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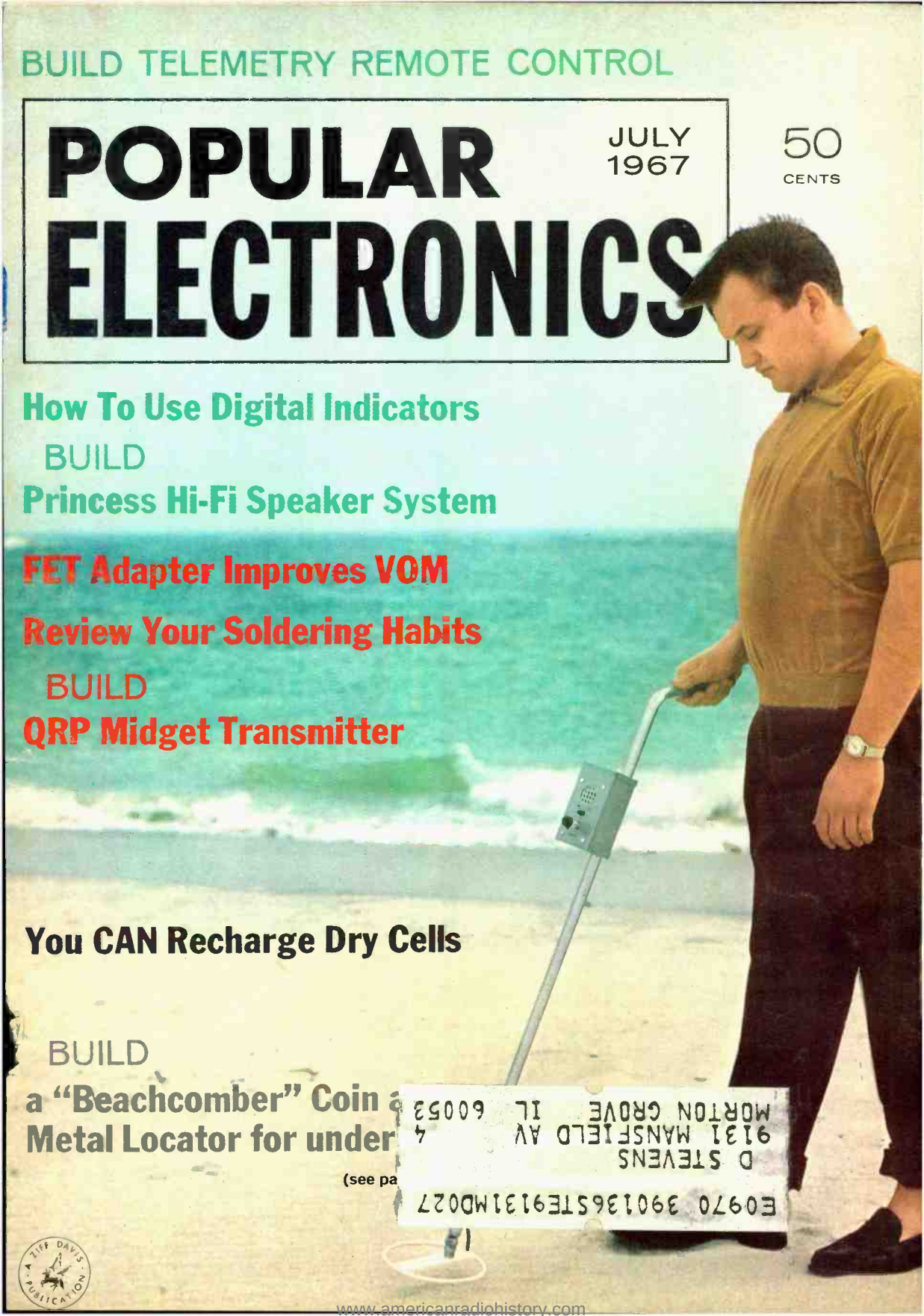

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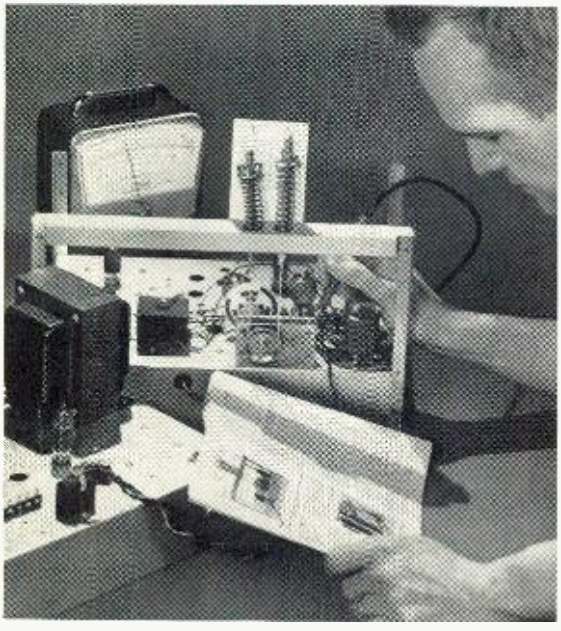

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L. V. Lynch, Louisville, Ky., was a factory worker with American Tobacco Co., now he's an Electronics Technician with the same firm. "I don't see how the NRI way of teaching could be improved."

G. L. Roberts, Champaign, Ill., is Senior Technician at the U. of Illinois Coordinated Science Laboratory. In two years he received five pay raises. Says Roberts, "I attribute my present position to NRI training."

Don House, Lubbock, Tex., went into his own Servicing business six months after completing NRI training. This former clothes salesman just bought a new house and reports, "I look forward to making twice as much money as I would have in my former work."

Ronald L. Ritter of Eatontown, N.J., received a promotion before finishing the NRI Communication course, scoring one of the highest grades in Army proficiency tests. He works with the U.S. Army Electronics Lab, Ft. Monmouth, N.J. "Through NRI, I know I can handle a job of responsibility."

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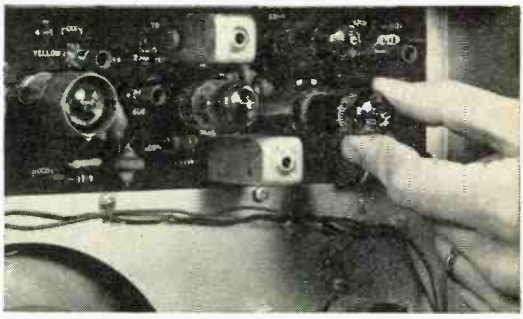

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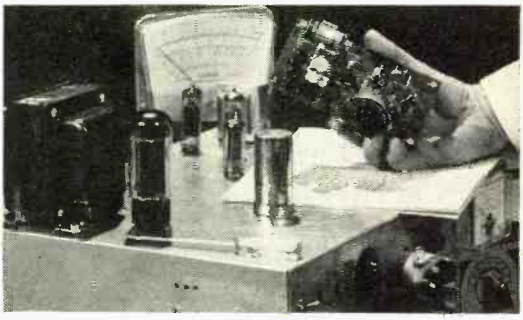

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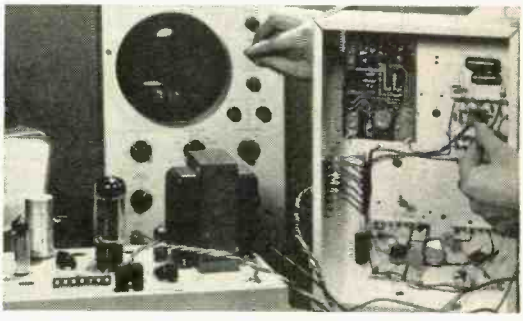

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POPULAR ELECTRONICS

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE

VOLUME 27 **JULY, 1967** NUMBER 1

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POPULAR ELECTRONICS is indexed in the Readers' Guide to Periodical Literature

This month's cover photo by Conrad Studios, Inc.

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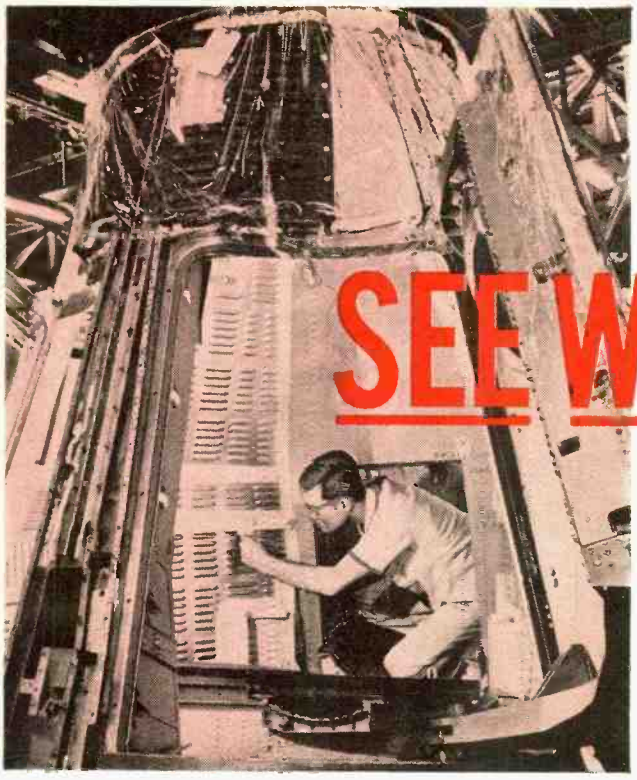

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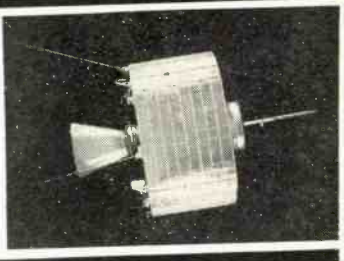

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THE MULE IS A JEWEL

We developed, designed, and have manufactured the "Jewel Box" since late 1964. This is an outboard r.f. amplifier similar to your "Mule Box" (March 1967, p. 45). It is often said that you should be flattered if someone thinks enough of your work to copy it. We are flattered.

RICHARD MARESH
Wawasee Electronics Company
Syracuse, Ind.

As with innumerable electronic circuits, there are similarities between the "Jewel Box" and the "Mule Box," but the "Jewel Box" was not designed for operation with Class D CB equipment. And although the method of reducing carrier amplitude is similar, there are at least a dozen other distinct differences between these two circuits.

TUNER TAMER

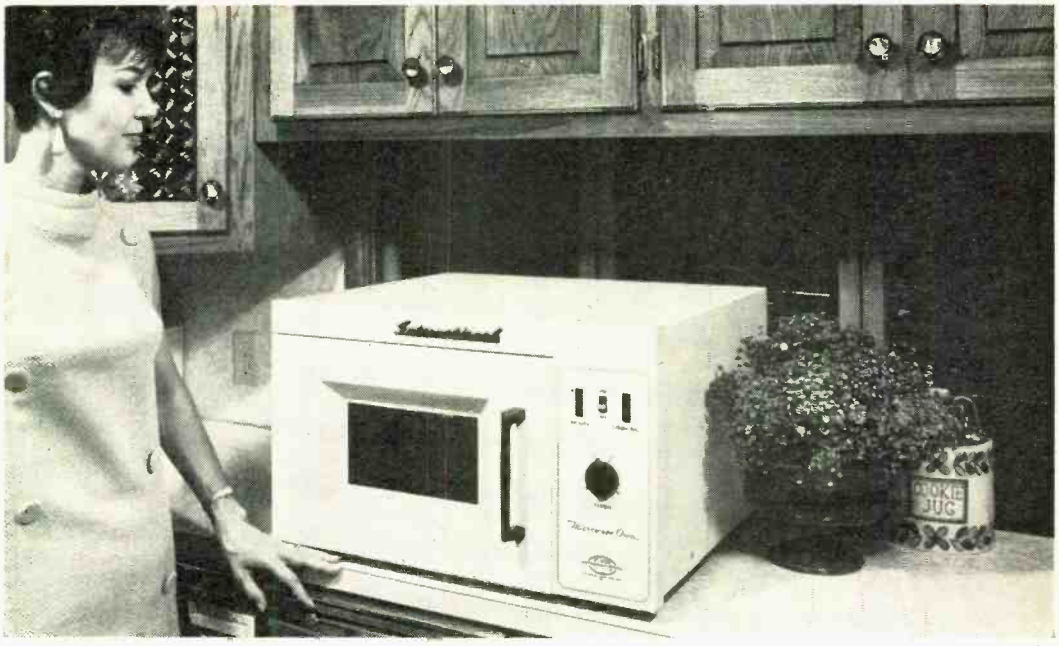
Being a Tuner Tamer myself for several years, I was happy to see the article called "Taming Your TV Tuner" (March, 1967). But I would like to add a P.S. to this fine article. On a recent safari into my Heathkit color TV tuner for its annual taming, I noticed a fair

amount of wear on the contact strips, and it seemed to me that this wear could be greatly reduced if the unused channel strips were removed. In our area only six channels are used, so I removed seven strips. The results were as expected: the wear was reduced in proportion to the number of strips removed. I eliminated 7/13 of the normal wear. Now my annual safari has become a biennial affair.

JERRY WALTER
N. Palm Beach, Fla.

PUBLIC COMMENDATION

I took my Weller Model 8200-PK soldering gun back to the store to be sent to the factory



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International Microwave Oven is truly remarkable. No more waiting for the oven to reach cooking temperature.

