to secondary to another jack installed on rear of transceiver chassis.



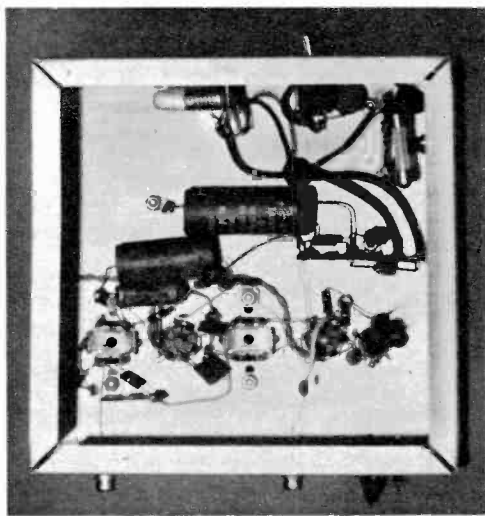
Because of the frequency at which the Channel Slicer operates, layout is important. Duplicate the arrangement shown here and you won't run into trouble later on. Install capacitor C3 on oscillator transformer T1 before you mount the transformer. Center lug on P1's socket is frame and is grounded. If your socket doesn't have such a lug, ground one of the filament leads to the socket's frame. Use heat sinks on D1's leads when soldering in place.

CB CHANNEL SLICER

transformers, and to a lesser degree with 262-kc transformers, speech will sound somewhat muffled. This also is normal.

Service Hints. If T2 and T3 can be aligned but the IF signal cannot be pushed through the Slicer, the oscillator may be inoperative. Check this with the VTVM connected to pin 1 of V1. If the oscillator is working you will get an indication in excess of -10 VDC. If you fail to get the correct indication, check to see if a pair of T1's leads is reversed.

If the Slicer is working—as evidenced by your ability to align it and feed a signal through—but won't work when connected to the transceiver, either T1 is adjusted incorrectly or the connections to the transceiver's last IF transformer are incorrect.



Chassis is wide open; therefore, you shouldn't have difficulty getting everything in place. Long leads will cause trouble, so keep them short.

MANY is the hobbyist who has put together, say, a speaker cabinet requiring a couple of dozen screws. By the time the last one was in, he would have given his numb right arm for a power screwdriver. But there's no need to run out and buy one when you own a common electric drill. True, the speed of the drill is much too high to drive screws. But our Full-Range Speed Control can solve this problem easily. Plug the drill into the controller, turn the knob counterclockwise to get the speed way down and that second cabinet will go together in half the time.

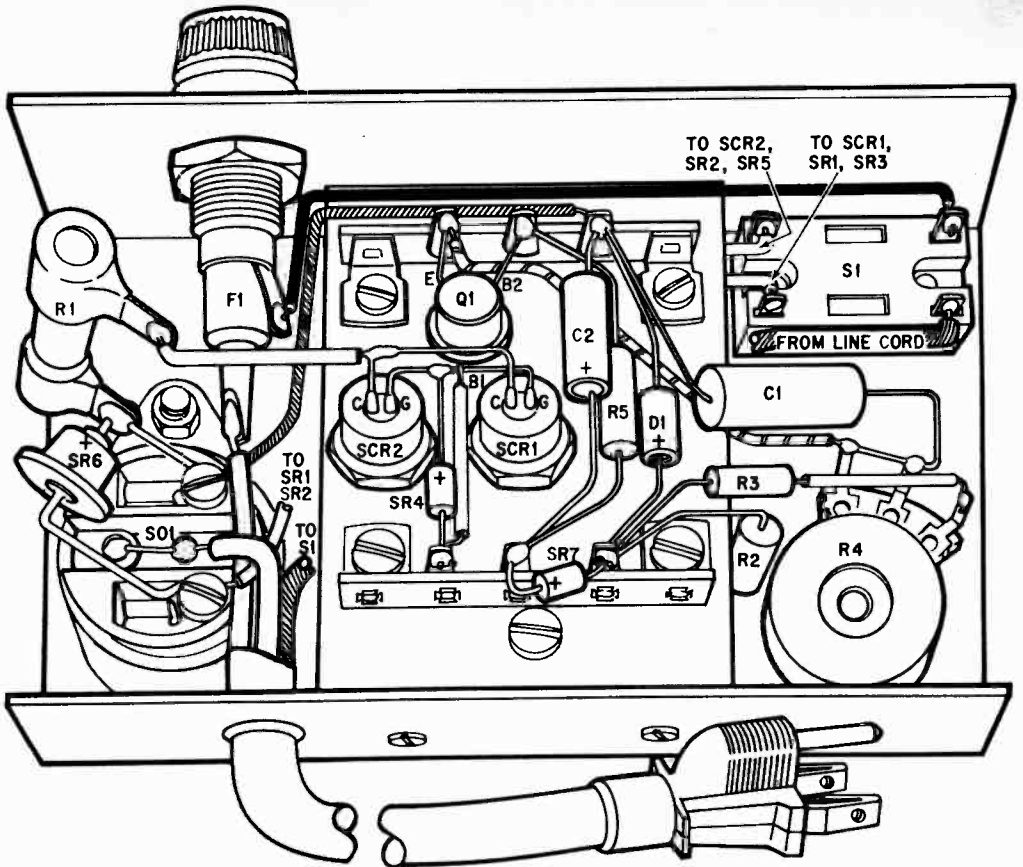
Speed controls are becoming both popular and plentiful but they're not all alike. Most are half-wave jobs with limited control range and fading torque. Our controller is a full-wave design that permits you to vary the speed of any universal motor from full speed to a virtual standstill—and the torque (or twisting power) remains constant

FULL-RANGE SPEED CONTROL

Now you can have the ultimate versatility in power tools or appliances with variation in rpm from full speed to a virtual standstill—and with torque that always will remain constant.

By **DARRELL THORPE**





SPEED CONTROL

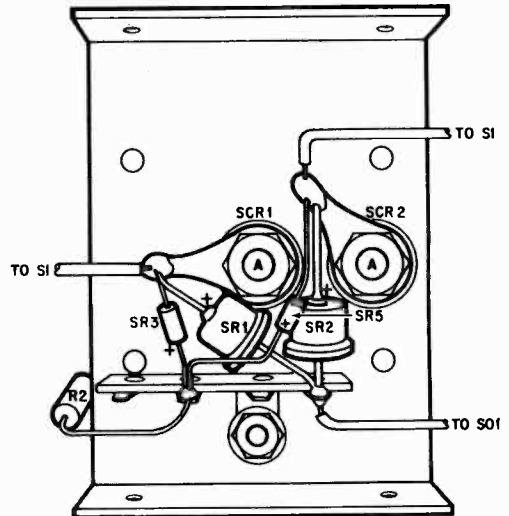
throughout the range. As the work load increases so does the power supplied to the tool to maintain torque.

There are many applications for the controller. When using a saber saw to cut metal or hard wood you must slow the motor to keep the blade from overheating. When cutting plastic the speed of the saw also will have to be reduced or the heat build-up will melt the cut edges of the plastic, causing them to fuse.

Or suppose you have to drill a ½-in. diameter hole in a thick piece of steel. Run the drill at full speed and the bit will burn up, lose its cutting efficiency and the hole will be filled with burrs. Not so at slow speed, though, and you'll be able to start the hole without a center punch because the bit won't creep.

Besides being able to reduce the speed of shop tools, the controller will work with fans, movie projectors, sewing machines, food blenders, sanders, lathes, vibrators or almost any tool or appliance that has a series or universal (brush) motor that does not draw

Fig. 1—Inside of controller. Mount SO1, F1, S1 and R4 near the edges of the cabinet to allow room for the heat-sink chassis in the center. Lead from B1 on Q1 goes only to anode of SR4. Underside of heat-sink chassis, below. Mount SCR1 and SCR2 as shown in the detail diagram at the right. Be careful when installing the chassis that SR1 and SR2 do not touch the cabinet or get pushed against SCR1 and SCR2.



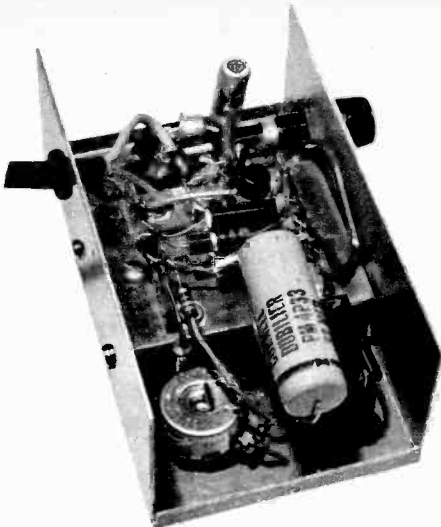


Fig. 2—Put tape on the inside of the other half of Minibox so that R1's (top) and C1's (bottom) leads do not short to the cabinet.

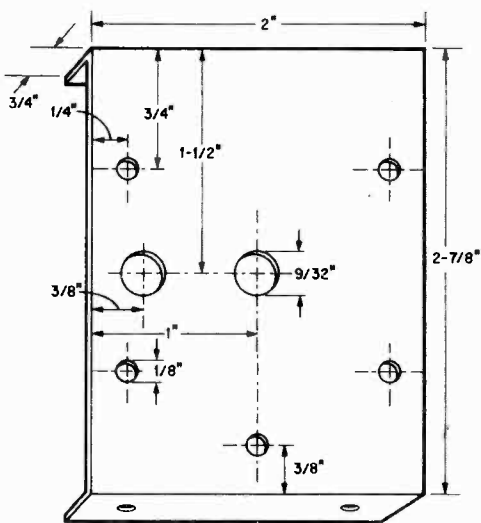
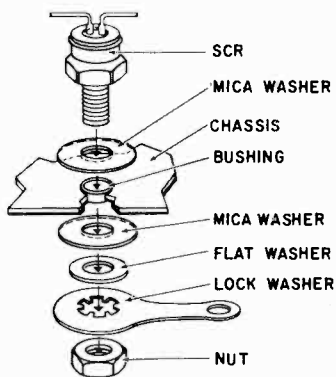


Fig. 3—Detail diagram above shows how SCRs are mounted with hardware supplied with them. Heat-sink chassis dimensions are shown below.

more than 6½ amps. Although some of the aforementioned appliances have built-in speed controls, the speed range and torque characteristics will be improved greatly by our controller. How does the controller achieve all this?

Many early-design speed-control devices had only one controlled rectifier. Hence, they were able to supply only half-wave power to the motor. This meant that the maximum speed was only about half the normal full speed. And at less than full speed many motors can't develop sufficient torque to keep turning as the work load increases.

Our controller overcomes these disadvantages because it provides full-wave power to the motor. It has a unique feedback circuit that furnishes extra power to maintain torque as the work load increases. To test this characteristic after you've built the controller, plug a drill into it and set potentiometer R4 for a speed of about 100 rpm. Then hold the chuck with your hand and turn the drill on. You'll be pleasantly surprised at the high starting and running torque.

Construction. Because many of the semiconductors used in the controller may be difficult to obtain locally, we have arranged with Allied Radio to supply a package of all parts except the fuse, resistor R1, the AC plug and other small hardware. However, our Parts List has sufficient information for you to purchase all parts on your own if you choose to do so. The Parts List includes Allied's special stock number and price for the parts package.

Our model is built in a 3x5¼x2⅞-*in.* Minibox. Silicon-controlled rectifiers SCR1 and SCR2 must be mounted on a 1/16-*in.*-thick aluminum (or copper) chassis. It is important that the chassis be this thick since it serves as a heat sink. A thinner piece of metal will not conduct the heat away quickly enough to prevent damage to the SCRs.

The SCRs also must be electrically insulated from the chassis, as shown in Fig. 3, with two mica washers, a bushing and hardware supplied with them. It is important that the holes for the SCRs be free of burrs or the mica washers may be punctured and there will be a short. This will create a shock hazard because the cabinet would have one side of the AC line connected to it. After the SCRs are mounted, install diodes SR1, SR2, SR3 and SR5 on the underside of the plate as shown in Fig. 1.

SPEED CONTROL

Drill the necessary mounting holes in the cabinet for mounting the SCR chassis, speed-control potentiometer R4, on/off switch S1 and the fuse holder. However, do not mount R4, S1 and the fuse holder in the cabinet until the SCR chassis has been installed. After all major parts are mounted, complete the interconnecting wiring. Where wiring must carry the load current, use heavy wire.

If the motor requires between 2 and 3 amps, R1 should be a 1-ohm, 5-watt wire-wound resistor. For a 5 to 6 amp motor, R1 should be a 1/2-ohm, 10-watt wirewound resistor. If you want to be exact about it, com-

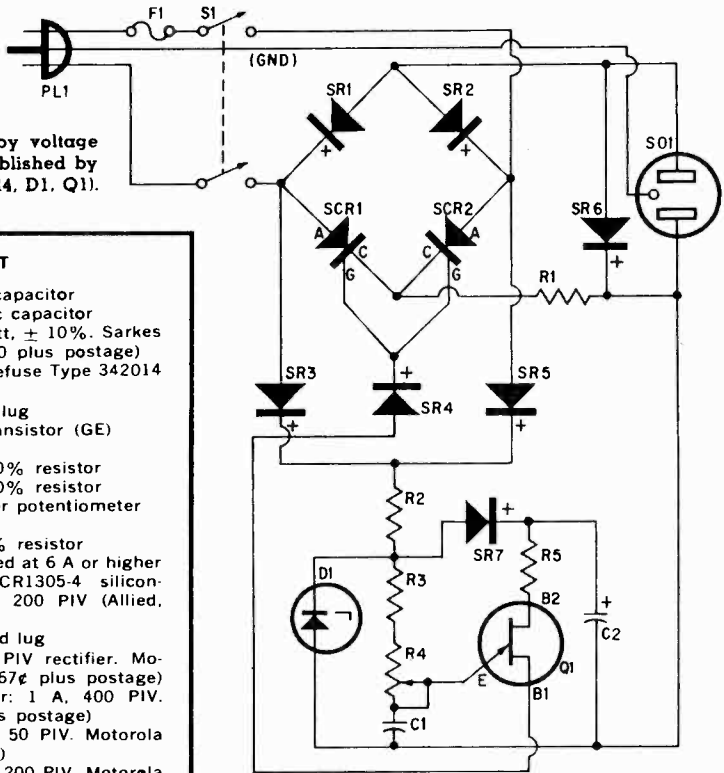
pute R1 with this formula: $R1 = 2/I_m$, where I_m is the maximum rated current of the appliance's motor in amperes.

Operation. Plug the appliance into SO1 and plug PL1 into an AC outlet. Set switch S1 to *on*. With the speed-control knob fully clockwise, the tool's motor will operate at full speed. Turning the knob counterclockwise will reduce speed until the motor runs at only a few rpm.

If you cannot slow down a power tool sufficiently, connect a 10,000 ohm, 1/2-watt, 10% resistor in series with R3.

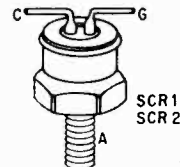
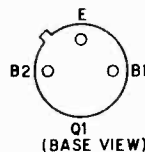
Most tools and kitchen appliances have a universal motor. However, if you are not sure of the type of motor, look for brush holders, or brushes, which are characteristic of this type of motor.

Fig. 4—Amount of power full-wave bridge (SR1, SR2, SCR1, SCR2) furnishes to motor (at SO1) is a function of the point in each half of the AC cycle at which the SCRs are caused to conduct by voltage applied to gates. This is established by phase-control circuit (C1, R3, R4, D1, Q1).



PARTS LIST

- C1—.33 mf, 200 V tubular capacitor
 - C2—10 mf, 25 V electrolytic capacitor
 - D1—Zener diode: 7 V, 1 watt, $\pm 10\%$. Sarkes Tarzian VR7 (Allied, \$1.50 plus postage)
 - F1—6 A, 3AG fuse and Littlefuse Type 342014 holder
 - PL1—AC plug with ground lug
 - Q1—2N2160 unijunction transistor (GE)
 - R1—Resistor (see text)
 - R2—15,000 ohm, 2 watt, 10% resistor
 - R3—3,300 ohm, 1/2 watt, 10% resistor
 - R4—25,000 ohm linear taper potentiometer (Mallory U-29 or equiv.)
 - R5—220 ohm, 1/2 watt, 10% resistor
 - S1—DPST toggle switch rated at 6 A or higher
 - SCR1, SCR2—Motorola MCR1305-4 silicon-controlled rectifier: 8 A, 200 PIV (Allied, \$2.15 plus postage)
 - SO1—AC socket with ground lug
 - SR1, SR2, SR6—3 A, 200 PIV rectifier. Motorola MR1032A (Allied, 67¢ plus postage)
 - SR3, SR5—1N4004 rectifier: 1 A, 400 PIV. Motorola (Allied, 67¢ plus postage)
 - SR4—1N4001 rectifier 1 A, 50 PIV. Motorola (Allied, 45¢ plus postage)
 - SR7—1N4003 rectifier: 1 A, 200 PIV. Motorola (Allied, 60¢ plus postage)
 - Misc.—3x5 1/4 x 2 1/8-in. Minibox (Bud CU 2106-A or equiv.), 1/16-in. thick aluminum.
- NOTE. A package of parts including the fuseholder (but not F1, PL1, R1, terminal strips, 1/16-in. aluminum, the line cord and small hardware) is available from Allied Radio Corp., 100 N. Western Avenue, Chicago, Ill., 60680. The price is \$14.95 plus postage. Specify special stock No. 39 AX 820.



MANY people say a little booze is the best way to start a tea party swinging. Could be, but we guarantee that anyone who wears our Electronic Name Dropper to a social will find himself in the midst of a crowd in less time than it takes to pour a double Scotch on the rocks.

So if you're the shy type and have trouble asking names, just tuck our Name Dropper in your pocket and wait for spectacular results. The gadget costs about \$8 to build, and that's economical in terms of Arthur Murray dance lessons or Charles Atlas muscles.

The Name Dropper has other uses, too. At conventions, where look-alike name tags are standard, it gives you a chance to be different. It can be made to supply flashing numbers for the front of your house, or it can become a warning light when you're stuck on the road at night.

Construction

The Name Dropper can be built in a 5¼x3x2½-inch Minibox. Since this is the thinnest box on the market that will accommodate all the parts, cut its thickness down to about 1¼ inches with a hacksaw so it will fit comfortably into your jacket or trouser pocket. In the bottom of the case mount a Keystone Model 182 battery holder for the four penlight batteries.

Directly above the battery holder mount C1 and hold it in place with a heavy wire soldered to one of the holder's lugs. Mount T1 in the upper right corner of the case and mount Q1 upside down in the upper left corner. Switch S1 should be mounted in the top. The hole through which the wires to the Nite-Lite pass should have a grommet.

Cut the lugsoff a Sylvania Panelescent Nite-Lite so they are about ⅛-inch long and solder a pair of twisted leads to the nubs. To one of the nubs solder a piece of stiff wire shaped like a clip. This will hold the Nite-Lite in your lapel pocket. Be sure to tape the exposed nubs and clip. The 500 volts they carry could give you a man-size jolt that would be dangerous.

Operation

The oscillator circuit produces a strong pulse about every half second, using the parts values specified. This short pulse is stepped up by T1 to about 500 volts. The pulse is fed to the Nite-Lite, causing it to flash much more brightly than it would when plugged into an AC outlet. However, the flash duration



ELECTRONIC NAME

By

FRED MAYNARD

*You come on strong at
convention or party and
no one forgets your name . . .
if you're properly equipped!*

DROPPER

NAME DROPPER

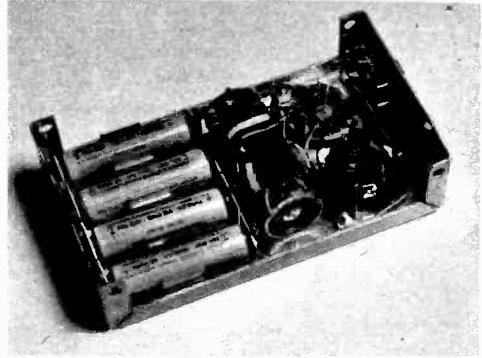
is short and the *average power* delivered to the Nite-Lite is about the same in both cases.

By reducing the value of R1, the flashing speed can be increased. In fact if R1 is reduced in value sufficiently, the Nite-Lite stays on all the time. R2 controls the length of time the Nite-Lite is on. By changing R2's value you can increase or decrease the on-time independently of the flashing speed.

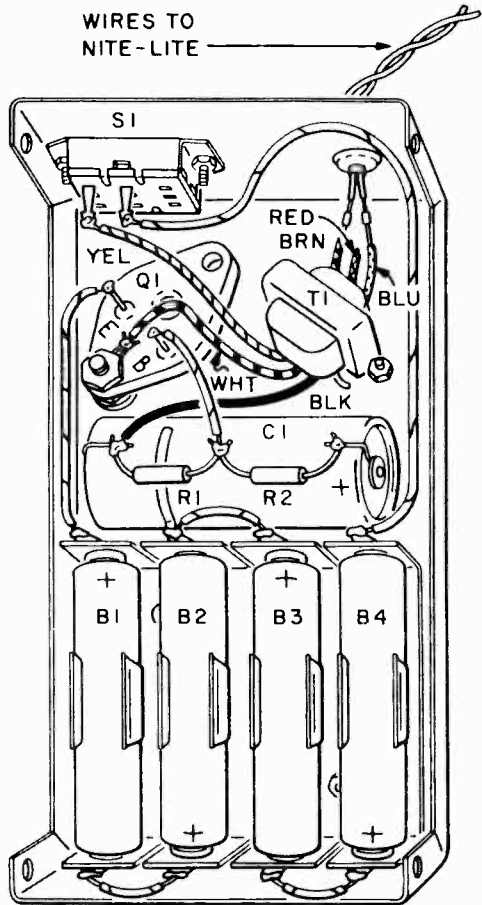
Don't worry about a squeak in the transformer. It is normal and is caused by the heavy surge of current through the primary. The sound comes from loose transformer laminations. As a matter of fact, the squeaking adds another attention-gathering feature to the gadget.

We found the best batteries to use are penlight-size alkaline energizers. They cost more than ordinary flashlight batteries but they produce a brighter flash and last longer. If you want to keep the size down, use smaller mercury batteries but keep the operating voltage around 5 to 7 volts.

You can letter the Nite-Lite with India ink or transfer-letter decals. The decals are available in a wide assortment of sizes at art supply stores. To protect the letters, spray the face of the Nite-Lite with clear lacquer.

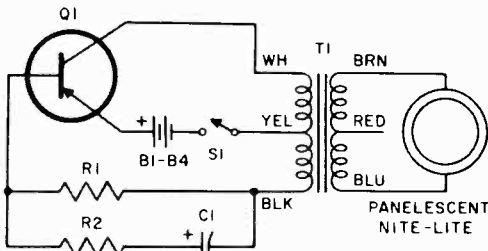


Our model was built in a standard 5¼x3x2½-inch Minibox, which was cut down so the thickness was reduced to 1¼ inches. The case will easily fit into your jacket pocket with relative comfort.



PARTS LIST

- B1-B4—1.5-volt alkaline-energizer penlight battery
- C1—1,000 mf, 6 V electrolytic capacitor
- Q1—2N176, 2N554 or 2N669 trans stor
- R1—2,700-ohm, ½-watt resistor (see text)
- R2—56-ohm, ½-watt resistor (see text)
- S1—SPST slide switch
- T1—Transistor output transformer (Stancor TA-10)



When S1 is closed Q1 conducts, producing heavy current in primary of T1, which is stepped up to fire Nite-Lite. Current also charges C1, which then cuts off Q1, causing the Nite-Lite to go off.

There's plenty of space in Minibox for uncrowded layout. C1 is held in place by heavy wire soldered to lug on battery holder. Q1 is mounted upside down with machine screw through the case.

SLOT-CAR LAP TIMER

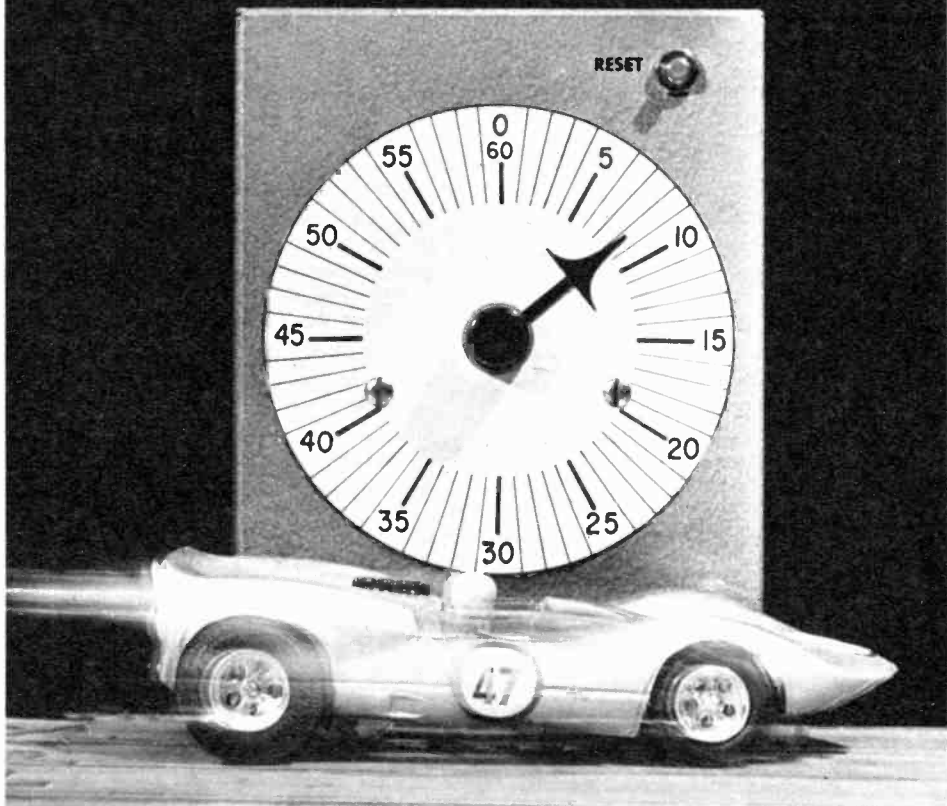
Now you can worry just like Jim Clark and Dan Gurney about how to get your lap time down to minimum!

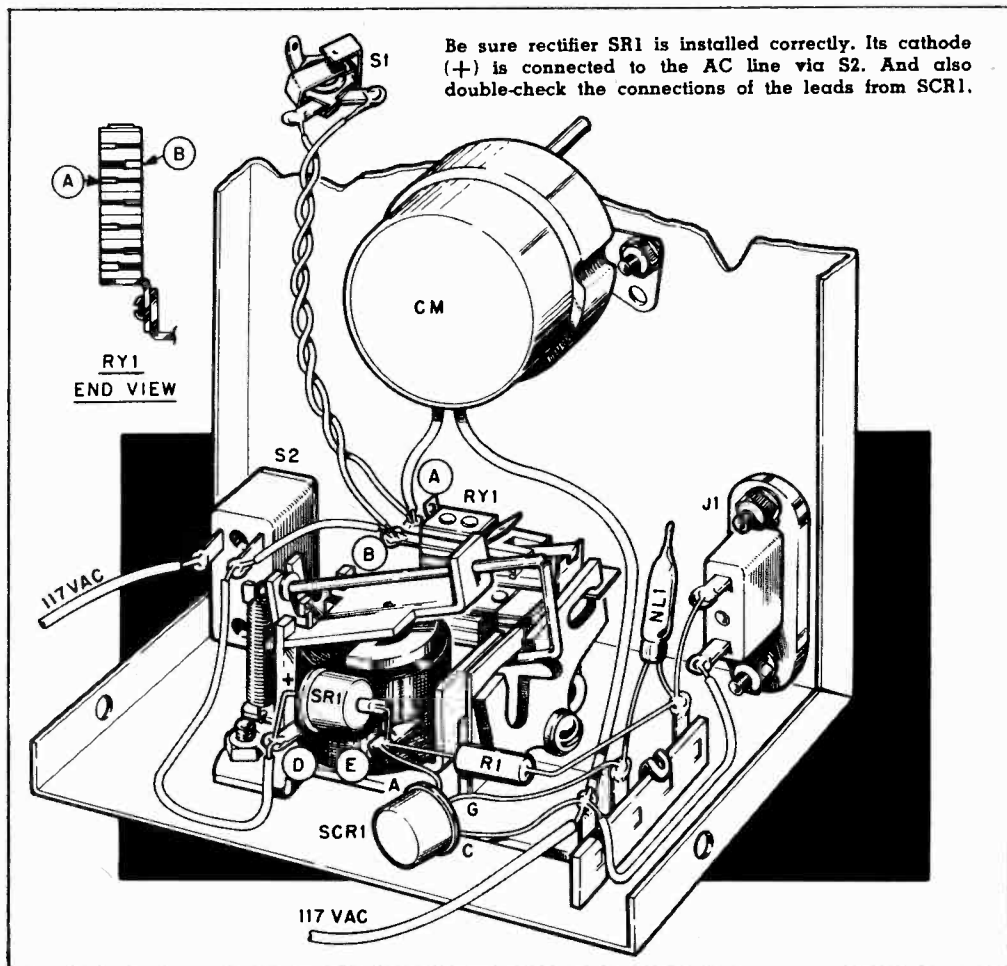
By AL TOLER

YOU could be running absolutely flat-out on your HO or 1/32nd track at home or wheeling with the best on the big banks at a slot parlor but all the soup-ups, tune-ups and skillful driving won't mean a thing unless you can *prove* it. And the way to do that is to race against an accurate clock.

You might win heat after heat but no one will know who really is the Jim Clark of the house until you use the same kind of measuring stick that they employ on the oval and road courses—lap times. Clark holds many lap records. So do Graham Hill and Dan Gurney. Who holds the lap record at your house or slot parlor? Now you can build our Lap Timer and find out!

While you *can* time slots with a stopwatch, the split-second pauses at the start and finish become a mighty large error when you consider that the average lap time is but a few seconds. But our timer is controlled by





the cars themselves—as on regulation tracks.

The timer starts when the car breaks the beam of light across the track. When the car comes around and breaks the beam again the timer stops. Since the timer is light-controlled, there are no mechanical connections to slow or throw the cars. In addition, the timer can be set up anywhere—curve or straightaway. Take it to a friend's layout or even take it down to your slot parlor.

The timer consists of three units: control box, remote-pickup box and light-source box. All component values are critical. Do not make substitutions.

The control box is built in the main section of a 3 x 5 x 7-in. Minibox. You must mount impulse-relay RY1 on the bottom as shown. If it's installed on the side or the top RY1 may trip slowly—causing timing errors—or may not trip at all.

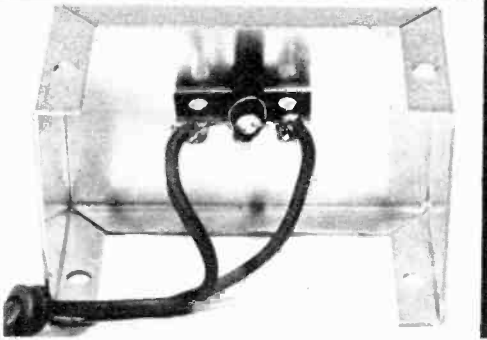
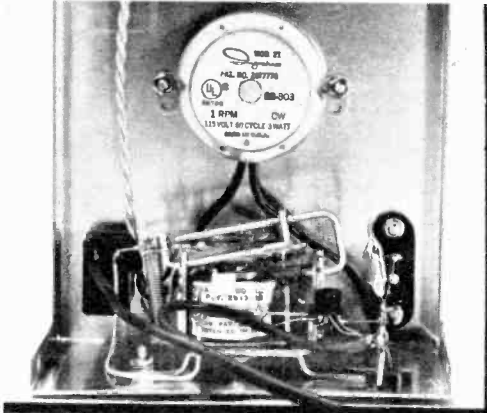
RY1 is supplied with two sets of DPDT contacts but only one set is used; it doesn't matter which as long as one lead is connected to the wiper (B in pictorial).

The specified clock motor (CM) makes a 360-degree sweep in 60 seconds; it was selected because it costs only \$1.19 and because our car takes slightly less than one minute to get around our track. While a 60-second sweep will be adequate for many tracks, you might prefer a slower or faster sweep.

Motors are available which turn as fast as 1 revolution per second or as slow as 1 revolution in several minutes. The choice is yours and depends on track length and speed of your car. Our chart lists some other clock motors and their prices.

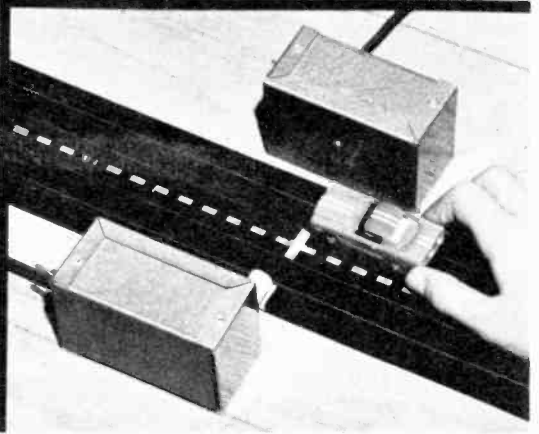
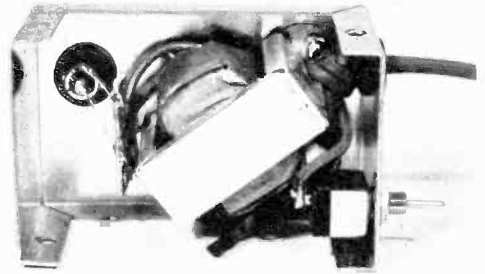
Position the motor in the cabinet so the largest possible dial can be used. Since the motors are equipped with only a shaft, drill a

Interior of control box. Our motor was mounted 3 1/4 in. from top of 3 x 5 x 7-in. cabinet to allow room for a 4 1/2-in. dial and for relay RY1.



Pickup box. Cover photocell with tape so tape extends 1/2-in. beyond cell's face. Fit cell through 1/4-in.-dia. hole so tape protrudes 1/4 in.

Light-source box. Push pilot lamp through grommet so edge of lamp's base is flush with side of grommet. We added a switch for convenience.



Light source and pickup boxes on track. Light from pilot lamp to photocell must be high enough to be broken by body, not just wheels.

tight-fitting hole in a block of plastic or wood and cement it on the motor's shaft after the motor is installed. Draw a dial on a piece of stiff paper, glue the paper on the cabinet and then cement a pointer to the shaft block with epoxy.

The pickup box is a 3 1/4 x 2 1/8 x 1 5/8-in. Minibox. Place a car on the track and measure the distance from the *table*—not the track—to the center of the side of the car. Then drill a hole in main section of the Minibox the same distance from the edge. This is important because if PC1 is mounted too low the car's wheels will interrupt the beam and produce two pulses—instead of one—each time the car passes.

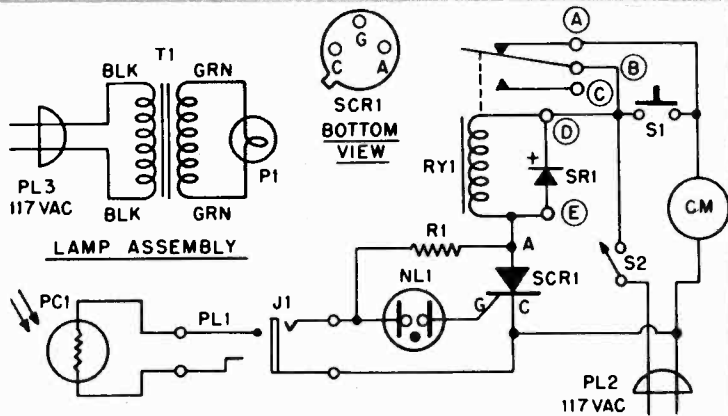
Drill a 1/4-in. hole and then mount a three-lug terminal strip directly behind the hole. Wrap three turns of plastic electrical tape around PC1 forming a tube so that the face

of PC1 is recessed 1/2 in. from the front of the tube. Then wrap two turns of tape around the back of PC1 so it is light shielded.