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CIRCLE NO. 13 ON READER SERVICE PAGE

LETTERS

(*Continued from page 8*)

because of a faulty switch. The gun came back, promptly, not just fixed, but polished, with a set of tools, three new tips, and a guarantee to boot. I would like to commend the Weller Electric Corp. for this fine service.

DOUG WEARY
Carlisle, Pa.

PARTS SUBSTITUTIONS—AGAIN!

Why-oh-why do your authors always use parts and components that I can't buy? They keep calling out parts that stores in my city don't sell, or have never heard of. Are you and the authors in some other business—like selling radio parts?

HAROLD HAGENS
Waterloo, Iowa

Generally, an author recommends a particular part for a project because it's the one he used and he knows that the project works

with it. Neither the author nor the magazine can get every possible substitution and try it out. To be on the safe side, we always tell you what the author used. It is often possible to substitute a different manufacturer's part, but such substitution must be made at the builder's discretion.

"ETERNAL VTVM 'C' CELL"

Incorporating the "Eternal VTVM 'C' Cell" (May, 1966) in my Heathkit IM-13 VTVM was easy, but it takes a little doing on the IM-11 with its printed circuit board. I made up a package of the resistor, rectifier, and a nickel-cadmium battery the size of a penlight cell (C450 or N46, Allied 55 U 629) wrapped with tape and padded out to the size of a "C" cell. The a.c. lead was connected to the hot side of the pilot lamp. I put a piece of insulating tape over the "plus" end with a hole for the contact, and wrapped the connecting wire around the contact—NO SOLDER. In case of trouble, this package can be easily removed and the regular "C" battery restored.

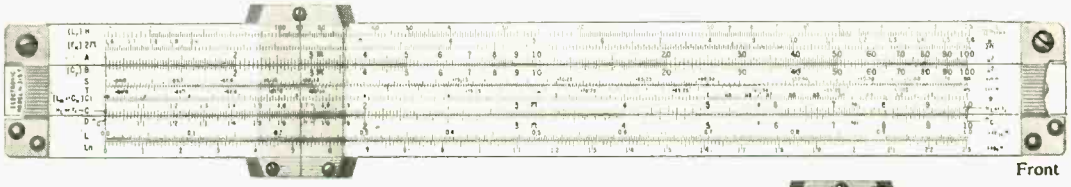
HENRY C. MCCARTY
Sun City, Calif.

ASSISTING OPERATION ASSIST

To Philco owners who want schematics: I have obtained schematics and specifications

(*Continued on page 14*)

LOOK!
A New Electronics Slide Rule with Instruction Course



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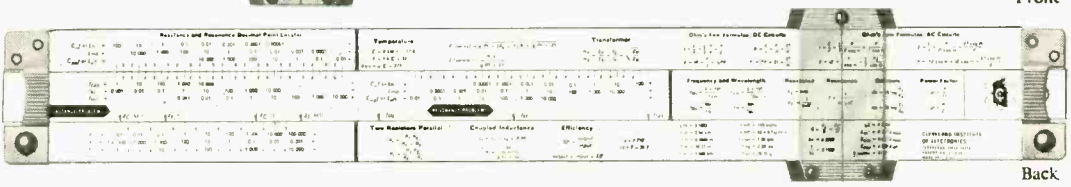

Back

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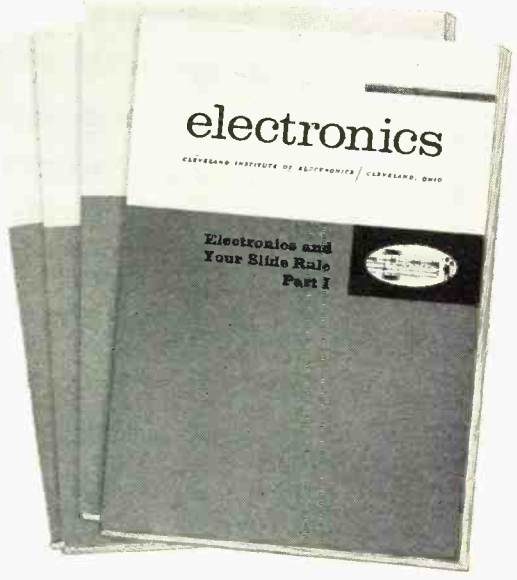

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CIRCLE NO. 6 ON READER SERVICE PAGE

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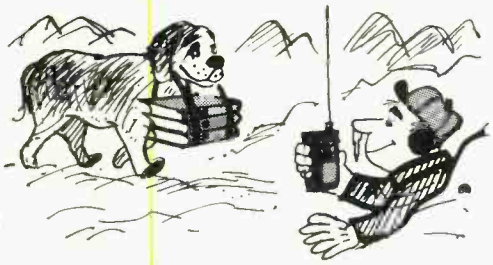
CIRCLE NO. 12 ON READER SERVICE PAGE

LETTERS (*Continued from page 10*)

from the Broome Distributing Company, 100 Tully St., Syracuse, N.Y., an address I received from the Philco home office. I obtained information on Models 40-180, 40-185, 40-190, 40-195, 40-200, 40-201, code 121-122; and Models 41-250, 41-255, 41-256, 41-246, code 121. They might well have other "old set" information.

ED YATES
Wyalusing, Pa.

We note many requests for circuit diagrams and service notes for pre-1935 radios in "Operation Assist." We have, in fairly good condition, several sets of RCA service notes covering the RCA "Superette," Radiola R-11, R-50, R-55, R-14-15, R-35, R-39, Re-57, #17, 42, 44, 46, 48, 8-, 86, portable "Victrola" 2-65, "Radiolette" R-5, etc. We would be happy to place these service notes with some responsible



group that would make the information available by photostat or otherwise to those interested. However, we would hesitate to turn them over to just any private individual for his personal use.

CHARLES W. SMALLWOOD
Charlotte Hardware
P.O. Box 368
Charlotte, Mich.

I have books on the Philco Models 3 to 511, all Philco models for 1939, 1941, and 1942, home and auto radios, which I no longer need. The books are complete, however—I would not want to tear out pages.

ERNEST PIIPPO
848 Summit St.
Hancock, Mich.

"HOW-TO" ELECTRONICS LIBRARY

The last item in "Electronics Library" (page 16, February, 1967) covers ten books which constitute a "How-To" electronics library. Would you be kind enough to give me an address that I can use to order these books by mail?

LARRY THOMAS
Franklin, La.

Since these books are distributed by the International Resistance Company through its electronic parts distributors, we suggest that you write to the company, which is located at 401 N. Broad St., Philadelphia, Pa. 19108, and let them take it from there. —30—

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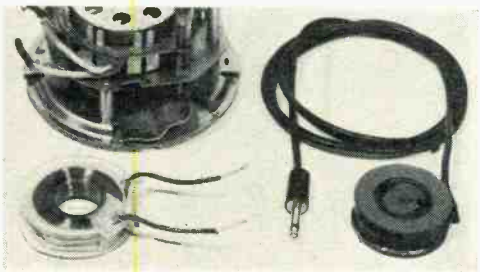
VOID AFTER AUGUST 31, 1967 7

PARTS METHODS IDEAS GADGETS DEVICES TIPS & TECHNIQUES

CLOCK MOTOR COIL DOUBLES AS TELEPHONE PICKUP

You can use the motor windings from an old electric clock as an inductive coupling coil to pick up telephone conversations and feed them into an amplifier for group or conference work. Remove the clock case and check the coil to see that it isn't open-circuited or otherwise defective. Then carefully remove the coil and connect it to one end of a shielded cable. Wrap the cable partially around the coil to act as a strain relief and secure it in place with several layers of electrical tape. Now connect the other end of the cable to a suitable jack to fit the input of your amplifier. Place the coil on the underside of the telephone cradle or in whatever position gives you maximum pickup.



—William Welch

"HOME-BREW" QUICKIE SOLDERING GUN TIPS

If your soldering gun tip breaks and you have no spares, you can improvise a new tip with a piece of No. 10 or 12 AWG solid copper wire. You can quickly fashion the wire to almost any shape you wish. Simply cut it to the correct length (3½" to 4½"), strip off the insulation, if any, and bend the wire to shape. Such a soldering tip might not last as long as the store-bought kind, but will tide you over until you have a chance to get a new supply of tips.

—Jack R. Kiser

GET 2, 4, 6, 8, 10 AND 12 VOLTS FROM YOUR CAR BATTERY

Car batteries are made up of a series of interconnected 2-volt cells, each of which can be tapped to provide a different potential up to 12 volts (6 volts with 6-volt batteries). To make the potential of each cell easily avail-

(*Continued on page 82*)

If General Custer had used a Messenger 300

. . . things might have happened differently that day along the Little Big Horn River.

There's really no need to fight a battle every time you want to go on the air. The Johnson Messenger 300 protects your flanks at all times from adjacent channel interference with a precision crystal filter. Your voice carries authority thanks to the Messenger 300's speech compression circuit. It gives you more audio without splatter or overmodulation.

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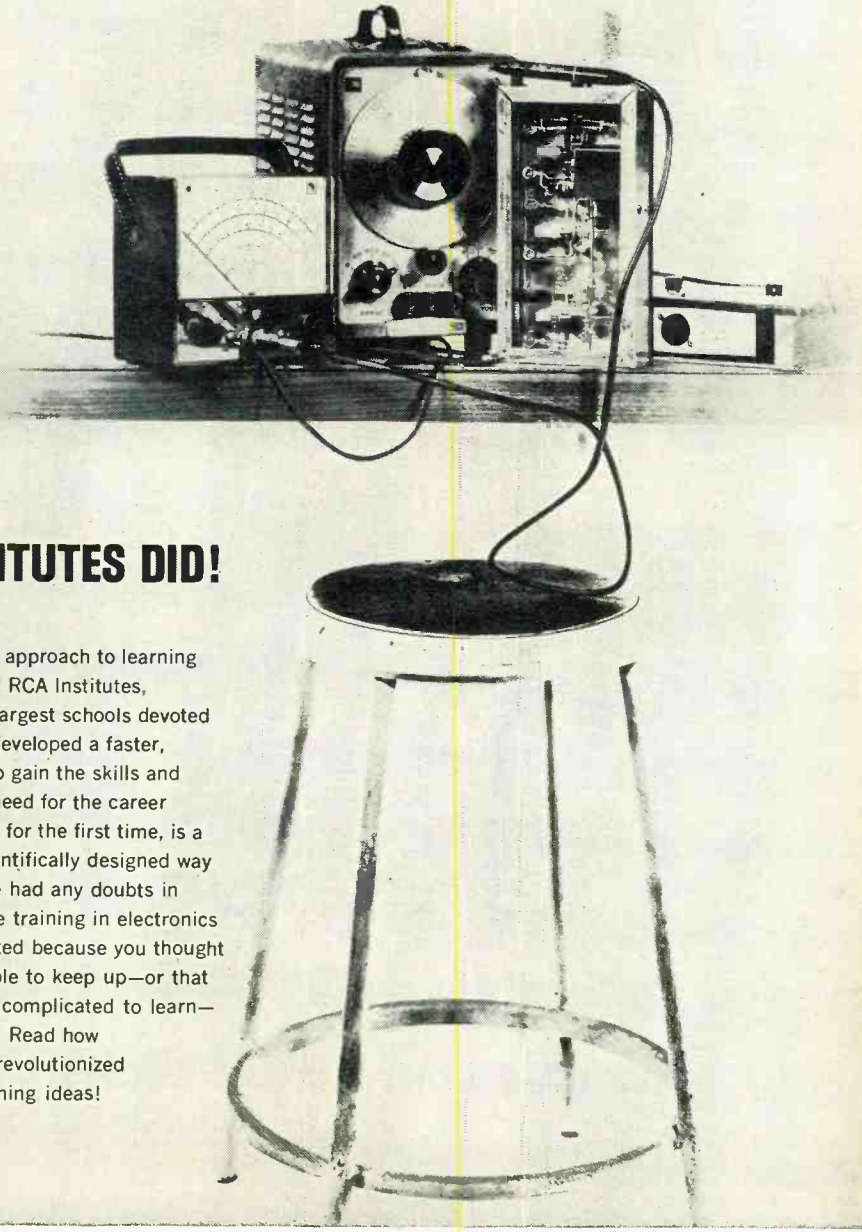
CIRCLE NO. 14 ON READER SERVICE PAGE

SOMEONE SHOULD DEVELOP AN EASY WAY TO LEARN ELECTRONICS AT HOME



RCA INSTITUTES DID!

Here is a whole new approach to learning electronics at home! RCA Institutes, one of the nations' largest schools devoted to electronics, has developed a faster, easier way for you to gain the skills and the knowledge you need for the career of your choice. Here for the first time, is a student-proved, scientifically designed way to learn. If you have had any doubts in the past about home training in electronics —if you have hesitated because you thought you might not be able to keep up—or that electronics was too complicated to learn— here is your answer! Read how RCA Institutes has revolutionized its entire home training ideas!

NEW PRODUCTS

Additional information on products covered in this section is available from the manufacturers. Each new product is identified by a code number. To obtain further details on any of them, simply fill in and mail the coupon on page 15.

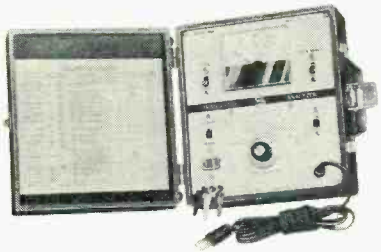
AM/VHF-AIR BAND PORTABLE

You can monitor aircraft in flight, tower transmissions, and weather reports with the low-cost "Jetstream" AM/VHF-air band portable receiver announced by *Radio Shack*. Measuring only 6" x 3½" x 1½", the unit weighs about a pound. Like the "Patrolman," a new AM/VHF-police band portable, the pocket-size "Jetstream" carries Radio Shack's "Realistic" brand label. An a.c. adapter is available.

Circle No. 75 on Reader Service Page 15

PORTABLE TRANSISTOR ANALYZER

Providing accurate analysis of both power and signal transistors, without setup, the *Seco Electronics* Model 260 solid-state transistor analyzer is said to be fast, easy to operate, and completely safe. The dynamic "in-circuit" go no-go test also lets you immediately identify *npn* and *pnp* types as well as lead connections. The d.c. analysis is made

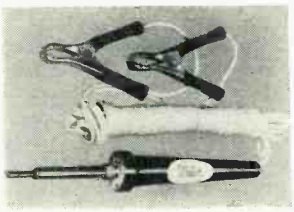


"out of circuit"; the *Beta* test position provides a direct meter reading of d.c. gain, the *Iceo* and *Icbo* test positions read both collector-to-emitter and collector-to-base leakage. Completely self-contained, the Model 260 is mounted in a durable vinyl-covered carrying case.

Circle No. 76 on Reader Service Page 15

12-VOLT SOLDERING IRON

Weller Electric Corporation's new soldering iron, Model TCP-12, operates from any 12-volt battery or 12-14 volt a.c./d.c. power supply, and incorporates Weller's exclusive "temperature control" system for minimal battery source power drain, long tool and tip life, and rapid recovery for maximum efficiency and performance. The lightweight pencil-style tool has a 12' power cord with battery clips, and a 700°F, $\frac{3}{16}$" screwdriver tip. Tips of other configurations and temperature ranges are available, however, as is a similar soldering iron for 24-28 volt operation.



Circle No. 77 on Reader Service Page 15

AUTOMATIC TURNTABLE

The new "Dual" Model 1015 automatic turntable announced by *United Audio Products, Inc.*, is the lowest-priced in the Dual Auto/Professional Series but shares with the more expensive models a dynamically balanced tone arm, direct-dial anti-skating, and a

versatile cueing system that can be used with either manual or automatic start. The low-mass, low-friction-bearing tone arm of the 1015 tracks as low as ½ gram, and accuracy of the tracking force is within 0.1 gram. Like all Duals, the 1015 is a fully automatic and manual single-play turntable, convertible to a record changer by interchanging the short single-play spindle with an "Elevator-Action" changer spindle.

Circle No. 78 on Reader Service Page 15

CB TRANSCEIVER/P.A. SYSTEM

Mobile operating convenience and safety features are emphasized for the 5-watt solid-state CB transceiver/p.a. system introduced by *Hallicrafters:* concentric volume and squelch controls, illuminated channel selector, and an easily operated rocker switch which quickly converts the transceiver into a public address system with 4 watts of low-distortion audio output. Designated as the Model CB-21, the unit contains a 17-transis-

what do you expect for $99.95, miracles?

YES

New Cobra V, 5 watt solid state CB. Created to perform miracles in performance.

Just what you'd expect from B&K, the people who developed and built the famous Cobra CAM 88: new standards of performance in selectivity, in sensitivity, in miniaturization. Talk power? Dependability? Beauty? This one you've got to see and hear . . . to believe. Cobra V, the neatest little package of punch, power and performance to hit the CB industry yet. 5 channels, 100% modulation . . . it's a miracle for only $99.95. You can hear it demonstrated at your B&K Distributor.

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CIRCLE NO. 4 ON READER SERVICE PAGE

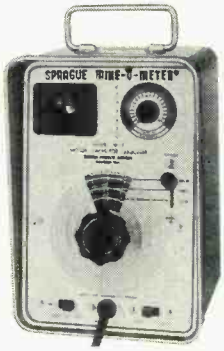
PRODUCTS (*Continued from page 22*)

tor, 8-channel transceiver with a dual-conversion receiver. Typical sensitivity of the receiver section is 0.4 μV for a signal with 30% modulation by a 1000-Hz tone. A special a.g.c. circuit compensates for variations in signal strengths and prevents "blasting" by nearby stations.

Circle No. 79 on Reader Service Page 15

MOTOR CAPACITOR ANALYZER

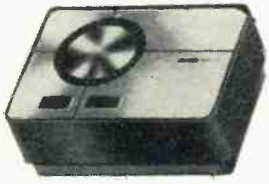
Motor capacitors can be checked faster and easier with the Model M-3 "Mike-o-Meter" capacitor analyzer introduced by *Sprague Products Company*—it eliminates the need for ammeters, voltmeters, wattmeters, and complicated charts to interpret meter readings. A twist of a dial tells you whether capacitors are good or bad, and gives direct readings of actual capacitance and power factor measurements by the Wien bridge method. Mounted in a steel case (9" x 6" x 5¾"), with a folding carrying handle, the unit weighs only six pounds. Model M-3 is designed for 110-125 volt a.c., 50-60 Hz applications. Also available is a Model M-3S for use on 110-125 or 220-230 volt a.c. (50-60 Hz) lines.



Circle No. 80 on Reader Service Page 15

SEMI-AUTOMATIC ANTENNA ROTATOR

Featured in *Channel Master's* complete "Colorotor" line is the semi-automatic Model 9513 antenna rotator—said to be the first of its kind. The Model 9513 incorporates a motor instead of a meter in the control console; this motor, driving the position indicator dial, is synchronized with the exterior drive unit motor to provide more precise aiming and relocation of stations than is possible with manual meter indicators. Hookup is simplified through the use of three-conductor wire. The other rotators in the "Colorotor" line—Model 9503 (manual), Model 9512 (automatic), and Model 9516A (automatic, with de luxe wood cabinet)—have all been restyled and given increased torque to handle the heaviest fringe area color antennas and stacked arrays.



Circle No. 81 on Reader Service Page 15

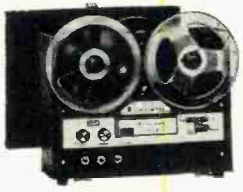
PORTABLE (CORDLESS) P.A. SYSTEM

Compact and lightweight (7" high, 4¾ pounds), the "Mark 7" p.a. system available from *AudioWave, Inc.*, can be carried virtually anywhere for hours on end with its shoulder-carrying strap, much as you would carry a camera. Features include solid-state and printed circuitry, battery operation, and a press-to-talk high-impedance dynamic microphone (frequency response, 70 to 15,000 hertz). Virtually unbreakable and impervious to weather, the Mark 7 has facilities for auxiliary speakers and microphones. Rechargeable batteries and a recharger are also available.

Circle No. 82 on Reader Service Page 15

SOLID-STATE PORTABLE TAPE RECORDER

An improved model of *Lafayette Radio Electronics'* RK-142 series of monophonic tape recorders, the RK-142V operates vertically as well as horizontally. It provides more than four hours of recording time with a long-play ½-mil, 2400-foot tape reel. Features include: a separate push button to prevent accidental erasures! a lever-type switch for fast forward, rewind, play/record, and pause; instant speed selection switch (3¾" or 7½ in/s); a recording level meter; a 4" x 6" full-range hi-fi speaker and capstan drive; output jack and two input jacks. The RK-142V is furnished complete with microphone and alligator clip patch cord.



Circle No. 83 on Reader Service Page 15

3-WATT CB WALKIE-TALKIE

Latest in the *Polytronics* line of "Duo-Comm" walkie-talkies is the "123," a 3-watt, 2-channel hand-held CB unit. As in the previous four "Duo-Comm" units, rugged construction and a dual-conversion superheterodyne receiver circuit are featured. All solid-state, the "123" has 11 transistors, and is powered by rechargeable nickel-cadmium batteries. The sealed speaker/mike transducer is impervious to weather and to humidity.

Circle No. 84 on Reader Service Page 15

CIRCLE NO. 8 ON READER SERVICE PAGE→

A new dimension in solid-state CB

COURIER CLASSIC

You are looking at the incomparable 23-channel Courier Classic—two years in development. Designed and engineered for *total* reliability, with years-ahead styling that sets a new standard of comparison. So advanced in performance, it required the creation of several new components by America's leading component manufacturers. With Illuminated S meter. Illuminated channel selector. PA system. Auxiliary speaker jack. Single-knob tuning. Modulation indicator. DC cord. Exclusive Courier "Safety Circuit" to protect against mismatched antenna, incorrect polarity, and overload. The first transistor rig designed to help pierce "skip." Every known feature that could be built into a CB rig, in a compact 6½" W x 8½" D x 2½" H. Plus the industry's biggest guarantee—**10 full years!**

Just **$189**
Complete with crystals for all 23 channels.

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Yes! Tell me all about the new Courier Classic.

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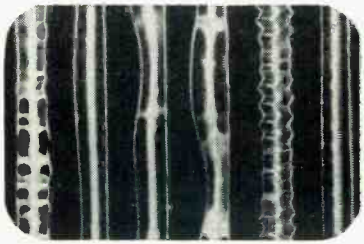
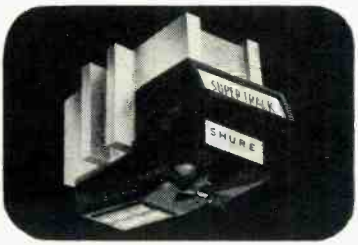
PE-77

CLOSE THE TRACKABILITY GAP

(AND YOU'LL HEAR THE DIFFERENCE)

The photomicrograph above portrays an errant, hard-to-track castanet sound in an otherwise conservatively modulated recording. The somewhat more heavily modulated grooves shown below are an exhilarating combination of flutes and maracas with a low frequency rhythm complement from a recording cut at sufficiently high velocity to deliver precise and definitive intonation, full dynamic range, and optimum signal-to-noise ratio. Neither situation is a rarity, far from it. They are the very essence of today's highest fidelity recordings. But when played with an ordinary "good" quality cartridge, the stylus invariably loses contact with these demanding grooves—the castanets sound raspy, while the flute and maracas sound fuzzy, leaden, and "torn apart." Increasing tracking weight to *force* the stylus to stay in the groove will literally shave off the groove walls. Only the High Trackability V-15 Type II Super-Track® cartridge will consistently and effectively track all the grooves in today's recordings at record-saving less-than-one-gram pressure . . . even with cymbals, orchestral bells, and other difficult to track instruments. It will preserve the fidelity and reduce distortion from all your records, old and new. Not so surprisingly, every independent expert and authority who tested the Super Track agrees.





SHURE V-15 TYPE II

SUPER TRACKABILITY PHONO CARTRIDGE

At $67.50, your best investment in upgrading your entire music system.

Send for a list of Difficult-to-Track records, and detailed Trackability story: Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois 60204

CIRCLE NO. 23 ON READER SERVICE PAGE

BUILD THE "BEACHCOMBER"

COVER STORY

By DANIEL MEYER

THE ALTER EGO OF OUR DEEP SEARCH "IC-67" LOCATOR WILL FIND THOSE SMALL METALLIC OBJECTS AND COINS

PROBABLY EVERY one of us has at one time or another had the urge to go searching for buried treasure. The "treasure" could be really valuable—a pot of gold coins buried during the Civil War, or a platinum locket lost on the beach—or it could be just a few cents dropped in some weeds or an old coffee can lid. A "treasure finder" or metal locator tells you where to dig.

Metal detectors come in two basic types. The one best suited to your needs will depend on just what you are searching for. The bulkier and more expensive transmit-receive detectors can find large objects at greater depths, but do not detect small objects easily. A simple single-loop beat-frequency locator, like the "Beachcomber," will detect objects at a depth of only about 2 feet maximum (depending on size) but can readily find small objects only 1 or 2 inches in diameter.

The Beachcomber can be a lot of fun to have along on a trip to the coast, or to an old battlefield to search for relics. It is lightweight, and operates 6 to 8 hours on an ordinary transistor radio battery. Its speaker is built in, so there are no headsets or wires to get in the way or get lost. And it only costs about $15 to build.