Position PC1 in the hole so only 1/4 in. of tape tube protrudes from the front of the cabinet. Secure PC1 by wrapping several turns of wire around it, then solder the wire to the center lug of the terminal strip. Make the pickup box's connecting lead long so it can be located a distance from the control box.

The light-source box is the same size as the pickup box. Drill a 1/2-in. hole in the box the same distance from one edge as you did for PC1 in the pickup box. Then install a 1/2-in. rubber grommet and push P1, a No. 47 lamp, into the grommet from the *inside* so the base just touches the grommet. Solder T1's secondary leads directly to P1's base and the center terminal.

Schematic of light source is in upper left corner. Control-box circuit is at right. When beam of light on PC1 is broken by car, SCR1 fires, causing RY1 to trip and clock motor CM to start. Because RY1 is latching-type relay, its contacts remain closed after light beam comes back on. When car returns and breaks beam a second time, SCR1 fires and energizes RY1, causing its contacts to open and motor to stop.



PARTS LIST

CM—1-rpm clock motor (Olson Electronics MO-113). See text
 J1—Phone jack
 NL1—NE-23 neon lamp (Allied 7 U 950, 16¢ plus postage. Not listed in catalog)
 P1—No. 47 pilot lamp
 PC1—Photoconductive photo-cell; Clairex type CL-603A (Allied 7 U 462)

PL1—Phone plug
 R1—100,000 ohm, ½ watt, 10% resistor
 RY1—Impulse relay: 115 VAC coil, DPDT. Potter & Brumfield type PC11A. (Allied 76 U 500 or equiv.)
 S1—Pushbutton switch
 S2—SPST toggle switch

SCR1—GE type C6B silicon controlled rectifier. (Allied No. C6B. \$2.07 plus postage. Not listed in catalog)
 SR1—Silicon rectifier: 750 ma, 400 PIV. (Lafayette 19 R 4202)
 T1—Filament transformer; secondary: 6.3 V @ 0.6 A.

Plug the pickup box into SO1. Turn on the light source and put it about 6 in. away from PC1. Then turn on the control box with S2. The clock motor may or may not start—it doesn't make any difference. Also, RY1 may or may not *click* when S2 is closed. If RY1 buzzes turn off the power and check to see that PC1's plug is making good contact in J1. If the connection checks out, look for a wiring error. (*Note:* RY1 will buzz if the light doesn't fall directly on PC1.)

Break the light beam with your finger. If RY1 fails to click in, check that SR1 is not installed in reverse and is not defective. If SR1 is all right and is installed correctly and RY1 still fails to operate, cover PC1 with your finger and see whether NL1 is glowing. If it is not, check the wiring of R1, PC1 and the SCR's gate (G) lead.

If everything checks out—indicating the control-box circuit is put together properly—trip RY1 once by passing your finger in front of PC1 to stop the timer. Bring the timer back to zero by pressing and holding S2. Finally, make a tube about 1 in. long from stiff paper and fit it over P1.

Place the pickup box on one side of the track and the light-source box on the other side of the track so P1 is shining directly at PC1. Then turn on power with S2. If the

motor is running place your finger in front of PC1 to stop it. Then reset the timer to zero with PB1. Place the car (s) directly behind PC1 and let it go. The instant the car cuts the light beam, the timer should start. When the car comes around and cuts through the beam a second time the clock motor will stop and indicate the lap time. Reset on the second lap and then time the third. The timer will time every other lap.

TIMING MOTORS				
RPM	Sec. per revolution	Mfgr.	Price	Source
¼	240		\$.59	Olson Electronics MO-115
1	60	Ingraham	1.19	Olson Electronics MO-113
4	15	Hurst Type SM	10.68	Lafayette 30 R 3802
6	10	Hurst Type SM	10.68	Lafayette 30 R 3803
30	2	Synchron	4.95	* Herbach and Rademan HI-14
60	1	Synchron	4.95	* Herbach and Rademan HI-18
150	0.4	Synchron	4.95	* Herbach and Rademan HI-21

* 1204 Arch St., Philadelphia, Pa. 19107.

the Mini Mitter



By **RUSS ALEXANDER** IT occupies little more space than a telegraph key, **W6IEL** weighs less than the power transformer it does not have, yet is more powerful than any of the popular lunch-box rigs—that's our Mini-Mitter, a neat 28½-ounce package that can put a clean 15-watt (input power) signal on the 40-meter band.

Secret of the Mini-Mitter's small size, of course, is the missing power transformer. In its absence, power is provided by a solid-state voltage doubler. The two tubes aren't visible because they're mounted on the outside of the back panel to keep everything cool. And because the two tubes have 50-V heaters they are connected in series with a power resistor across the line. This means no filament transformer, either.

The first day we put the Mini-Mitter on the air in California we contacted not only the East Coast but **UAØER** in *Russia* as well (see log excerpt)!

Unless otherwise indicated in column 6, type of emission is *A2*, freq. is *7* Mc., input power is *15* watts.
(MINI MITTER)

1. DATE YR.	2. TIME OF QSO START	END	3. STATION CALLED	4. CALLED BY	5. HIS. SIG. RST	6. OTHER INFORMATION AND CHANGES
<i>3/22</i>	<i>5 30</i>	<i>A 5 35</i>	<i>UAØER</i>	<i>7004</i>	<i>5-6-9-5-7-9</i>	<i>MY R.S.T. HANDLE QTH</i>
<i>3/22</i>	<i>2 25</i>	<i>4 40</i>	<i>ØR 7030</i>	<i>W4Y-1A</i>	<i>5-6-9-5-6-9</i>	<i>"ED" SAKHALIN ISLES, RUSSIA</i> <i>"PAVI" BELGOROSS, N.C.</i>

Fig. 1—Portion of the author's log shows a contact made with **UAØER** in *Russia* with the Mini-Mitter on 40 meters. Input of 15 watts goes to show you that power isn't everything.

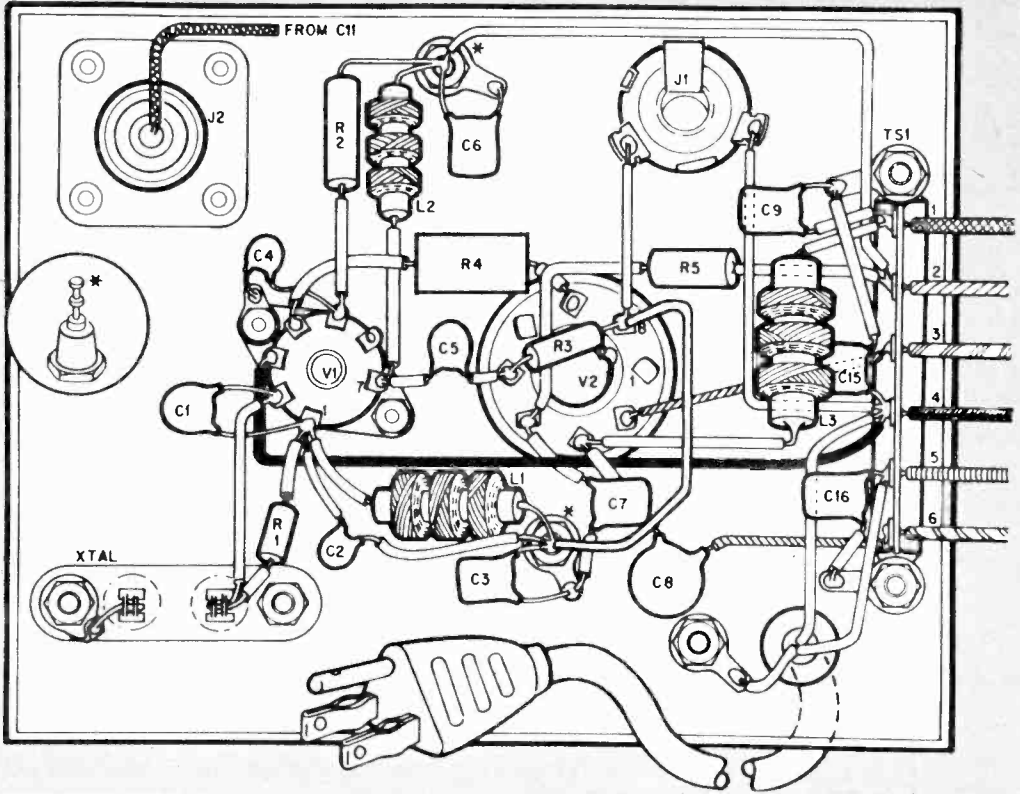


Fig. 2—Rear (above) and front (right) panels. Standoff terminals (circle at extreme left) that hold R9 are sol-

Mini-Mitter

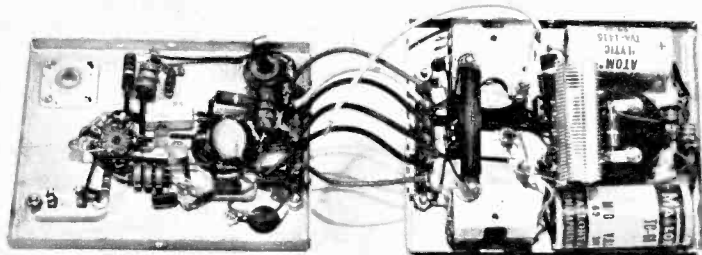
Later we worked Japan, Alaska and many points in the U.S.A.

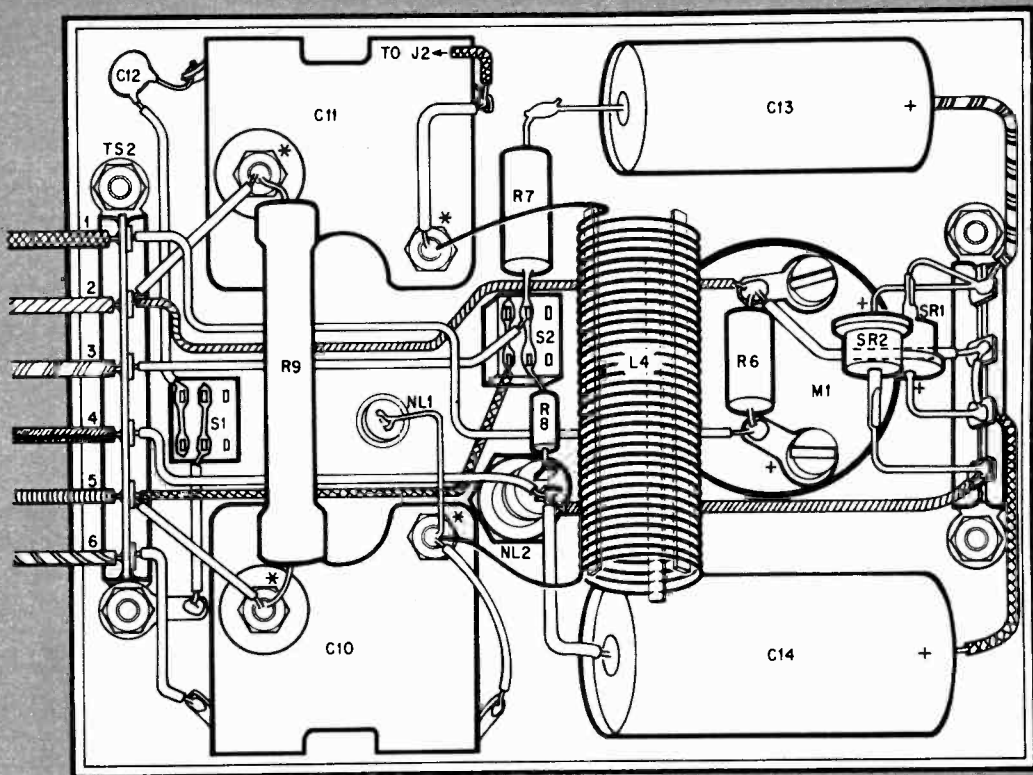
When our main rig failed, Mini-Mitter kept up our MARS schedules and maintained other schedules up and down the Pacific Coast. Because of its vest-pocket size, Mini-Mitter has been carried along on several field

trips without difficulty. It and a Drake 2-B receiver were powered by a 12 VDC-to-117 VAC converter in the car. On several radio picnics we used all sorts of antennas hung from trees, kites and balloons.

The Mini-Mitter circuit is pretty straightforward but includes several unusual features. As we said, instead of the usual heavy power transformer, there is a solid-state voltage doubler for the plate supply. A neon lamp is used as an RF-resonance indicator.

Fig. 3—Photo of completed panels ready to be installed in cabinet. Only lead from C11 on right panel remains to be connected to J2 in upper corner of left panel. Watch for loose strands on interconnecting wires at terminal strips. These strips are close to panel edges. Mount all of the components near panels.





dered to C10, C11. Mount others with screws, seeing that screw heads on L4's don't touch plates of C10, C11.

The rapid response of the lamp to RF voltage provides visual monitoring while you send and is of great help when tuning.

The final has pi-net tuning and there's a switch to add or remove capacity for matching to different impedance antennas. The power supply delivers about 310 V when the key is down. All of this goes to putting out a mighty easy-to-copy signal.

Mechanically, the Mini-Mitter has several features which simplify its construction.

Refer to the pictorial in Fig. 2. Note that the front and back panels are separate parts that are joined electrically by flexible leads. This makes it possible to mark and drill the panels and then mount and wire the components on a flat surface. Layout and handling are thus simplified.

Construction

The first step is to remove the front and back panels from the 3 x 4 x 5-in. case. Holes

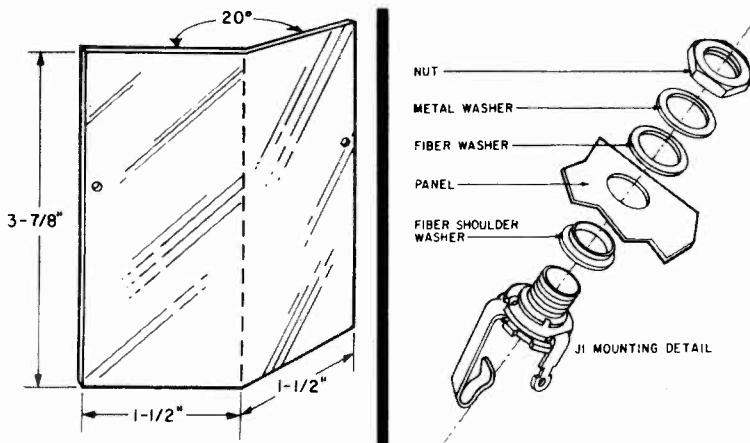


Fig. 4—Sketch at far left is of supporting plate (of 1/16-in. scrap aluminum) that should be used to support and electrically connect front and rear panels so transmitter can be operated out of cabinet. Plate is shown in use in Fig. 6. Sketch at left shows method of mounting key jack J1 so it is insulated electrically from cabinet.

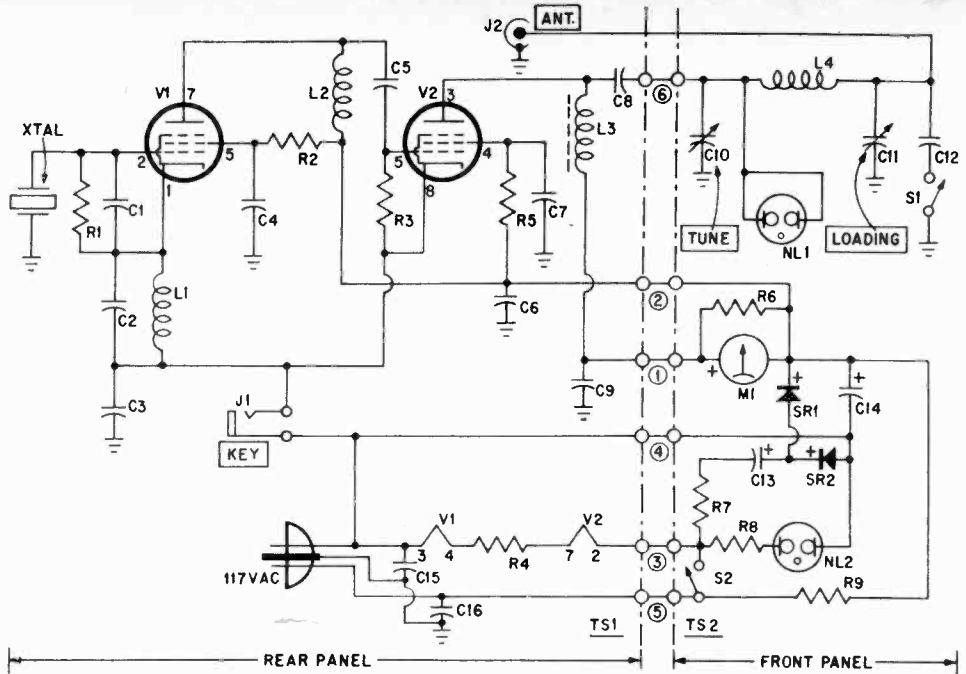


Fig. 5—Schematic of Mini-Mitter. Since J1 is connected directly to one side of line, it must be insulated from cabinet. Make sure the AC plug is wired so that one side of the key will not be hot.

Mini-Mitter

for mounting the components should be drilled next. As an aid to laying out the panels, rubber-cement brown wrapping paper on them. After marking and drilling is completed the paper can be pulled off easily and the rubber cement can be rolled off. This technique prevents the panels from being scratched and permits laying out all holes with easy-to-see pencil markings.

Next, install 6-lug terminal strips (TS1, TS2) on the bottom of each panel. The lugs are the component and wiring terminations (shown as circles on the schematic) and are used to join circuits on front and back panels.

The power-supply filter capacitors (C13 and C14) are mounted by cementing their cardboard jackets directly to the front panel. Cambion (Cambridge Thermionic Corp.) standoff terminals rather than ordinary terminal strips are used to support several components. These lugs are excellent space savers for miniature equipment. One is shown in detail in the circle at the extreme left of the

PARTS LIST

- Capacitors: ceramic disc unless otherwise indicated
 C1—30 μf , 1,000 V, C2—220 μf , 1,000 V
 C3, C6, C9, C15, C16—.02 μf , 500 V
 C4, C5—.001 μf , 500 V, C7, C8—.01 μf , 500 V
 C10, C11—10-365 μf variable capacitor
 (J. W. Miller No. 2111, Newark Electronics
 40F190, \$2.10 plus postage)
 C12—390 μf , 1,000 V
 C13—60 μf , 150 V electrolytic
 C14—60 μf , 350 V electrolytic
 J1—Open-circuit phone jack
 J2—Coax connector, SO-239
 L1—620 μh y RF choke (J. W. Miller No. 4650)
 L2—.15 mh RF choke (J. W. Miller No. 4644)
 L3—2.5 mh RF choke (J. W. Miller No. 6302)
 L4—Barker and Williamson Miniductor No.
 3007, 2-in. long, $\frac{3}{8}$ -in. dia., 16 turns per in.
 (Lafayette 40 R 1616 or equiv.)
 M1—0-100 ma DC milliammeter (Lafayette
 99 R 5055 or equiv.)
 NL1, NL2—NE-2 neon lamp
 Resistors: $\frac{1}{2}$ watt, 10% unless otherwise indicated
 R1—47,000 ohms, R2—8,200 ohms, 1 watt
 R3—27,000 ohms, R4—130 ohms, 5 watts
 R5—6,200 ohms, 1 watt, R6, R7—10 ohms, 1
 watt
 R8—100,000 ohms, R9—40,000 ohms, 10
 watts
 S1, S2—Miniature DPDT toggle switch
 (Lafayette 99 R 6162 or equiv.)
 SR1, SR2—Silicon rectifier, minimum ratings:
 750 ma., 600 PIV
 TS1, TS2—6-lug terminal strip
 V1—50HC6 tube, V2—50L6GT tube
 XTAL—40-meter crystal and socket
 Misc.—Solder terminals (6 reqd. Cambion No.
 1947-2, Newark Electronics 40F1842), 7-
 pin tube socket, octal tube socket, 3 x 4
 x 5-in. utility box (LMB No. U-C 971,
 Newark Electronics 91F1025), 4-lug terminal
 strip

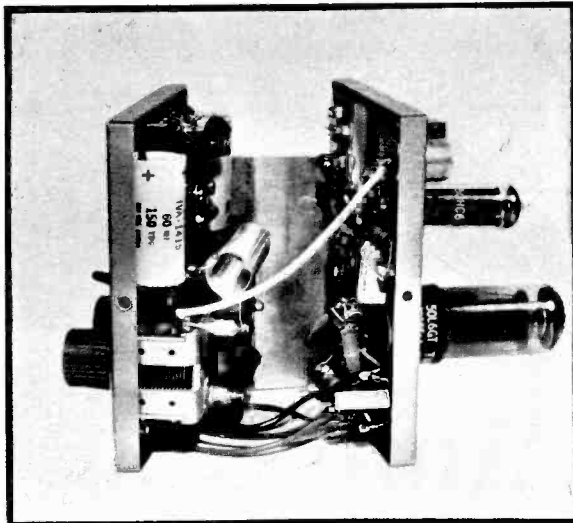


Fig. 6—Photo shows how mounting plate shown in Fig. 4 supports front and rear panels to permit transmitter to be operated out of the cabinet.

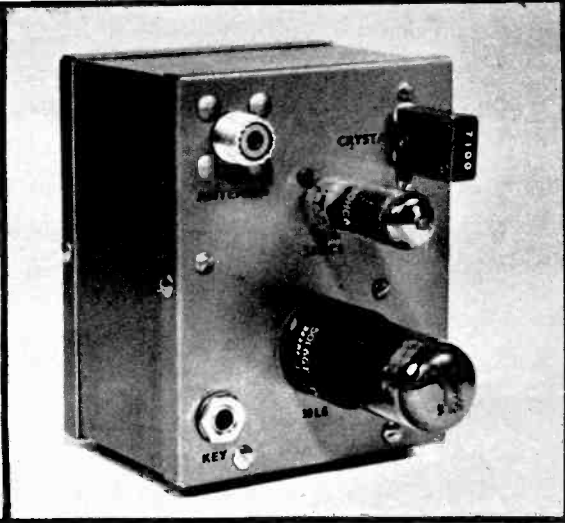


Fig. 7—Rear view of Mini-Mitter. If you feel uneasy about building the transmitter in such a small box the answer is obvious. Get a larger cabinet!

pictorial in Fig. 2. Their locations are indicated by asterisks.

Tank coil L4 and bleeder resistor R9 are mounted on two terminals which are soldered to the frames of variable capacitors C10 and C11. Key jack J1 *must* be insulated electrically from the panel with fiber shoulder washers as shown in Fig. 4. To be sure the jack is insulated from the cabinet, check it with an ohmmeter.

Since one side of the line is connected to the key (and J1) be sure you wire the power cord correctly or there will be a dangerous shock hazard. After the unit is wired, connect the front and back panels with the plate shown in Fig. 4. Turn on power and measure the voltage between jack J1 and either panel. If you measure line voltage, interchange the line cord's leads to lugs 4 and 5 on TS1.

Both leads of neon lamp NL1 are soldered together and connected by a single wire to the ungrounded side of tuning capacitor C10 at a standoff terminal. The bulb should protrude slightly through a 1/4-in.-dia. hole in the front panel. The lamp's internal elements are coupled capacitively to the panel and RF energy through this capacitance lights the lamp.

After wiring both front and back panels connect the two with flexible insulated leads between the indicated lugs on TS1 and TS2.

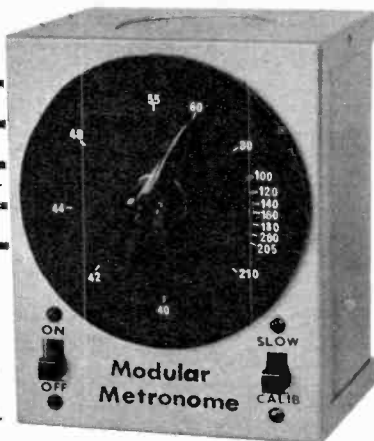
Tune Up

The Mini-Mitter is now ready for testing with a 15-watt, 117-V lamp. After inserting the tubes, plug in a 40-meter crystal and the key. Turn on your receiver and tune it to the crystal's frequency. Turn on the receiver's BFO. Turn on the Mini-Mitter's power and note if NL2 and the tubes light up.

After a warmup of about one minute, press the key. If the Mini-Mitter is wired correctly you'll hear its signal on your receiver. Close S1 and adjust C10 (*tune*) to obtain the brightest glow from NL1 and the lowest plate current, as indicated on M1. (From the full counterclockwise position, we used the first dip.) The 15-watt lamp should glow, indicating RF output.

To load the transmitter, gradually decrease the capacity of C11 (open its plate), simultaneously dipping plate current by adjusting C10. At maximum loading the meter should indicate about 80 ma and the neon and 15-watt lamps will glow brilliantly.

The Mini-Mitter is now ready to go on the air. Connect it with RG59/U coax to a dipole or vertical 40-meter antenna and tune it again, using an SWR or field-strength meter, if available. Capacitor C12 may be cut in or out of the circuit, as needed, for different antennas.



MODULAR METRONOME

Potted parts, an hour's time and you've got the beat.

"**T**IME is the stuff life is made of," someone once said. And if you've studied a musical instrument you know how true this is since timing and rhythm are as important as hitting the right note. To get the music really swinging you've just gotta have the beat. Best way to develop it is with a metronome.

Most standard spring-wound metronomes cost around \$12. Commercially-made electronic metronomes could run a lot more. However our Modular Metronome (MM) can be built for about \$6. Its construction is so simple that all you have to know is the difference between black and white piano keys to get it together.

Secret of its simplicity is a module designed specifically for the application. It's a potted black cube that contains transistors, capacitors and resistors; five leads extend from it.

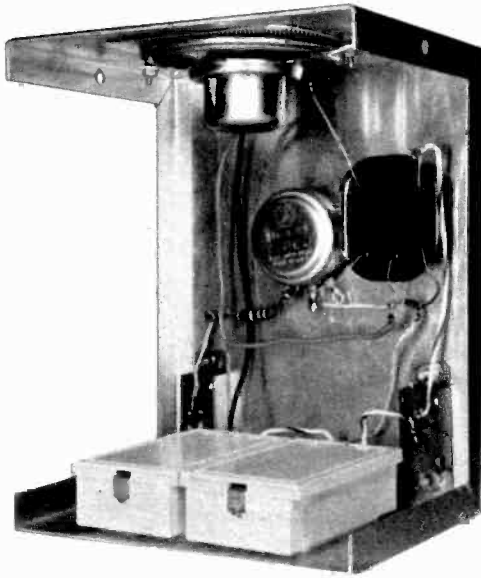
Add batteries, a potentiometer, switches, a resistor and a speaker and you've got a two-speed metronome that counts from 20 to 200 beats per minute. And besides being useful to musicians, it can also be used as an audible timer in a darkroom. For this application you'd just set the MM to 60 beats per minute and count off the seconds. This will allow you to pay full attention to other operations instead of watching a sweep-second hand on a clock. You could even use the MM to help you count sheep when you're trying to fall off to sleep.

Construction. A 3x4x5-inch Minibox will house the MM perfectly. The speaker is mounted in the top of the box. Use a piece of grille cloth or perforated metal to protect the speaker's cone from dirt or damage.

Potentiometer R1 should be mounted in the upper center of the front panel as shown in the photo on the next page. On-off switch S2 should be mounted on the lower left side of the front panel, and slow-calibrate switch S1 should be mounted at the lower right.

Switch S1 and resistor R2 aren't really necessary, but their added expense is worth it for two reasons: 1) They produce an extra slow speed of about 20 beats per minute, and 2) they spread out the calibration markings. Even if you don't want the two-speed feature, it's a good idea to use R2 for the second reason. If you don't use S1, place S2 in the center of the front panel.

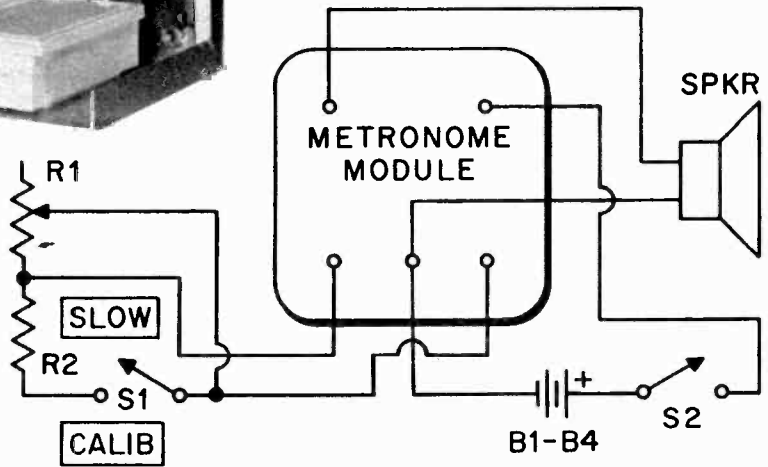
All wiring is straightforward and not critical. Terminal strips are not required



- PARTS LIST**
- B1-B4—1.5-volt penlite battery
 - R1—500,000-ohm linear-taper potentiometer
 - R2—330,000-ohm, ½-watt resistor
 - S1, S2—SPST slide switch
 - SPKR—2-inch PM speaker
 - Metronome module (Lafayette SP-298)
 - Misc.—3x4x5-inch Minibox, pointer knob, battery holder

Mount the speaker on top of the cabinet and glue the module in place. Author used plastic boxes for batteries, but a Keystone type 182 battery holder (Allied 55 J 904) will do the job just as well. Cover the module leads with spaghetti.

Instructions supplied with metronome module specify a 2-megohm potentiometer for R1. However we used a ½-megohm potentiometer to get the unit to operate at about one beat every three seconds when S1 is open. Close S1 and slowest speed is about 40 beats per minute. Speed increases as R1's wiper approaches R2.




since the module leads can be used for tie points.

It's a good idea to mark calibrations on a separate circular disc rather than on the front panel since calibration is affected by battery voltage and, to some extent, by temperature. Cut the disc from a thin sheet of soft aluminum and paint it dull black or dark gray. It should be about 3½-inches in diameter to allow the use of a large pointer knob and so there will be plenty of room for all markings. By sandwiching the disc between an extra set of nuts and washers on R1's shaft, the disc can be turned to correct calibration.

Calibration requires a sweep-second hand watch and patience. With the disc mounted in position, turn on the MM and close S1. Rotate R1's shaft full counterclockwise, aim the pointer knob straight down and tighten it on the shaft. Now, simply count the number of beats in one minute. There should be

around 40, but this may vary with individual modules.

Great accuracy is not required or attainable with the MM, so count to the nearest round number. Rotate the knob about 45 degrees and count for one minute. Put a light pencil mark on the disc opposite the pointer and keep track of the number of beats for each mark on a separate sheet of paper. You'll find after about 180 degrees of rotation that the speed increases more rapidly with only a small change in knob position, therefore pick out numbers about 20 beats apart.

When calibration is completed remove the disc and mark it with transfer-type numbers. The easiest way to check the calibration is at 60 beats per minute. Always move this marking on the disc under the pointer knob when it is set for this speed. The rest of the scale will now be pretty close. 

WHAT YOU CAN DO WITH KNIGHT'S KG-221 VHF RECEIVER

**First build the kit.
Then modify it
—that's what!**

A BIG world of fascinating listening awaits you in the VHF reaches of the radio spectrum. Once you've spent a few hours monitoring some of the bands, you may just put the old short-wave receiver back up on the shelf and give the TV set a well-deserved rest.

One of the best ways to break into VHF is with the \$39.95 Knight-Kit KG-221 FM receiver which tunes from 152 to 174 mc. First we'll talk about the kit and then describe later how to modify it for operation from 88 to 176 mc.

The 152-174-mc band for which the receiver is designed will enable you to monitor police and fire calls, private mobile telephone conversations, Civil-Defense messages, U.S. Weather Bureau reports, taxis, railroads, public-utility vehicles as well as conservation and forestry-service communications. Modified, the receiver will tune the 88-108-mc FM broadcast band, the 108- to 136-mc aircraft band and the 2-meter (144 to 148 mc) ham band.

The KG-221 is not a difficult or time-consuming kit to put together. The circuit includes five tubes and one transistor. Because of the frequencies it tunes, the critical front-end is supplied completely assembled and aligned.

The Circuit

The front-end consists of a dual triode (12AT7) one section of which is a mixer; the other section is a Colpitts oscillator. You simply mount the assembly on the chassis and make four connections to it.

The mixer's output is amplified by two 10.7-mc IF stages (12BA6) and fed to a



ratio detector (the solid state diodes are built in the ratio-detector transformer). From the detector, the audio signal is amplified by two triodes (12AX7A) and fed to a 6AQ5 power amplifier. The squelch circuit contains a single transistor. The transformer power supply is half-wave, solid state. Other features include vernier tuning, headphone jack (8 ohms) and a squelch control.

How did the kit go together? Without any hitches. The manual is profusely illustrated with large pictorials each of which covers only a few steps. This means uncrowded illustrations that are very easy to follow.

The few parts that went into the kit were logically packaged and all resistors came

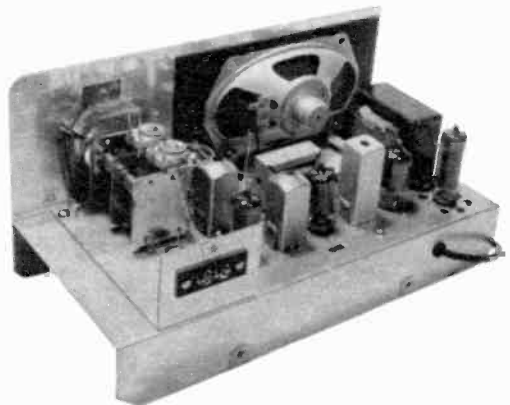


Fig. 1—Top-chassis view of receiver. Front-end is supplied wired and aligned. It's on the chassis on which the antenna terminal strip is also mounted.

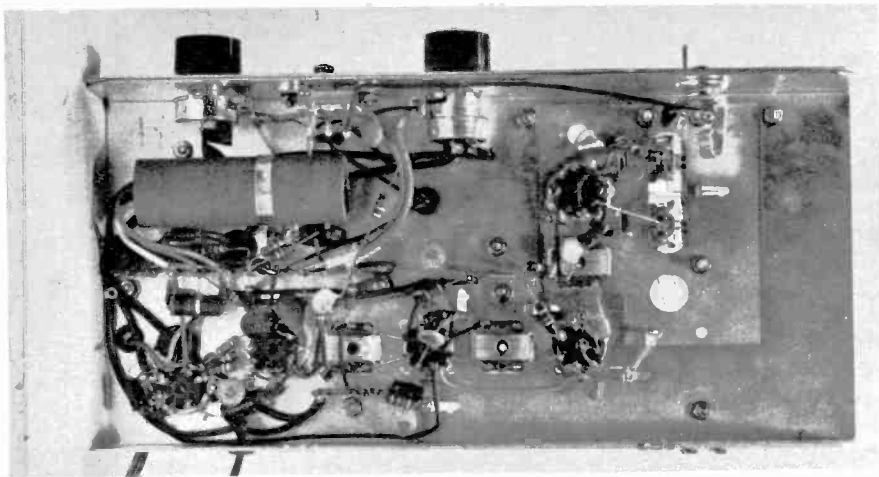


Fig. 2—Underside of chassis. Note how little crowding there is. Everything is wide open and there are no tight corners to work in. Front-end fits in large hole in front-end chassis can be used for wires added for modification of receiver for operation on other bands.

mounted on cardboard strips and identified. We completed construction in about 5 hours.

How it Worked

The KG-221's front-end and IF transformers are supplied pre-aligned, and well aligned they are. Sensitivity necessary to deliver an intelligible signal was $9 \mu\text{v}$. Instrument alignment only improved the sensitivity to $8 \mu\text{v}$. Either factory or instrument aligned, the receiver's squelch opens up the audio at the point where the signal strength is just strong enough to produce intelligibility—a good feature.

While the selectivity—the ability to reject interfering signals on adjacent frequencies—is not outstanding, it will be adequate most

of the time.

Image rejection is about 8db—comparable to that of an inexpensive short-wave receiver. Considering that the band covered by the KG-221 is not going to be busy everywhere at the same time, image interference was not and will not be a problem.

Audio quality is exceptionally good though there is a tendency toward microphonic howling at high volume levels. However, this is common in inexpensive high-frequency receivers. Knight makes mention of the possibility of this happening in the instruction manual and suggests you use an external speaker, which can be plugged into the headphone jack, for high-volume listening.