How It Works. The simple circuit (Fig. 1) consists of two r.f. oscillators—operating around 400 to 500 kHz, a detector, and an audio amplifier. The oscillators are identical, except for the coils used to tune them. One coil, *L1*, is tuned to make this oscillator's frequency slightly

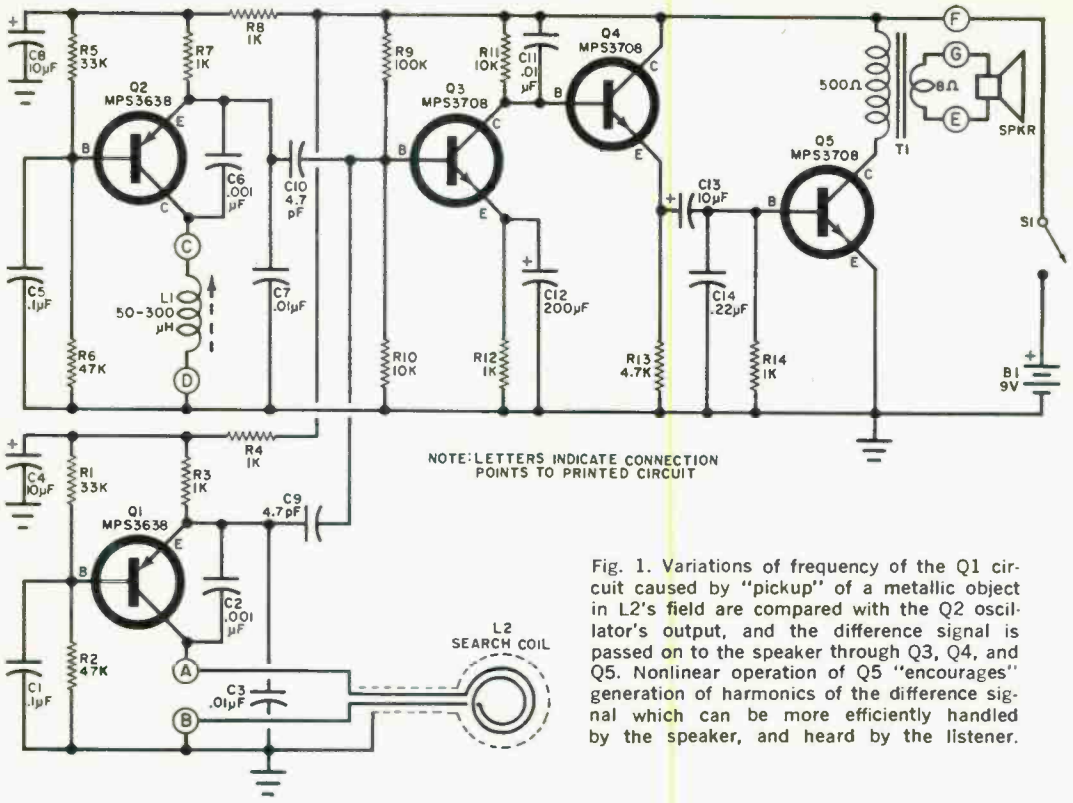


Fig. 1. Variations of frequency of the Q1 circuit caused by "pickup" of a metallic object in L2's field are compared with the Q2 oscillator's output, and the difference signal is passed on to the speaker through Q3, Q4, and Q5. Nonlinear operation of Q5 "encourages" generation of harmonics of the difference signal which can be more efficiently handled by the speaker, and heard by the listener.

higher or lower than that of the search coil oscillator. The two signals are combined in detector stage *Q3*, whose output is the audible difference between the two frequencies. This signal is fed to emitter follower *Q4* and output stage *Q5*, and finally to the speaker.

The search coil oscillator frequency changes slightly whenever the conductance of the material in the field of the loop changes. This means that if the coil passes over a metal object, the oscillator frequency will change slightly, and the pitch of the audio beat note you hear from your speaker will also change. It is easier to hear a small frequency change in a low-pitched sound than an equal change in a higher frequency tone.

To get the best results from the Beachcomber, set the oscillators as near the same frequency as possible. *Both oscillators must be very stable.* Good sturdy construction with no loose parts is a must. The circuit must also be so laid out as to reduce coupling between the two oscillators to the minimum. Other-

PARTS LIST

B1—9-volt battery
C1, C5—0.1-μF, low-voltage disc ceramic capacitor
C2, C6—0.001-μF polystyrene capacitor
C3, C7—0.01-μF polystyrene capacitor
C4, C8, C13—10-μF, 15-volt electrolytic capacitor
C9, C10—4.7-pF ceramic disc capacitor
C11—0.01-μF, low-voltage disc ceramic capacitor
C12—200-μF, 6-volt electrolytic capacitor
C14—0.22-μF low-voltage disc ceramic capacitor
L1—50-300-μH variable inductor (Thordarson WC-11, J. W. Miller #6196, or similar)
L2—Search coil—see text
Q1, Q2—MPS3638 transistor (Motorola)
Q3, Q4, Q5—MPS3708 transistor (Motorola)
R1, R5—33,000 ohms
R2, R6—47,000 ohms
R3, R4, R7, R8, R12, R14—1000 ohms
R9—100,000 ohms
R10, R11—10,000 ohms
R13—4700 ohms
All resistors ½ watt
S1—S.p.s.t. slide switch
T1—Transistor output transformer: primary, 500 ohms CT (do not use CT); secondary; 8 ohms, 150 mW.
Misc.—Miniature speaker, chassis box, battery clip, enameled wire, spacers, solder, etc.

NOTE: Printed circuit board for this project is available for $2.50 from DEMCO, 219 West Rhapsody, San Antonio, Texas 78216. A complete kit (excluding the coil form, chassis and rod) is also available for $15 postpaid.

wise, the oscillators will "pull"—suddenly lock together every time the beat frequency is brought down to a low pitch. That is why both oscillators are decoupled from the battery supply and from each other (through *R4-C4* and *R8-C8*) and why such small value capacitors are used for *C9* and *C10*.

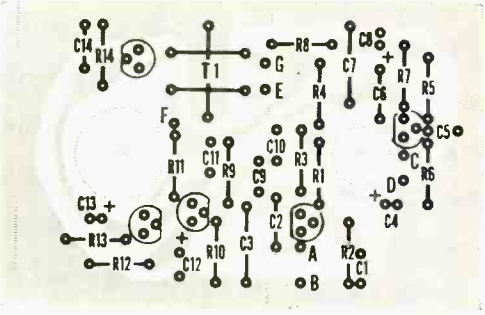
The output stage is purposely designed to produce "distortion," so that the low-frequency beat notes can be heard from the small speaker. If the audio circuit were designed for linear operation and little distortion, the speaker would produce little or no output below 150 to 200 hertz. In this circuit the audio output stage is not biased "on" at all. When it is driven with an audio signal from emitter follower *Q4*, transistor *Q5* conducts and produces an output on each positive half cycle. The signal to the speaker is therefore a series of pulses at the frequency of the beat signal. Since the pulses contain many harmonics, they can be heard down to a few hertz.

Construction. The electronic portion of the metal detector is easy to assemble, and there is no chance of coupling problems or shifting parts if the printed circuit board construction shown is used. The board (Fig. 2) serves as a template to locate the holes for *L1*, the mounting spacers, and the speaker.

Cut a $\frac{7}{16}$"-diameter hole for *L1* and another of the correct diameter for your speaker. Then mount the small parts by simply inserting them in the positions indicated by the parts numbers on the top side of the board, turning the board over, and soldering them in place.

File the switch hole in the cabinet to fit the type of switch used. Mount the switch, speaker, battery clip, and *L1* as shown in the photograph (Fig. 3). Wire the switch and battery clip as shown. The lead from the positive terminal of the battery goes to one switch contact, and a short lead should be soldered to the other contact—to go to point *F* on the board. A doughnut cut from plastic foam is placed around the rear of the speaker; the board compresses the foam when it is mounted, and thus holds the speaker snugly.

Now connect the battery and speaker wires to the underside of the board at the points indicated on the schematic diagram. Mount the completed circuit



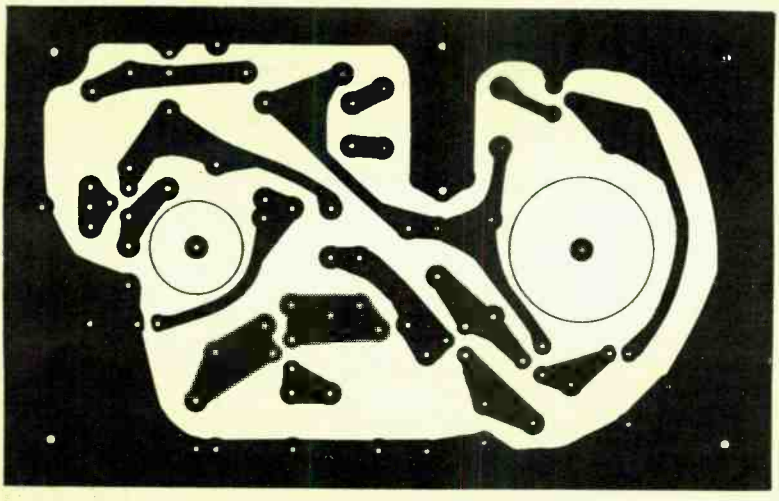


Fig. 2. Actual size drawing of foil side of printed circuit (left) will help you make your own board. Parts are installed on the plain side of the board as shown above. Figure 4 shows parts assembled on board.

Fig. 3. Part of the speaker and coil L1 pass through the circuit board and must be carefully positioned to fit properly. The speaker is not bolted and can be shifted.

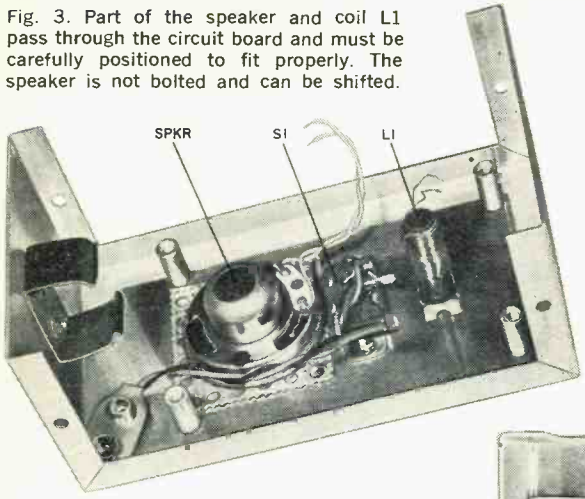
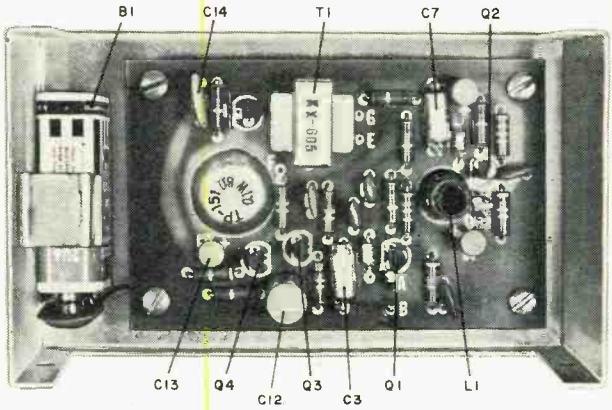


Fig. 5. Clean, firm assembly of internal as well as external components and other hardware means clean operation. Any variations due to movement of parts can cause false readings.



board (Fig. 5) and connect *L1* to the eyelets at points *C* and *D* on top of the board.

The Search Loop. This important part of the locator can be made in several ways. Of the two presented here, the copper tubing search coil shown in Fig. 6 is more rugged, but the plastic tubing loop will work well and is much easier to build.

To make the copper coil, obtain a piece of ¼″ *soft* copper tubing 42 inches long and bend it into as smooth a circle as possible. (Be sure it is straight when you buy it—and bend it around a cylindrical object a little less than a foot in diameter.) Leave a quarter-inch gap between the ends. Drill a ⅛″-hole on the inside of the circle opposite the gap.

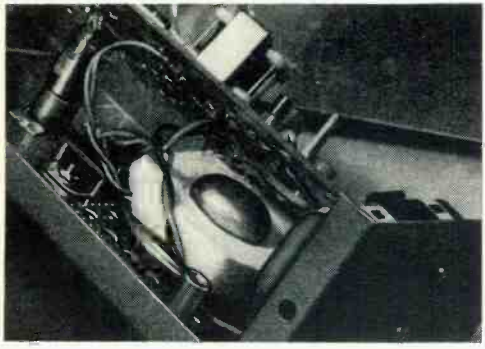


Fig. 4. A "doughnut" of foam rubber or plastic placed around the speaker holds it securely in its correct position when circuit board is installed.

Then take a hacksaw and split the tubing around its outside wall. (Cut through the outside wall only, not completely through the tube.) The edges of the cut can be smoothed with a small file. Solder about 6 inches of insulated hookup wire to one end of a 50′ length of No. 24 enameled magnet wire, and slip a piece of insulating tubing over the connection. Thread the insulated wire through the ⅛″-hole in the tubing from the outside (through the slot) and leave about an inch or two of insulated wire inside the split loop.

Now wind 14 turns of wire inside the copper tube through the saw slot, being careful not to pull the ¼″ end gap together. Cut the magnet wire and solder another piece of hookup wire to that end. Insulate the connection and thread the hookup wire through the hole in the tubing. Finally, paint the coil of wire inside the copper shield with coil dope or white glue.

You can make the plastic loop (Fig. 6) in much the same way. Slip a 2″ length of ⅜″ plastic tubing over the ends of the

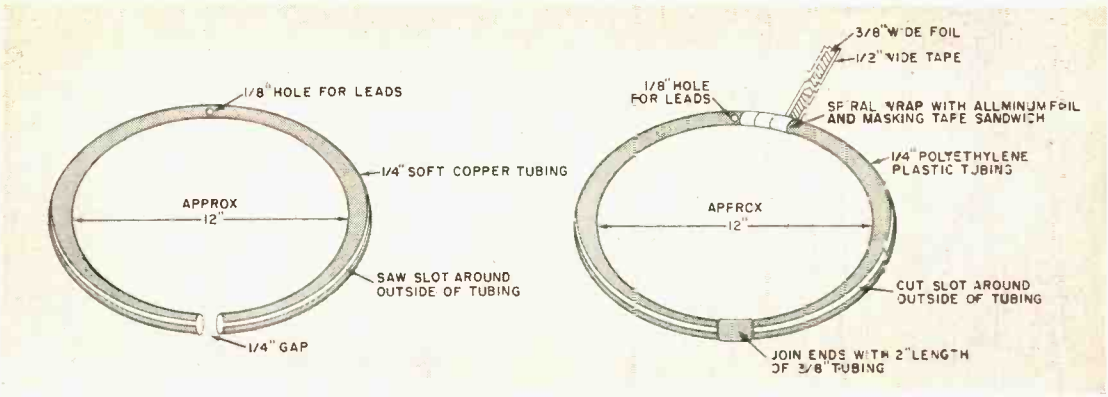


Fig. 6. Loop housing made of copper is shown above, and plastic tubing at right, above. If plastic is used, a metal outer covering can be made from aluminum foil. In either case, there must be a gap.

¼" plastic tubing to hold the ends in place. Then cut or drill a hole on the inside of the loop opposite the gap, and split the outside of the loop with a knife. Cut out a 1/16" strip all the way around the outside.

Make up the magnet wire as described for the copper loop and wind the search loop with 14 turns. Cement the turns together. Since the plastic loop does not shield the coil—as does the copper loop—it must be shielded before mounting.

You shield the plastic loop by cutting a piece about ⅜" wide from the end of a roll of aluminum foil. Stick the foil to a piece of ½" plastic masking tape, leaving a border on each side. Then strip the insulation off of about half of a 6" piece of *stranded* hookup wire, and place the bare portion between the foil and tape at the beginning of the spiral roll.

Now, starting at the point where the connections come out of the loop, spiral-wrap the tape-foil sandwich around the coil form. When you have gone all the way round, tear the foil off and go round

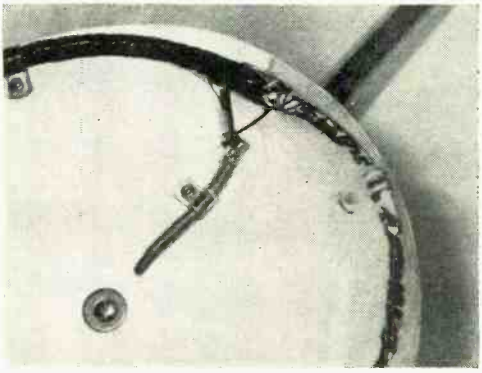
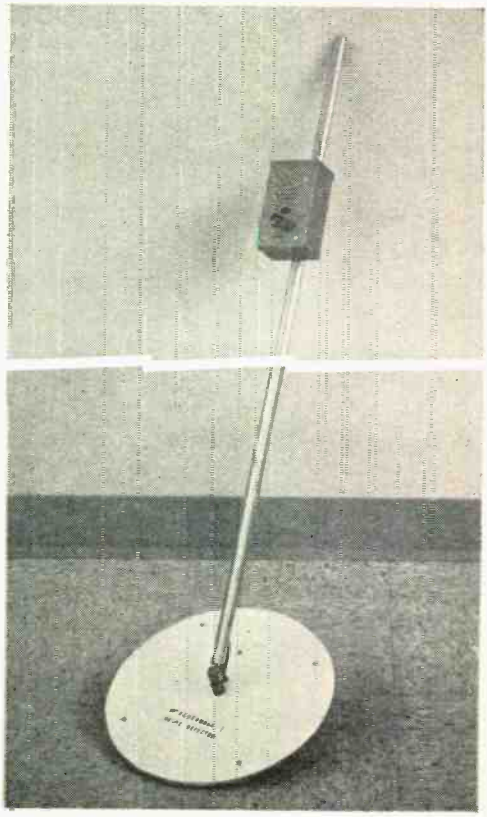
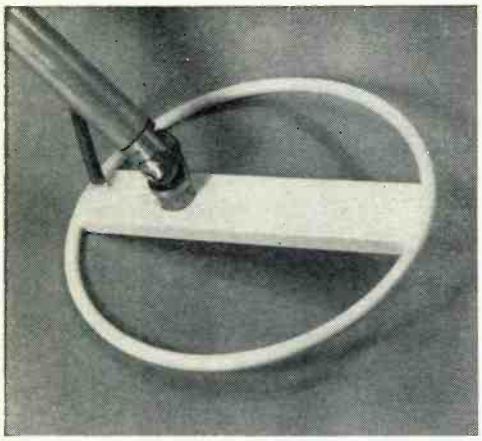


Fig. 7. Plastic-covered loop must be securely positioned. Use plastic cable clamps and putty or cement to hold the entire loop on the plywood board.



Completed "Beachcomber" is ready to "look for" buried treasure. Adjust loop so it is parallel to the ground while you hold unit at comfortable angle.



The copper tubing loop assembly is rigid enough to permit the use of a small wood brace for assembly. Some weight reduction can be gained in this manner.

again with the masking tape only, to hold everything firmly in place. *Note that the foil must not form a continuous loop.* Do not let the end of the foil—where you stop—touch the beginning of the winding.

The finished loop is mounted with plastic cable clamps to a ¼" plywood base (see Fig. 7). Use at least four clamps. The plastic loop must be potted in place on the plywood base with water putty to make sure it won't move or bend.

Finishing Touches. The handle on the Beachcomber can be any convenient length of ¾" aluminum tubing, and it can be fastened to the plywood base with a universal elbow made for ¾" tubing. (These items were obtained by the author off a "do-it-yourself" rack in a local hardware store. If you have trouble finding them, the handle can be made of wood. Even an old hoe handle will do.)

Connect the two ends of the loop to the two wires and the shield to the shield braid of a two-conductor shielded cable long enough to run up the handle to the control box. Screw the bottom of the box to the handle and bring the cable through a hole in the bottom of the box to a three-lug terminal strip, which can be mounted with one of the screws that hold the box to the handle.

Connect circuit board points *A* and *B* to the loop wires at the terminal strip with about 3 to 4 inches of hookup wire twisted together. Clip in the battery, put the box together, and you're ready to go.

Using the Detector. The Beachcomber is simple to use and—with a little practice—you should be able to find buried metal easily. The first thing to do is to set the tuning control to produce a beat note. Since the adjustment range of the coil is very wide, you should be able to get a beat note even if your search coil is not identical to the one shown.

If you are not sure whether the circuit is operating, hold a transistor radio near the detector while you turn the tuning control. You should be able to get a strong signal near the low end of the broadcast band somewhere in the tuning control's range.

Place the search loop flat on the ground and adjust the tuning to give a low beat note. Raising the loop 4 to 6 inches

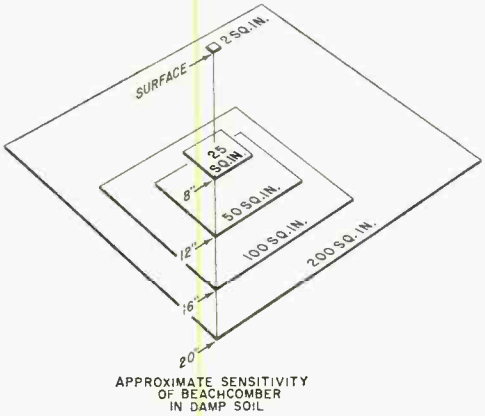
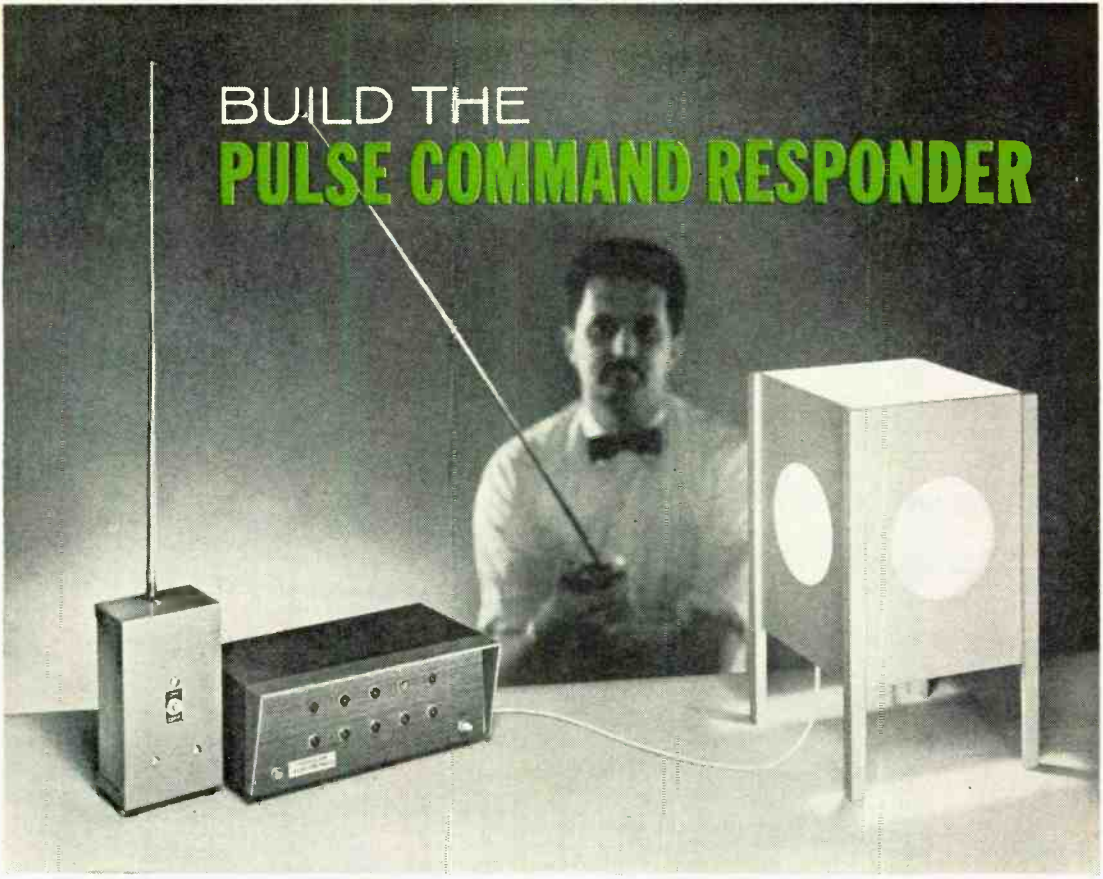


Fig. 8. When loop is on ground surface, you can pinpoint an object within 2 square inches. As loop is raised above ground, it will cover a wider area: about 50 square inches at a height of 12 inches, 100 square inches at a height of 16 inches, etc.

above ground should not change the beat note very much. To search, you simply hold the coil near the ground and swing it from side to side, parallel to the ground. If you hear a change in the pitch of the beat note, move the coil slowly around the area to get an idea of the exact location and size of your find.

The change in beat note will depend on the size of the buried object and its area as seen from straight above. Thus, while you can easily find a coffee can lid buried flat, you might miss it if it were buried on edge. Figure 8 should give you a good idea of the results you can expect with the detector.

(*Continued on page* 84)



BUILD THE PULSE COMMAND RESPONDER

YOU CAN CONTROL ALMOST ANY NUMBER OF ELECTRICAL DEVICES FROM ALMOST ANYWHERE

By ELDEN C. MAYNARD, K6SAI

THE "Pulse Command Responder" is perhaps one of the most versatile selective multifunction types of remote control centers you are likely to find anywhere. With just the touch of a single button, you can control many different electrical circuits individually and at any time. You can turn your TV set, lamps, motors, and just about any other electrical device on and off from one or more locations, and at distances of up to several hundred feet.

The Responder can be operated by radio control (R/C), carrier-current remote control, or direct "on-line" switching. For R/C operation, a transmitter and a receiver—of the types for controlling model airplanes—are suitable. The carrier-current remote control also has a transmitter and a receiver; but instead of the signal radiating from the transmitter into space, it is coupled to the receiver by way of your house wiring. (Construction of a "Carrier Current Remote Control System was described on page 50 of the January 1967 issue of POPULAR ELECTRONICS.) The "on-line" switching technique calls for a 3-wire hookup going from the Responder to one or more strategically-located pushbutton switches. A complete R/C system is illustrated in Fig. 1.

Regardless of the type of control employed, operation of the Responder remains the same: a number of pulses are used to trigger an electronic switching circuit, which in turn controls a stepping-type relay. Except for the first two steps, each step on the relay is connected to a different device to be controlled.

Unlike certain sequential or stepping relay control devices no unwanted circuit or device is energized even momentarily while the stepping relay "finds" a

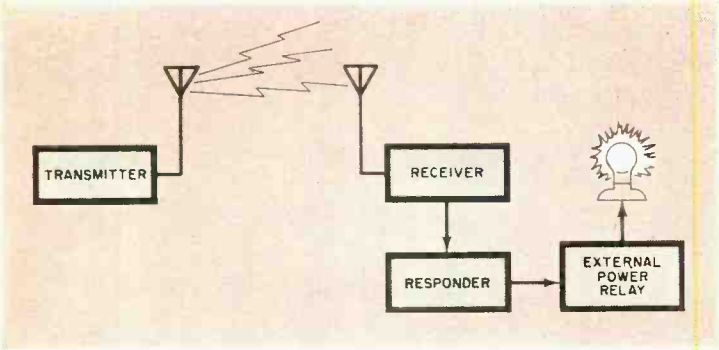


Fig. 1. The Responder can be radio-controlled if it is connected as shown. Details for constructing an R/C system for operating the Responder will appear in a coming issue.

wanted position. For example, you can start a motor in step 5, without affecting anything connected to steps 3, 4, 6, etc., and then, at a later time, control the devices on steps 4 or 7 without affecting the action on step 5. (Steps are on *K5* as shown in Fig. 2.)

The Responder is foolproof. It will seek a numbered step in accordance with a like number of pulses on the first round. On the second round, it will reset itself almost instantly in the presence of a single pulse. Sending up to three pulses on the second round will have the same effect as a single pulse. However, not until the stepping relay is in its *0* position can it accurately respond to a given number of pulses for a given position.