Our on-the-air test revealed some distort-

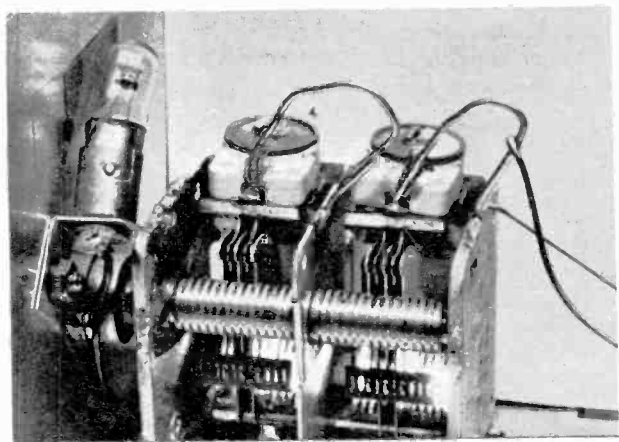


Fig. 3—View of tuning capacitor before modification. Coils weren't bent by accident. Knight shaped them this way during alignment procedure.

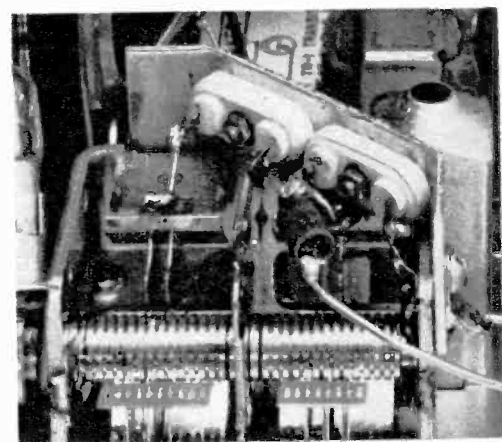


Fig. 4—View of tuning capacitor after modification. Coils were removed and bracket with two coil sockets was added. Note short connections.

KNIGHT'S KG-221 VHF RECEIVER

tion which we at first thought was caused by overload from a strong signal. We felt this was possible since the receiver lacks AGC. Curious, we did a little troubleshooting and found a defective ratio-detector transformer. We replaced the transformer and the problem was solved.

While Knight includes an instrument alignment procedure (which they do not recommend unless a repair results in changes to the factory alignment) it requires a special signal generator not generally found in even the best radio-TV service shops. We tried alignment with the type generator you'd find on a hobbyist's bench and found the receiver could be aligned easily using standard techniques.

But as we said, home alignment is not necessary since factory alignment is just about perfect. As Knight suggests, we recommend you don't realign the receiver unless absolutely necessary and then only if you've had experience with VHF-equipment alignment.

Weighing the few minor shortcomings against its really hot performance and remarkably good frequency stability after a 15-minute warmup, the KG-221 ranks as one of the best buys in Allied's catalog.

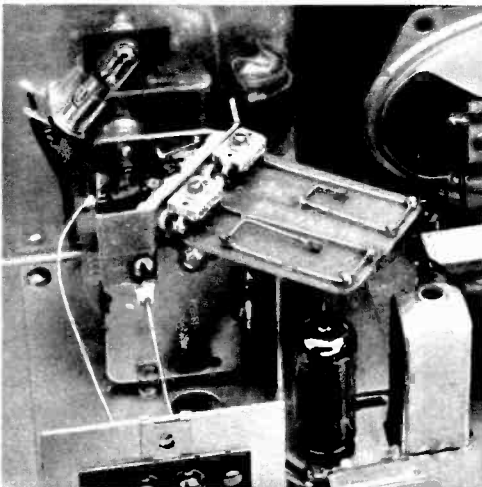


Fig. 5—View of the tuning capacitor with L1, the 88-108-mc coil, plugged in. Note the position and connections of leads from antenna terminal strip.

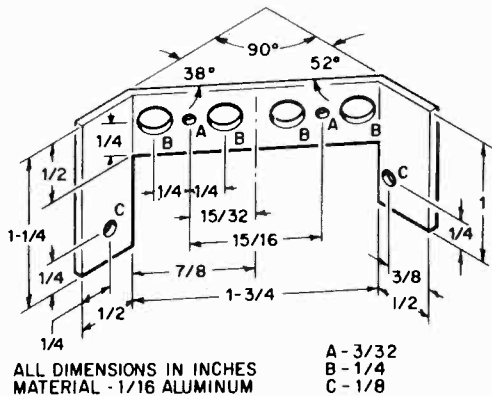


Fig. 6—Bracket for sockets for coils is made from a piece of 1/16-in.-thick scrap aluminum. Tab at right goes on back of the tuning capacitor.

Modifying the Receiver

While the KG-221 does a good job in covering 152 to 174 mc, hearing *signal 29, car 43, 10-4* may get pretty boring after a while. With our plug-in-coil conversion, you easily can extend the range of the KG-221 to receive FM and AM stations all the way from 88 to 176 mc in four bands.

The plug-in coils you use are built on four 1 3/4 x 2 5/16-in. pieces of perforated circuit board. You insert them from the rear of the receiver into a socket assembly on top of the tuning capacitor. A slide switch added at the rear of the chassis changes detectors for FM or AM reception on any band. The under-chassis circuit modification is not tricky.

Begin by carefully unsoldering the coils and trimmer capacitors on top of the tuning capacitor (Fig. 3). Store them in case you want to convert the receiver back to its original design later on. Leave the antenna lead going to the mixer coil in place and unsolder the

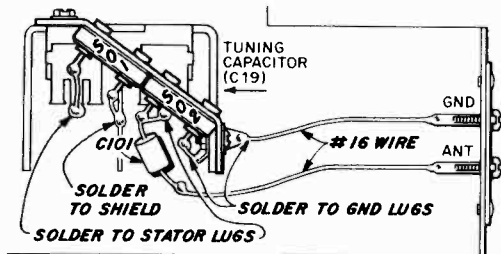
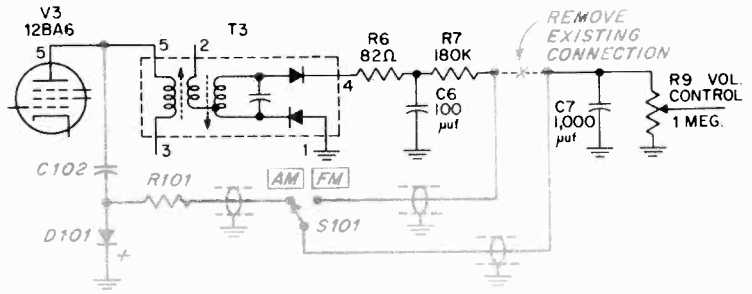


Fig. 7—Diagram of top of tuning capacitor shows the bracket mounted in place. Keep leads from sockets to tuning capacitor and C101's leads short.

Fig. 8—Schematic shows addition of AM detector circuit to receiver in tone. When S101 is in FM position, output is taken from ratio detector. When S101 is in AM position, output is taken from diode detector D101. Use shielded wire from R101, R7, R9 to S101.



lead from the antenna terminal strip.

Cut the coil-socket bracket shown in Fig. 6 and bend the ends to fit the rear and side of the tuning capacitor. The bracket is mounted at an angle (Fig. 4) to enable you to plug the coils in easily and to keep the connections to the tuning capacitor short. Mount the two crystal sockets on the bracket as shown in Figs. 4 and 7 and position its mounting holes over the existing holes on the side and rear of the tuning capacitor.

Use a machine screw and nut to mount the bracket and the two ground lugs on the rear of the tuning capacitor (Figs. 4 and 7). Use a self-tapping screw to mount the bracket on the side of the tuning capacitor as it is difficult to fit in a machine screw and nut. Make sure the screws do not touch the capacitor's rotor or stator plates. We cut away a small length of the fiber tie strip on the rear set of rotor plates to provide clearance for the bracket's mounting screw.

Refer to Fig. 7. Cut C101's leads as short as possible and solder C101 to SO2. Then solder the lead from the antenna terminal-

strip lug to C101. Position C101 so it isn't touched by the rotor blades on the rear section of the tuning capacitor. Make sure all connections are as short as possible.

Make a small bracket for S101 (Fig. 9) and mount it on the rear of the chassis. Install a 3-lug terminal strip under the chassis near V3 as shown in Fig. 9. Unsolder the 180,000-ohm resistor (R7) at the volume control (R9) and connect it to the new 3-lug strip as shown. Connect the shielded wires and run them through the large hole in the front-end to switch S101 on top of the chassis as shown in Fig. 7.

The Coils

Cut the perforated circuit boards to the sizes shown in Fig. 10. Bend the #16 buss wire to shape before mounting on the boards then fit them in the flea clips. Cut the lead ends so they protrude about 1/8-in. beyond the edge of the board. Crimp the flea clips on the wire and apply solder to prevent the wires from coming out. Cut off the excess lengths of the flea clips and install the eight trimmer

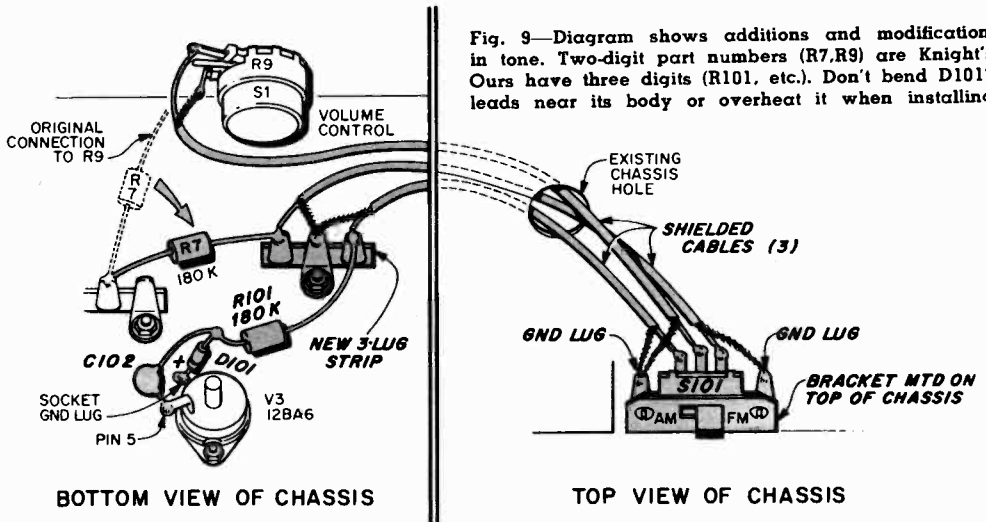


Fig. 9—Diagram shows additions and modifications in tone. Two-digit part numbers (R7,R9) are Knight's. Ours have three digits (R101, etc.). Don't bend D101's leads near its body or overheat it when installing.

KNIGHT'S KG-221 VHF RECEIVER

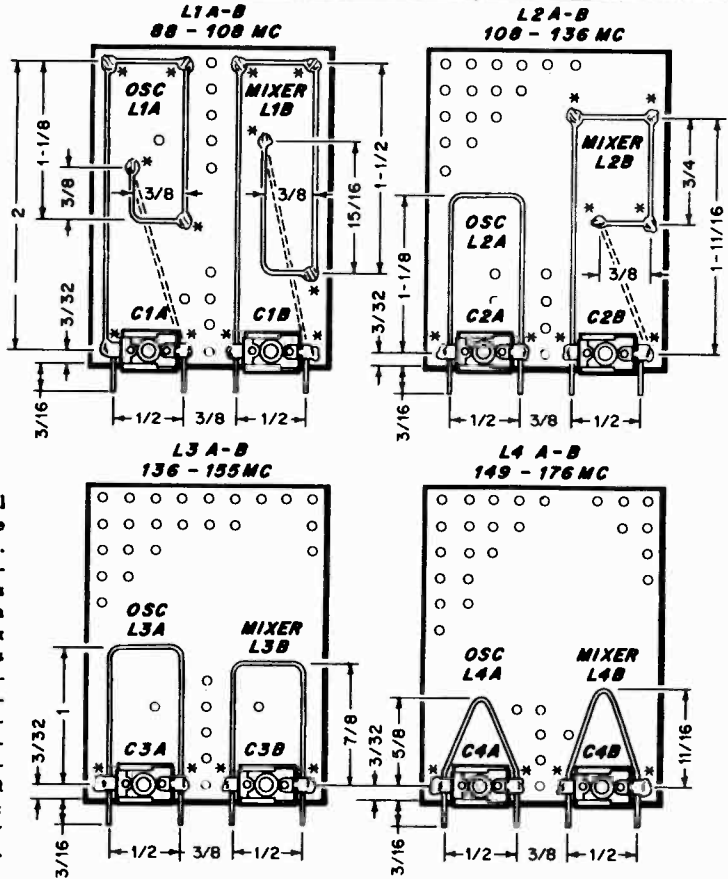


Fig. 10—Coil details. All pieces of perforated board are the same size—1 3/4 x 2 5/16-in. Dimensions are such that spacing between sides and ends of coils will line up with rows of holes. You can be a slight bit off on dimensions without worrying about performance as trimmer capacitors will compensate for coil-shape variations. But it is important that the spacing between the ends of the coils at the trimmers be exactly 1/2 in. so the coils will easily slip in and out of sockets.

- NOTES
1. ALL DIMENSIONS IN INCHES
 2. CAPACITORS SHOWN IN SMALLER SCALE FOR CLARITY
 3. ALL BOARDS ARE 1-3/4 BY 2-5/16
 4. BOARDS ARE PERFORATED BOARDS WITH 1/16 HOLES ON 3/16 CENTERS
 5. 3/32 FROM BOTTOM EDGE OF BOARDS TO $\frac{1}{4}$ OF 1ST ROW OF HOLES
 6. USE 28 PUSH-IN TERMINALS WHERE INDICATED BY *

capacitors (C1A through C4B). Bend the wires so they slip in the sockets easily.

Tune Up

Connect a 16-in. length of wire to the antenna terminal and plug in a coil. Set up a signal generator (capable of going up to 176 mc) to produce a modulated output at the high end of the band for which you've installed a coil. Open the tuning capacitor's plates and loosely couple the generator's output to the antenna wire. Then adjust the A trimmer to pick up the signal. Tune up the B trimmer for maximum signal amplitude. Repeat this procedure for each coil.

PARTS LIST	
C1A-C4B	—0.9-7 μf miniature trimmer capacitor (8 reqd.) Arco No. 400 (Allied 17 U 087 or equiv.)
C101	—5 μf , 500 V silvered-mica capacitor
C102	—10 μf , 1,000 V ceramic disc capacitor
D101	—1N64A diode
Flea clips	—(Vector type T28. Allied 40 U 879 or equiv.)
Perforated board	—1/16-in. thick, 0.062-in.-dia.-holes spaced 0.18-in. center-to-center. (Vector 45B30, Allied 46 U 005 or equiv.)
R101	—180,000 ohm, 1/2 watt, 10% resistor
S101	—SPDT slide switch
SO1, SO2	—Crystal socket: 0.05-in.-dia. pins spaced 0.486 in. (Allied 45 U 532 or equiv.)
Misc.	—1/8-in. thick aluminum for bracket, shielded wire, No. 16 buss wire, 3-lug terminal strip, hardware.



SOUP-UP FOR AC/DCs

By HERB CENAN



ANYONE looking for a *good*, cheap table radio—one with decent sound quality, reasonable sensitivity and a fair number of operating conveniences—doesn't have to go far. True, you couldn't find such a set on the market for under \$30. But hike up to the attic or down to the basement, dig out that old All-American 5 and you've got the makings of a darn good table radio. All it takes is an evening's work and a few bucks' worth of parts.

In its day the AA5 was a major breakthrough in consumer electronics. It used but five tubes and about as many resistors and capacitors as you have fingers. And, thanks to a relatively large cabinet and a 4- or 5-in. speaker, the AA5 delivered pretty good sound.

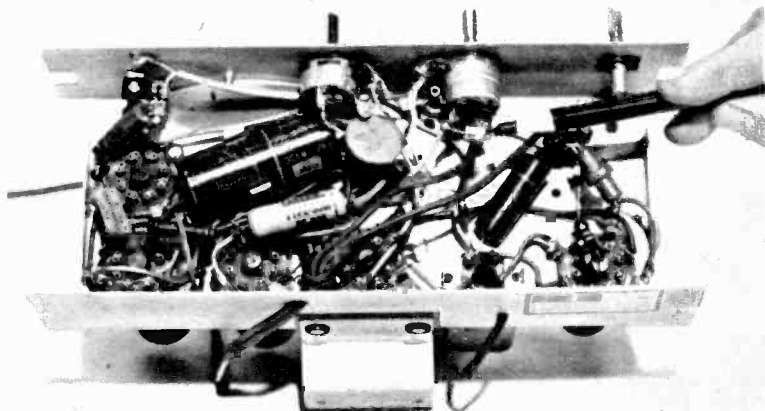
What's more, it was built to last and last and last. Even that old squawker you've held onto just for spare parts can be rebuilt for like-new performance. Or you can go all-out and add a tone control, instant-on, extra sensitivity for DXing, even extra selectivity to untangle howls and groans when night-time DX rolls in.

A new lease on life for the AA5 starts with capacitors. Years of high ambient temperatures probably have caused the capacitors to leak like washerless faucets so the first job is to replace all paper capacitors. But only *paper* ones. Ceramic or molded capacitors in the oscillator circuit could foul up the alignment if replaced so leave them alone. Also replace the filter capacitors with new ones having at least the capacitance ratings of the originals. If your radio sports a value not commonly available—such as a dual 70/40 μf —substitute the next highest rating, an 80/40, say.

Since you will be dropping solder blobs in the chassis, this also would be a good time to add *instant-on* and a tone control. Instant-on idles the heaters at reduced current with the plate voltage off. Within a second or so of turning on the power switch the radio comes on, just like a transistor portable. And don't worry about shortening tube life; it's clicking tubes on and off that burns them out.

To add instant-on, simply connect a silicon rectifier rated at 200 PIV, 500 ma (or higher) across the power switch as shown in Fig.

New capacitors, new tubes and careful alignment are all it takes to give most any All-American 5 a new lease on life. Pencil points to silicon diode which can be connected across power switch to provide AC/DCs with instant-on operation much in the manner of modern all-transistor sets.



SOUP-UP FOR AC/DCs

1. Make certain the SR's cathode—the end marked with a + or band—is connected to the line side of the switch. The SR's anode connects to the side of the switch that feeds the heaters and rectifier plate (if the SR is reversed the whole radio stays on).

Addition of a tone control—actually a high-cut (low-pass) filter—allows you to get a more balanced tone from the speaker. Further, since you now can reduce your set's high-frequency response, it often makes copying DX stations a little easier. The necessary components appear in color in the circuit in Fig. 2. A .05 μf capacitor usually is adequate for C1, but if you want a little more bass you might try a .1 μf .

Capacitor C2, a .001 μf , 500 V ceramic disc, is needed only if adding the tone control causes a buzz. Whether you get the buzz or not depends on the wiring layout of the radio. First try just C1 and R1 (a 20,000-ohm, linear-taper potentiometer); if the sound is clean forget about C2. Potentiometer R1 is installed on any clear spot on the front apron; if the chassis is too crowded you may find it necessary to use a miniature pot.

So long as you have a wooden cabinet you'll have no trouble cutting the hole for the tone control's shaft. If the cabinet is Bakelite or plastic, use a sharp, high-speed drill.

With all the drilling and soldering completed, vacuum the solder blobs and metal chips from the chassis; then blow the dust off. If the tuning capacitor originally was noisy—if you got Rice Krispies (snaps, crackles and pops) every time you tuned in a station—spray the tuning capacitor's plate with No-Noise, Contact-Kleen or similar product and rock the capacitor back and forth several times. Should the noise persist, repeat the procedure.

The foregoing will result in a good-sound-

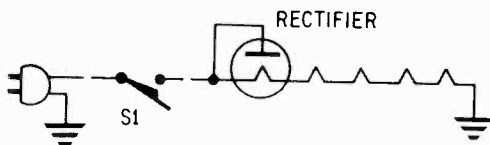


Fig. 1—A single component, a 500 ma, 200 PIV diode (SR1), brings instant-on to any AC/DC radio.

ing table radio; but you now can move on to a real soup-up in sensitivity and selectivity. Let's tackle sensitivity first.

If your radio is equipped with a loop antenna—many turns of wire on the back panel—you can't improve sensitivity for local reception by removing the loop and substituting a loopstick. To be sure, there are advertising claims to the contrary but they're not necessarily true.

On the other hand, if your radio has an antenna coil with a short wire antenna trailing out the back you can eliminate the wire and possibly pick up a little extra sensitivity by removing the coil/wire combination and installing a ferrite-rod loop antenna such as the Miller 705A. Use the largest rod you can fit on the back of the radio—the larger the rod the greater the sensitivity (an itsy-bitsy rod delivers an itsy-bitsy signal).

For real DX work you need an outdoor antenna and this is no problem if your set is equipped with a rod. Just wrap a few turns of the antenna's free end around the rod as far as possible from the rod's coil. Tune in a weak signal, slide the antenna coil toward the rod's coil, then tape it in the position that results in maximum sensitivity. If your radio is equipped with a loop and you need extra sensitivity for DXing, replace the loop with a rod antenna and, similarly, wrap the antenna around the rod. The increased sensitivity immediately should be apparent, with even local stations coming in much stronger.

For extra selectivity you can install a gimmick which will regenerate the IF amplifier. Explanation is that regeneration will cause an IF amplifier to be on the verge of self-oscillation. Circuit Q rises sharply at this point and selectivity, therefore, is increased many-fold. The circuit in Fig. 3 shows how

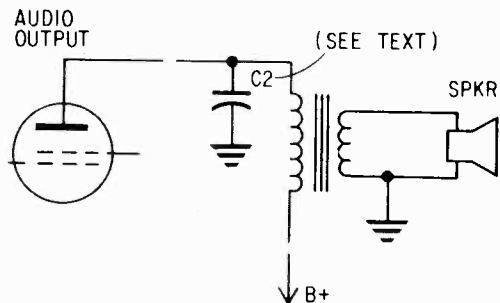


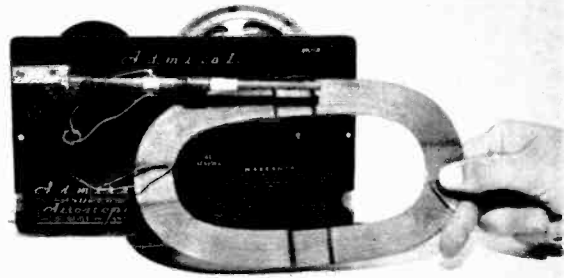
Fig. 2—Simple tone control consisting of C1 and R1 improves audio quality, helps in DX work.

simple it is to pull off this trick. Just connect a short length of solid, insulated hookup wire to the plate of the IF amplifier and a similar wire to the grid, then twist them together two or three times to form a gimmick.

Turn on the radio (if you've replaced the antenna coil align the receiver first). If you can't hear any signals or if you get squeals cut off a small section of the gimmick. Keep repeating the cut-and-try until the signals suddenly boom in without squeals. A properly trimmed gimmick can turn a jumble of stations into individual, in-the-clear signals. Don't forget to *pull the plug* before snipping away at the gimmick; high voltage is present. When you have the right length, tape the ends of the insulated wires.

Final step is to install a complete set of new tubes and align the radio. And to do the job right, buy or borrow a signal generator. First, connect one lead of a 150-V AC voltmeter to a ground, such as a cold-water pipe, and the other lead to the chassis. Insert the radio's plug in the outlet and turn the power on. If the meter indicates full line voltage reverse the plug to put the chassis at ground potential.

Next, set the tuning capacitor's plates to full open, connect the signal generator's ground lead to the radio chassis and connect the generator's output lead through a .01 μf capacitor to the mixer's input grid—the grid which connects to the antenna coil. Set the generator to the radio's IF frequency and adjust the generator for minimum output. If you have a VTVM, connect it to the radio's AVC buss (usually across the volume control), set the generator for *no-modulation* and align for maximum negative voltage. Lacking a VTVM, you can turn the receiver's volume control full on, set the generator for



Replacing old-style loop antenna with modern ferrite rod permits addition of external long-wire.

internal modulation and align for maximum speaker volume. In either instance, be certain the signal generator is at its minimum usable level.

Alignment chiefly consists of using an insulated alignment tool to adjust the IF transformers for maximum output. Unless junior has screwed the loose screws tight, even an old radio should require just a slight trimming for peak alignment. On the other hand, addition of the gimmick may have thrown the alignment off considerably.

Now disconnect the generator's output lead and set the generator to 1000 kc for RF alignment. If you have a loop antenna it's a single adjustment. Place the generator's output lead near the loop or clip it over the loop. Set the radio dial to 1000 kc and adjust the oscillator trimmer for maximum output. (The oscillator trimmer is the one for the small set of tuning capacitor plates.) Then adjust the antenna trimmer (the one for the larger plates) for maximum output.

If you are using an adjustable rod antenna, place the generator's output cable near the coil or clip it to the rod. Adjust the oscillator as previously described. Then, pushing the rod's coil with an insulated alignment screwdriver, position the coil for maximum output at 1000 kc. This done, set the dial and generator to 1600 kc and adjust the antenna trimmer for maximum output.

The receiver now should exhibit reasonably linear sensitivity over the entire BC band. For extra sensitivity at some particular frequency, just peak the antenna trimmer for that frequency. Such adjustment may give little effect on loop or fixed rod antennas, but it can increase sensitivity appreciably with an adjustable rod antenna.

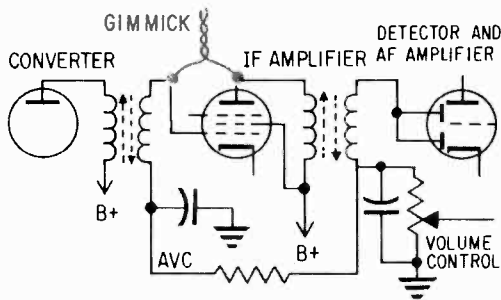


Fig. 3—Gimmick causes IF amplifier to be on verge of oscillation, increases selectivity significantly.

EXPERIMENTING with a new project has a special kind of satisfaction—but it has frustrations, too. Like when you're pawing through the junk box for an inductor. You find one that looks like it might be the right value. When you examine it closely though, you discover to your dismay that the markings have vanished. It's useless.

Or you have an odd-looking variable capacitor that was removed from a piece of surplus equipment. How would you determine its capacitance range?

Even though you own a VOM and perhaps even a capacitance meter these two instruments won't always measure a *wide range* of resistance and capacitance accurately. It takes an impedance bridge to do this job.

Our impedance bridge turns those unidentifiable parts into useful components. It measures resistance from 0.1 ohm to 14 megohms, capacitance from 1 μf to 14 μf and inductance from 10 μh to 10 hy. Carefully calibrated, its accuracy is ± 5 per cent.

For most measurements, the bridge is powered by a battery. A few ranges however, require a 60-cps signal. Since low-frequency transistor oscillators can be complex, a 60-cps signal from a 6.3-V filament transformer (and, consequently, 117 VAC) is used some of the time when measuring either inductance, capacitance or resistance.

By
WALT HENRY

BRIDGE TO NOWHERE

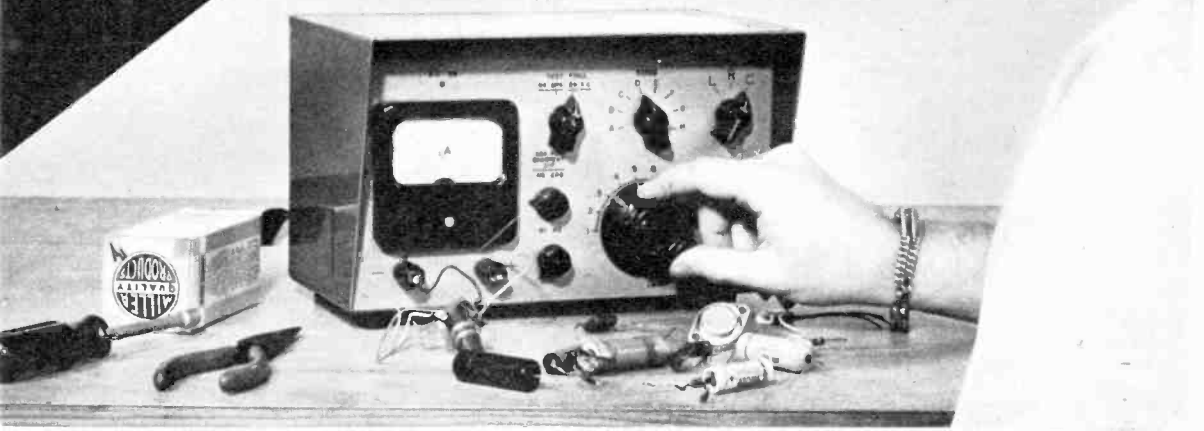


Fig. 1—View down into bridge. Wire selector switches S1, S2 and S3 before mounting them on front panel. Then mount circuit board on bottom of U-section of Minibox with four 1¼-in.-long spacers. Connect front-panel controls to circuit board, then install filament transformer T2 and associated components on rear panel. Pictorial of components on rear panel is shown in Fig. 3.

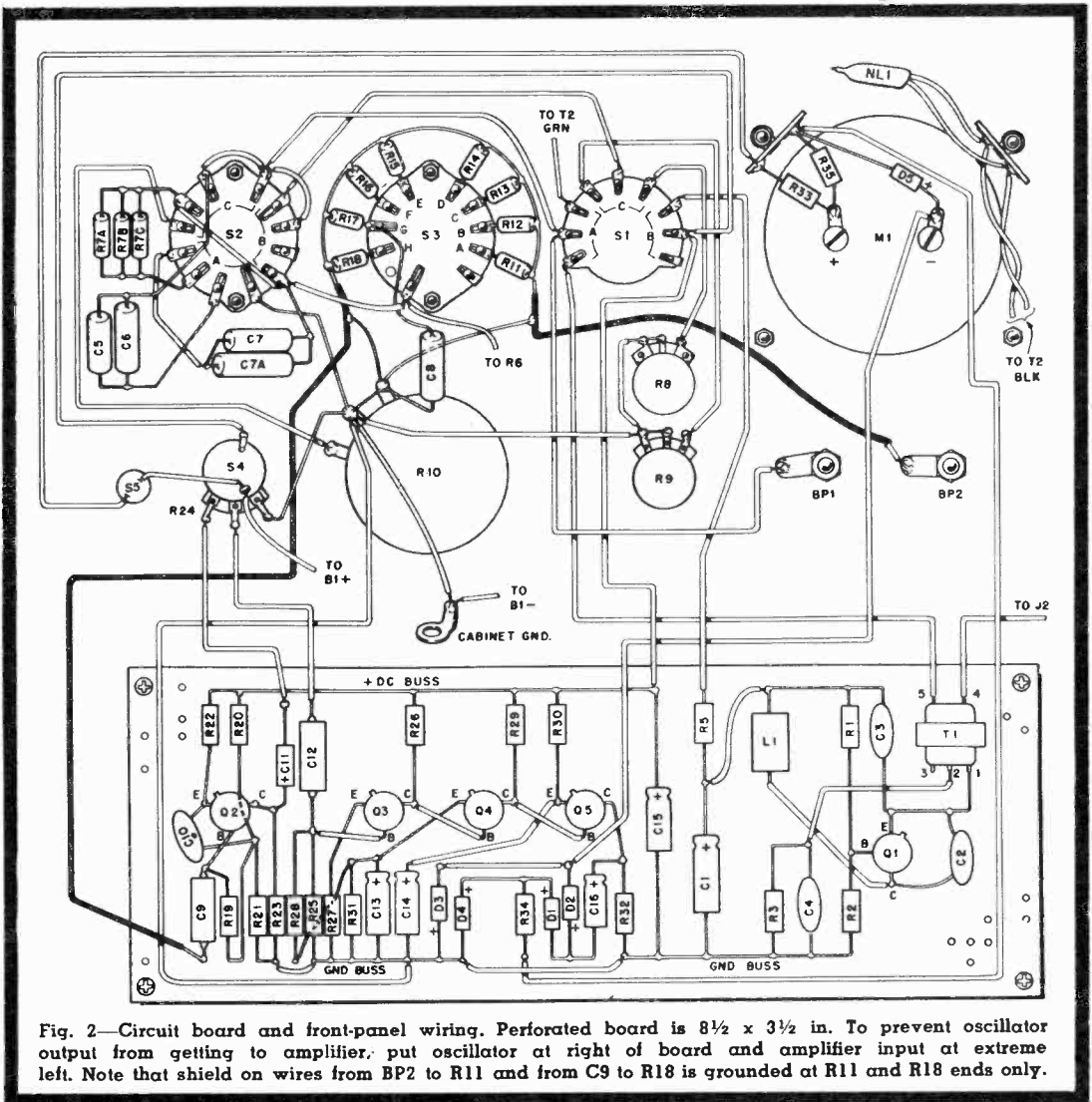
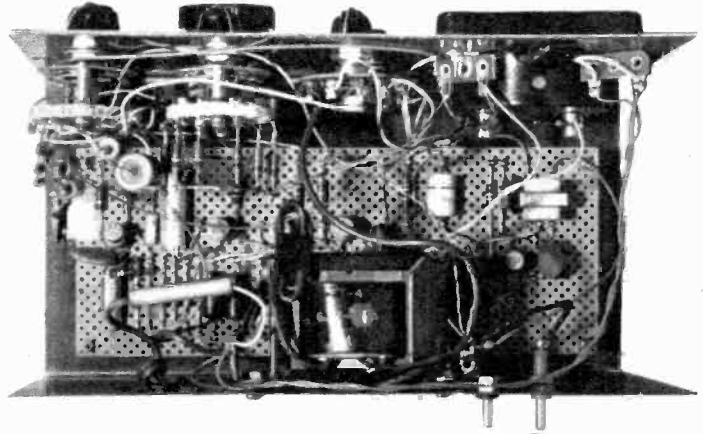
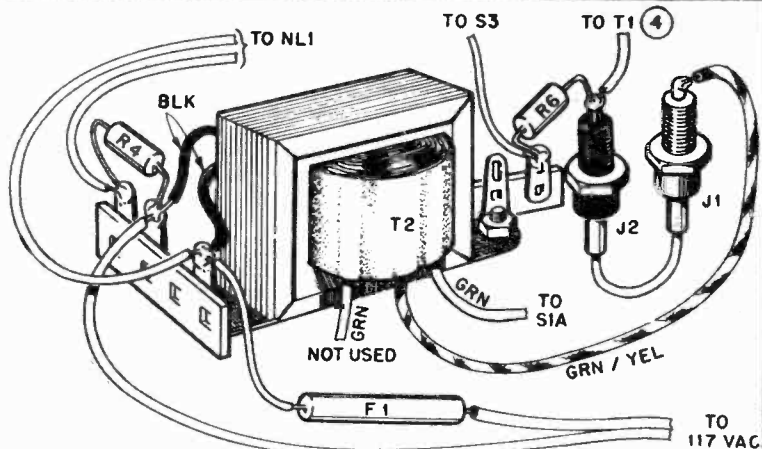


Fig. 2—Circuit board and front-panel wiring. Perforated board is 8½ x 3½ in. To prevent oscillator output from getting to amplifier, put oscillator at right of board and amplifier input at extreme left. Note that shield on wires from BP2 to R11 and from C9 to R18 is grounded at R11 and R18 ends only.

Fig. 3—After circuit board is installed, mount these components on top of rear panel. We soldered F1 in AC line but you could use fuse holder. J1 and J2 normally are connected with jumper. When checking electrolytics, remove jumper and connect + terminal of 9-V battery to J1, negative terminal to J2.



BRIDGE TO NOWHERE

Construction

Circuit layout is not critical but for best performance a few points should be noted. When laying out the circuit board be sure the oscillator (Q1) is located to the right of the output end (Q5) of the amplifier to minimize stray-signal pickup. This keeps the oscillator away from the amplifier input at Q2.

The ground wire from the front-panel components to the circuit board should be connected near the second stage (Q3) as shown in Fig. 2. Note that several ground wires are connected to R10 to stabilize the circuit. Filament transformer T2 should be located away from the input end of the amplifier. In our model it is mounted on the top of the back of the U-section of the Mini-box as shown in Fig. 2. One of T2's green secondary leads should be cut short and taped.