By tying steps *1* and *2* together and connecting them to the reset function (*K4* in Fig. 2), a certain amount of noise immunity is built into the Responder. It will not activate any control circuits unless at least three pulses are received in rapid order. This feature is especially desirable for R/C operation, or where the Responder may be accidentally pulsed.

How It Works. An s.p.d.t. switching mechanism, such as that shown for *K1* in Fig. 2, is used to connect a positive or a negative voltage as needed to *K3*, *K4*, *K5* and the base of *Q1*. This switch (on *K1*) can be part of a relay in an R/C receiver or in any other appropriate external control device. (Note that *K1* is actually not considered as a part of the Responder, but rather as an integral component of whatever external control system is used.)

Relay *K1* (or its equivalent) switches the voltage from positive to negative and back to positive for each pulse. Therefore, this switch should be a spring-loaded affair which always returns to an upward position (positive voltage on the normally-closed set of contacts).

Before tracing the action of the positive and negative voltages on *Q1*, the various diodes and relays *K2*, *K3*, *K4* and *K6*, you should know how *K5* works. Both the *Advance* and *Reset* coils of *K5* operate on 117 volts a.c. Since the control voltages are on the order of 6 volts d.c. in the Responder, relays *K3* and *K4* are used to switch the *Advance* and *Reset* coils, respectively.

Each time the *Advance* coil is ener-

PARTS LIST

*C1, C2—100-μF, 15-volt electrolytic capacitor**
*C3, C6—6-μF (or 5-μF), 15-volt electrolytic capacitor**
*C4, C5—0.02-μF ceramic or disc capacitor**
*D1, D2, D3, D4—1N4004 (or 1N4001) diode**
I1, I2—6-volt lamp—see text
K1—See text
K2—6-volt s.p.d.t. relay
K3, K4—6-volt s.p.s.t. relay
K5—117-volt a.c. stepping relay (Guardian IR-MC, 24 contacts, or similar)
K6—6-volt power relay
Q1—2N217 transistor
*RECT 1—2-amp, 50-PIV rectifier bridge (International Rectifier 10DB2A-C, or similar)**
*R1, R2—100-ohm, 1-watt resistor**
S1—S.p.s.t. switch
T1—Filament transformer: primary, 117 volts; secondary, 12 volts, 1 ampere, center-tapped
*1—Printed circuit card, or 3¼" x 4" perforated phenolic board—see text***
1—Aluminum or steel cowl-type utility box
Misc.—Indicator lamp sockets, line cord, hookup wire, spacers, solder, hardware, barrier strip, etc.

The asterisked parts are available from Southwest Technical Products Co., 219 West Rhapsody, San Antonio, Texas 78216.

*Included in package of components for printed circuit board, $5.

**Drilled and etched fiberglass printed circuit card, $2.

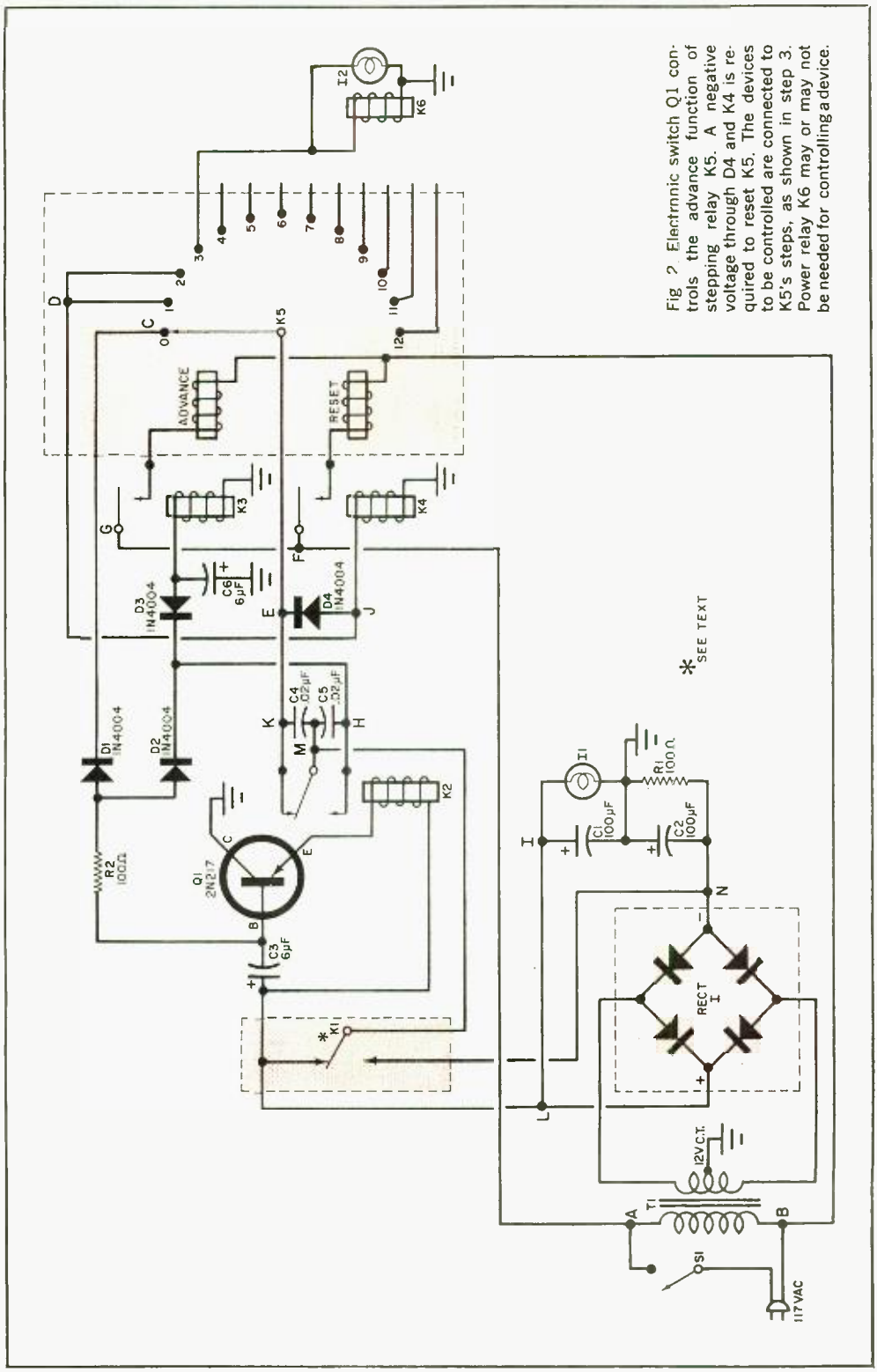


Fig 2 Electronic switch Q1 controls the advance function of stepping relay K5. A negative voltage through D4 and K4 is required to reset K5. The devices to be controlled are connected to K5's steps, as shown in step 3. Power relay K6 may or may not be needed for controlling a device.

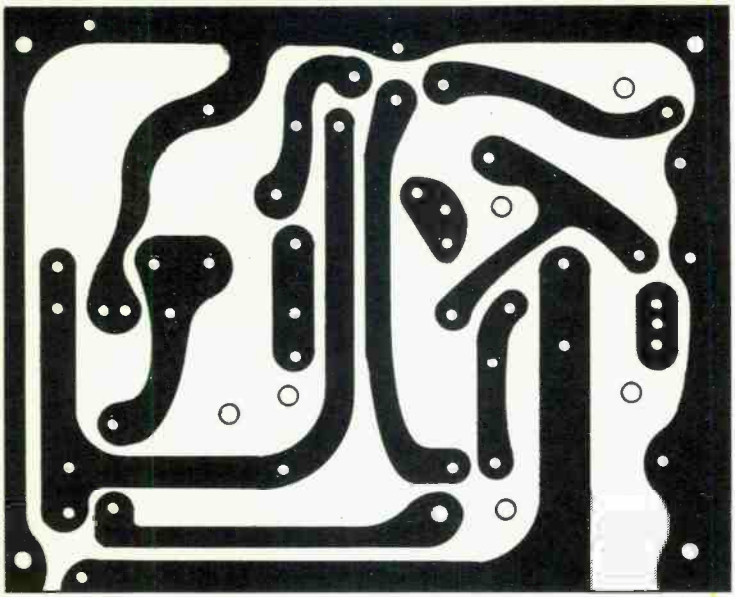


Fig. 3. If you decide to make your own printed circuit board, use this full-size drawing as a guide to proper etching of foil side of board.

gized, *K5* advances one step and holds. When the *Reset* coil is activated, *K5* is spring-returned to its *0* step.

When *S1* is closed and power is applied, the pilot lamp, *I1*, lights and the Responder is ready to go to work. In the Responder's quiescent state, *Q1* does not conduct and all relays and coils are de-energized. Note that *K6*—like *K1*—is not considered to be part of the Responder proper.

When *K1* is energized, a negative voltage is applied through the upper contacts of *K2* to *D4* and the armature of *K5*. In step *0* on *K5*, the negative voltage is fed to *D1* and forward-biases *Q1* to allow it to conduct. When *Q1* conducts, *K2* becomes energized, which removes the negative voltage from the *D4-K4* circuit and applies it to the *D3-K3* circuit. Each time *K3* sees a negative pulse, it advances one step. Capacitor *C3* holds *Q1* conducting and *K2* energized to prevent the *Reset* coil from being activated. As long as *K2* is energized, no control voltage reaches any of the steps on *K5*, and no externally controlled circuits are affected until the Responder settles down to a quiescent state. The train of pulses must come in a rapid enough succession to be within the discharge time of *C3*.

If *K5* is on step *3* or higher when *K1* is energized, the negative voltage cannot get to *Q1*, and now *D4* is able to go to work and pass this voltage on to *K4* and reset *K5*. Notice that steps *1* and *2* on *K5* (the noise immunity circuits) are connected back to *K4*; if for any reason *K5* is advanced only to either step, *K5* will reset itself with a positive or a negative voltage, but not until *K1* de-energizes, *Q1* in turn stops conducting, and *K2* releases.

Transformer *T1*, full-wave bridge rectifier *RECT 1*, *C1*, *C2*, *R1* and *I1* provide suitable positive and negative voltages to

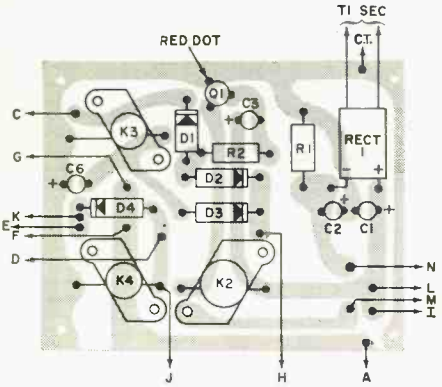


Fig. 4. Parts layout is not critical, but be careful not to confuse polarity of diodes, and the connections to the relays' frames, coils, and contacts.

operate the Responder. Pilot lamp *I1* does double duty; it helps power supply regulation as does *R1*, and it also serves as an on/off indicator. Lamp *I2* is optional. Capacitors *C4* and *C5* are used for relay contact protection; a 0.02-μF capacitor can also be placed across the contacts on *K3* and another on *K4*, if you wish. Capacitor *C6* tends to prevent chatter and helps *K3* to perform in a more positive manner.

Circuits to be controlled having voltage and current requirements different from the 6 volts d.c. available at *K5*'s steps, or for continuous operation—once activated, require relays (*K6*, etc.) or other switching devices (SCR's) to be interposed between *K5* and the controlled circuit.

Construction. The Responder can be built into any 8″ x 6″ x 3″ enclosure. Parts placement is not critical, but perhaps the most suitable layout for the small parts is on a printed circuit board or plain perforated phenolic board. If you want to make your own printed circuit board, follow the actual-size drawing shown in Fig. 3. You can buy one already etched and drilled for $2 postpaid (see Parts List).

If you use a circuit board, you can follow the same general layout for parts as shown in Fig. 4. When mounting capacitors, diodes and transistor, be careful to observe polarity. After all parts are mounted, set the circuit board aside.

Drill the mounting holes for the circuit board, power transformer, indicator lamps, switch and stepping relay, referring to Fig. 5 for the general location of these major parts. Actual location of parts is not too important provided that the parts do not interfere with the circuit board or each other. To facilitate mounting of the board and other parts, secure *T1* to the metal case last.

Use 3/8″ spacers to get adequate clearance between the board and case. Optional indicator lamps (*I1*, *I2*, etc.) should be mounted on the front part of the case.

After all parts are mounted, wire the circuit in accordance with the schematic. For your convenience, the lettered points in Fig. 4 correspond to the same lettered points in Fig. 2.

Each of the steps on stepping relay *K5* should be connected to a suitable terminal strip or set of output jacks mounted on the back of the case, such as the jack marked "TO K6" in Fig. 5. Because only 6 volts d.c. is available at each step at any one time, power relays or circuits to be controlled should also be able to operate on 6 volts d.c.

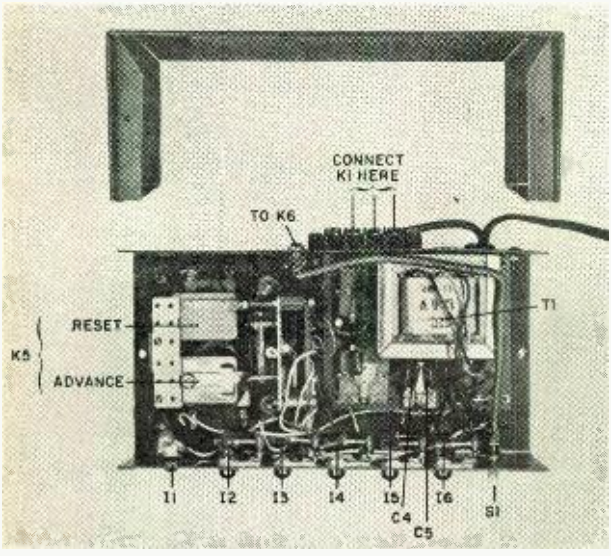


Fig. 5. Position the parts so that they do not interfere with each other or with the circuit board. Both Reset and Advance coils are 117-volt a.c.-operated and care must be exercised to keep them clear of the case. If necessary, use a larger case.

Final Check. When construction of the Responder is complete, connect the pulsing device to satisfy the switching requirements for *K1* as shown in Fig. 1. Turn the Responder on, and pulse it once. Relay *K5* should advance to step 1. After a short delay, as *C6* discharges, the stepping relay should automatically reset to step *0*. The same is true when you pulse the responder twice, except that *K5* should first advance to step *2*. Check each of the other steps of *K5* by pulsing the Responder the same number of times as the step number you want, but between each selection of steps, reset *K5* to step *0* with one or two pulses.

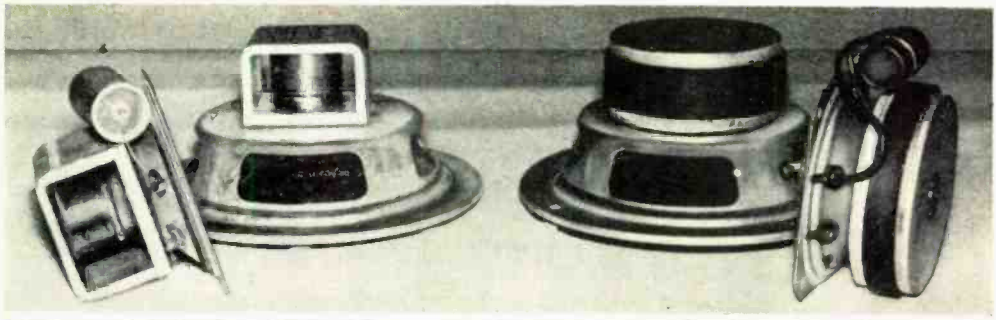
When you are satisfied that the Responder is operating properly, you can connect your power relays and circuits to be controlled. Once you work with and get to know the Responder, you will find that its applications and functions are practically limitless. -30-

"PRINCESS CINDERELLA"

BUILD THE UP-RATED VERSION OF THE CINDERELLA BOOK-SHELF HI-FI SYSTEM

By DAVID B. WEEMS

THE HALF-CUBIC FOOT sealed enclosure called "Cinderella" described in the October 1965 POPULAR ELECTRONICS (p. 49) was a reasonable example of what $10 will accomplish if you build your own hi-fi speaker system. Inside the original "Cinderella" enclosure was a 6" woofer and a miniature cone tweeter. Both speakers could be purchased for just under $7. The 6-inch woofer had a very flexible suspension and a 5-oz. magnet.



Both earlier model speakers (left) had 4.6-ounce alnico V magnets; improved model speakers (right) sport 10-ounce magnets in tweeters and 20-ounce magnets in woofers for superior damping and transient response.

During the intervening two years, an improved woofer has been developed with a 20-oz. magnet. This magnet weight is rarely found in small speakers —at least those with a diameter of less than 8 to 10". You can build a "Princess Cinderella" speaker enclosure using this new woofer for about $15.

Although the size of the enclosure must be increased, this new system is still classified under the category of *small bookshelf systems*. The sound it can produce will compare favorably with many similar size units that sell for as high as $40.

New Speakers. The really interesting characteristic of the original "Cinderella" woofer was that the cone suspension was free enough to allow a fundamental resonance between 45 and 50 Hz. The woofer in the "Princess Cinderella" has a somewhat more rugged suspension and the free air resonance has been measured by the author to be about 60 Hz. Since this 10-15 Hz increase in fundamental resonance would be detrimental in a sealed enclosure, the author has designed the "Princess Cinderella" as a ported enclosure. Simultaneously, the use of a port has raised the efficiency of the overall system while the increased magnet weight has provided superior damping and transient response.

The top end response of the system has also been extended. Efficiency of the tweeter has been improved due to the use of a 10-oz. magnet. The roll-off at the high end of the audio spectrum appears to be around 17,000-18,000 Hz.

The New Enclosure. A somewhat larger enclosure is required to compensate for the greater displacement of the more massive speakers. As in the original "Cinderella" system, rigidity of the

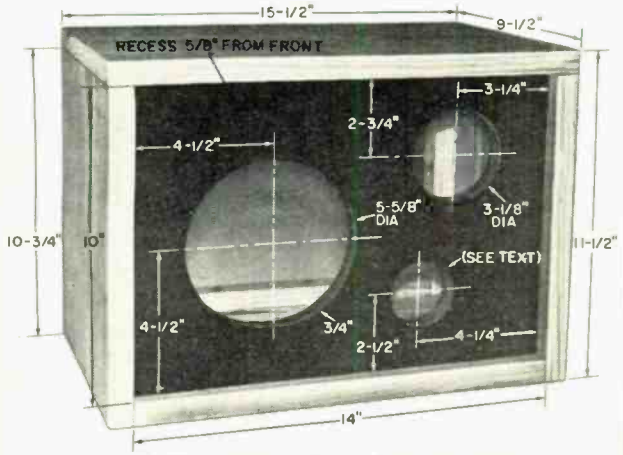


Fig. 1. Dimensioning of speaker board is critical. Speaker hole sizes are given, but outer diameter of mailing tube selected determines size of port hole.

PARTS LIST

1—Woofer (McGee Radio Co. Model SX-6071)
1—Tweeter (McGee Radio Co. Model TS-6070)
2—10" x 14" pieces of ¾" fir plywood for speaker and rear boards
1—15⅓" x 9½" piece of ¾" pine shelving for top
1—14" x 9½" piece of ¾" pine shelving for bottom
2—10¾" x 9½" pieces of ¾" pine shelving for sides
1—45" x ¾" x ¾" piece of pine for cleats
1—5-ft. length of ½" quarter-round molding for trim
Misc.—#6 x 1½" finishing nails, #8 x ¾" sheet metal screws, #8 x 1¼" flathead wood screws, steel brads, grille cloth, glue, wire, etc.

structure is a prime requisite for best possible performance. Either ¾"-thick fir plywood or light pine shelving (sold as 1" x 10" clear pine board) can be used for the top, bottom, and sides, although pine is specified in the Bill of Materials.

The port and speaker locations and the dimensions are fairly critical. Locate the holes for the speakers exactly as shown in Fig. 1. The hole size for the port will be determined by the outer diameter of the hard cardboard mailing tube you choose for the port duct. This mailing tube should be 2½" long and should preferably have an inner diameter of 2". The outer diameter is only important in that it will guide you in cutting out the right-size hole.

After the three holes are cut, insert the mailing tube into the port hole and dress it flush with the front of the speaker board so that some of the cardboard duct extends inside the enclosure. Glue the tube in place and, when dry, apply a coat of flat black paint to the front of the board, inside the cardboard duct, and inside the speaker cutouts.

Assembly. Set the speaker board ⅝" back from the front edge of the enclosure's bottom board and glue and nail these two pieces together. Do the same for the top and both sides. Then sand and stain or paint all exterior surfaces—except the speaker board. When the paint or stain dries, mount the speakers over their respective cutouts and wire them according to Fig. 2.

Nail or screw ¾" x ¾" pine cleats ¾" in from the rear edge of the enclosure as shown in the illustrations. Now staple or tack a 2"-thick layer of cotton batting or other suitable acoustic damping material to the sides and rear wall of the enclosure near the woofer. Also staple a 2"-thick curtain of cotton batting to the inside top of the enclosure and arrange this curtain so that it drapes over the woofer but is clear of the inside mouth of the port duct.

Attach the grille cloth to the front of the speaker board and miter-cut four pieces of 1½"-quarter-round molding to neatly frame the front of the enclosure and to hide the ragged edges of the grille cloth.

Finally, screw the rear board of the enclosure in place and connect the speaker wires to the 4-ohm output tap of your amplifier. You'll note that this is a small system which gives a special feeling of "presence," particularly in the reproduction of music from small instrumental groups. You can increase the bass output from your amplifier without adversely affecting the system (doubling). The end result will be a sound that is much *bigger* than would seem possible considering the physical size of the new "Princess Cinderella" enclosure.

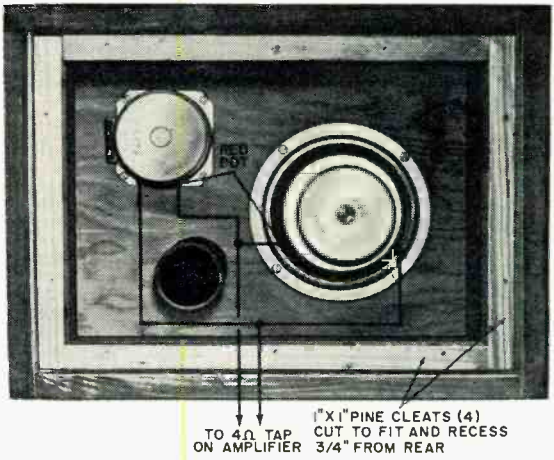


Fig. 2. Pine cleats hold rear board of enclosure in place. Proper speaker phasing is obtained only when red dots on speakers are wired common to each other.

Construction Variations. In place of the usual grille cloth, the author used an expanded aluminum grille on the front of the "Princess Cinderella" enclosure. For maximum attractiveness, the grille should be backed by a black cloth of open weave to hide the speakers.

Various readers of the original "Cinderella" article have asked whether the choice of enclosure material is of importance to the performance of the system. Apparently, what these readers had in mind was the possibility of using one of the new, very hard, "pressed" boards for the enclosure walls. You can use any material for the "Cinderella" systems, provided that it is inflexible, and that the enclosure can be sealed so there are no air leaks in the corners or wrap-around which fits the front and back of the enclosure. —30—

CAN DRY CELLS BE RECHARGED?

YOU CAN GET UP TO 20 TO 30 TIMES MORE LIFE OUT OF YOUR BATTERY

By FRED SHUNAMAN

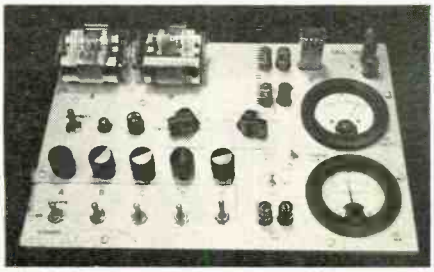
WAY BACK in the days when I was powering my peanut tube (Western Electric 215A to the historians) with a No. 6 dry cell, recharging a dry cell was no problem. We simply took the cardboard case off the cell, punched a few nail holes in the zinc, and dunked it in a fruit jar filled with a solution of water and sal ammoniac. The thinking was that there was still some zinc in the cell and that it probably lacked moisture. The cell's life was increased tremendously—it ran until big holes appeared in the zinc.

But charging a dry cell electrically? That was something else again. There were persistent rumors that someone had done it, but the manufacturers' instructions were explicit. "Dry cells are not designed to be recharged," they said. So the matter rested in indecision until a.c. sets came along and we forgot all about it—for a while.

Shortly after the transistor radio ap-

COMING NEXT MONTH

Plans for combination battery tester and charger that lets you control and monitor charging current and voltage as well as perform tests under desired loading conditions! Project designed and built by Harley H. Stover.



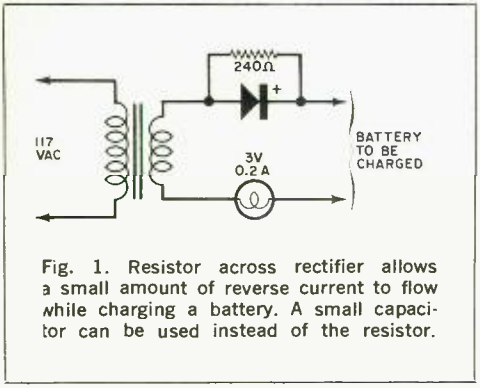


Fig. 1. Resistor across rectifier allows a small amount of reverse current to flow while charging a battery. A small capacitor can be used instead of the resistor.

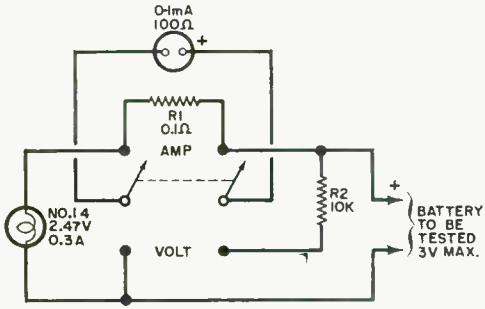


Fig. 2. Test jig made it possible to check battery voltage and current while the battery was discharged through the lamp. Open-circuit battery voltage can be measured by partially unscrewing the lamp.

peared on the market, dry battery charging began to stage a comeback. Besides the transistor sets, children's toys were using large quantities of these cells—nothing beats a stalled toy electric motor for running down a battery. A few chargers were offered to the public, usually through highly pictorial Sunday-supplement advertising.

I picked up a charger and tried it out on my collection of dry cells, some of which were nearly new. Running the cells in a flashlight until the light dimmed and turned yellow, then recharging the cells overnight or a little longer, I came to the conclusion that the life of a dry cell could be about doubled, with a large number of recharges.