So little AC power is consumed that we did not use a switch to turn off power to T2. But since the amplifier is battery powered switch S4 should be turned off when the instrument is not in use. All wiring should be short and direct. Note that shielded wires are used from BP2 to R11 and from R18 to C9. Ground the shield at the R11 and R18 ends only.

To lay out R10's dial as shown on the first page of this article, put 0.1 and 1.0 marks 180° apart on a horizontal line. Then mark off 20° divisions for 0.2 through 0.9. Also mark off 20° divisions for 1.1 through 1.4.

Test and Calibration

Set S2 to R and set test freq. switch S1 to 60 cps. Do not plug in the line cord. Turn potentiometers R8, R9 and R10 full counterclockwise. Set S4 to on but leave amp. gain pot R24 full counterclockwise. Measure the voltage with respect to ground on Q5's emitter (point A on the schematic) and on the collector (point B). The voltage at A should be about twice the voltage at B. If it is not, use a different value resistor for R28 to get the proper voltage.

Now measure the voltage on Q2's collector (point C). It should be between 2 and 4 V. If it is not in this range a slight change in the value of R20 will do the trick.

Set range switch S3 to E and slowly turn R24 clockwise. With the gain wide open the meter should indicate below 5 microamps. If it is higher Q2 may be noisy and should be replaced.

Leave S3 at E, turn R24 counterclockwise and plug in the line cord. Connect a 10,000-ohm, 1 per cent calibration resistor to BP1 and BP2 and turn R24 clockwise until M1 deflects almost all the way to the right. Now adjust mult. pot R10 until the meter nulls. It may be necessary to readjust R24. (If you don't get a null go on to the next paragraph.) Loosen the set screw on R10's knob, set the pointer to 1.0 and tighten the set screw. Now connect a 1,000-ohm, 1 per cent resistor to BP1 and BP2. The null should occur when R10 is set to 0.1.

If you don't get a null it is because components are out of tolerance. It probably will

Range Switch Position	Multiply R10 by		
	C	R(ohms)*	L
A	10 μf *	1	—
B	1 μf	10	100 μh
C	.1 μf	100	1 mh
D	.01 μf	1,000	10 mh
E	.001 μf	10,000	100 mh
F	100 $\mu \mu f$	100,000	1 hy
G	10 $\mu \mu f$	1 meg	10 hy*
H	—	10 meg	—

* Use 60 cps

Fig. 4—Cut out this chart and paste on top of cabinet for reference. Set S3 for approximate value of component to be checked. For exact value of part, multiply reading on R10's dial when meter nulls by figure in the appropriate column.

be necessary to change the value of R7A, B, C slightly to get nulls at exactly 1.0 and 0.1. We had to parallel R7 with a 1,500-ohm resistor. An easy way to determine the value of the resistor is to parallel R7 with a 5,000-ohm pot and repeat the above procedure with different potentiometer settings until nulls occur at exactly 1.0 and 0.1. Measure the pot's resistance and solder a resistor of the same value in parallel with R7. If R7 should happen to be too low in value, replace one of the 68-ohm resistors with an 82-ohm resistor and repeat the procedure.

When you are through tighten the knob set screw securely. It is a good idea to check the other ranges, using several resistors of known value. The bridge's accuracy can be increased if R11 through R18 are 1 per cent resistors instead of the 5 per centers specified in the Parts List.

For accurate capacitance measurements, the values of C5 and C6 must be selected; their combined value will be close to 0.3 μf . We obtained the proper value by paralleling 0.1 μf and 0.18 μf capacitors. Connect a 0.001 μf 5 per cent calibration capacitor to BP1 and BP2. Set S3 to E, S2 to C and S1 to 20 kc. Increase the gain (R24) for a full-scale deflection and adjust R10 for null. Try various parallel combinations for C5 and C6 until the null occurs with R10 set at 1.0. Then use a 100 $\mu \mu f$ capacitor to make sure the null occurs when R10 is set at 0.1. Always adjust R9 or R8 first for sharpest dip. Check other ranges with different capacitor values. For values greater than 1 μf , S1 should be

set to 60 cps instead of to 20 kc.

If the capacitor under test is an electrolytic, connect a 6- to 9-V battery to *ext. bias* jacks J1 and J2. Be sure to observe polarity marks when connecting the capacitor to BP1 and BP2.

Calibration for inductance is accomplished by selection of C7 and C7A. Their combined value normally is about 0.25 μf . We obtained the proper value by paralleling a 0.22 μf and a 0.047 μf capacitor. Connect a 1-mh choke to BP1 and BP2, set S3 to C, S2 to L and S1 to 20 kc. Adjust R8 and R10 for sharpest null and try parallel combinations for C7 and C7A until the null occurs when R10 is set at 1.0. Check out the other ranges with other chokes. For values above 1 hy, 60 cps should be used.

The bridge can be simplified if you're willing to sacrifice some features. For example, if you do not have to measure capacitance above 1 μf , inductance above 1 hy, and resistance above 1 meg, T2, S1, R8, R4, R9, F1, J1, J2 and NL1 can be eliminated. S5 and R33 can be left out if you don't need the battery-test feature.

A less sensitive meter can be used with some loss in measurement sensitivity. For example you can use a 1-ma meter and eliminate R35 and D5. But change R34 to 2,200 ohms.

Operation

First, check the battery. With S4 off, press *batt. test* push button S5. If the meter indicates between 30 and 40 microamps, the battery is good.

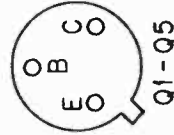
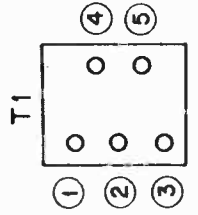
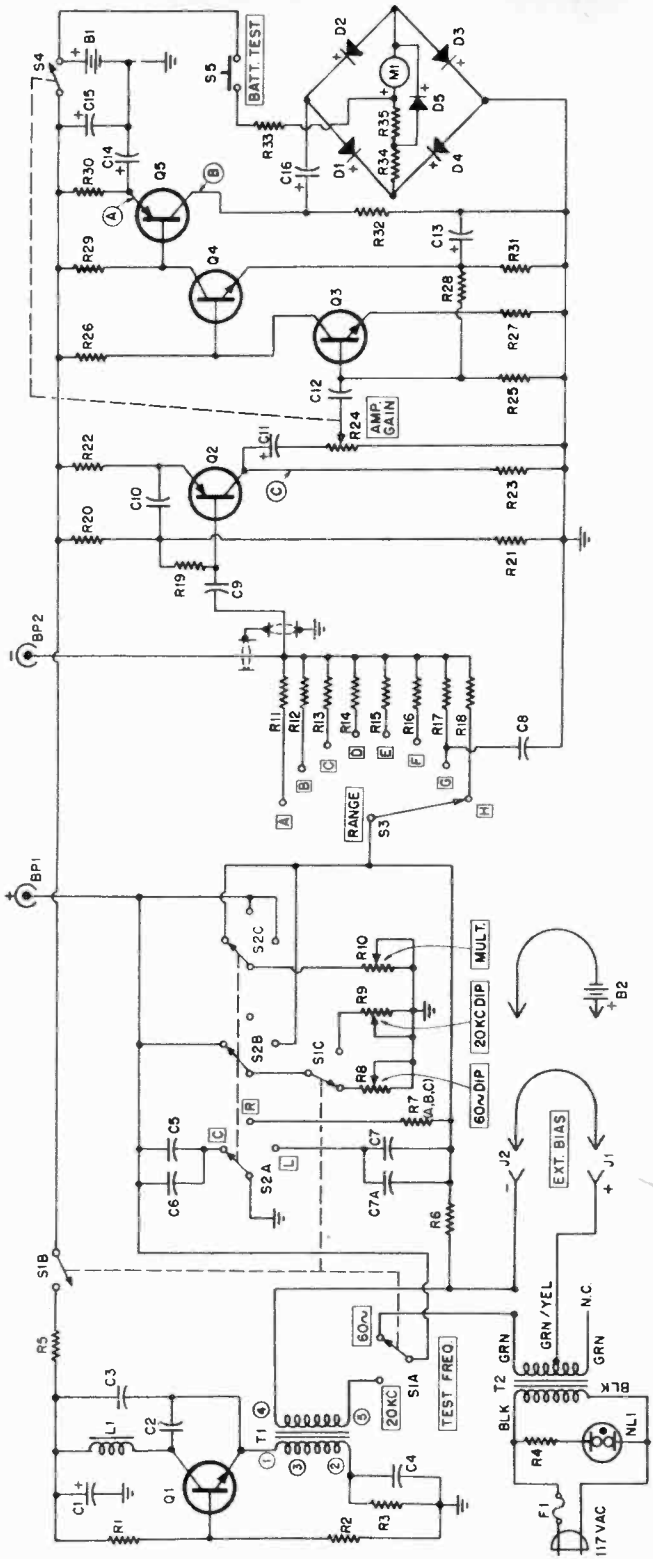
For all resistance measurements, set S1 to 60 cps. For capacitance measurements up to 1 μf , set S1 to 20 kc. Above 1 μf , set S1 to 60 cps. Do likewise for inductance up to 1 hy. Set switch S2 to either C, L or R, depending on the component you are checking.

Set S3 to the appropriate position determined from the chart in Fig. 4. Adjust either R9 or R8 (depending on the test frequency) for the sharpest null, keeping R24 turned down to prevent M1 from going off scale.

Then adjust R10 for a sharper dip, turn R24 clockwise and adjust R10 for another null. Now multiply the value on R10's scale by the number in Fig. 4 to get the value of the part.

How it Works

The bridge contains three major circuits: the signal source (20 kc from the built-in os-



TOP VIEW

BOTTOM VIEW

Fig. 5—Schematic of impedance bridge. Two different test signals are used. The 20-kc signal is generated by Q1 and associated components. The 60-cps signal is provided by T2. Switch S1 selects the test signal and feeds it to bridge. Depending on whether part to be checked is capacitor, resistor or inductor, S2 is used to set up either a Wheatstone or a modified Maxwell bridge configuration. Output of bridge then is fed via range switch S3 to the high-gain amplifier, which consists of Q2 through Q5. Bridge is first coarse-nulled by either R8 or R10, depending on test frequency. Amplifier gain is increased by R24 and bridge finally is fine-nulled by R10. In our model, T1 was an Olson Electronics transformer with lugs. The Lafayette transformer has color-coded leads. Its green and black secondary leads correspond to lugs 5 and 4, respectively. And on the primary side, the brown, red and green leads correspond to lugs 1, 3 and 2, respectively.

PARTS LIST

- B1—9 V battery (Burgess 2MN6 or equiv.)
 B2—6 to 9 V battery (see text)
 BP1, BP2—Five-way binding post
 C1—100 μ f, 10 V electrolytic capacitor
 C2, C3, C4—.01 μ f, 100 V (or higher) ceramic disc capacitor
 C5—.1 μ f, 200 V tubular capacitor (see text)
 C6—.2 μ f, 200 V tubular capacitor (see text)
 C7—.22 μ f, 200 V tubular capacitor (see text)
 C7A—.022 μ f, 200 V tubular capacitor (see text)
 C8, C9—.1 μ f, 200 V tubular capacitor
 C10—.1 μ f, 100 V (or higher) ceramic disc capacitor
 C11, C16—5 μ f, 10 V electrolytic capacitor
 C12—.47 μ f, 200 V tubular capacitor
 C13, C14, C15—50 μ f, 10 V electrolytic capacitor
 D1-D4—1N60 diode
 D5—1N270 diode
 F1— $\frac{1}{8}$ A fuse
 J1, J2—Phone tip jack
 L1—10 mh RF choke (J. W. Miller 70F102A1, Newark Electronics 59F250; 99¢ plus postage. Minimum order \$2.50)
 M1—0.50 microampere panel meter (Lafayette 99 R 5042 or equiv.)
 NL1—NE2 neon lamp
 Q1, Q3, Q4—2N388 transistor
 Q2, Q5—2N414 transistor
 Resistors: $\frac{1}{2}$ watt, 10% unless otherwise indicated
 R1—100,000 ohms
 R2, R23, R34—10,000 ohms
 R3—4,700 ohms
 R4—150,000 ohms R5—390 ohms
 R6—10 ohms, 1 watt
 R7A, R7B—68 ohms (see text)
 R7C—1,500 ohms (see text)
 R8—250,000 ohm, linear taper potentiometer
 R9—10,000 ohm, linear taper potentiometer
 R10—50 ohm, wirewound potentiometer (Clarostat 58C1-50, Newark 8F439. \$1.35 plus postage)
 R11—1 ohm, 1% R12—10 ohms, 5%
 R13—100 ohms, 5% R14—1,000 ohms, 5%
 R15—10,000 ohms, 5%
 R16—100,000 ohms, 5%
 R17—1 megohm, 5%
 R18—10 megohms, 5%
 R19—68,000 ohms R20—270,000 ohms
 R21—220,000 ohms R22—5,600 ohms
 R24—10,000 ohms, log taper potentiometer with SPST switch
 R25—22,000 ohms
 R26—6,800 ohms
 R27—220 ohms
 R28—43,000 ohms, 5%
 R29—3,900 ohms
 R30, R35—1,000 ohms
 R31—3,300 ohms
 R32—2,200 ohms
 R33—200,000 ohms, 5%
 S1—3-pole, 2-position non-shorting rotary switch (Centralab PA-1007, Allied 35 U 068)
 S2—3-pole, 3-position non-shorting rotary switch (Centralab PA-1013, Allied 35 U 071)
 S3—1-pole, 8-position non-shorting rotary switch (Centralab PA-1001, Allied 35 U 065)
 S4—SPST switch on R24
 S5—Normally-open push-button switch
 T1—Transistor audio transformer; primary impedance: 500 ohms, center tapped. Secondary impedance: 3.2 ohms (Lafayette 99 R 6127 or Olson T-231)
 T2—Filament transformer; secondary: 6.3 V center tapped @ 1.2 A (Allied 61 U 419 or equiv.)
 Misc.—6 x 10 x 7-in. cowl-type Minibox (Bud SC-2130), RG174/U coax, terminal strips, line cord, perforated board, flea clips, knobs.
Note—One of each of the following parts should be borrowed or purchased to calibrate the bridge: 10,000-ohm, 1% resistor; 1,000-ohm, 1% resistor; 1-mh RF choke (J. W. Miller 70F103A1, Newark 59F243. 75¢ plus postage); .001 μ f, 5% capacitor (Centralab CPR-1000J, Newark 19F2377. 15¢ plus postage); 100 μ f, 5% capacitor (Centralab CPR-100J, Newark 19F2353. 15¢ plus postage).

BRIDGE TO NOWHERE

illator or 60 cps from a filament transformer), the bridge circuit and the amplifier-meter circuit. An AC signal is applied to the bridge circuit and the bridge is balanced by turning R8, R9 and R10. The output from the bridge then is applied to the high-gain amplifier.

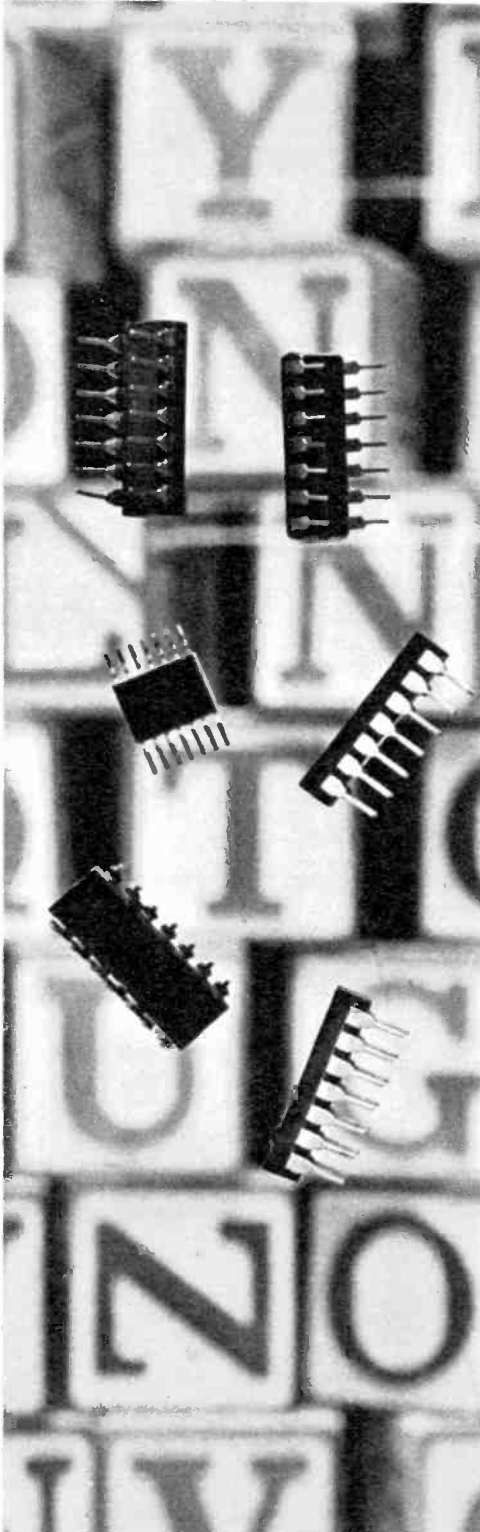
The amplified signal is rectified by a diode bridge whose DC output goes to M1. The meter current depends directly on the amplitude of the signal from the bridge. Thus, when the bridge is balanced, the meter indicates a low value, or nulls.

Switch S3 permits you to check component values over a wide range. Switch S2 sets up the bridge for measurement of resistance, inductance or capacitance. The test frequency is selected by S1 and the instrument's sensitivity is adjusted by R24.

The 20-kc oscillator (Q1 and associated components) is a modified Colpitts whose output is coupled through a transistor audio-output transformer (T1) to the bridge. The oscillator's frequency is determined by L1, C2 and C3. The output is a clean sine wave.

The bridge has to have different circuit configurations for measuring R, L or C. Switch S2 makes the necessary changes. For inductance and capacitance measurements, two potentiometers (R8 for 60 cps, R9 for 20 kc) cancel variations in component values.

The four-stage amplifier (Q2 through Q5) has a high input impedance and a high voltage gain. Stability or motorboating problems are eliminated by the upside-down output stage, Q5. The use of this configuration made stage-by-stage decoupling unnecessary. The oscillator is decoupled from the amplifier by R5 and C1. R34, R35 and D5 prevent the meter from being overloaded.



Mini Modules: Great Fun for Hobbyists

By C. R. Lewart

HOW things have changed! If you happen to be interested in electronics as a hobby, you can double it in spades. It seems like only last week that the hobbyist wired up a bunch of tubes and capacitors and resistors, then plugged it in and watched the filaments glow and waited for sound—or maybe smoke.

The transistor took most of the pyrotechnics out of electronics but there still were individual components. The latest development is mini modules—circuit chips encased in plastic—which may represent anywhere from a couple of dozen to a couple of hundred—or more—working parts.

In general, wire leads stick out of the modules. The hobbyist now need only hook up power to these leads, a couple of controls somewhere else, a signal input at one end and look for the output at the other.

For example, using a mini module, you can build your own electronic calculator. The mini module in this device is the MX 5010 made by Mostek of 1400 Upfield Dr. in Carrollton, Tex. 75006. Now in order to feed your tax figures into the device you'll need a keyboard. In addition electronic display tubes will be required to let you know the sad news after all the figuring is done. A simple power source and a few other resistors and capacitors will complete the project. Complete details are available from the manufacturer.

On about the same level of difficulty is a digital electronic clock which can be built around an AMI S1736 IC available from American Microsystems, 3800 Homestead Rd., Santa Clara, Calif. 95051. This IC interfaces with a liquid crystal digit display (the latest in up-to-date technology) which is manufactured by the same company. Only a simple

power supply consisting of one transistor and a few diodes, resistors and capacitors is required to make this clock work.

Now before you go writing to these manufacturers in all fairness we have to warn you about the present high building cost of both the clock and the calculator. Both use state-of-the-art technology and it might take a few months before lower production costs allow lower retail prices. Prices of these projects are both about \$70 but they will improve with time. (In the meantime we have two simpler projects to keep you happy.)

Probably the simplest of all mini-module projects (and low in cost) is the AM radio. This circuit uses a ZN414 integrated circuit which is available from Ferranti Electric Inc. This baby will run on a single AA cell for a period of three months. It is a tuned radio frequency receiver with one added transistor stage for excellent audio performance.

You can put the AM radio together on a small perf board. Our circuit is complete with a volume control that regulates the audio in a high impedance crystal earpiece.

You can either make coil L1 by mounting 80 turns of No. 29-gauge enamelled copper wire on a 3-in.-long ferrite rod or you can buy the unit in the parts list. The Miller coil listed, however, is not quite as sensitive as the hand-made version.

If you put this radio in a metal case you'll have to mount L1 on the outside to prevent shielding of the signal.

If you think that a tachometer might get more use around your home than an AM radio there's a mini-module that will let you build one in record time. The best part is that you'll get a precision tach for under 12 bucks.

This tach is basically independent of battery voltage, temperature and the condition of your breaker points. Our model is designed to operate with excellent stability in autos (or other vehicles) where noise levels often make other tachs unreliable. Once this instrument is calibrated it will always give correct and precise readings.

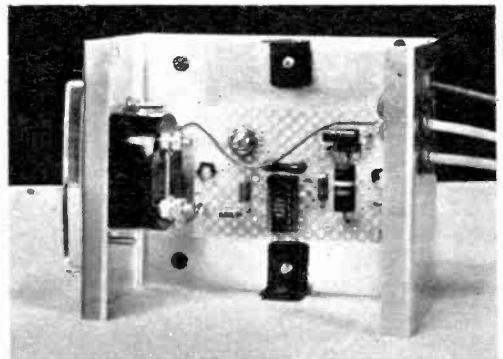
Follow the schematic and layout

PARTS LIST FOR TACH

- R1—10,000 ohms, 2 watts
- R2—1200 ohms, 1/2 watt
- R3—4700 ohms, 1/2 watt
- R4—50,000 ohm potentiometer (Laf. 33 R 11347)
- R5—3,600 ohms, 1/2 watt
- C1—0.005 mf. capacitor
- C2—0.25 mf. capacitor
- C3—500 pf. capacitor
- IC1—from Stewart-Warner Corp., \$5.25 pp. 730 E. Evelyn Ave., Sunnyvale, Cal. 94086
- M1—0-to-1ma. meter, Calectro D1-912 from GC Electronics, 400 S. Wyman St., Rockford, Ill. 61101 for \$6.50 plus post.
- Misc.—Cabinet 3 x 4 x 5 in., Hazelton Scientific Co., Hazel Park, Mich. 78030 for \$2.69 plus post. Wire, hardware, etc.
- T1—Transformer (Calectro D1-745)
- RC—Calibration Resistor, 220 ohms

PARTS LIST FOR AM RADIO

- Resistors: All resistors are 1/4 watt unless noted otherwise.
- R1—100,000 ohms
 - R2—1,000 ohms
 - R3—100,000 ohms
 - R4—10,000 ohms
 - R5—100 ohms
 - R6—250 ohm potentiometer, 1/4 watt or greater, Lafayette 33 R 13087 or equiv.
 - L1—80 turns of No. 29 enamelled copper wire on a 3-in. ferrite rod, or a type 2001 Miller coil (Laf. 34 R 88194).
 - C1—Variable Capacitor 140 or 150 pf. max. (Laf. 40 R 28569) for homemade L1; 365 pf. unit for the Miller coil (Radio Shack 272-1344).
 - C2—0.01 mf. ceramic disc capacitor
 - C3, C4—0.1 mf. ceramic disc capacitor
 - Q1—Ferranti ZTX300 NPN transistor or RCA 2N222 or equiv.
 - IC1—Ferranti ZN414 integrated circuit from Circuit Specialists, P.O. Box 3047, Scottsdale, Ariz. for \$5 ppd.
 - E1—Dynamic earphone Laf. 40 R 78010
 - S1—optional miniature toggle switch (for earpiece)
 - Misc.—perfboard, battery and holder, etc.



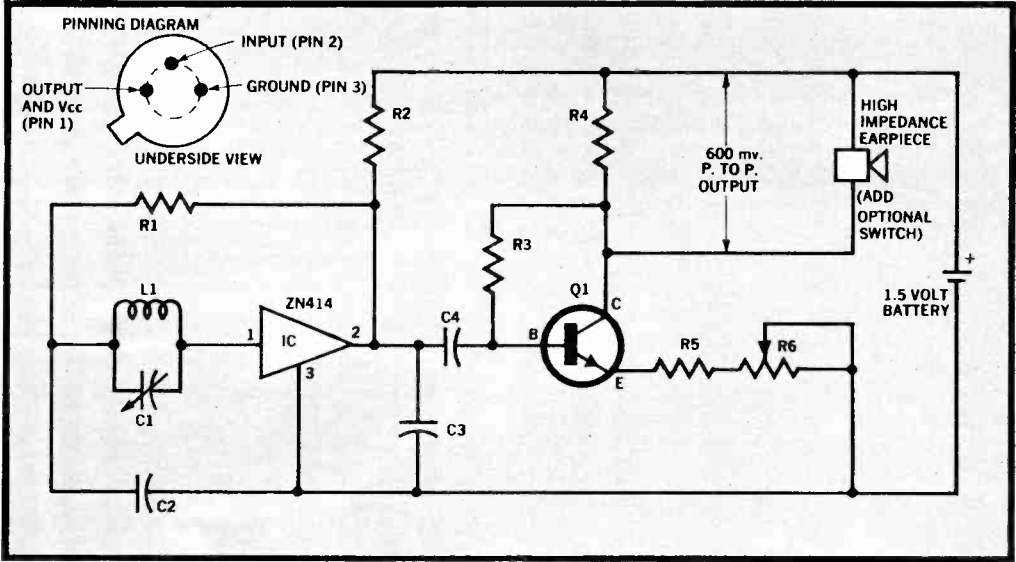
MODULE tach is wired on perfboard then mounted in cabinet. Meter is shown at left.

Great Fun for Hobbyists

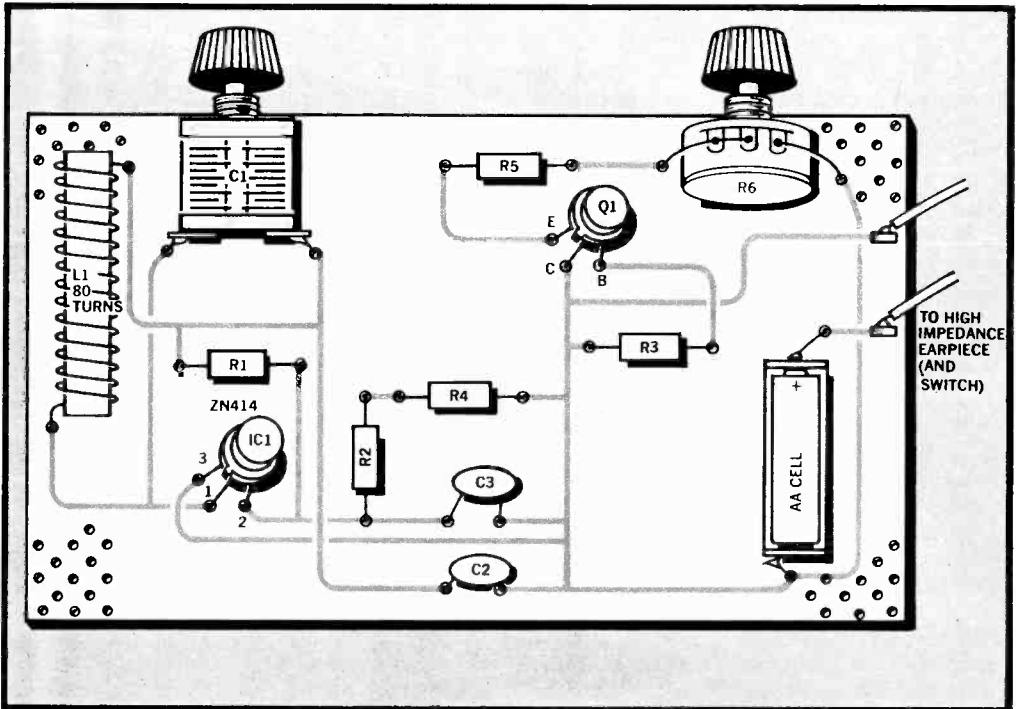
shown. Don't take any substitutes for the parts listed—especially for the meter. Mount the IC and associated

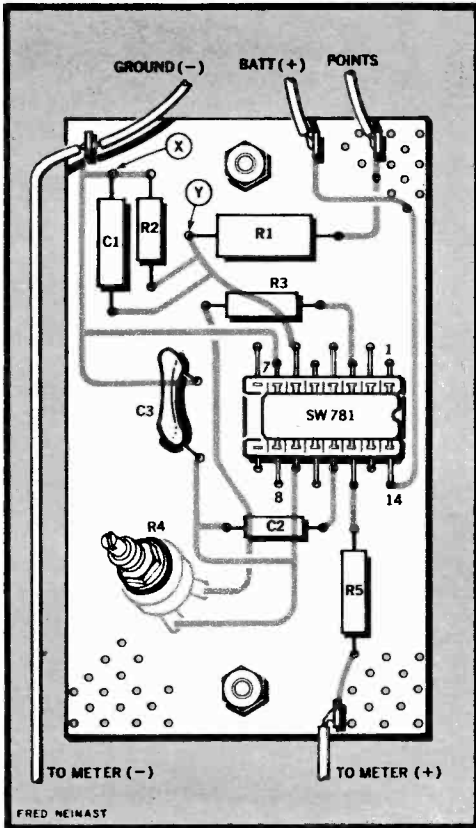
components on a 2x3-in. perfboard. You can install the 1-ma. meter and the perf board in a 3x4x5-in. metal cabinet.

As you can see from our schematic diagram you can use a filament trans-



AM RADIO can be built from manufacturer's schematic using the layout shown.





TACHOMETER layout and schematic are shown; take note of calibration circuit.

former to calibrate the tachometer. Use a 220-ohm resistor on the Y lead of the transformer. Connect a 12-volt battery to the BAT and GROUND leads and connect the calibrating circuit to points X and Y. At the variable resistor R4 adjust RPM on the tach according to the following table:

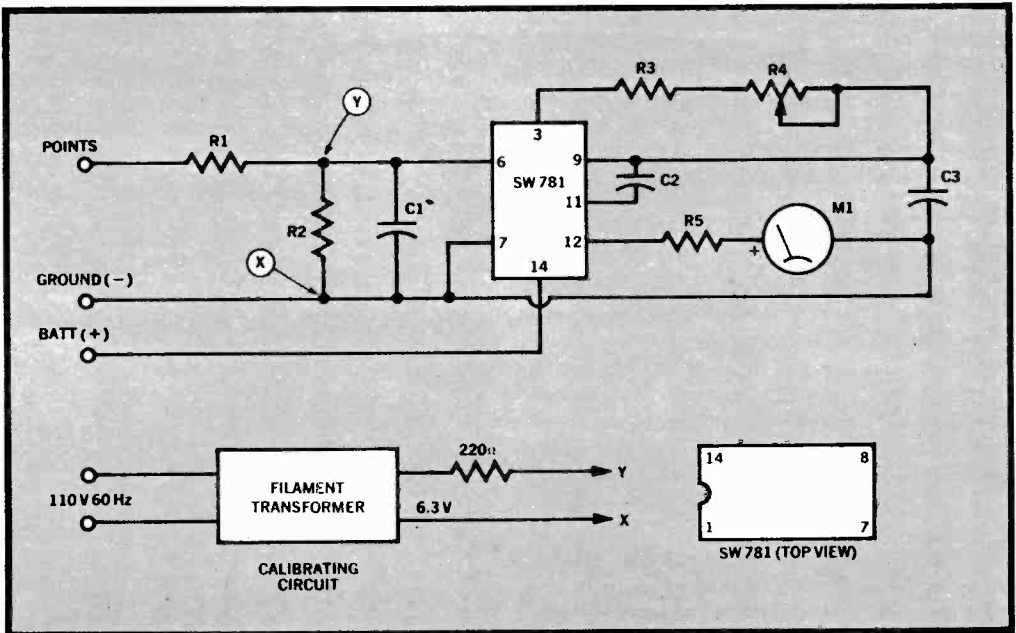
4-cylinder engine	1800 RPM @ 60 Hz
6-cylinder engine	1200 RPM @ 60 Hz
8-cylinder engine	900 RPM @ 60 Hz

If, for example, you decide that the full scale of the 1-ma. meter should correspond to 2000 RPM and you have a 6-cylinder engine, set the needle to .6 ma. For an 8-cylinder engine and 1000 RPM full scale reading, adjust to .9 ma., etc. Of course if you have an Eight and want to use a 1000 full scale, your label for the meter would be "RPMx1000."

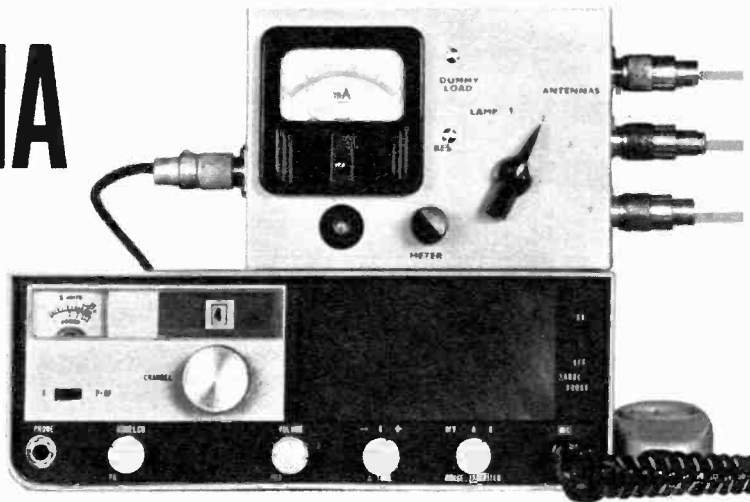
If you would like to choose between different full-scale RPM readings, you could wire a switch and small resistor to select different values of R4.

Calibration of your tach using another tachometer is easier, but not good for precision.

If you find happiness with your first mini-module don't hesitate to write the manufacturers listed for information on the others. After all you'll want to be ready for the upcoming mini-module revolution—even if it is small. ●



AN ENNA CONTROL CENTER



Twist a switch for your choice of three skyhooks or two dummy loads.

By VERNON SIMMS

THAT mess of antenna cables, adaptors, coax connectors and dummy loads—toss it all out and install the Antenna Control Center. Connected to your CB transceiver, the Center will permit you to connect conveniently as many as three antennas or two dummy loads to the rig's output. Then, at the twist of a switch—and that's a lot easier than plugging in and removing half a dozen connectors—you have your choice of skyhook or test load.

And there's no need to remove the Center from the line. It can remain connected permanently to your receiver. It has no effect on SWR and will not cause significant loss of power to the antenna.

Here's what the Center will do:

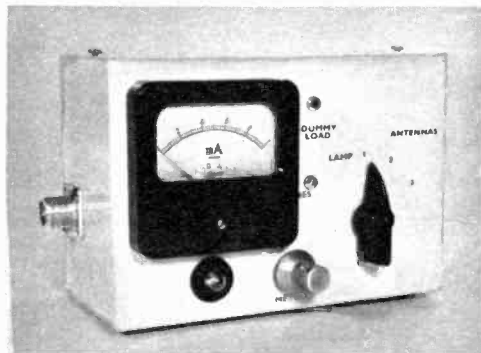
- **Antennas.** As we said, the Center enables you to hook as many as three different antennas to your rig. Maybe you want to shift from ground-plane to directional beam or collinear to quad. No need to fumble at the back of the rig—you can make a quick changeover with a rotary switch. This function is valuable for making instant comparisons between two or three different antennas.

- **On The Air.** Ever wonder whether you're really getting out or just heating up the microphone? Glance at the Center's meter and you'll know whether RF is going to the antenna. And no matter what the switch posi-

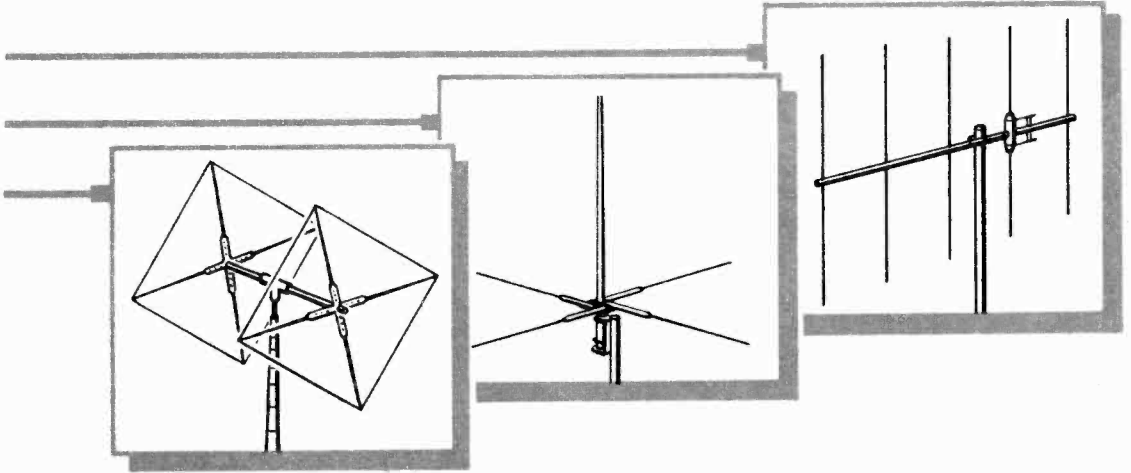
tion, the meter samples continuously and indicates whether there's RF in the line.

The meter also gives warning if something's wrong. That is, its indication should be about the same each time you hit the push-to-talk switch. If there's a provision on your transceiver for peaking the final the Center will be an invaluable aid in tuning up.

- **Dummy Loads.** The Center also can connect either of two dummy loads to your rig's output. One load is the old standby, a No. 47 pilot lamp. Main purpose of this indicator, which will glow brightly when you



Built in a 3 x 5 x 7-in. cabinet, the Antenna Control Center enables you to connect any of three antennas or two dummy loads to your rig.



transmit, is to give a quick check of modulation. As you speak into the mike, varying lamp brightness tells you whether audio is modulating the carrier.

The second dummy load is used when you have to troubleshoot the rig. It's resistive and is a close match to the transmitter's output impedance (unlike the lamp). It lets you run lengthy tests on the transmitter portion of the transceiver without violating the law or interfering with others on the channel.

How It Works

Your CB rig's output is fed via socket SO1 (see schematic) to the wiper of selector switch S1. From there, RF can be fed to either of the three output connectors depend-

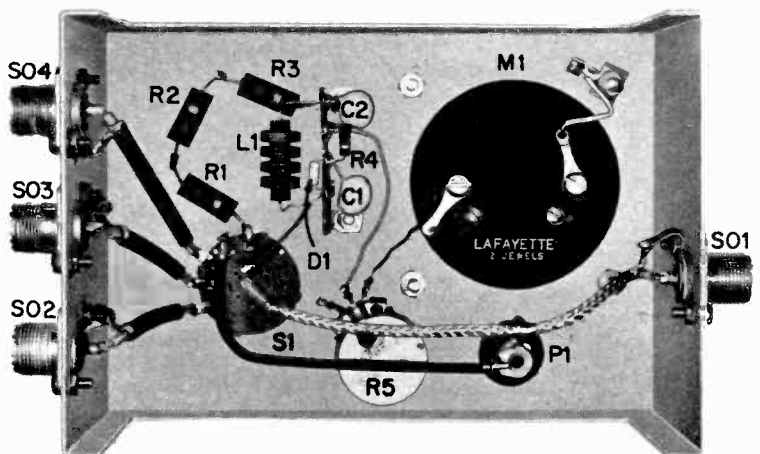
ing on S1's position. A fourth position on S1 sends the signal to the lamp. The fifth position applies the signal to the resistive dummy load. The three load resistors add up to 48 ohms—a close enough match to the 50-ohm transmitter output. Wattage of each resistor is sufficient to provide a safety factor when fed the typical 3-watt output of a transmitter.

The meter circuit takes an insignificantly small amount of signal from the wiper of the selector switch and applies it to a diode detector circuit which converts RF to DC for the meter. A control pot (R5) permits you to adjust the meter's sensitivity.

Construction

Here are some tips you should keep in

Signal from CB rig is fed into Center at connector SO1 at right. Antennas are plugged into three connectors at left. Watch the polarity of D1 when installing it. End with color band gets connected to junction of R4 and C1. Shield on coax from S1 to SO2, SO3 and SO4 is grounded at connector end only and not at S1. Shield on coax from S1 to SO1 is soldered to P1 and to R5's case.



Antenna Control Center

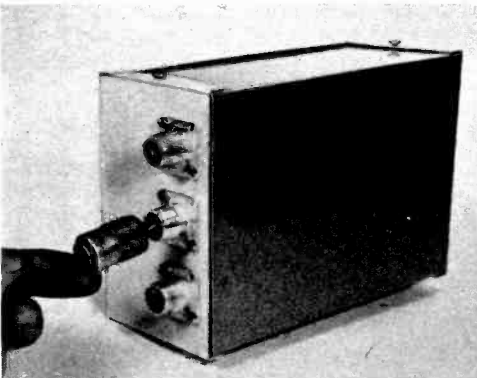
mind when building the Center in a 3 x 5 x 7-in. Minibox. Use short lengths of RG58/U coax to connect the three antenna sockets to the selector switch. The wire shields, however, are soldered only to lugs placed under each socket's mounting nut. Trim off the shields at the other end and do not connect them to the selector switch.

The coax from SO1 to the switch should have its black jacket removed completely. This permits you to solder the shield to both R5's case and to the ground lug on pilot lamp P1's socket. Note that the ground lug is the one closest to the lamp. The other lug is connected to selector switch S1 with a spaghetti-covered piece of No. 16 wire. This arrangement will hold the lamp socket in place. The bulb should protrude through the panel in a 7/8-in. dia. rubber grommet.

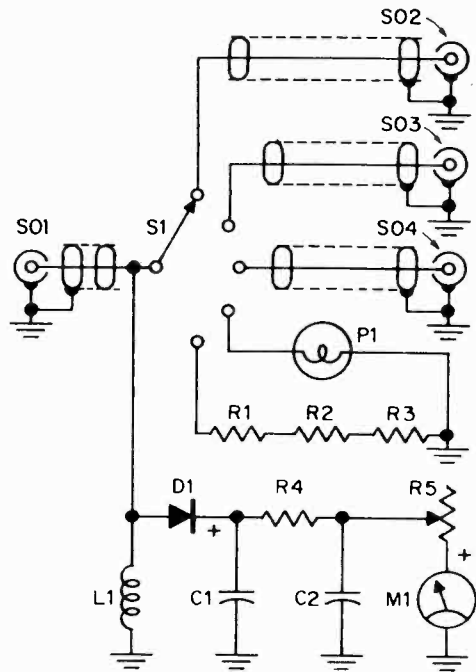
The resistor load, R1, R2, R3, is self-supporting. Be certain that none of the resistor leads shorts to the case. Other components are soldered to a five-lug terminal strip two of whose lugs are grounded. Avoid excessive heat on diode D1's leads while soldering.

Operation

Run any convenient length of RG58/U coax from your transceiver's output to SO1. If you don't wish to place the center on or next to the rig, it can be wall-mounted so it's within easy reach. Connect the cables from your antennas to the output connectors SO2, SO3, and SO4.



Output side of Center. Scrape away the paint on Minibox under connectors to make sure there is good contact between connectors and the cabinet.



Signal from CB rig is fed via S1 to either of three antennas or pilot lamp or resistive dummy loads. Part of signal is detected and fed to M1.

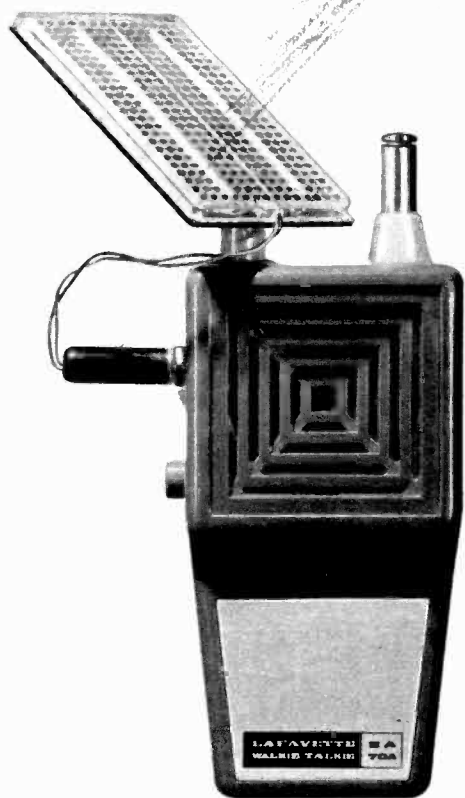
PARTS LIST

- C1, C2—.001 μ f, 500 V ceramic disc capacitor
- D1—1N60 diode
- L1—2.5 mh RF choke
- M1—0.1 ma DC milliammeter (Lafayette 99 R 5040 or equiv.)
- P1—No. 47 pilot lamp and socket
- R1, R2, R3—16 ohm, 2 watt carbon resistor
- R4—10,000 ohm, 1/2 watt, 10% resistor
- R5—50,000 ohm, linear taper potentiometer
- S1—1 pole, 5 position rotary switch (Mallory 3115J or equiv.)
- SO1-SO4—SO-239 coax connector
- Misc.—3 x 5 x 7-in. Minibox, 5-lug terminal strip, grommet, solder lugs, 2 ft. RG58/U coax.

The meter sensitivity may vary from one switch position to the other because of the different antenna. Therefore use R5 to keep the needle from going off scale. An indication about halfway up the scale is most desirable. Finally, if your rig is a transistor job, don't switch to an antenna position that does not have an antenna connected to it. No harm would be done to tube sets, but a transistor rig might be damaged if operated without a load.

SUN POWERED CB

By
HERB FRIEDMAN, KBI9457



YOU would think batteries were going out of style the way walkie-talkies use them up. Not only do pennies spent on batteries add up to mucho dollars each month but it's a sure bet a battery will do a fast fade just when you need it most.

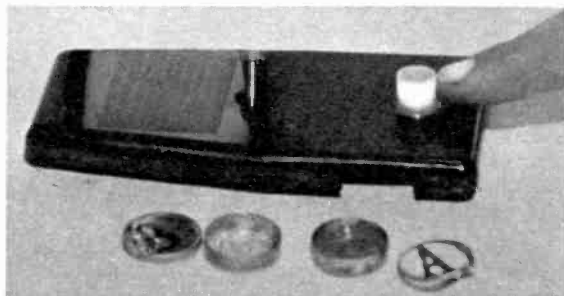
You know the scene. You're on a picnic or camping or hunting or perched on the roof trying to orient a TV antenna while your wife watches the screen and you're listening either for others in your party or for your wife. Then just as you hear something other than static from the speaker and press the button to answer, the extra current drain is too much for the battery and away it goes to join the big rig in the sky.

But power is available for free—enough to keep the receiver running all day without removing a bit of energy from the battery. This means that when a call is received the battery is ready to put out a strong signal. The free power comes from Old Sol himself—the sun. Just make a minor change in the transceiver's wiring and plug in a solar cell. As long as the sun shines you've got free power to run a walkie-talkie's receiver, or in an emergency, even its transmitter. The only restriction is that the walkie-talkie must be powered by a 9-V battery, such as a Burgess 2U6 or equivalent.

The Hoffman model HSB-9 solar cell we use delivers 9 to 10 volts with sufficient cur-



The photo at the left shows where we placed the jack and one solar-cell mounting cup on our walkie-talkie. The photo below shows where we mounted another cup for the cell. This extra cup is used to store the cell when it is not in use. The two containers hold the epoxy cement and, like the two plastic cups, they are supplied with the cell.



SUN POWERED CB

rent for small walkie-talkies—about 15 ma. At higher current drains the voltage falls. However, the cell can deliver about 8.5 V with a 20- to 25-ma current drain. This amount of current often is enough to drive a three- or four-transistor walkie-talkie when transmitting.

Installation. All that's required is a slight modification of the receiver's power supply connections, as shown at the bottom of this page. The schematic diagram at the left shows the normal battery connection. The modification is shown at the right. A miniature jack (J1) is connected in series with the battery's positive lead. When the cell is not plugged in battery current flows through the normally closed contacts to the circuit. When the cell is plugged in, the plug opens the connection and the cell's output goes to the transceiver.

Select a part of the transceiver's case which is not jammed with components and mount J1. But remove all the guts, including the speaker, before you do any drilling. To avoid melting the plastic case with the soldering iron, solder the leads to J1 before it's in-

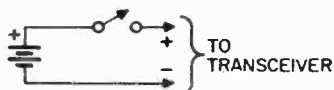
stalled. Put the guts back in and solder the battery leads to J1.

The cell has a ball-joint mount. Two mounting cups and epoxy cement needed to glue the cups to the transceiver's case are supplied with the cell. Cement one cup on the back of the case near the top. Cement the other cup on the top of the case. Make certain it is mounted away from the antenna to allow the cell to be turned.

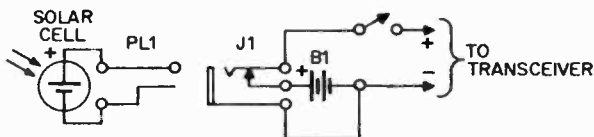
Operation. Snap the cell into the top or rear cup and orient it so it faces the sun. Then plug PL1 into J1. When the power switch is turned on the transceiver will operate as if the battery was being used. To transmit, pull the plug out and press the push-to-talk button.

PARTS LIST

- J1—Subminiature phone jack. Switchcraft Tini-Jax No. 42A. Allied 44 U 985 or equiv.
- PL1—Subminiature phone plug. Switchcraft Tini-Jax No. 750. Allied 41 U 520 or equiv.
- Solar Cell—Hoffman HSB-9. Olson Electronics BA-114. \$7.98 plus postage.



The schematic above shows the normal connection of the walkie-talkie's battery. The switch usually is on the back of the volume control but it could be elsewhere.



Modification of rig for solar cell operation. Connect cell's positive lead to plug's tip. Be sure to keep polarities straight when connecting battery and lead from switch to the jack.



Explore radio's fascinating basement with our 3-tube receiver!

By CHARLES GREEN, W3IKH

TELL someone you have a radio that tunes from 10 kc to 30 kc and he'll figure you spend your time listening to dog whistles and super-duper tweeters

But way down in this world called VLF (very-low frequency) there's some mighty interesting activity. Imagine hearing a U.S. Navy station transmitting messages to ships at sea and *submerged* submarines! In addition, you'll be able to pick up useful frequency-standard and time transmissions similar to those from WWV.

Why such low frequencies for communications when the trend nowadays is toward higher and higher frequencies in the gigacycle region and beyond? Greater reliability for one thing. Transmissions down in radio's basement are affected little, if at all, by ionospheric disturbances. The other reason is that VLF is about the only way to communicate with submerged subs hundreds of miles from land. Matter of fact, VLF station NAA (17.8 kc) at Cutler, Me., puts out the world's most powerful signal—a 2-million watt— that can be picked up by submerged subs almost anywhere in the world.

You'll find the activity on the VLF band is of two types: frequency-standard signals and straight coded CW. The stability of VLF frequency-standard transmissions is much greater than those from WWV since the signals are not affected by ionospheric conditions and magnetic-storm blackouts. The CW often is marine communications, in the form of weather and time reports, and is excellent for code practice.

The output power of most VLF stations is many times greater than that of higher-frequency stations. The power, frequency and type of transmissions of a few stations are listed in our table. But frequencies, power and operating hours change occasionally since experimentation is going on constantly.

Full-Band VLF RCVR

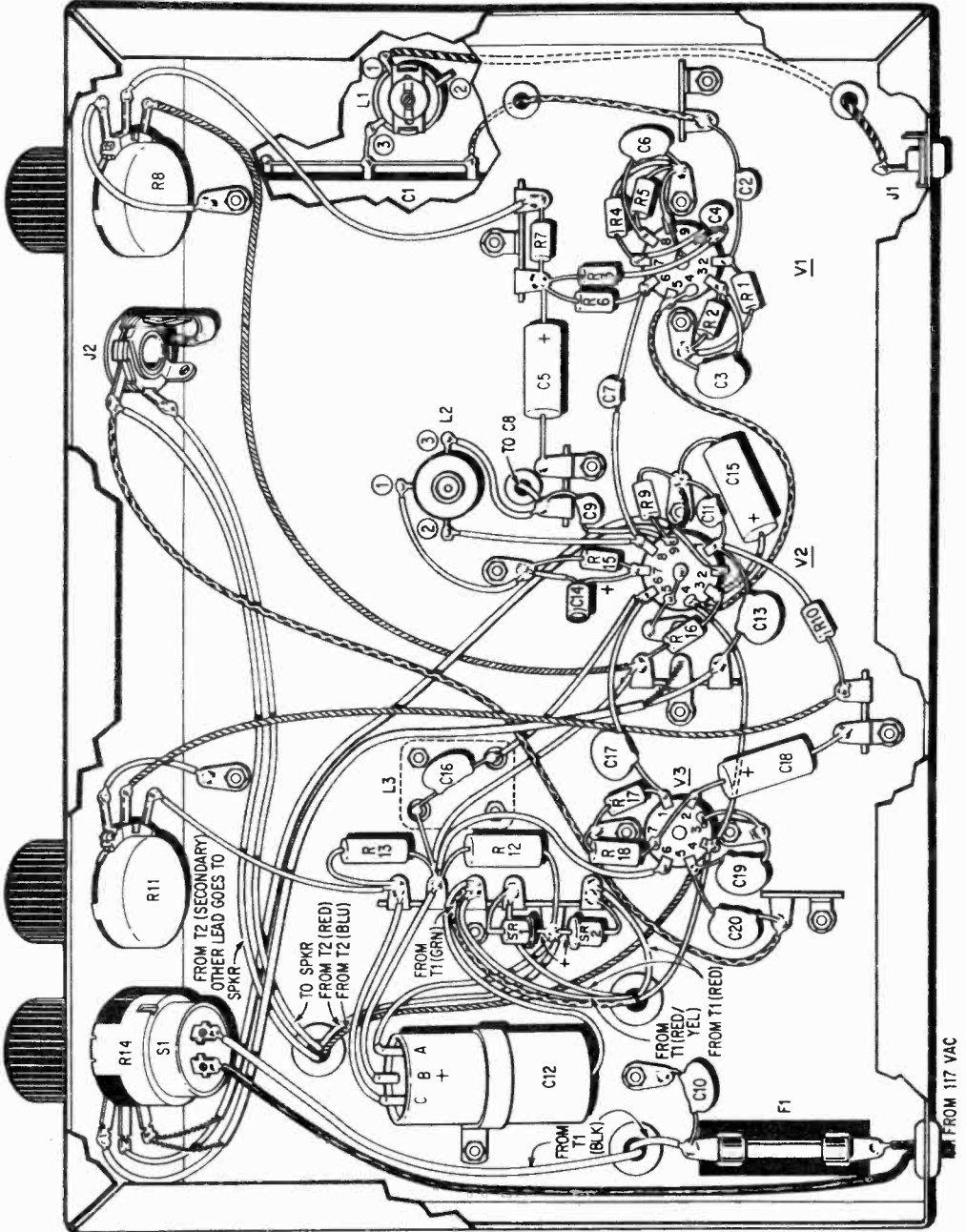


Fig. 1—Underside of receiver. To lay out your chassis, take dimensions from diagram and multiply by 1.7. For best performance duplicate layout as closely as possible. Chassis has been cut away under C1 in diagram to show how three sections of C1 are connected. C8's sections also are tied together.

PARTS LIST

Capacitors: 600 V ceramic disc unless otherwise indicated

C1A, B, C; C8A, B, C—3 gang variable capacitor: 12-367 μmf per gang. (Allied 13 U 522)

C2, C4—1,000 μmf

C3, C6, C19—.01 μf

C5, C15—4 μf , 150 V electrolytic

C7, C9, C11—500 μmf

C10, C13, C17, C20—5,000 μmf

C12A, B, C—20/20/20 μf , 150 V electrolytic

C14—5 μf , 6 V electrolytic

C16—2,000 μmf

C18—10 μf , 25 V electrolytic

F1—1 A fuse and holder

J1, J3—Phono jack

J2—Closed circuit phone jack

L1, L2—65-300 mh tapped adjustable inductor (J. W. Miller No. 9018. Lafayette 34 R 8999)

L3—10 hy variable inductor (UTC No. HVC-9.

Allied 62 G 123, \$9.60 plus postage: not listed in catalog)

Resistors: $\frac{1}{2}$ watt, 10% unless otherwise indicated

R1, R4—1.2 megohms

R2, R5—4,700 ohms

R3, R6, R10, R16—180,000 ohms

R7—15,000 ohms

R8—200,000 ohm, linear taper potentiometer

R9—2.2 megohms

R11—30,000 ohm, linear taper potentiometer

R12—1,800 ohms, 2 watts

R13—47,000 ohms, 2 watts

R14—1 megohm, linear taper potentiometer with

SPST switch

R15—1,000 ohms

R17—1 megohm

R18—560 ohms, 1 watt

S1—SPST switch (on R14)

SPKR—3.4 ohm, 3-in. speaker

SR1, SR2—Silicon rectifier: 500 ma, 400 PIV (Lafayette 19 R 4204 or equiv.)

T1—Power transformer, secondaries: 250 V c.t. @ 25 ma, 6.3 V @ 1 A (Allied 62 U 008 or equiv.)

T2—Output transformer, primary impedance: 10,000 ohms; secondary impedance: 4 ohms (Allied 61 U 448 or equiv.)

V1—12AT7 tube

V2—6U8A tube

V3—6AK6 tube (Allied \$1.40 plus postage)

Misc.—2 x 7 x 11-in. aluminum chassis (Premier ACH-405 or equiv.), 7- and 9-pin tube sockets, terminal strips, No. 28 enameled wire, phone plugs, RG174/U Coax.

With this sensitive 3-tube receiver you'll be able to tune in all this activity from 10 to 30 kc. The circuit is a TRF/regen and has both a speaker and a jack for headphones.

Construction

Best way to build the receiver is as we did it—on a 7 x 11 x 2-in. aluminum chassis, mounting the components where shown in the pictorial (Fig. 1) and top-chassis photo (Fig. 5). Since the operating frequency is so low the layout is not terribly critical.

First, drill and punch the chassis. The easy

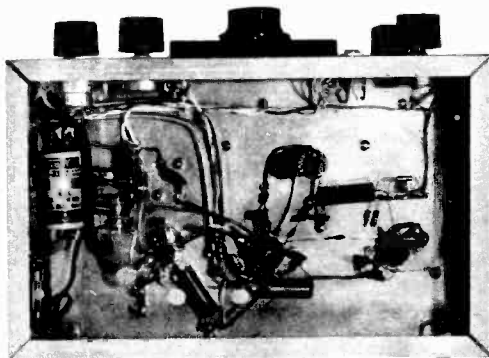


Fig. 2—There's plenty of space so there should be no crowding. Keep long runs of wire at top and center close to chassis in the locations shown.

way to mount variable capacitors C1 and C8 is to make a paper template of the undersides. Then transfer the mounting-hole locations to the chassis. Make sure that C8 is mounted right at the front of the chassis to permit the dial to operate properly. Mount the dial on the chassis with two brackets and extra-long mounting screws.

To mount L1 and L2, first put $\frac{3}{8}$ -in. rubber grommets in the chassis. Next, remove the core and mounting clip from both coils and insert the forms in the grommets as far in as they will go. Then replace the cores and clips. Make sure that you locate L1's mounting hole so C1 doesn't touch the coil.

When wiring the receiver make sure that leads from pin 6 on V2 to L3 and capacitors C2, C4, C7, C9, C13 and C17 are positioned above surrounding wiring. Use rubber grommets when running wires through chassis holes to prevent fraying of insulation.

Antenna Construction

Cut four 22-in.-long x $\frac{3}{4}$ x $\frac{1}{4}$ -in. wood strips and mount them at the corners of a 9 $\frac{1}{2}$ -in.-square piece of perforated Masonite as shown in Fig. 5. Wrap plastic electrical tape on the four screws mounted at the ends of each strip to prevent chafing of the wire.

Wind 38 turns of No. 28 enameled wire

[Article continued on next page,
text continued on page 84.]

VLF RCVR

Fig. 3—Schematic of receiver. Signals from the loop antenna enter at J1 and are fed to the L1/C1 tuned circuit. V1A and V1B amplify selected signal and R8 controls the gain of the stages. C7 couples the amplified signal to the regenerative detector V2A via the cathode tap on L2. L2 is tuned by three-gang variable capacitor C8. R11 controls amount of regeneration and C13 feeds the detected signal to volume control R14. Signal then goes to audio amplifier stage V2B. L3 and C16 in V2B's plate circuit constitute a 1-kc peak filter that sharpens receiver selectivity. C17 couples the audio signal to V3 where it is further amplified to drive speaker. T2 and C20 provide output to speaker or phones jack J2. The B+ and heater power is supplied by transformer T1, full-wave rectifier circuit comprising SR1, SR2 and R/C filter which includes R12, R13 and C19A, B, C. Output tube V3, a 6AK6, is capable of delivering up to 1 watt of audio.

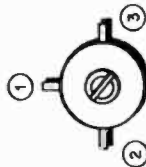
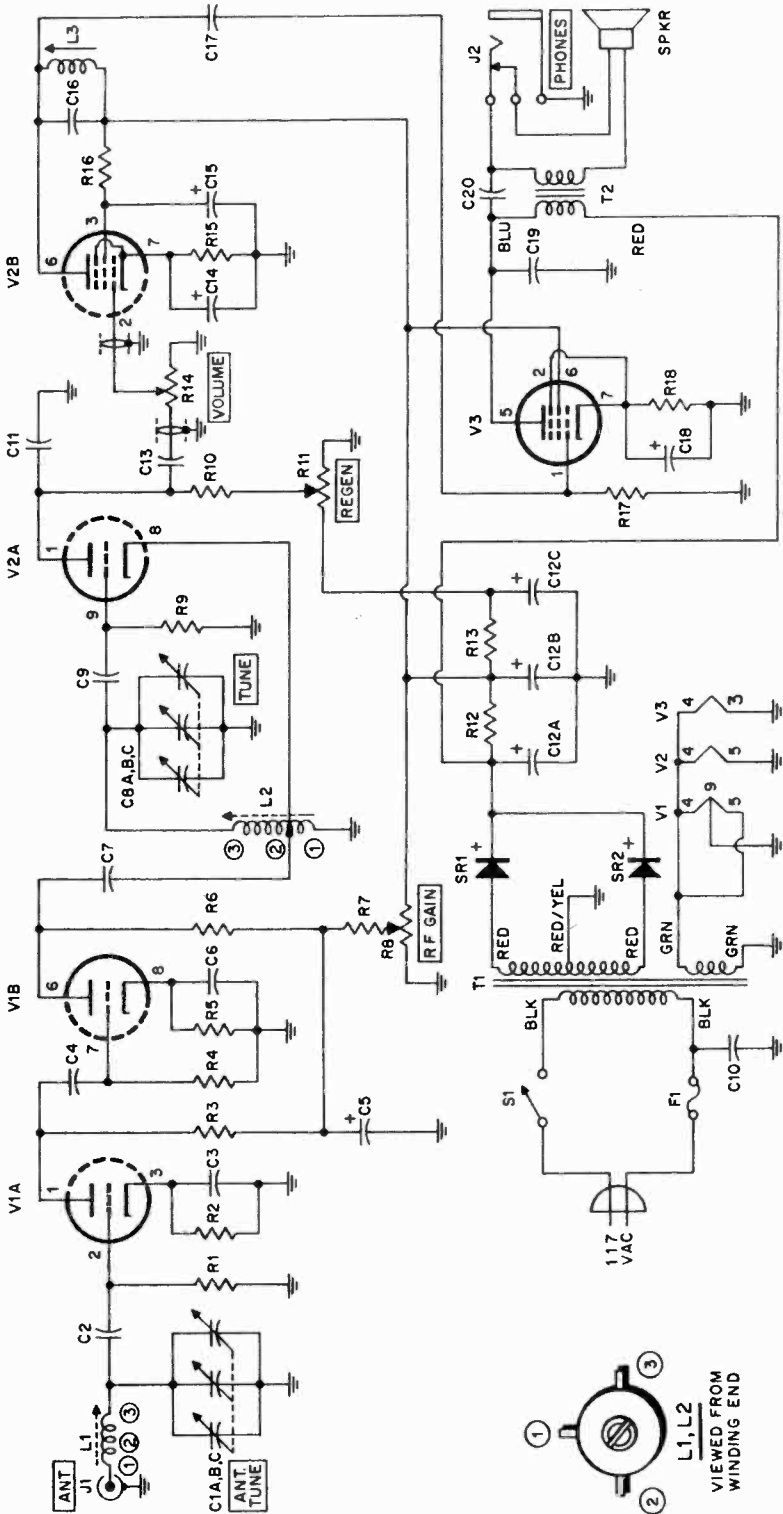
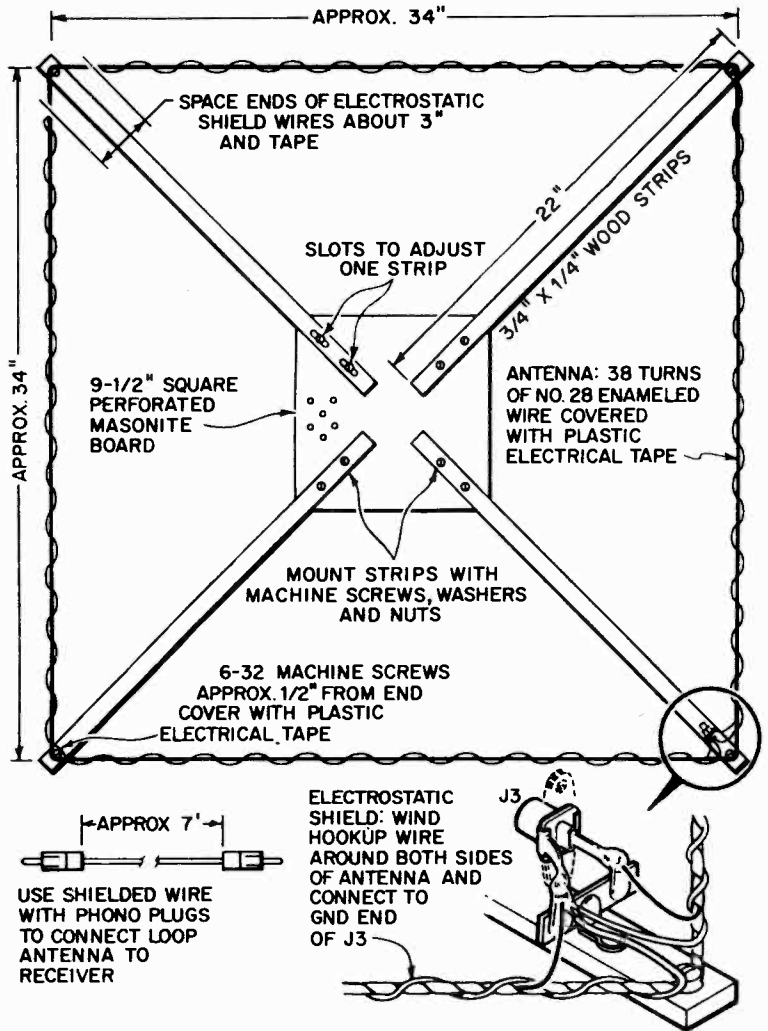


Fig. 4—Loop antenna. Three wooden strips are mounted firmly to Masonite board. Fourth strip should have slots cut for mounting screws so strip can be adjusted to tighten loop. Wind 38 turns of No. 28 enameled wire around screws at ends of wood strips and cover turns with plastic electrical tape. Then wind electrostatic shield over loop. Be sure to space ends of shield as shown in upper left corner. Detail diagram at lower right shows connections of loop and shield. Be sure to connect shield to ground lug on jack J3.



SOME VLF STATIONS				
Call	Freq. (kc)	Power (kw)	Location	Transmission
FUB	17.0	—	Paris, France	—
GBR	16.0	300	Rugby, England	—
NAA	17.8	2,000	Cutler, Me.	CW—Navy traffic
NBA	18.0	36	Balboa, C.Z.	Pulses each second. Every fifth pulse omitted.
NPG/NLK	18.6	250	Jim Creek, Wash.	CW—Navy traffic
NPM	19.8	100	Lualualei, Hawaii	CW—Navy traffic
NSS	21.4	100	Annapolis, Md.	CW—Navy traffic
WWVL	20.0	1	Ft. Collins, Colo.	Frequency and time standards. Call sign given every 20 min. and on the hour.

Full-Band VLF RCVR

around the screws and connect the ends to a two-lug terminal strip. Cover the loop carefully with a single layer of plastic tape. To minimize noise pickup, an electrostatic shield made of ordinary hookup wire must be wound around the loop. Connect one end of each electrostatic shield wire to the ground side of J3 as shown in Fig. 4 and wind the wire spirally with about 1-in. spacing around the loop. Leave a 3-in. space at the ends of each shield wire as shown. For best performance you can try different loop sizes.

Calibration and Operation

An audio signal generator with a range of 10 kc to 30 kc is a must to calibrate the receiver. If the generator goes only to, say, 20 kc use the second harmonic of a lower frequency.

Allow the receiver to warm up for a few minutes, then connect the output of the audio generator to ground and the high side of volume control R14. Set the generator to 1 kc and adjust the screw on L3 for peak volume.


Connect the generator to J1 and set its output to 10 kc. Set R14 to half rotation,

adjust *regen* control R11 until the receiver starts oscillating, then turn *RF gain* control R8 counterclockwise to prevent overload.

Close C8's plates and adjust L2's slug for zero beat. Use the audio generator to calibrate the dial, being careful not to disturb the adjustment of L2. We calibrated our receiver at 1-kc points to 20 kc and every 2.5 kc to 30 kc. Use C1 to peak the signal as required but be sure that you're not tuned to the wrong harmonic.

After the dial is calibrated disconnect the signal generator and connect the loop antenna. When hanging up the loop keep it away from fluorescent lights and large metal objects.

Couple the audio generator loosely to the receiver by connecting a length of hookup wire to the hot side of the generator's output cable and placing it near L1. Set the generator's output to 10 kc and tune the receiver to about 11 kc for a beat note. Set C1 to full capacity (plates closed) and adjust L1's slug for maximum beat-note volume. Disconnect the signal generator and turn it off to eliminate any chance of the receiver's picking up its signal.

Now tune the receiver for signals, keeping C1 in approximately the same position as C8 to minimize reception of station harmonics. Turn the loop around to find stations. 

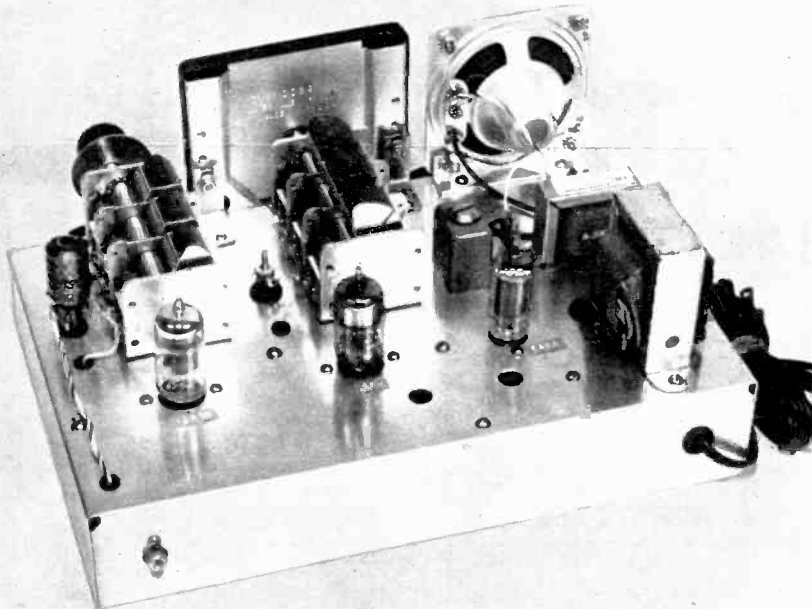


Fig. 5—Top of receiver. Coil L1 is at extreme left and antenna tuning capacitor C1 is right next to it. V1 is behind C1. Main tuning capacitor C8 is located in center of chassis. L1 is located between C1 and C8. Variable inductor L3 is low gray object to the right of C8. Power transformer T1, output transformer T2 and speaker are at right side of chassis.

JUNK BOX VOX

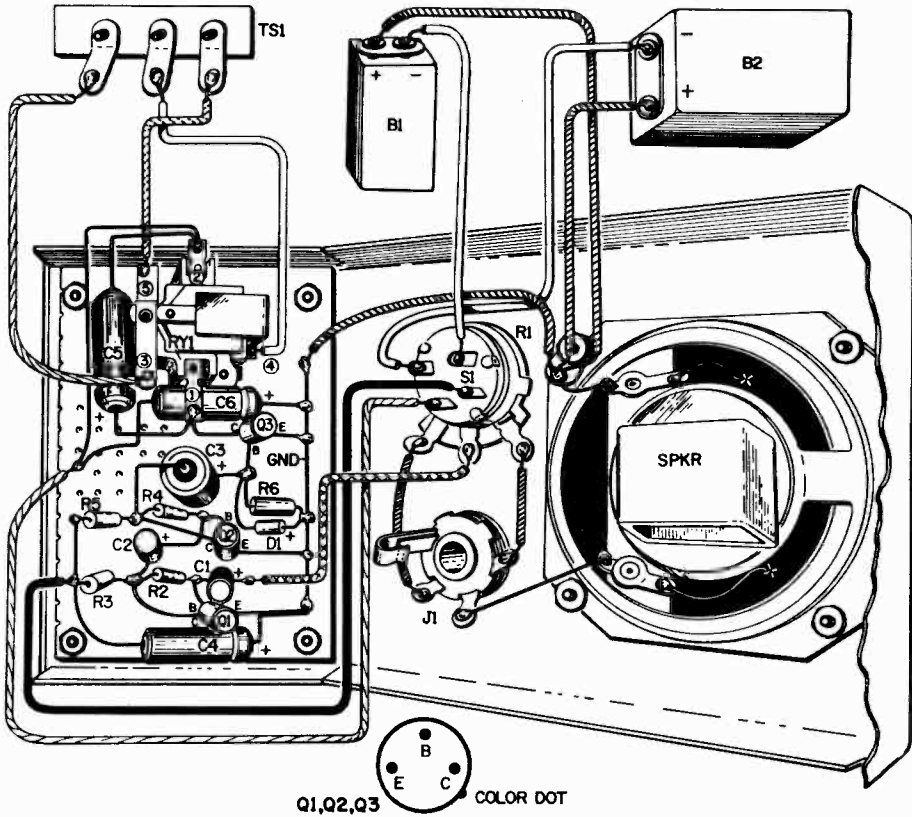
By
AL TOLER

MOST every electronics experimenter has the proverbial well-stocked junk box which is supposed to contain enough parts to build practically anything. But like old Mother Hubbard's cupboard, the box always seems to be bare when you start looking for specific components for a project.

We aren't about to give you a list of parts to purchase to fill a junk box. Instead, we have a project that we guarantee can be built from almost anything—and it's mighty useful, too. (If you don't happen to have a junk box you can buy the parts new for about \$10.)

Called the Junk-Box Vox, it's a voice-operated relay that turns devices on or off when you start speaking. Connect it to a tape recorder and the machine will start automatically when you begin dictating. Or you can use it with model trains to start or stop them when you speak. Connect it to a ham or CB transmitter and you've got a voice-actuated push-to-talk switch. In addition, the vox can be used as a baby sitter or as an





JUNK BOX VOX

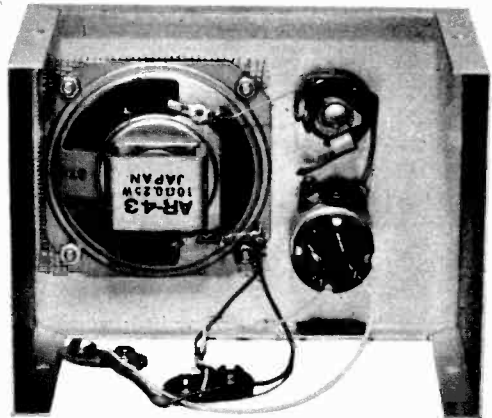
intruder alarm.

The vox's sensitivity can be made so high it will trip when a doorknob is turned. The circuit shown in fig. 4 is for the intruder alarm/baby-sitter version. The only difference between this model and a basic vox is the cabinet-mounted speaker.

If the vox has an external speaker-mike, a sound input will trip relay RY1, which will release one-half to two seconds after the sound ceases. When the speaker is mounted in the same cabinet, the click RY1 makes as it opens will be picked up by the speaker. This may cause RY1 to trip again and again until power is turned off. A bulb or buzzer and battery connected to the vox will blink or buzz until power is turned off. Set up in a child's room, a cough, cry or fall out of bed will set the alarm into continuous operation. Placed in the basement or a backroom, the vox will sound off when someone enters.

Fig. 1—Before mounting perforated-board subassembly, install the speaker, R1 and J1 on 4 x 5-in. side of main section of Minibox. Put spacers under the board to keep it away from the cabinet.

Fig. 2—Cabinet before installation of board. Connect wire from ground buss on circuit board to solder lug on one of speaker's mounting screws.



Construction. The unit shown is built in a 3x4x5-in. Minibox. The amplifier/relay circuit is built as a subassembly on a 2 $\frac{3}{8}$ x 3 $\frac{1}{2}$ -in. piece of perforated board. Flea clips are used for tie points. Parts layout isn't critical.

Transistors Q1, Q2 and Q3 can be a general-purpose type such as the RCA 2N217. Even the three-for-a-buck variety transistors will do. For super-sensitivity use high-gain 2N2613 transistors. With 2N217s the vox will be tripped by a moderate-level voice two feet from the speaker-mike. With 2N2613s a whisper will trip the vox at four feet. Intermediate sensitivity can be obtained using general-purpose transistors and a 500-ohm to 3.2-ohm output transformer (T2 in the Parts List) connected between the speaker-mike

and sensitivity control R1.

Resistors can be up to double the specified values. Except for C3, capacitors can range in value from half to twice the values listed. However, C3's value is somewhat critical as it partially determines RY1's hold-in time. The specified value of 100 μ f will hold RY1 in for full sentences with a loud voice two feet from the speaker-mike. For a longer hold-in time, or for lower input levels, C1 should be increased to 200 μ f to 500 μ f (with high-gain transistors 100 μ f is generally adequate). For a shorter hold-in time, say, complete words or syllables, C4's value should be reduced.

Any SPDT relay can be used as long as its coil resistance is from 150 to 400 ohms and the pull-in current is 10 to 20 ma. Two

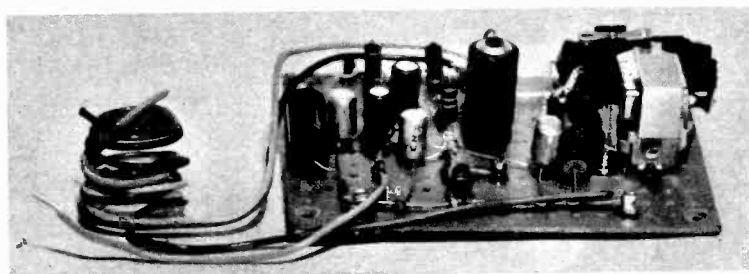


Fig. 4—To increase the gain without adding another transistor, connect a 500 to 3.2-ohm transformer between J1 and R1. The 500-ohm winding goes to R1.

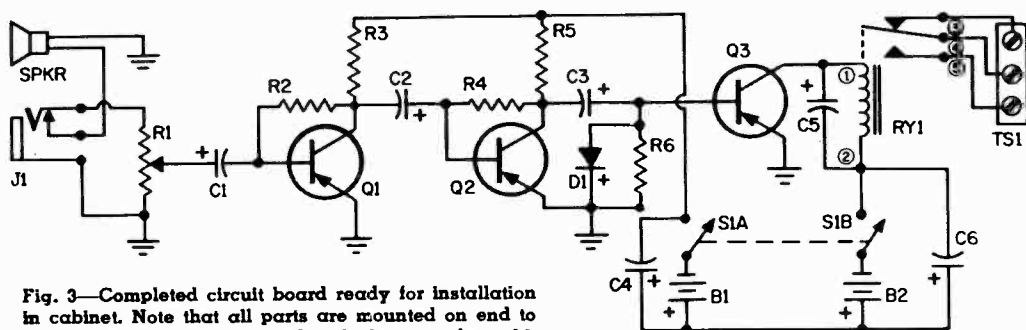


Fig. 3—Completed circuit board ready for installation in cabinet. Note that all parts are mounted on end to save space. Connecting leads which go to the cabinet-mounted components should be soldered to the circuit board before installing board in the cabinet.

PARTS LIST

B1—9 V battery (Eveready 2U6 or equiv.)

B2—9 V battery (Eveready 246 or equiv.)

Capacitors: 15 V electrolytic unless otherwise indicated

C1, C2—10 μ f, 6 V

C3—100 μ f (see text)

C4, C6—50 μ f

C5—100 μ f

D1—1N34A diode

J1—Closed-circuit phone jack

Q1, Q2, Q3—2N217 or 2N2613 transistor (see text)

Resistors: $\frac{1}{2}$ watt, 10% unless otherwise indicated

R1—5,000 ohm, audio taper potentiometer

R2—33,000 ohms

R3—4,700 ohms

R4—180,000 ohms

R5—10,000 ohms

R6—22,000 ohms

RY1—SPDT relay, 250-335 ohm coil, Sigma 11F-250-G/SIL or Potter and Brumfield RS5D

RY2—DPDT relay, 117 VAC coil (Potter and Brumfield KA11AY)

S1A, S1B—DPST switch on R1

S2—Normally-closed push-button switch

SPKR—8 ohm speaker

T1—Transistor output transformer, primary: 500 ohms, secondary: 3.2 ohms (Lafayette 99 R 6123).

See text

TS1, TS2—3-lug screw type terminal strip (Cinch-Jones 17-3 or equiv.)

Misc.—perforated board, flea clips, 3x4x5-in. Minibox, knob, battery connectors.

Fig. 5—To use the vox to control a tape recorder (left), connect RY1's normally-open contacts in series with motor. To switch a CB or ham transmitter (right), connect the normally-open contacts in parallel with the PTT switch in transmitter.

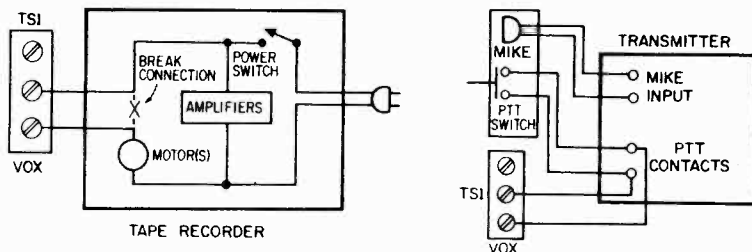
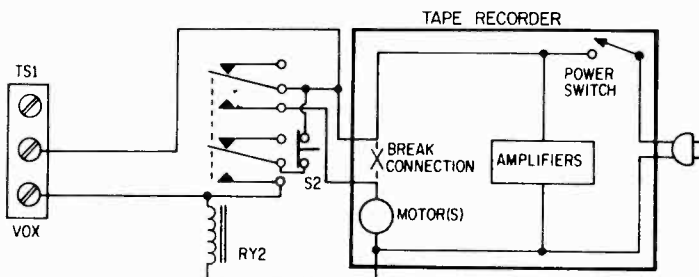


Fig. 6—To obtain continuous operation of recorder after vox is tripped, another relay, RY2, must be used. Recorder is restored to normally-off by pressing S2, a normally-closed push-button switch. Relay RY2 is a 117 VAC DPDT type.



JUNK BOX VOX

batteries *must* be used. Battery B1, which powers Q1 and Q2, can be an ordinary transistor-radio battery. B2 must be no smaller than an Eveready No. 246 or equivalent.

Using The Vox. The vox will not work with a crystal or dynamic microphone. You must use a speaker. Reason is Q1's low input impedance will load any other microphone and reduce its output. Because RY1 closes as soon as power is applied (it opens a second later), don't hook the vox to the equipment to be controlled until the vox is turned on or the power-on pulse will trip the controlled equipment.

There are two ways to control a tape recorder. The first method starts and stops the recorder's motor (or the capstan motor if the machine has more than one motor) in step with the input signal. When a sentence is complete, the motor stops. Fig. 5 shows how it's done. Trace the leads which go to the capstan motor and open one lead. Then connect the opened leads to RY1's normally-open contacts. The only difficulty with this method is that a time delay of a second or so needed to allow the motor to come up to speed. It is best to activate the vox by clear-

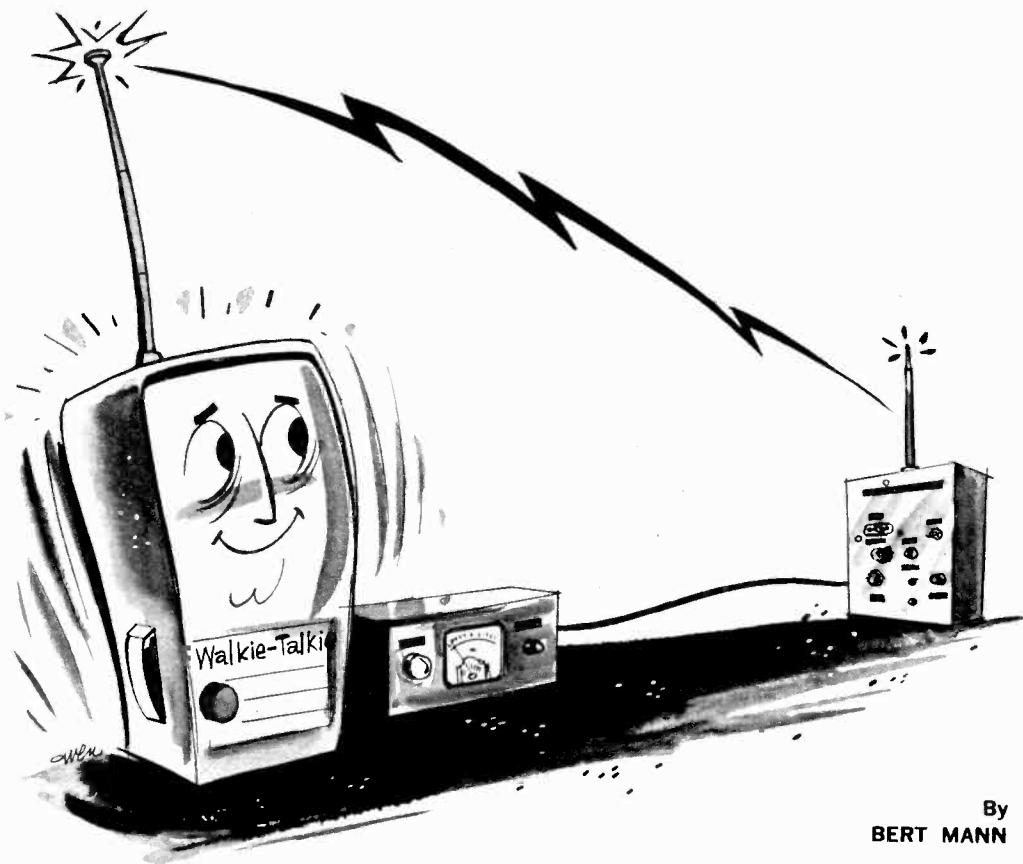
ing your throat first to allow the motor to get up to speed.

The second method gives continuous operation once the vox is tripped. Open the motor leads but now connect the relay circuit shown in Fig. 6. When RY1 closes, power is applied to relay RY2. One set of RY2's contacts starts the motor and the second set of contacts applies a holding voltage to RY2's coil to keep it closed after the vox releases. The recorder is stopped by pushing S2.

To use the vox to control a CB transceiver or ham transmitter, connect RY1's normally-open contacts across the rig's push-to-talk leads as shown in Fig. 5. Place the vox's speaker-mike alongside your regular mike and adjust R1 so RY1 holds in for complete sentences.

In the intruder-alarm version, rotate R1 just enough to turn power on, then slowly turn R1 fully clockwise. The slightest vibration to the cabinet or even a footstep will be enough to trip the vox.

If the vox fails to trip, check Q1's collector voltage; it should be 4 to 6 volts with respect to ground. If it isn't, select a value for R2 which produces 4-6 volts. Similarly, try other values for R4 to get 3 to 5 volts at Q2's collector.



By
BERT MANN

Walkie-Talkie Tester

Put punch back in your transceiver with this all-in-one service instrument.

SO long as it's working, a walkie-talkie is an extremely reliable, rugged electronic device. But when it gives up the ghost it becomes a giant migraine headache.

When it comes to servicing walkie-talkies, you'd think a conventional signal generator would be the answer. But a generator has only rough calibration at 27 mc and it's useless for alignment. And a 5-watt rig, more often than not, will overload the walkie-talkie rather than provide a useful signal.

What you need for alignment is a *crystal-controlled* signal generator with an adjustable low-power output. You also need an audio signal for testing the modulator and speaker/mike. A remote indicating field-strength meter (FSM) for measuring the walkie-talkie's RF output at a distance also is a must.

The Walkie-Talkie Tester sports all these features. It's a *modulated* crystal-controlled

RF generator whose signal you use to align the walkie-talkie's receiver. It also puts out an audio signal at just the right level so you can check if the walkie-talkie's modulator is working or if its speaker/mike is defective. Finally, it's a sensitive remote-indicating FSM.

Construction. Component values are critical, therefore, make no substitutions. The Tester is built in the main section of a 4 x 5 x 6-in. Minibox. A large cabinet is needed to prevent the whip antenna from tipping over the cabinet.

First, build the modulator/AF oscillator, on a piece of 2 7/16 x 3 3/8 in. (stock size) perforated board, following the pictorial in Fig. 1. Cut off the yellow and green leads on T1's secondary and use only the white and brown. Set the board aside and go on to the oscillator.

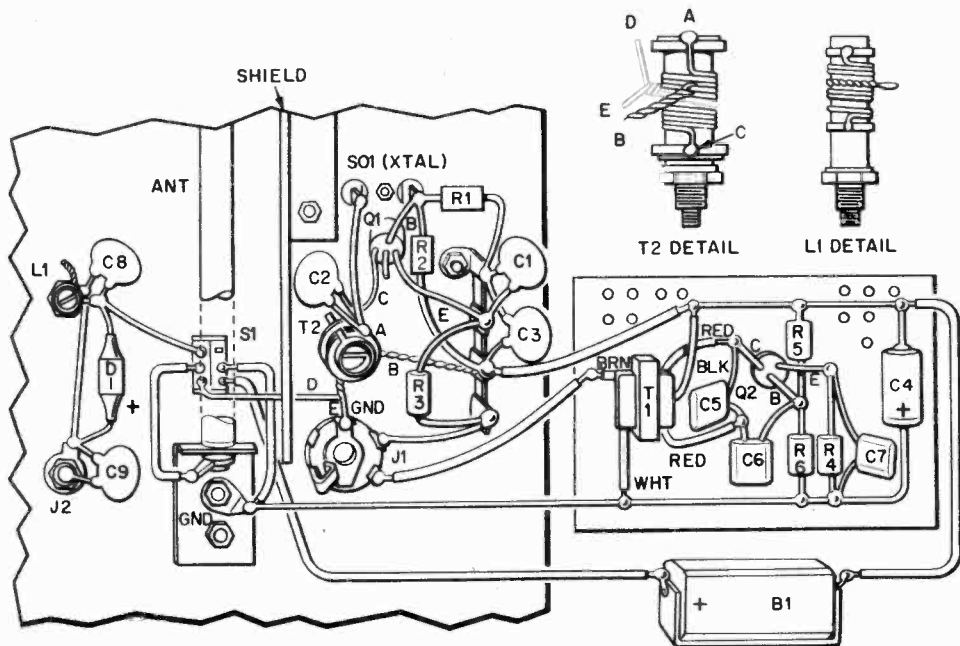


Fig. 1—Mount the antenna on home-brew L-bracket using fiber shoulder washers to insulate it. Shield between FSM at left and RF oscillator at right is made of scrap aluminum.

Walkie-Talkie Tester

The construction of coil T2, which is wound on a stock form, is critical so take care when winding it. If it isn't a neat job, start over again. First, tensilize a 2-foot length of #22 enameled wire by clamping one end in a vise and pulling the wire until it goes dead slack. If the wire is not tensilized it will unwind after you wind the coil. Scrape about ¼-in. of insulation from one end and solder it to lug C near the mounting screw.

Run the wire along the form for ⅛ in. and then wind 5 closewound turns. Bring the wire away from the form to make a loop, bring the wire back to the form, twist the loop once at the form and then wind 6 more turns. Solder the wire to Lug A. Scrape away the loop's enamel insulation, twist it tightly and tin it with solder.

In the center of the coil right over the loop, wrap a single turn of #22 wire as shown in the detail sketch in Fig. 1. Twist the loop's leads on the side opposite the form's lugs. The single-turn link should have 6-in.-long leads. Cover the coil with coil dope or radio service

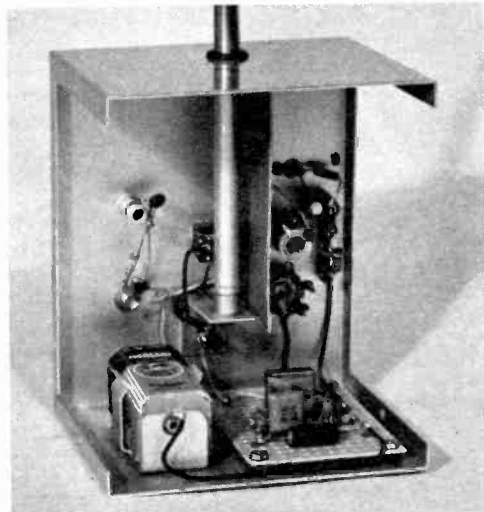


Fig. 2—Antenna hole is 1⅜ in. back from front of cabinet. Put grommets between board and bottom of cabinet. Put tape on cabinet under board.

cement and set it aside to dry for about 24 hours.

Now build the oscillator on the front of the cabinet. Connect all leads, except the lead from J1, to the modulator board and connect the battery. Install a 2¼-in. wide by 4-in. long shield, cut from a section of scrap alumi-

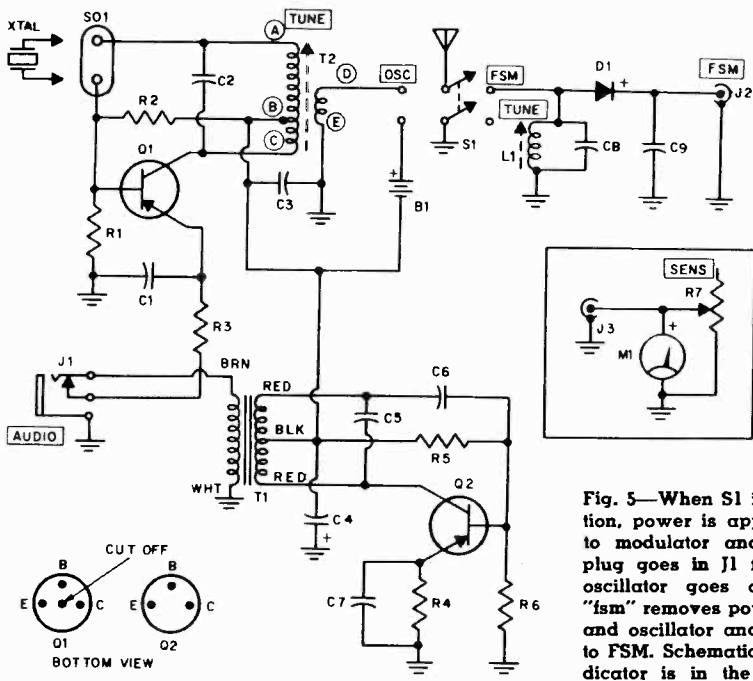


Fig. 5—When S1 is set to "osc" position, power is applied automatically to modulator and oscillator. When plug goes in J1 for audio tests, RF oscillator goes off. Setting S1 to "fsm" removes power from modulator and oscillator and connects antenna to FSM. Schematic of FSM remote indicator is in the box at the right.

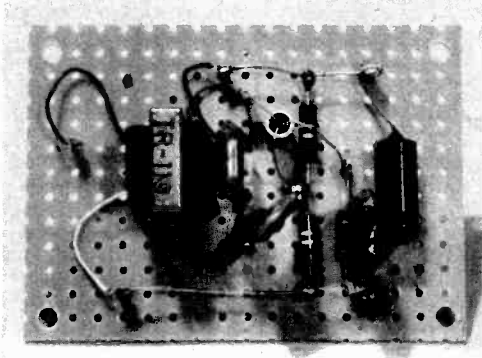


Fig. 3—Modulator is built on a 2 7/16 x 3 3/4-in. piece of perforated board. Drill holes in corners and mating holes in cabinet bottom for mounting.

num, from the top of the cabinet to the antenna L-bracket. Drill a 1/8-in. hole in the shield, as shown in the pictorial, pass one lead from the single-turn link (D) through the shield and solder it to S1. The remaining link-lead (E) connects to the ground lug on normally-closed jack J1. Make certain that the lead from R3 to J1 is connected to lug that's *lifted* when a plug is inserted.

Next, install the FSM section (at the left of the antenna in Figs. 1 and 2). No problems here as L1 is a stock coil; just push its

tap out of the way. Complete all wiring, install the collapsible antenna using a grommet in the top of the cabinet. Finally, connect the antenna to S1.

The FSM's remote indicator is built in the main section of a 2 1/4 x 2 1/4 x 4-in. Minibox as shown in Fig. 6. Any layout will do.

Checkout and Operation. Plug a third-overtone CB transmit crystal into SO1, extend the antenna and set up your 5-watt rig or a walkie-talkie nearby. Either should be tuned to the same channel as the crystal in the Tester. Put a knob on T2's slug-adjustment screw. Set S1 to *osc* and from the full counter-clockwise position, adjust T2's slug until you hear the Tester's signal on the 5-watt or the walkie-talkie. If necessary a slight adjustment of T2's slug will rubber (shift) the oscillator's frequency slightly. This will be indicated by a fall in the 5-watt's S-meter indication or by distortion of the tone in the walkie-talkie.

The Tester is deliberately designed to shift the crystal frequency as many walkie-talkies are not exactly tuned to the channel frequency. And it is important that the walkie-

Walkie-Talkie Tester

talkies be aligned to *each other's* operating frequency, regardless of what it is.

Before you attempt to do anything to the walkie-talkie, be sure to get hold of a copy of its schematic. In addition to the schematic, try to obtain a diagram showing the physical location of all parts so you can quickly find the RF and IF transformers and coils.

To align a walkie-talkie set up the Tester across the room from the walkie-talkie. Then extend both the walkie-talkie's and Tester's antennas. Adjust T2's slug if necessary, to get the oscillator working. Then adjust T2's slug again for maximum S-meter indication on the 5-wattmeter or for undistorted tone on the walkie-talkie. Collapse the Tester's antenna until the signal received by the walkie-talkie being aligned is just audible.

Now, align the walkie-talkie receiver's RF and IF transformer for maximum audio output. Keep the Tester's signal at the lowest readable level by collapsing the antenna or moving the Tester farther away to prevent the walkie-talkie's AVC from masking the alignment adjustments.

If the walkie-talkie just produces an unmodulated carrier, disconnect its speaker and connect it to J1. If the speaker is okay you'll hear a weak but clean tone. If the speaker checks out, connect the leads that went to walkie-talkie's speaker to J1. If the walkie-talkie's modulator is defective there will be no modulation of the carrier (as received on another walkie-talkie or the 5-wattmeter).

You can then signal-trace as you'll have a steady tone feeding into the walkie-talkie. If you can drive the tone through the modulator—even if it sounds distorted—the defect is probably in the speaker or switching leads.

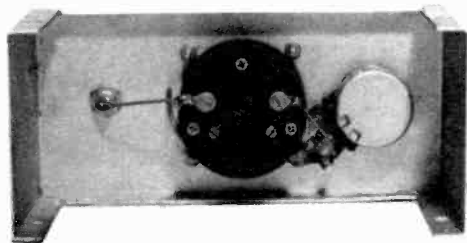


Fig. 6—FSM remote is built in a 2½ x 2½ x 5-in. Minibox. Parts placement is not critical. Connect it to Tester with RG174/U coax cable.

The remote FSM is used to tune up the walkie-talkie's transmitter. Extend the Tester's antenna all the way, set S1 to *fsm* and plug the remote indicating meter into J3 using shielded cable. Set R7 to about mid-position and activate either an operating 5-watt transmitter or a walkie-talkie. Using a plastic alignment tool, adjust L1 for maximum meter indication. Use R7 to keep the pointer on-scale.

To peak the walkie-talkie's transmitter, place the Tester as far as possible from the walkie-talkie. Stand the walkie-talkie upright—away from metal objects—and peak-up the transmitter for highest meter indication.

After the transmitter is peaked, check to make sure it starts by pressing the push-to-talk button. The FSM should indicate as soon as you press the button. If it doesn't, slightly detune the oscillator, tuning first on one side and then the other until the oscillator starts each time the button is pressed.

PARTS LIST

- ANT.—12 section, 54½-in. collapsible antenna (Lafayette 99 R 3008 or equiv.)
- B1—6 V battery (Eveready 724 or equiv.)
- C1, C3, C9—.001 μf, 500 V ceramic disc capacitor
- C2—25 μf, 500 V ceramic disc capacitor
- C4—30 μf, 15 V electrolytic capacitor
- C5, C7—.25 μf, 75 V ceramic capacitor
- C6—.1 μf, 75 V ceramic capacitor
- C8—62 μf, 500 V silver mica capacitor
- D1—1N34A diode
- J1—Single closed circuit phone jack (Switchcraft 12A or equiv.)
- J2, J3—Phono jack
- L1—CB transceiver oscillator coil (1,650 kc IF) Lafayette 32 R 0909
- M1—0.50 μa DC microammeter
- Q1—2N274 transistor
- Q2—2N217 transistor
- Resistors: ½ watt, 10% unless otherwise indicated
- R1—33,000 ohms
- R2—22,000 ohms
- R3—2,700 ohms
- R4—82 ohms
- R5—270,000 ohms
- R6—10,000 ohms
- R7—1,000 ohm, linear taper potentiometer
- S1—Miniature DPDT toggle switch
- SO1—HC6/U crystal socket
- T1—CB modulation and audio output transformer; primary: 500 ohms, center tapped. Secondaries: 8 ohms and 3,000 ohms. Lafayette 99 R 6132
- T2—Oscillator coil wound on a J. W. Miller No. 42A999CB1 coil form (Lafayette 34 R 8948). See text.
- XTAL—Third overtone CB transmit crystal
- Misc.—4 x 5 x 6-in. and 2¼ x 2¼ x 5-in. Miniboxes, perforated phenolic board, flea clips, battery holder, terminal strip, shielded cable



Heathkit HD-10

LOW-COST ELECTRONIC KEYS

BRASS pounders become artists with the key after using an electronic keyer. Quite unlike the ham's old standbys, the J-38 straight key and the semi-automatic bug, an electronic keyer enables you to send perfect code every time. Hold its paddle to one side and it produces dahs continuously. Hold the paddle the other way and dits pour out without end. And you never have to worry about character duration and spacing—they're always perfect.

Up to now electronic keyers have been expensive accessories and regarded as luxuries around the ham shack. But the \$39.95 Heathkit HD-10 has brought the electronic keyer into the ball park of practically any operator whose dream has been to send clean-as-a-whistle code effortlessly.

Eleven transistors, in a computer-like circuit full of flip-flops, put the HD-10 among the most advance-design keyers. Regardless of where the speed knob is set the spacing between and the length of the characters remain constant. The dits and dahs are self-completing. That is, even if you just tap the paddle to one side of the other, the dit or dah lasts for its full duration.

Building It

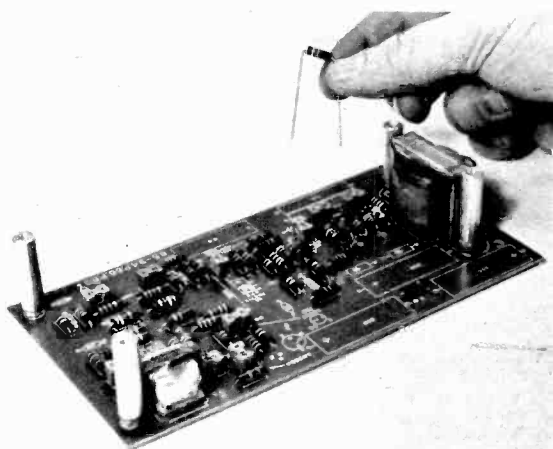
Construction includes two types of wiring: printed-circuit and point-to-point. The circuit board virtually eliminates all chances of error and saves much construction time. However, there's enough routing and soldering of cable-harness wires to give that real build-it-yourself feeling. It's about a ten-hour

job to assemble the kit, plus a little time for puttering with mechanical adjustments.

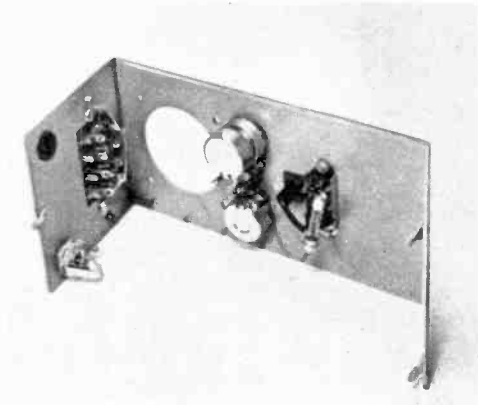
On The Air

It was with trepidation that we put this keyer on the air for the first time. Reason was that its design looked similar to a circuit we'd seen published somewhere before. We constructed that circuit, which worked beautifully until the transmitter was flipped on. Then RF fields occasionally caused false triggering and garble.

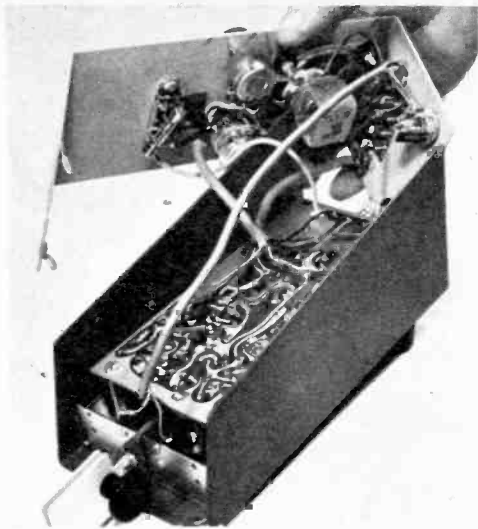
The problem did not exist with the HD-10. It keyed a 100-watt transmitter when it was about 15 ft. from the antenna (thus in strong



The keyer contains a lot of components but construction is not that difficult since most parts are mounted on an uncrowded printed-circuit board.



Controls in cover are connected to circuit board with cable harness. The dual pot is the speed control. Other pot is for the keying-monitor volume.



Final assembly step. Key lever is mounted on ballast plate, a heavy sub-chassis that prevents the unit from walking across table when operated.

LOW-COST ELECTRONIC KEYS

RF fields) without one misfire. A big feature of the HD-10 is that it has electronic (transistor) switching instead of a rat-a-tat-tat keying relay found in some other keyers.

If the keyer can be faulted at all it's for lack of flexibility in allowing selection of the basic speed range. Early in construction you must decide whether you want to send 10 to 20 wpm or 15 to 60 wpm. You then solder either a 10,000-ohm or a 68,000-ohm resistor on the board, depending on desired speed range. Neither range met all the requirements for our CW operator, an 18-to-25-wpm man.

The high-range resistor did not permit the keyer to be slowed sufficiently for two important functions: working DX through heavy QRN/QRM conditions or working slower operators who could well provide a rare QSL, say, to get a worked-all-states certificate. Installing a low-range resistor, on the other hand, can cramp your style if you want to get over 20 wpm.

The back panel of the keyer permits hookup of a manual key for slow-speed work, but in a sophisticated instrument such as the HD-10 the addition of a speed-range switch would be a welcome feature.

The keyer works with most transmitters but cannot be plugged indiscriminately into every key jack. Keyed current shouldn't exceed 35 ma and voltage across the key contacts must be under 105 V.

The manual gives a good checkout procedure plus a method for adjusting the dit-

space ratio with a VTVM. Shown, too, are several possible hookups for listening to your fist through the keyer's built-in speaker or via your receiver.

Old-time hams like to caution beginners against any kind of speed key. You'll send faster than you can receive, goes the argument. We disagree. The statement is *almost* true since anyone who sends faster than he can copy has neither much fun nor success on CW. And he soon finds it out. An electronic key, on the other hand, provides a near-effortless method for sending remarkably clean code that others find a pleasure to copy. Getting the hang of the key takes no great skill—just some practice.



Rear terminal board takes connections to transmitter for keying, to receiver for optional monitoring and has a jack for a conventional key.



Now!
Hands-free
conversation with our
SWITCHLESS INTERCOM

By DAVID WALKER

HOW many times have you watched a conversation between two people that never mastered the art? Before long they're both talking at once. And what happens if these same people try to talk to each other over an ordinary intercom? You guessed it—they'll be tied in knots after two minutes of fiddling around with the push-to-talk switches.

The answer is not a course in the fine art of conversation but a switchless intercom like ours. Such an intercom lets each party break into the conversation at any time. It's like the telephone, but with loudspeaker volume. While one person is yacking, the other can start talking and will be heard instantly. You can even interrupt while your friend is interrupting you!

There are no voice-operated relays or other switches to delay the back-and-forth action. Everything is done electronically. But before you set about ordering parts, consider carefully the end use of such an intercom. Though fun to operate, its special design requires plenty of construction and parts.

Unlike push-to-talk intercoms, the switchless intercom requires two complete amplifiers instead of the usual one. Total cost of parts is about \$30 to \$35 if everything is purchased new. But for certain applications, you can't beat it.

Say the boss is dictating a letter to his secretary in another room. She can stop him and ask how to spell *phthisis* without a lot of distracting button pressing.

Construction. Since both units are identical, we show the diagrams of only one and the power supply. Most of the parts are mounted on a 3½x5½-inch piece of perforated board. Mount all parts on the board before fastening it in the U-section of an 8x6x3½ inch Minibox. Flea clips or other small push-in terminals serve as tie points. Transformer T1 and transistor Q4 are installed

on the board as shown in the pictorial.

Grounds are important. Notice that a piece of heavy bare wire runs along two edges of the board. One point on this wire must connect to the solder lug which is attached to a long machine screw near C2. This screw also supports the front edge of the board about 1/4 inch above the bottom of the cabinet. A third nut on the top of the board locks it in place. The rear of the board is held to the case with two small L-brackets.

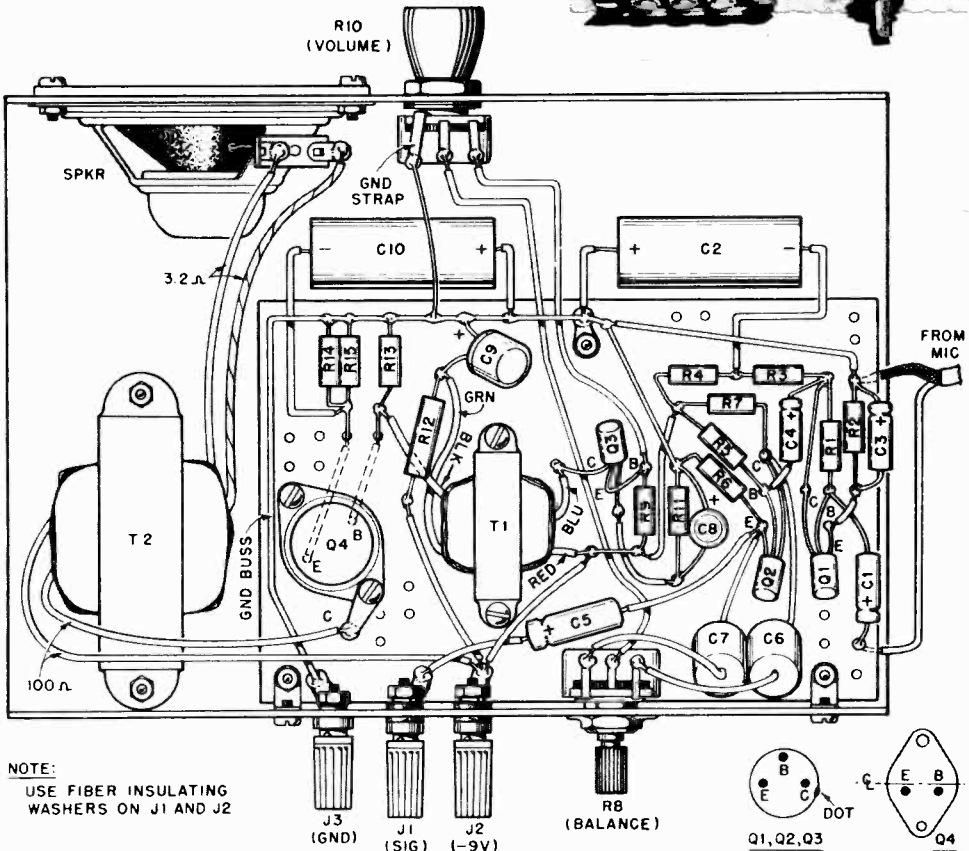
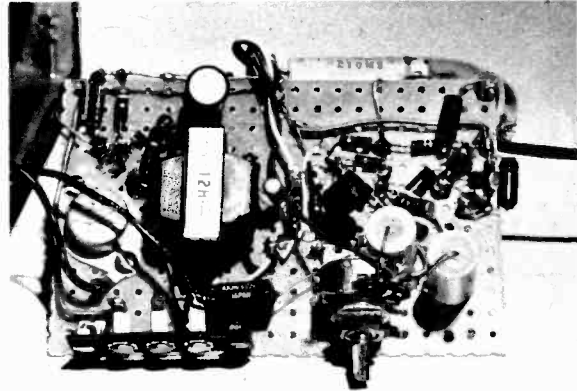
Another ground point is binding post J3. It is not necessary to use a fiber insulating

washer for this post since it must make contact with the case. Binding posts J1 and J2 must be insulated from the case. The solder lug at one side of transistor Q4 is not for grounding. It is for T2's connection to Q4's collector (the case).

Set-Up and Operation. After both units and power supply are complete, connect all similarly marked terminals (*gnd, sig, -9V*) with a length of 3-conductor wire (No. 20 plastic-insulated hookup wire). The *aud* terminal that appears in the photo of the power supply has no internal connection to the

SWITCHLESS INTERCOM

First model was built in metal cabinet, hence J1, J2, J3, R8, R10 and the speaker are mounted as shown below. Circuit board is held in place with angle brackets at rear and machine screw at front. Later model (photo at right) was built for installation in wood cabinet shown on first and last pages of story. For this construction, mount R8 and screw-type terminal strip with angle brackets.



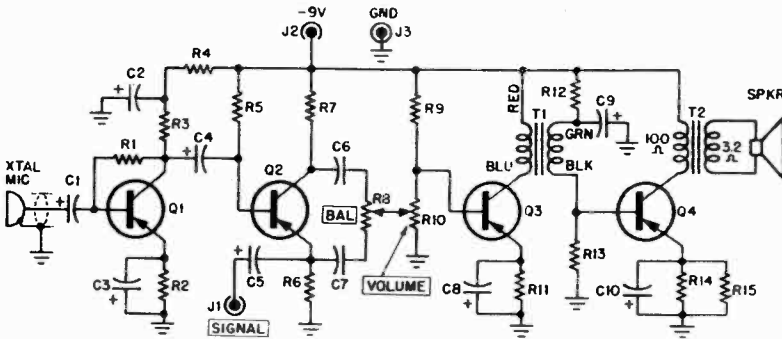
PARTS LIST

Capacitors: all electrolytic unless otherwise indicated

C1, C3—10 mf, 15 V
 C2, C10—500 mf, 12 V
 C4—10 mf, 6 V
 C5, C9—100 mf, 15 V
 C6, C7—.1 mf, 200 V tubular
 C8—30 mf, 12 V
 *C11—1,000 mf, 25 V
 *C12—1,000 mf, 15 V
 J1-J5—Five-way binding posts
Transistors: all RCA
 Q1—2N2613 Q2—2N217
 Q3—2N408 Q4—2N2147
Resistors: ½ watt, 10% unless otherwise indicated
 R1—1 megohm

R2, R4—1,000 ohms
 R3—10,000 ohms
 R5—150,000 ohms
 R6, R7—820 ohms
 R8—10,000 ohm linear-taper pot
 R9—47,000 ohms
 R10—5,000 ohm audio-taper pot
 R11—82 ohms
 R12—270 ohms, 1 watt
 R13—39 ohms
 R14, R15—2 ohms, 5%
 *R16—32 ohms
 *S1—SPST toggle switch
 *SR1, SR2—Silicon rectifier: 500 ma, 100 PIV
 SPKR—3x5-inch speaker

T1—Driver transformer: primary, 8,000 ohms; secondary, 3.2 ohms (Allied 62 G 093)
 T2—Output transformer: primary, 100 ohms; secondary, 3.2, 8, 16 ohms (Allied 64 G 149)
 *T3—Power transformer: primary, 117 V; secondary, 26.5 V @ .6 A (Allied 61 G 476)
 Misc.—8x6x3½ and *5x2¼x2¼-inch Miniboxes, perforated board, flea clips, crystal microphone
***Note:** Order twice the quantity of all parts except those marked with an asterisk (*)



Signal from mike is amplified by Q1 and fed to Q2. Out of phase signals at Q2's emitter and collector cancel in R8 and very little signal gets to speaker. Hence, no feedback from mike to speaker at same unit. Signal at Q2's emitter is coupled by C5 to J1 and other intercom. Signal from other intercom is fed by C5, C7, R8 and R10 to Q3 where it is further amplified and fed to the speaker.

supply. It is just a tie point for the sig wires of the two intercoms. The location of the power supply may be anywhere along the line.

First thing to do is place the intercoms in separate rooms and close the door. (Feedback will occur if the two stations "hear" each other.) The mike should be located about two feet to the side of each intercom's cabinet. With power turned on, turn the volume control on one unit all the way up. Chances are you'll hear howling feedback. Reduce this by slowly turning balance control R8.

At some point near the middle of R8's rotation, the feedback should stop or become very weak. Now repeat this procedure at the other unit. (Note: this adjustment must be always made with both units connected.) If there is no feedback hold the mike a few inches from the speaker.

It is possible that feedback cannot be killed with the R8 because of mechanical feedback between mike and speaker through the table surface. You can determine this by holding

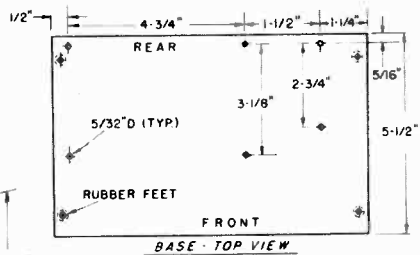
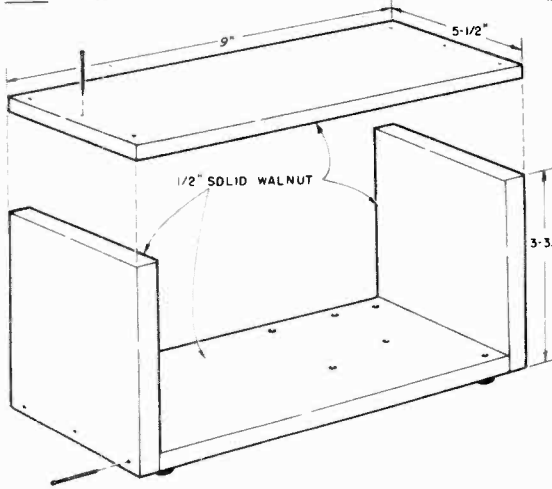
the mike in your hand. If this stops it, place some soft material under the mike. Feedback may also occur if the mike is placed atop the intercom case or if it is too close to the speaker.

Some experimentation will be required to determine the best speaking level and setting of the volume control. Talking too close to the mike will produce distortion at the other unit. With our model, speaking at a distance of about one foot from the mike produced good intelligibility at the other unit.

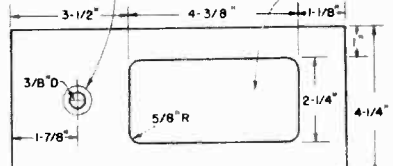
How it Works. It's easy enough to use two wires with a telephone communications system, since there's no problem in having signals travel two ways simultaneously on one pair of wires. And there's no feedback at either end because the microphone and earphone are separated by the handset and because the gain is low.

With most conventional intercoms, the speaker is not used as a microphone and a speaker at the same time because there'd be feedback. Okay, you say, why not build an

NOTE: ASSEMBLE WITH GLUE & FINISHING NAILS

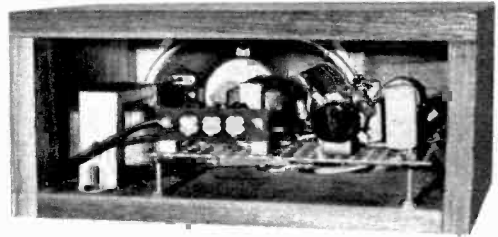


COUNTERBORE 3/4" DIAM., 3/32" DEEP FROM OUTSIDE SPEAKER GRILL CLOTH GLUED FROM INSIDE



FRONT PANEL - 3/16" SOLID WALNUT

If you install intercom in wood cabinet, mount speaker first, then output transformer. Attach volume control to front panel with long leads then mount circuit board atop machine screws. Connect one lead of output transformer's primary to collector of Q4, and other lead to the terminal strip.



SWITCHLESS INTERCOM

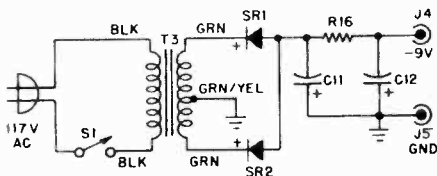
intercom with a speaker and mike at each end? Fine, except that you'd get feedback between them because of the high gain required to produce room volume.

The switchless intercom solves this problem. Here's how. Take a look at the schematic. When you talk into the mike, you want your signal to go to the other unit but not to your speaker. Watch what happens. The signal from your mike is amplified by Q1 and fed to Q2. This signal now appears at both Q2's emitter and collector. These two signals, which are 180 degrees out of phase, are fed to balance potentiometer R8, and at some point on R8 they cancel each other out. That point is where R8 must be set for minimum feedback, as we explained earlier. Since there's hardly any of the signal from your mike at this point none of it gets through to Q3, Q4 and to your speaker. Hence, there

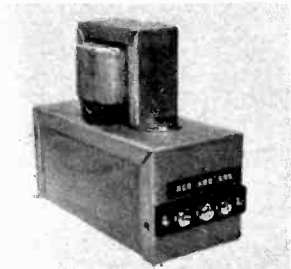
won't be any feedback at your unit.

Remember that we said your signal also appears at Q2's emitter. At this point the signal is not cancelled out. It is coupled through C5 to J1 and fed to the other intercom. Let's see what happens at the other intercom which is identical to yours.

The incoming signal at J1 goes through C5 to the emitter of Q2. Since this signal never goes through Q2 from its base, it is not cancelled out. Therefore it continues through C7 to R8 and goes on to Q3, Q4 and the speaker. In a nutshell, then, your signal to your own speaker is cancelled out at R8. But it is fed to the other intercom through C5. The signal passes through C7 to R8 and goes on to Q3, Q4 and to the speaker.



Power supply right, and schematic, left. Lug marked "aud" on chassis is not shown in schematic as it is merely a tie point. Be sure you hook up SR1 and SR2 correctly.



How to Upgrade a Speaker

By David Weems



ANYONE CAN upgrade his budget speaker system. All that's needed is a high-compliance speaker and some damping material.

WITH shortages upon us and the cost of living ballooning, it's no surprise that speaker prices are headed for the blue yonder. So if you're planning to trade up, you might consider improving what you have rather than buying new.

You can better the sound of most budget systems in two low-cost steps. The easiest way is to add acoustical damping material to the enclosure. This will help smooth mid-range and high-frequency response. It's an almost-no-cost improvement.

For a little more labor and cash you can get a still-better sound system. Install high-compliance speakers in the original enclosures. The results will amaze you as bass notes leap into balance with the highs.

You might want to try the same technique on the small speakers that come with a stereo radio or record player. It can bring incredible improvement to the sound of cheapie speakers that are mounted in cheapie plastic cases.

Before you start, check the back of the enclosure. If the box is sealed it may already contain a high-compliance speaker. But you should open it if possible to see if damping material was used.

If it was not used, add damping material behind each speaker. Loosely fill the entire box with fiberglass, polyester batting or other similar material. Be careful not to compress the filling or you will overdamp the system and choke its bass response.

If you decide to switch speakers, inspect the wiring carefully. If it is not coded, mark the lead going to the positive terminal of each speaker. Most speakers have a red dot on or near one terminal, which indicates the positive terminal.

Remove the speaker (or speakers) and take it to an electronics supplier. Ask for a high-compliance model with the same dimensions and impedance (usually 8 ohms). In general, low-cost speakers have a bigger and heavier coil housing.

Install the new speaker, observing proper polarity by connecting the marked wire to the positive terminal of each new speaker. If the old speaker did not have marked terminals, temporarily hook up the new speaker and try reversing the leads after listening for a short time. Choose the connection that produces the smoother sound and more pronounced bass response. When you are satisfied that the connections are correct, solder leads to the terminals.

Replace the back or insert the speaker board into the enclosure, depending on box construction. Try the sound. If you still are not satisfied and your speaker happens to have an open back, try taping heavy cardboard over the opening. Don't forget to add the damping material before doing this, of course.

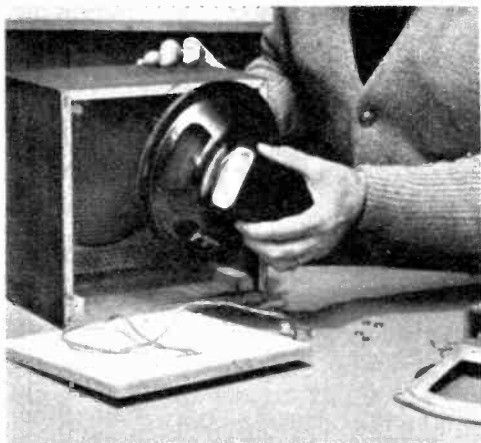
In the 8-in. system we show here we

replaced a stiff-cone speaker that was choking off bass with a high-compliance speaker of the same size and impedance. Cost for this modification was about \$9 and included some polyester quilt batting material. The final result was about an extra octave of good, solid bass and a much smoother sound throughout the frequency range.

The same encouraging results were obtained when we applied our technique to a pair of speakers from a low-price department-store stereo receiver. When we added the batting the mid-range reflections from the box's plastic walls disappeared. But the response was still poor and we decided to put in high-compliance speakers.

We picked up the speakers for \$5 each from an electronics supplier. The new system's resonance occurs at about 100 hz, two octaves below that of the original speakers. But this proved to be lower than necessary or even desirable. The receiver had little output at 100 hz so it was better to raise the resonance to 170 hz by sealing the enclosure back with silver-back duct tape. All of this was done without altering the styling or appearance of the baffles.

You'll have no problem doing the same thing to your hi-fi speakers. While we had test equipment, you can meet with equal success by the tried-and-true method of trial and error. ●



HIGH-COMPLIANCE speaker is mounted inside old baffle. Check speaker polarity.



BE CAREFUL not to overdamp the speaker by packing in too much damping material.

Build an Electronic Appliance Timer

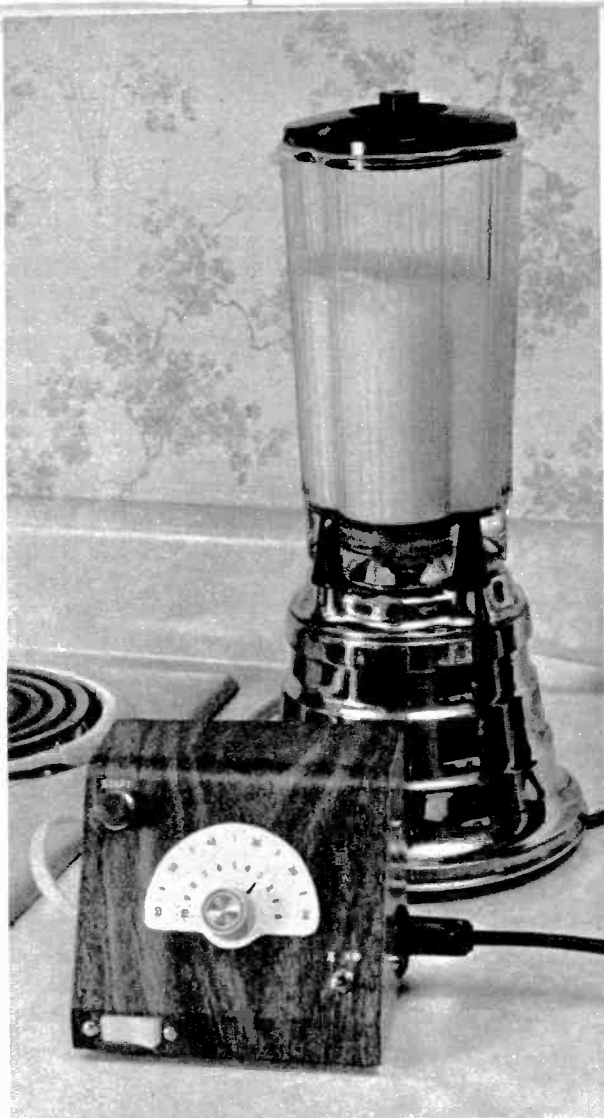
By Harry Kolbe

AN ELECTRONIC timer to control such small kitchen appliances as food mixers, blenders and so on can be quite useful to the modern, harried housewife-cook. All she does is connect the appliance to the timer and select the time that's required.

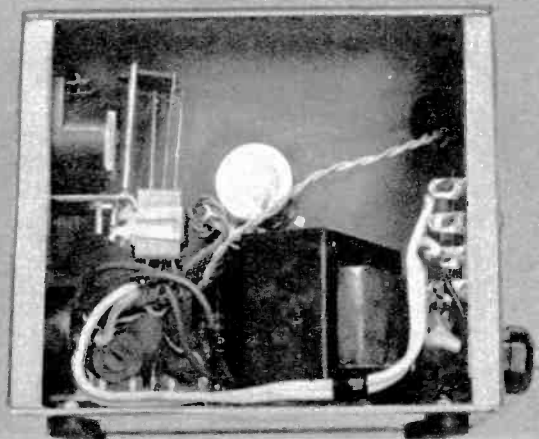
You can build our electronic timer for your wife to give her robot control over most anything that takes a short cycle of operation. Precise control extends from a fractional second up to 60 secs. (in two scales).

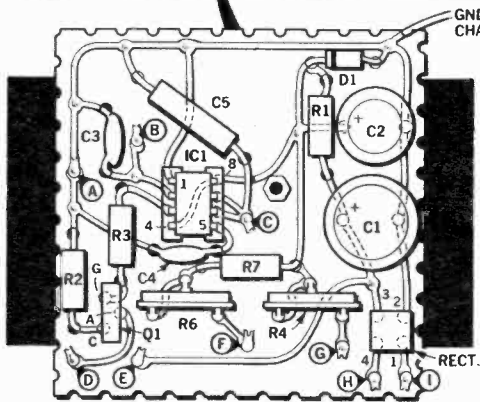
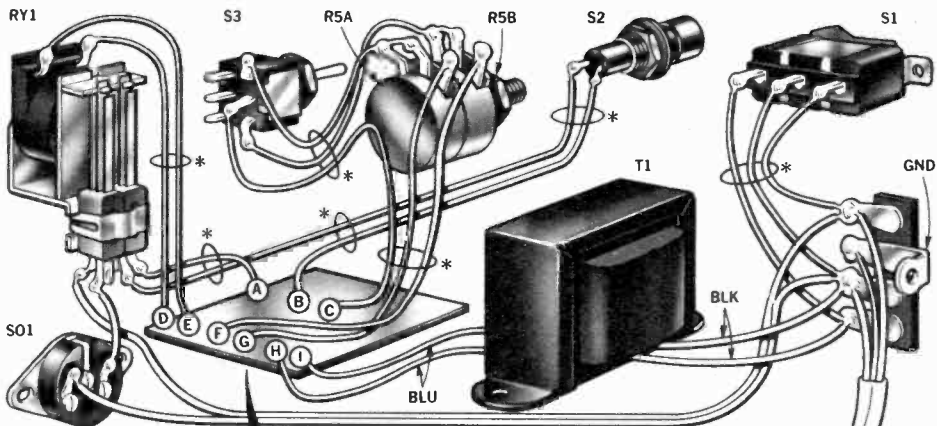
Besides helping out in the kitchen the timer makes a great instrument for the darkroom. You'll have no problem getting uniform prints when your enlarger is controlled by our timer.

The reason for dependable performance on both the cooking and photo-printing fronts actually boils down to the precision of integrated circuitry. An IC chip acts in conjunction with a resistive/capacitive timing circuit to form an electronic clock. When the time runs out a relay gets into the act to give a switching capacity of about 1000 watts. Your wife, of course, must avoid those gluttons that eat a lot of juice—electric grills and ovens are definitely taboo.

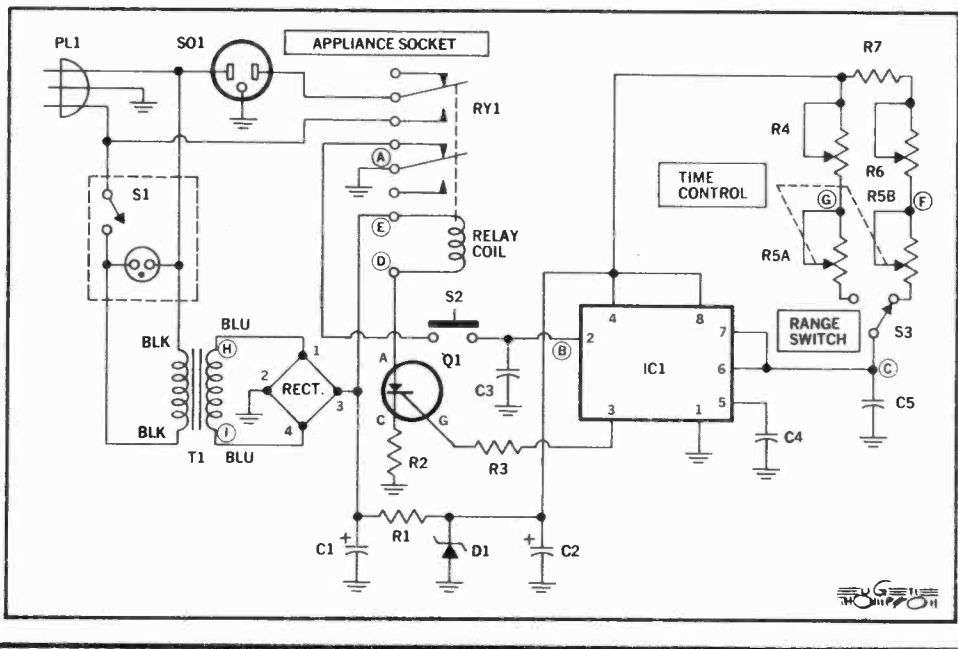
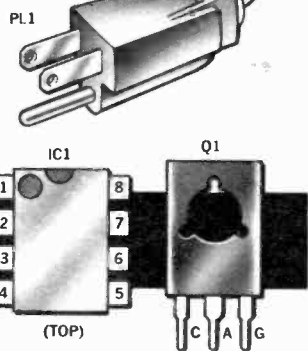


TRANSFORMER, relay and other timer parts are mounted in a sloping panel utility box.





* — TWISTED WIRES



Build an Electronic Appliance Timer

While we used a 5-in. sloping utility box, you might want to build the timer in a 7-in.-wide box to give you more room to work. The pushbutton start switch is mounted in the upper left-front corner of the sloping panel. In the middle of this panel, drill a small clearance hole for the shaft of pot R5—the main time control. Range switch S3 is a toggle mounted on the lower right of the panel.

Over on the left a 1-1/16x1/2-in. rectangular cutout must be made in the bottom of the front apron for the on/off-rocker switch. The single-socket AC receptacle, which should have a third terminal for ground, is mounted on the right side panel. Make sure that you leave plenty of space to mount the relay above the receptacle. The AC power cord with a strain relief mount is connected to a four-lug-terminal strip and later mounted on the right, inside the utility box.

Make all these holes and cutouts in the box and, after checking to see that the components fit, remove them to spruce up that cabinet.

You can cement walnut veneer to the front and top of the box. Then, after covering the veneer with tape (for protection) spray the box with metal primer. Allow the primer to dry and then spray with brown paint. You can also mount four rubber feet on the bottom of the box.

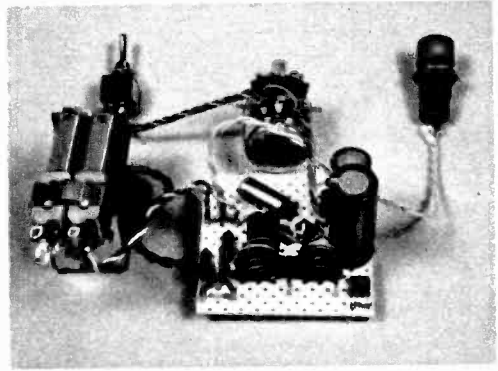
Now remount the AC cord and strain relief, the terminal strip, receptacle and the on/off switch. Make connections to these parts. All wires in the circuit that will carry 110 VAC should be No. 12 or No. 14 with good insulation. Do not mount other components at this time.

The timing electronics are built on a 2 1/4-in.-sq. piece of perfboard. Using epoxy cement, mount two No. 4-40 nuts and 1/4-in. spacers so that they will accept screws coming from the bottom of the board. Put the board aside to dry.

Later use flea clips for solder terminals. It's a good idea to run a ground bus around the perimeter of the board to ease wiring of components.

Determine the lead lengths that will

(Continued on page 109)



PERFBOARD is wired to some components before mounting to help ease construction.

PARTS LIST

Resistors: all are 1/2 watt, 10% tolerance unless noted.

R1—150 ohms

R2—7.5 ohms

R3—2.2 ohms

R4—100 kohms trimpot

R5A—500 kohms linear taper pot

R5B—5 megohm pot ganged to R5A

R6—500 kohms trimpot

R7—500 kohms

C1—250 mf, 35 volt electrolytic capacitor

C2—300 mf, 16 volt electrolytic capacitor

C3,C4—0.02 mf ceramic disc capacitor

C5—10 mf, 35 volt tantalum electrolytic capacitor

IC1—NE555 Signetics integrated circuit or Radio Shack equivalent.

D1—HEP105 12 volt, 1 watt zener diode

Q1—HEP245 transistor from Motorola
RLY1—12 volt, 3 watt power relay from Calcraft (D1-976)

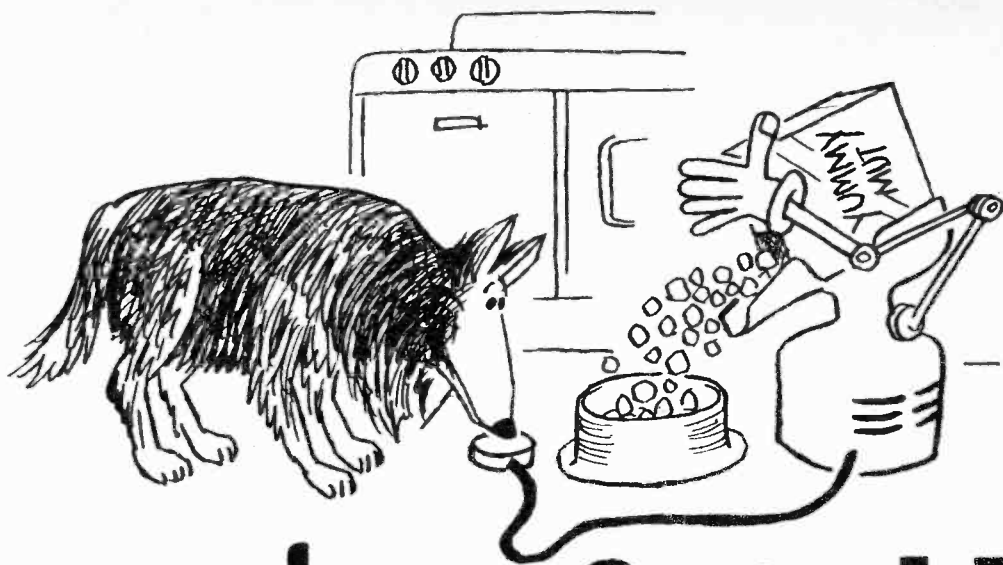
S1—SPST lighted rocker switch, Calcraft E2-135

S2—Pushbutton switch Calcraft E2-142

S3—DPDT miniature toggle switch, Calcraft E2-118

T1—12.6 volt, 1.5 amp transformer, Triad F-25X

Misc.—Sloping panel utility box, ASPC 1201—5 in. or 1203—7 in., 110 volt AC single-socket receptacle, wire, solder, knob for main control, hardware, perfboard, etc.



Touch to Switch!

Go modern! Instead of flipping switches, be lazy and just touch a plate.

By A. J. MOLINARA

PEOPL**E** get lazier every day. It seems whenever you turn around there's a new labor-saving device designed to make life easier. For example, did you know it's even possible to eliminate the strain of flipping a switch?

We got so exhausted from turning the lights on and off with a wall switch the other day that we built a gadget to spare ourselves even this exertion. Now, all we do is *touch* a small plate to control the lights.

Commonly known as a capacity switch, our gadget has many other practical applications. Amateurs, for instance, can put the sensing plate near the mike and use our touch switch as a transmit/receive switch. Install the switch's sensing plate at the front door and you have a light-touch doorbell button.

Put the sensing plate near the top of a tank or tub and when the water level gets too high a bell will ring. Install the plate near the ground at the back door and all Fido has to do is touch it with his nose to let you know he wants in.

You have an option when building our touch switch. Our design includes a latching

relay (RY2) to keep, say, a light or bell on *after* you remove your finger from the sensing plate. To turn the light or bell off, you touch the sensing plate a second time.

If you are going to use the switch for a doorbell or a water-level alarm, eliminate RY2 and connect the bell circuit to contacts 3 and 4 on RY1. The doorbell then will stop ringing the instant you remove your finger from the sensing plate.

Construction. Our model is built on a 2 $\frac{3}{8}$ x5-in. piece of phenolic board. However, perforated board, plastic or bakelite will work just as well. If you expect to mount the circuit board inside a 4x6x2-in. chassis (Premier ACH-431), check the clearance before mounting the relays on the board.

Temporarily position the relays, terminal strips and transformer to determine where to drill mounting holes for them. Then mount these components. Install all wiring on the board before mounting components.

When installing diodes D1, D2, D3 and D4, hold the leads near the case with a pair of longnose pliers while bending them. If you simply hold the diode itself and bend a lead, the lead may break out of the diode's

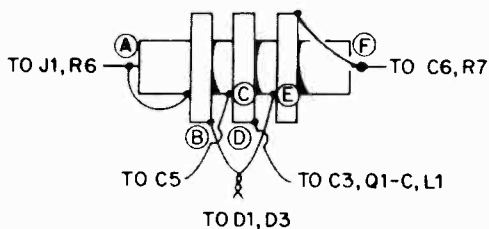
Touch to Switch!

body. Also, be sure to hold the pliers on the leads when soldering to dissipate heat.

The cathode end of diodes D1, D2, D3 and D4 (marked with a + sign in our schematic and pictorial) is identified with a color band on the diode's body. Be sure to use 5 percent resistors for R6 and R7 and the temperature-compensating capacitors specified for C3 and C4.

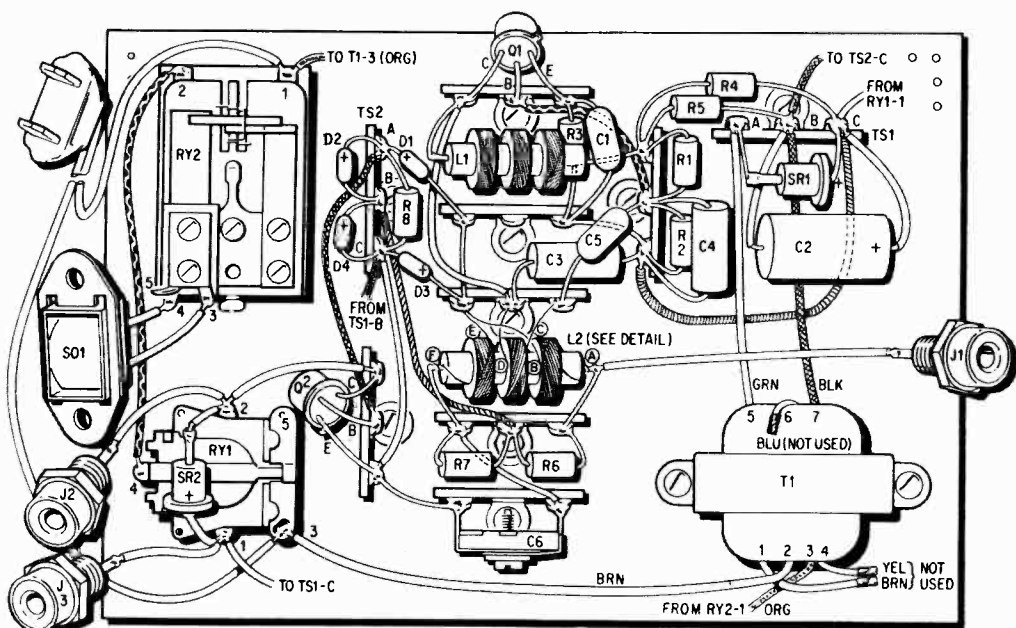
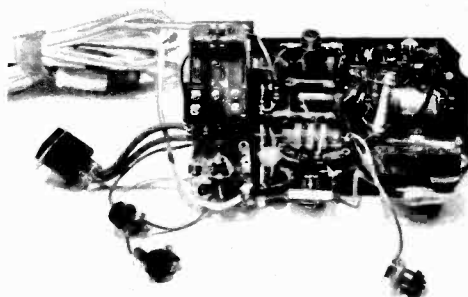
Coil L2 is a modified 3-section, 2.5-millihenry RF choke. The modification converts the choke into a transformer in which the center section becomes the primary and serves as the inductance in the RF oscillator circuit. The two outer sections become secondaries of the transformer and couple the RF from the oscillator to the four-diode bridge.

Take a look at the pictorial of the coil at the top of the second page of this article.

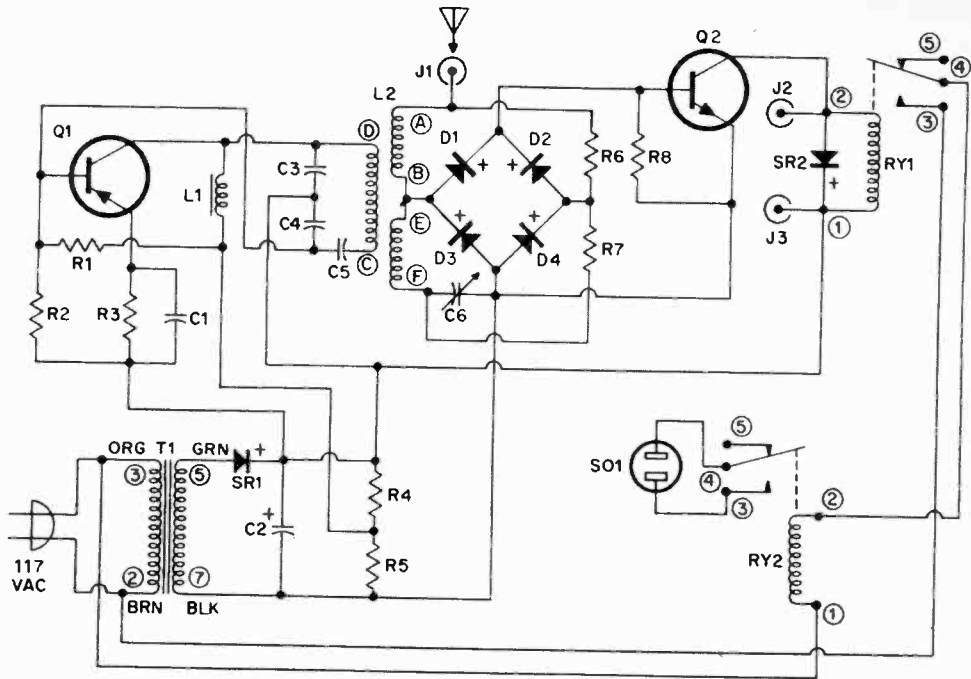


L2 MODIFICATION

L2 must be a three-section, 2.5-millihenry RF choke. It is modified by breaking the wires between sections, unwinding them and soldering the wires from the left and right windings together.



Space is at a premium on the 2 $\frac{1}{2}$ x 5-in. board shown in the photo above, so take care. Author used the brown and orange secondary leads of T1, across which the voltage was highest. Keep wires from L2 to D1-D4 and other parts short and mount capacitor C6 so it can be adjusted through hole in cabinet.



RF produced by Q1 is coupled to the two secondary windings of L2. If capacitances to ground at J1 and C6 are equal, voltage across diode bridge and Q2's base is zero. When J1 is touched, bridge is unbalanced and its output forward-biases Q2, causing it to conduct and energize, which then energizes RY2.

Break the wire between the sections and unwind a few turns from each section. Wires from the left and right sections are connected together. We have identified each wire with a letter and show circuit destinations.

Check-Out. First thing to do is determine if the RF oscillator is working. Plug in the touch switch and tune a broadcast radio placed nearby to around 800 kc. If the oscillator is working you'll hear it (the radio will go silent). The frequency isn't critical so long as you pick it up somewhere in the broadcast band.

If you are not going to mount the switch in a metal box, plug a 3-ft. wire with a 1-in. dia. plate on one end in J1. (If you *are* going to mount the switch in a metal box, hold off making the following adjustment until the board is installed in the box.) Connect a VTVM set to a low DC range to jacks J2 and J3. Using a plastic alignment tool, adjust C6 for the lowest voltage.

If you are going to mount the switch in the box, be sure to use spacers to keep the back of the circuit board away from the box. After mounting the board, mount jacks J1, J2 and J3 and SO1. Now, make the adjustment discussed in the preceding paragraph. ●

PARTS LIST

- C1, C5—.01 mf, 100 V, 10% mylar capacitor
- C2—50 mf, 50 V electrolytic capacitor
- C3—240 mmf, 600 V temperature compensating (N750) tubular capacitor (Centralab TCN-220, Lafayette 33 G 2222)
- C4—510 mmf, 600 V temperature compensating (N750) tubular capacitor (Centralab TCN-510, Lafayette 33 G 2231)
- C6—9-180 mmf trimmer capacitor (Lafayette 34 G 6831 or equiv.)
- D1, D2, D3, D4—1N34A diode
- J1, J2, J3—Insulated pin jack or phono jack
- L1—2.5 mh, 3-section RF choke (National R-50, Lafayette 32 G 5118)
- L2—2.5 mh, 3-section RF choke (Modified National R-50; see text)
- Q1—2N1305 transistor Q2—2N696 transistor
- R1—22,000 ohm, ½ watt, 10% resistor
- R2—2,700 ohm, ½ watt, 10% resistor
- R3—100 ohm, ½ watt, 10% resistor
- R4—3,900 ohm, ½ watt, 10% resistor
- R5—1,500 ohm, ½ watt, 10% resistor
- R6, R7—24,000 ohm, ½ watt, 5% resistor
- R8—4,700 ohm, ½ watt, 10% resistor
- RY1—SPDT relay, 2500-ohm coil (Potter & Brumfield RS5D, Lafayette 30 G 8599)
- RY2—Latching relay; SPDT 5A contacts, 117 V, 60-cycle coil (Guardian IR-610L-C116. Available from Newark Electronics Corp., 223 W. Madison St., Chicago, Ill. 60606. Stock No. 24F098. \$4.50 plus postage)
- SO1—AC socket SR1, SR2—1N1692 diode
- T1—Filament transformer, primary: 117 V secondary: 26 V @ .04 A. (UTC type FT-13, Lafayette 30 G 7129)

LONG before VOMs or VTVMs came along to measure resistance, a bridge that never crossed a river was used to do the job. Called a Wheatstone Bridge, it determined resistance by comparing an unknown-value resistance with a known-value resistance.

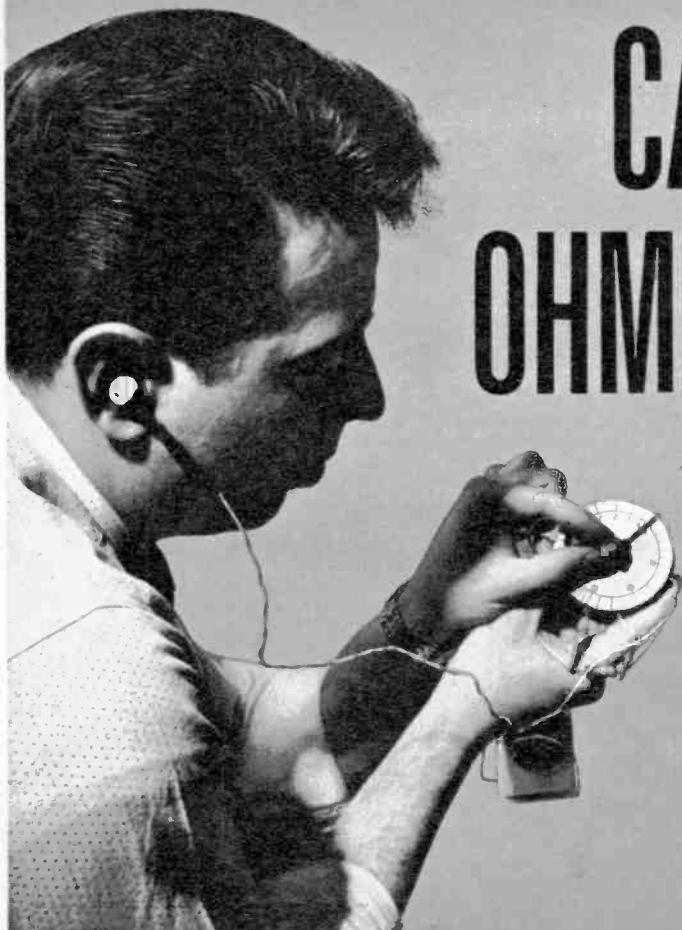
Using about \$2 worth of parts and your transistor radio (or any audio-signal source) you can build a Wheatstone Bridge ohmmeter that will measure resistance from less than an ohm to 1 megohm. Most any small container can be used as a case. A handy one from the size standpoint is a cleaned-out shoe-polish can which ours was built in. If calibrated with care its accuracy will be as good as the tolerance of resistors R2-R8.

To measure resistance you simply plug the ohmmeter via PL1 into the earphone jack of a transistor radio and put the Canned Ohmmeter's earphone in your ear. Turn the ohmmeter's knob (R1) until the volume is at a minimum, or until you don't hear anything, then read the value of the resistor from the ohmmeter's dial. Construction details are covered in the pictorial's caption.

To calibrate the dial, turn R1 full counterclockwise and mark this point on the dial. Turn R1 full clockwise and also mark this point on the dial. Having found R1's rotation extremes, use a compass and a ruler to determine the exact midpoint of rotation. This point represents half of R1's resistance and should be

CANNED OHMMETER

BY MARTIN H. PATRICK



CANNED OHMMETER

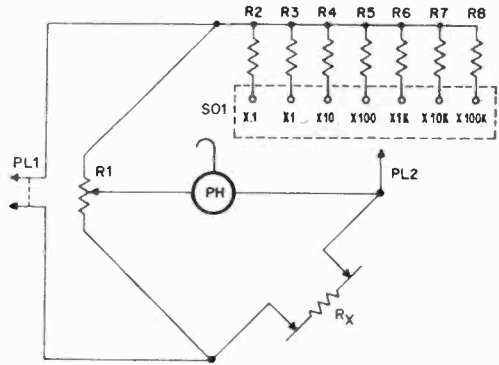
marked 10 on the dial.

Plug PL1 into the earphone jack of a radio tuned to a strong station. Put the earphone in your ear and put PL2 in the hole in SO1 marked $\times 100$. You should be able to hear the station. Now, connect a 5,000-ohm potentiometer (which we'll call *pot A*) to the alligator clips, set R1 to number 10, and adjust *pot A* until you either hear nothing or the volume is at minimum (null). *Pot A* is now set at 1,000 ohms. In conjunction with a 10,000-ohm potentiometer (which we'll call *pot B*) connected in series with *pot A*, we are now going to calibrate the ohmmeter's dial from 1 to 10.

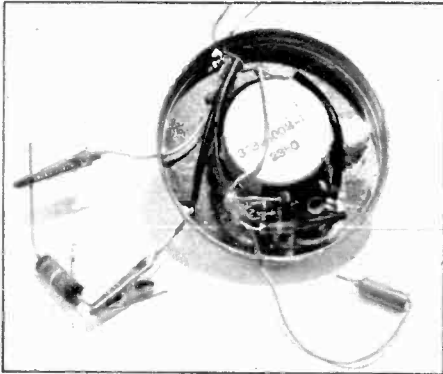
With *pot A* (which is set at 1,000 ohms) connected to the alligator clips, move PL2 from the $\times 100$ to the $\times 1,000$ hole in SO1

Turn R1 counterclockwise for another null. Mark this as point 1.

Set R1 at 10 again, put PL2 in the $\times 100$ hole and connect *pot B* to the alligator clips. Adjust *pot B* for null. *Pot B* is now set at 1,000 ohms. Connect *pot A* and *B* in series (1,000 plus 1,000 equals 2,000 ohms) to the alligator clips. Plug PL2 in the $\times 1,000$ hole and adjust R1 for null. Mark this as point 2.



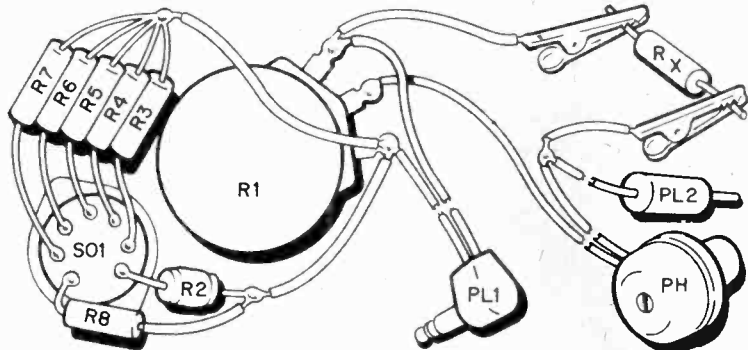
Ohmmeter is a bridge to which audio is fed at PL1. When R1 is set so voltage drops across Rx and part of R1 are equal, signal will be weak or inaudible.



Our model was built in a 2 $\frac{3}{4}$ -in.-dia. shoe-polish can. A larger housing, and consequently a larger dial, will enable you to make more accurate measurements. Socket SO1 should be right next to the edge of the can. And put tape on all connections so they don't short to the can. PL1 mates with phone jack on your transistor radio.

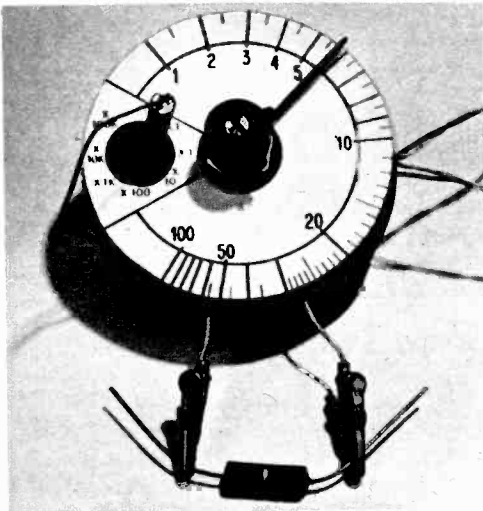
PARTS LIST

- PL1—Miniature phone plug to match phone jack on radio
- PL2—Tip plug PH—8 ohm earphone
- Resistors: $\frac{1}{2}$ watt, 5% or 10% unless otherwise indicated
- R1—5,000 ohm, wirewound linear taper potentiometer
- R2—1 ohm, wirewound resistor (6 feet No. 32 enameled wire wound on 3/16 in. dia. X $\frac{1}{2}$ in. long piece of wood.)
- R3—10 ohms R4—100 ohms
- R5—1,000 ohms R6—10,000 ohms
- R7—100,000 ohms R8—1 megohm
- SO1—Miniature 7-pin tube socket
- Misc.—Miniature alligator clips



Canned Ohmmeter

Remove pot A and connect pot B to the alligator clips without moving R1. Adjust pot B for null (pot B's resistance is now 2,000 ohms). Connect pots A and B in series and again adjust R1 for null. Mark this as point 3. Remove pot A and connect pot B to the clips. Adjust pot B for null. (Pot B's resistance is now 3,000 ohms.) Connect pots A and B in series and to the clips. Adjust R1 for null. Mark the dial 4. Continue in this manner until you calibrate the dial from 1 to 10. Just remember that pot A *always* remains set at 1,000 ohms and pot B is adjusted



Cut a piece of cardboard to fit over the top of the can and draw a circle on it $\frac{1}{4}$ -in. in from the edge. Cut a V-section out of the cardboard for SO1. R1's mounting nut holds the cardboard.

to produce a null at the newly found resistance. When you reach 10 on the dial the pointer should be right over the 10 mark.

Mark the rest of the dial as follows: place PL2 in the $\times 1,000$ hole in SO1, set R1 at 2 (connect pot B to the alligator clips), and adjust it for null (pot B's resistance is now 2,000 ohms). Move PL2 from $\times 1,000$ to $\times 100$ and turn R1 for null. Mark this as point 20. Place PL2 in $\times 1,000$, set R1 to 3 and adjust pot B for null. Put PL2 in $\times 100$, turn R1 for a null, and mark 30 on the dial. Continue this procedure until you reach 100. ●

Electronic Timer

(Continued from page 103)

be needed to connect the perfboard wiring with the start switch, range switch, time-control potentiometer and the relay. Make these connections before you mount the board.

Carefully measure the distance of the spacers from the edge of the perfboard. Mark the bottom of the utility box and then drill two clearance holes for two No. 4-40 screws. The board should fit nicely in the corner of the box under the AC receptacle.

In the following order mount the range switch, the time-control pot, the push button start switch and the relay. Make the two connections between the AC receptacle and the relay contacts.

The power transformer is then mounted and connected to the terminal strip and the electronics board.

Calibration requires an accurate time source such as a stopwatch or electric clock. The best method would be to plug an electric clock into the receptacle and be able to check timing cycles right on the clock. However a good stopwatch will do the trick.

Set calibration pots R4 and R6 to mid rotation. Set time-control pot R5 exactly to mid-rotation. Plug in the timer and turn on power switch S1. Make sure range switch S3 is in the X10 position.

Press the start button and time the length of the control cycle (until the relay drops out or clicks). If you are using an electric clock plugged into the appliance socket, merely read the elapsed time off the clock. Adjust R6 repeatedly until the cycle is exactly 35 secs.

Now with time-control pot R5 in the same position throw the range switch to the X1 position. Adjust R4 until the timing cycle is 5 secs. Because this cycle is so short, you should check the scale also at 10 secs.

If you're a little deeper into electronics you can experiment with the chip to get longer timing cycles. By adding another capacitor in parallel with C5 and increasing the resistance in the timing circuit you can significantly increase this IC's time-delay capability. ●

Souped-Up Phone Tap


EASIEST way to tap your phone (*that's legal*) to record a message or for group listening through an amplifier is with an induction pickup coil. One commercially available type is a thin rectangle and fits under the telephone base. But it's hard to find the best coupling position. Cylindrical coils with a suction cup have somewhat better pickup than the flat-coil bit they're clumsy and often fall off the handset. Both types are high impedance (1,000 ohms) and are designed to work with tube or transistor amplifiers.

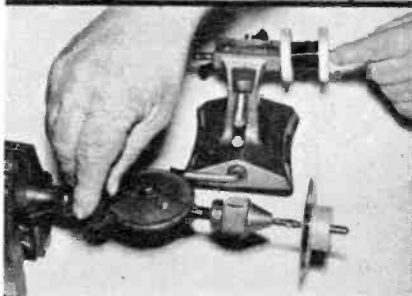
Our souped-up phone tap can be made for half the cost of other coils and, because it has a larger coupling area, it is about twice as sensitive. And its lower impedance (100 ohms) is a better match for transistor-amplifier inputs.

The rubber cap in which our coil is installed (see top photo) is called a Tele-Muff and is available for about 25¢ in stationery and office-supply stores. It holds the coil in perfect position over the handset earpiece and affords ear comfort.

The best form on which to wind the coil is the hub of a 50-foot 8mm movie film reel or a 3-inch tape recorder reel (modified, see second photo). If neither of these is available, wind the 1,000-turn coil (No. 34 enameled wire) on a 1¼-inch-diameter form between cardboard flanges spaced 3/16 inch apart. A quarter-pound spool of No. 34 wire has about 2,000 feet—enough for four pickup coils.

After the coil is wound, remove it from the form and wrap it tightly with masking tape. Neatness isn't terribly important but don't scrape any enamel insulation off the wires or you will short out some of the turns. Connect the coil leads to a length of shielded microphone wire.

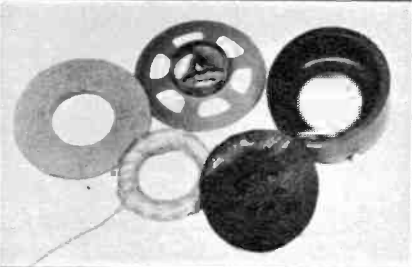
Cut two 2¼-inch discs from cardboard and punch about six holes near the center of each (see top and bottom photos). Sandwich and glue the taped coil between the two discs. Then punch a small hole near the front of the Tele-Muff for the cable. Pull the cable through and push the coil/cardboard sandwich all the way into the Tele-Muff. Install a plug on the other end of the wire and you're ready to go.—Gregg Bruce, Jr. 



Remove flange from 8mm film reel, slip on cardboard disc 3/16 inch from other flange, then wind 1,000 turns.



After removing cardboard disc from reel hub, pull off coil, compress turns and wrap tightly with tape.



Movie-film reel with flange removed; cardboard-disc spacer and coil are at left. Finished tap is at right.

Consumer's Guide to CB Equipment



IT'LL COST you \$22 (plus equipment) to join the world's biggest radio club—the 1 million Americans who use two-way citizens-band radio in their personal and business affairs. Twenty pays for a five-year government license, two

is for the rules you must have. (For both, check with the nearest FCC office.) Then, if you're typical, you'll purchase one transceiver—a radio that sends and receives—for your home, add one for the car, then possibly a set for a second car, camper, boat or office.

To start a workable CB system, expect to spend about \$300 to \$400. This buys a pair of transceivers, antennas for each, all the connecting cables and possibly a simple tune-up instrument. CB sets share certain qualities:

Number of channels. CB has a maximum of 23 channels and you may as well get a set that has them all. All-channel rigs today are a bargain and give you most freedom to switch away from the interference of static and other voices. You'll also be able to operate on any special channel—for example, Channel 9 is reserved for road emergencies while 13 is a favorite of pleasure boats.

If you find what seems to be a great buy, make sure that crystals for all 23 channels are supplied. Some rigs have tunable receivers that can pull in all channels but to get on the air you might have to spend \$75 for a set of crystals.

Physical size. Many CBers buy a big set for home and a small one for the car. Size rarely affects basic performance but large cabinet dimensions allow more convenient operating knobs and meters, a larger speaker for improved sound and a slicker appearance. Small size has the advantage of easy mounting in a vehicle, especially under the lip of a car dashboard. Otherwise, large and small rigs perform about equally as well. Fully transistorized rigs are recommended for car or boat because they'll operate longer on a vehicle battery during an engine-out emergency.

Power source. Most sets operate from either 117 volts AC (in the home) or 12 volts DC for mobile work. Thus you can dismount a boat set (to prevent theft) and operate it at home. If you want to save money or need extremely small size, you can buy a set that works solely on 12 VDC. Later you can get an AC power supply.

If you need communications while on foot, then the power supply must be a battery pack. Radio Shack has a \$29.95 housing that converts its mobiles to portables with a unitized battery case, shoulder sling and telescoping antenna.

The ultimate in walk-along CB is the high-power walkie-talkie that shrinks everything—batteries, antenna, microphone—into a case you heft like a telephone. For this degree of miniaturization you pay about \$145 for a Fanon T-1000, for example, and enjoy full 5-watt power.

Several other specialized CB sets are on the market. One is single sideband (SSB), usually the highest-price model of all. With sophisticated circuits that multiply a set's efficiency, the con-

ventional 5-watt transmitter is made to sound like 40 watts. It punches through poor conditions where normal communications often fail, but the price tag is near \$300 (the Midland Model 13-894, for example). Through another electronic twist, an SSB set also doubles the number of available channels from 23 to 46. But an SSB set must talk only to another of its own breed. It's fine if you're equipping your own stations for maximum range among themselves. Perhaps the best bet is an SSB transceiver that also has the regular 23-channel coverage. Lafayette offers the mobile Telsat SSB-50 for \$289.95.

If you live in a populous city, the citizens band will surely be crowded with stations, so pick a set with good selectivity to help keep them apart. Such sets have a dual-conversion receiver, along with a ceramic, crystal or mechanical filter. A squelch control is important to keep out annoying static. A receiver should also have some form of noise silencer or limiter to quiet a nearby vacuum cleaner, ignition system or other electrically noisy source.

Some receivers not only cover CB, but let you listen in on other channels or even two at a time. One example is the Channel 9 priority feature. If someone calls for help on CB's distress channel, the call is automatically sounded in your set, even as you operate on some other channel. Another add-on feature is an extra band for hearing police and fire communications (though this is often restricted in cars by local statute).

If you must go it alone in the dealer showroom, here are some items to watch for. A receiver with good selectivity chops off interfering adjacent channels; that is, if you're tuned to Channel 7, strong stations on 6 or 8 shouldn't break through. High sensitivity, another good trait, is the ability of a set to pull in distant or weak signals.

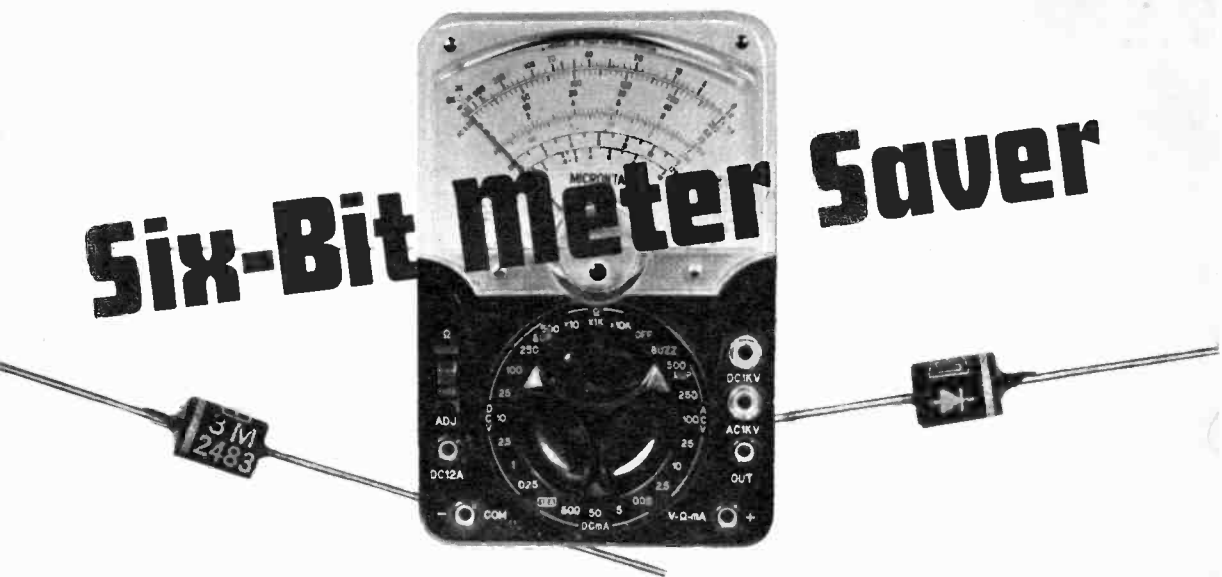
The most important CB accessory is the antenna. The beginner should probably choose one of the mainstay antennas that give excellent results over CB's operating range of about 10 mi. between home and car (it's several times that distance over water). A big seller for the home is the collinear, a vertical rod which extends nearly 20 ft. with several short horizontal rods at the base.

Another indispensable accessory for the new CBER is a basic measuring instrument known as the SWR-Field Strength meter. It takes little skill to operate but gives an excellent check of whether you've done the installation properly.

The first time you turn on a newly installed mobile set you could be greeted by ear-splitting static from the car's ignition system. Expect to shell out another \$10 or so for spark-plug suppressors, an alternator filter and other noise-killing devices.

The most recent consumer news about CB is that the FCC is now considering a *second* CB service—Class E (we now have Class B). If it's approved (and its chances look good) it could take effect by about 1975. Although the new band will have important advantages—less interference and more channels—equipment will probably cost somewhat more than today's gear. So, is it wise to buy now? Yes. The FCC has no plans to abolish today's band and it should coexist for years with the new one. ●

Six-Bit meter Saver



EVEN if it's only a \$10 VOM, nobody likes to see it burned out by a moment of carelessness. And if it's a \$60 instrument you've deep-sixed, the grief and loss of green stuff are horrifyingly real.

Sure, most of us at one time or another by incorrectly setting a switch or by putting a test lead in the wrong place have sent a meter movement to the big shop in the sky. It usually happens fast enough to prevent second chances. All it takes to burn-out proof most any meter is cigarette money and ten minutes work.

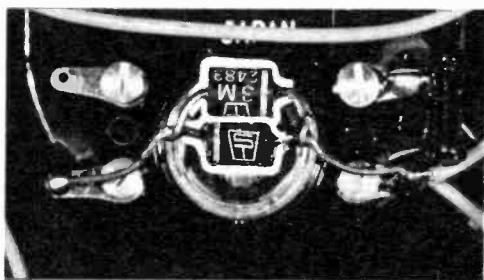
The secret is two inexpensive silicon diodes connected back-to-front and paralleled across the meter terminals, as shown below. But you cannot protect a meter that has a series resistor built into it. The terminals must be connected directly to the meter coil.

Silicon diodes require a nominal 0.7 V across them before they conduct. Most me-

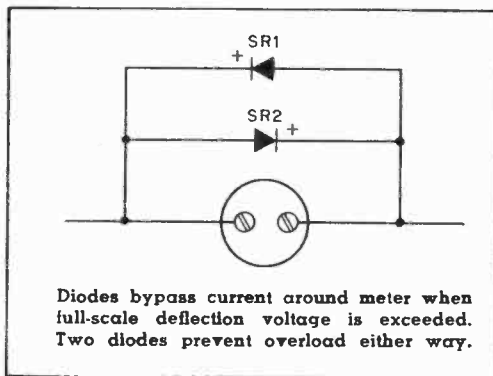
ters when deflected fully will have a voltage that is less than 0.7 V across their terminals. The diodes, therefore, will have no effect on the meter. But when the meter is overloaded severely the voltage across its terminals reaches the diode's breakover voltage, the diodes conduct and excess current is bypassed around the meter.

SR1 and SR2 can be any low-cost silicon diodes, such as Lafayette's 19 R 5001. They will protect virtually any 50- μ a to 1-ma DC meter. With some meters the diodes may interfere with accuracy. To check whether they do, try them before they're installed permanently. Measure a voltage and note the quarter-, half-, three-quarter- and full-scale deflections. Connect the diodes temporarily across the meter terminals and repeat the procedure. If the meter readings don't change, connect the diodes permanently in place.

—Chet Stephens



Install diodes (shown here outlined in white) directly across meter terminals in VTVM or VOM.



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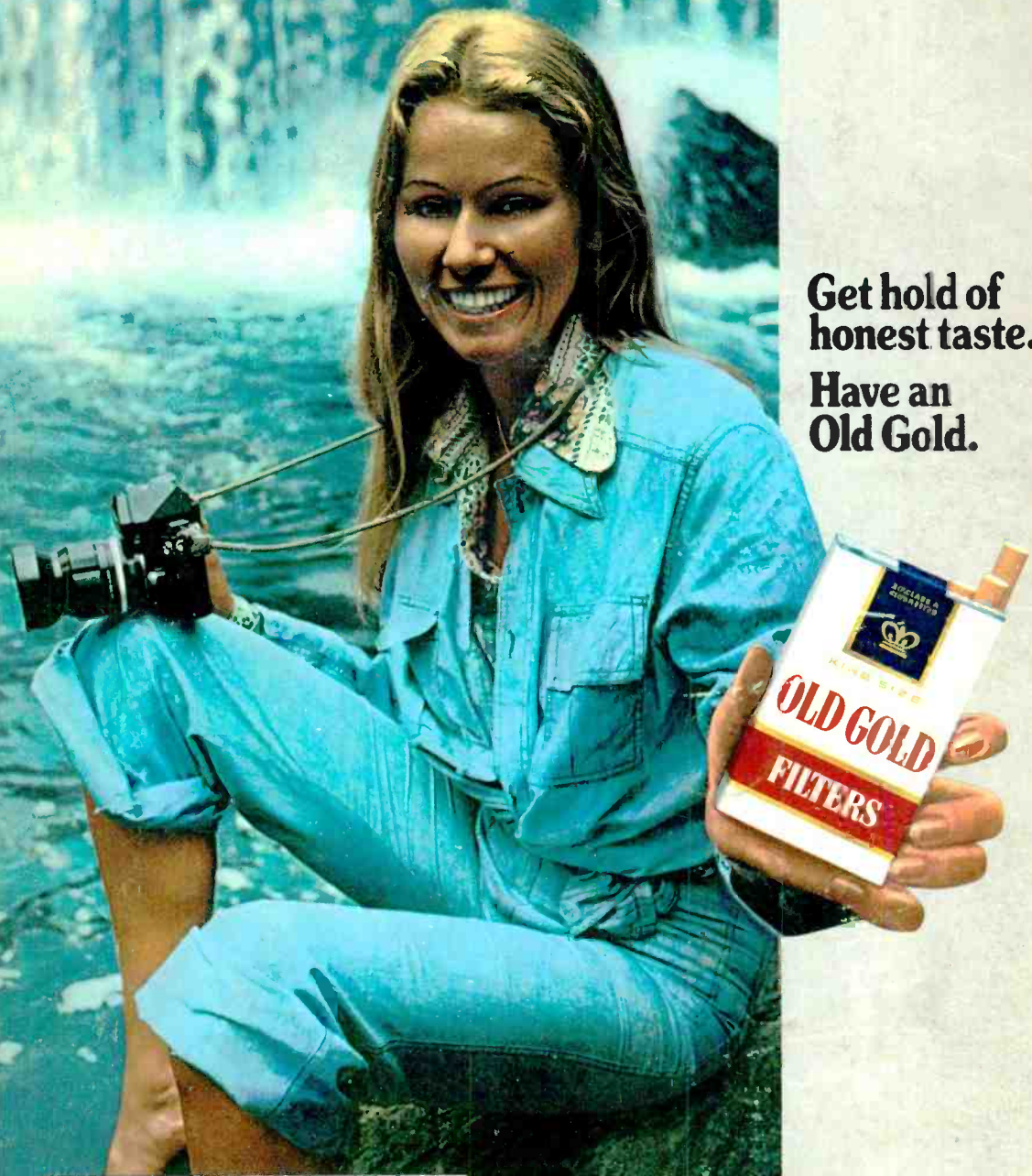
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