Shortly afterward, I read an article by a British author, Ralph W. Hallows, in which he claimed excellent results with the help of a technique borrowed from electroplating. He used a small amount of a.c. along with the d.c. charging current—about 10% reverse current. (Half of the time, the a.c. looks like a reverse charging current.) "This technique," he said, "deposited the zinc smoothly and evenly on the inside of the can, instead of in spongy clumps." Commercial chargers using this principle (Fig. 1) were in use in Europe, according to Hallows, and he had recharged flashlight cells repeatedly for more than 18 months of

Fig. 3. This inexpensive, commercially available unit, with modification, was used to charge the batteries. An interlock similar to the type used on TV sets prevents the a.c. line voltage from getting at any of the exposed battery connections while the lid is up.

service. I made a note to try the system, but just didn't get around to it. All this was more than a decade ago.

But the growing popularity and flood of transistor radios, phonographs, tape recorders and the other battery-operated devices has made the subject topical again. A number of charges are now on the market and available in department stores, hardware stores, hobby stores, electronics parts stores and in variety stores. They are available by mail order and as premium gifts. At the present rate of market penetration, there will be more battery chargers in this country than there are bathtubs, or refrigerators, within the next year or two. There are good chargers and there are bad chargers, and price is not always the best guide to quality.

I obtained an inexpensive charger, one that would handle four dry cells at a time. In spite of its low price, the appearance of the equipment inspired confidence—it was well constructed out of plastic, and looked as if it were intended for use. An ingenious shorting device made it equally easy to charge one or four cells, and the contacts immediately suggested the right way to insert the batteries. An interlock disconnected the 117-volt power line whenever the unit was open, for safety. I was almost ready to prove or disprove to myself some of the claims about charging dry batteries.

Reading up a little on the subject, I found that—among other things—a 1½-volt cell should not be allowed to drop below 1 volt. So a little test jig (circuit shown in Fig. 2) was constructed to make it easy to check the condition of the battery at any time. Either the voltage under load, or the current, could be determined at the flip of a switch. Also, unscrewing the lamp made it possible to determine open-circuit voltage.

I bought four RCA VS 036 cells: two for putting through the charger as many times as possible, and two to act as controls by using them without the benefit of being recharged. Putting a pair into the jig, and running them down, and then putting the other pair into the jig and doing the same thing, I learned an interesting fact: just how good a flashlight cell is. Both pairs discharged down to 1.8 volts, or 0.9 volt per cell, and kept

Fig. 4. The lamp in the charging circuit serves as a current limiter. The charger was modified by adding a 0.08-μF capacitor to provide a small amount of reverse charging current. Unfortunately tests were not made to see if the addition of this capacitor made any difference in extending battery life, or in improving charging action.

the lamp lit for an identical time (3 hours and 40 minutes). "Removed from service," each cell showed 1.1 volt on open circuit.

Set 1 was placed in the commercially available charger (Fig. 3) and charged in accordance with instructions that came with the charger. The batteries were then returned to service, and "ran" nearly as long as the first time. (Incidentally, I modified the charger to supply reverse current. It seemed easier to install a capacitor than a resistor in the space I had, so I put a 0.08-μF paper capacitor across both the "lamp-resistor" and the diode, as shown in the dashed lines in Fig. 4. Unfortunately, no comparison was made of charging batteries with and without this capacitor.)

The first three charges added an additional 9 hours to the original almost 4 hours of life. Now I learned a second interesting thing about dry cells: the ability of a run-down dry cell to recuperate. Remembering that batteries tended to recover somewhat after discharge, after two days of rest I put my control cells (set 2) back into the test jig. They again lit the lamp to full brilliancy, with a loaded voltage of 1.45 each (as against 1.5 when they were absolutely new) and "ran" for nearly three hours (170 minutes) on the second discharge. With two-day rests between each discharge, set 2 went through two additional discharges, one for 100 minutes, and the other for 90 minutes. After two more days of rest, they measured 1.5 volts open circuit, but only 0.8 volt loaded, and were considered to be at the end of their useful life. They had worked a flashlight lamp for an approximate total of 9½ hours.

The control cells were, for practical purposes, of no further use, but I thought it might be interesting to see what would happen if I tried to charge them up. After a 36-hour charge, they showed 3.7 volts (1.85 each) on open circuit, and 3.4 volts when loaded down with 350 mA of current through the lamp. The lamp stayed on for 3 hours and 40 minutes (surprisingly, the same as when the batteries were new) before the batteries dropped to 1.8 volts (under load); the light had not as yet started to dim appreciably. So I continued to put them on a regular charge-discharge cycle and was able to drain another 34 hours and 35 minutes out of those "used up" cells, for a total of 44 hours, 15 minutes.

So it appears that the story that, "You can't charge a run-down cell," needs modification. However, there seem to be a number of variables as to how much "second-life" batteries have. Much depends upon their age, state of charge while standing around and not in use, and how the batteries were used. Batteries that have been run down in a normal manner and then put on charge soon after do take and hold a charge. On the other hand, I tested two pairs of cells from flashlights as soon as they ceased to give enough light, after several months of intermittent service; neither pair would light a lamp more than momentarily after being taken off charge.

Meanwhile, set 1 was going through cycle after cycle of charge and discharge, dropping down to 180 minutes of life per charge, from the original 220. After the first few discharges, battery life per charge continued to decline more slowly and leveled off at about 170 minutes. For more than another dozen charges, it maintained this level, ±5 to 10 minutes. After another two dozen charge and discharge cycles, the batteries dropped to less than 120 minutes per discharge. Around the 30th cycle, no more than 60 minutes at a time of useful life was obtained. See Fig. 5.

I abandoned charging after the 31st round. The pair of cells had worked a flashlight lamp for about 68 hours, or roughly seven times the "normal" expected life. They still had potential life in them, but I didn't think it was worthwhile to charge a battery that couldn't produce more than a single hour of illumination.

My experiments were not quite up to laboratory precision. Other work interfered with the regularity of the charging and discharging cycles. It wasn't possible for me to always stop the discharge cycle at exactly 1.8 volts for the two cells. But the exceptions were indeed rule-provers and showed that the cells, under- or overdischarged, tended to return to their proper place on the "hours vs. discharges" curve. Of course, in actual use, the start and stop of a charge-discharge cycle can also be expected to take place at other than ideal times.

Authorities say that recharged cells have a shorter shelf life than new ones. It is likely that if the cells I used had

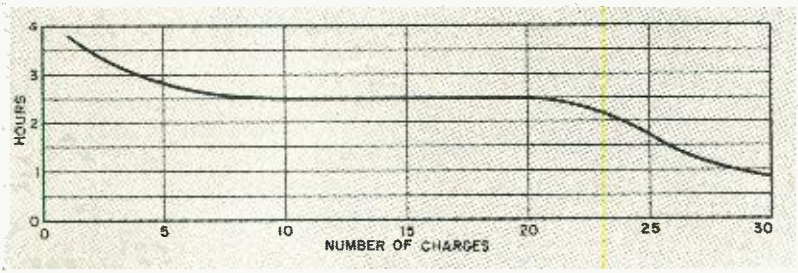


Fig. 5. Two 1.5-volt "D" cells placed in series were discharged to about 1.8 volts (0.9 volts each cell) and then charged. Graph shows number of hours it took for batteries to drain down to 1.8 volts after each charge. About 2½ hours of life per charge was realized between the 8th and the 21st charge. Tests were stopped when less than one hour of continuous battery operation could be expected. Shelf life was not determined.

been put in a flashlight and used intermittently for about a month until the voltage dropped to the recharge point, the cell life would have been much shorter in terms of total milliampere-hours. However, the experimental conditions more closely resembled certain industrial and law-enforcement applications, where flashlights are used every night and returned for charging every morning.

While I confined my experiments to ordinary carbon-zinc D-cells (and kept the charger tied up three months doing only that), I did get a chance to try a charge or two on some of the smaller cells. Results appeared similar. One set of AA's, in particular, was taken out of an illuminated probe, where they no longer lit the lamp. After being recharged, they brought the lamp up to full brightness, and remained useful for about two weeks.

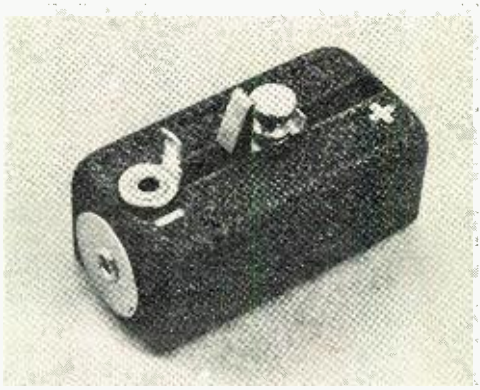


Fig. 6. Hearing-aid battery adapter has movable slide to accommodate different-size batteries. A zener diode inside adapter regulates charging voltage. Adapter is about same size as a "D" cell and easily fits into battery charger shown in Fig. 3.

I did not try to charge alkaline cells, but there is sufficient reason to believe that these cells can also be recharged.

Mercury batteries are another story. In theory, they are highly chargeable, but in practice they come in such a variety of sizes and voltages that they can be difficult to handle. I brought leads out from my charger to one small cell. Two hours later I found the case empty. I have not yet found the top or the contents of the cell. Could be that the battery blew up because of an excessive charging rate.

A constant-voltage charger is the only kind that will handle these batteries properly. (The charger I used would be classified as a constant current type.) When the battery approaches full charge, the charging current falls practically to zero. The current must also be limited to a safe value. There are automatically regulated mercury battery chargers on the market. And an adapter the size of a D cell is available to charge hearing-aid batteries. It fits into the charger in lieu of a battery, and it uses a zener diode to establish a constant-voltage type of charge.

While mercury batteries can be recharged, chargers built to handle more than one type of battery would have to be a bit more elaborate, because of the variety of sizes and voltages. Danger of explosion is greater than with other types of cells. You *can* blow up a carbon-zinc cell, but only by charging it at a grossly excessive rate. Most such blow-ups of carbon-zinc cells are due to steam, and would be impossible at a 45-mA charging rate.

In conclusion, dry cells can be easily recharged. If you can get about two hours or more out of a recharged cell, the job of removing, charging, and reinstalling the batteries is worthwhile. The electricity cost is small—it averages out to 3.4 cents per charge. Indeed, most of the power used is consumed in the dropping resistor.

The better chargers use a transformer to deliver not more than about 3.5 volts to two cells connected in series. Overcharging is then impossible since the charge tapers off to nothing as the rising voltage of the cells approaches that of the supply. A resistor or capacitor across the rectifier to provide about a 10% reverse charging current could be desirable.

Whether adding the a.c. component made the difference between the up-to-date results above and the rather inconclusive ones of the 1950's, I don't know. I suspect that leakproof construction, now universal, may have been an important factor. Batteries don't dry out as quickly as they used to. —30—

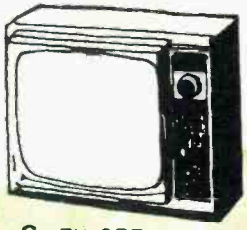
INTERNATIONAL ELECTRONICS QUIZ

By ROBERT P. BALIN

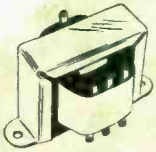
Recent technological advances in the field of electronics tend to overshadow contributions by earlier scientists from many parts of the world. For example, few students remember that the first known magnetic device—the compass—is a contribution from China, or that the theoretical groundwork in the field of atomic physics which eventually led to the splitting of the atom by the United States, was actually laid by Albert Einstein, the German-born physicist, while doing research work in Switzerland. To test your biographical knowledge of some earlier scientists and their inventions, see how many of the common electrical devices (A-J) illustrated below you can associate with the country of origin (1-10) of their inventors.

(Answers appear on page 90)

1 BELGIUM ____
2 DENMARK ____
3 ENGLAND ____
4 FRANCE ____
5 GERMANY ____
6 HOLLAND ____
7 ITALY ____
8 JAPAN ____
9 RUSSIA ____
10 U.S.A. ____

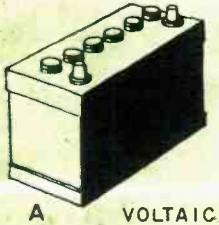


C TV SET

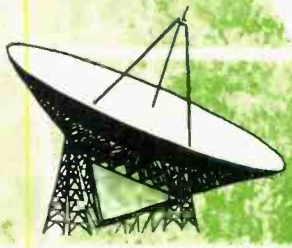


B TRANSFORMER

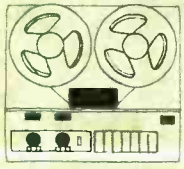
D X-RAY TUBE



A VOLTAIC PILE



E RADIO TELESCOPE



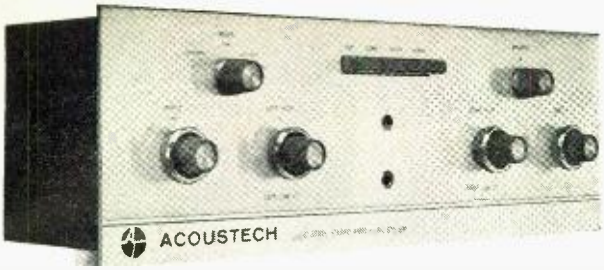
J WIRE RECORDER

F DYNAMO

I CRYSTAL

G CAPACITOR

H TV ANTENNA



ACOUSTECH "ADD-A-KIT" SOLID-STATE INTEGRATED HI-FI AMPLIFIER

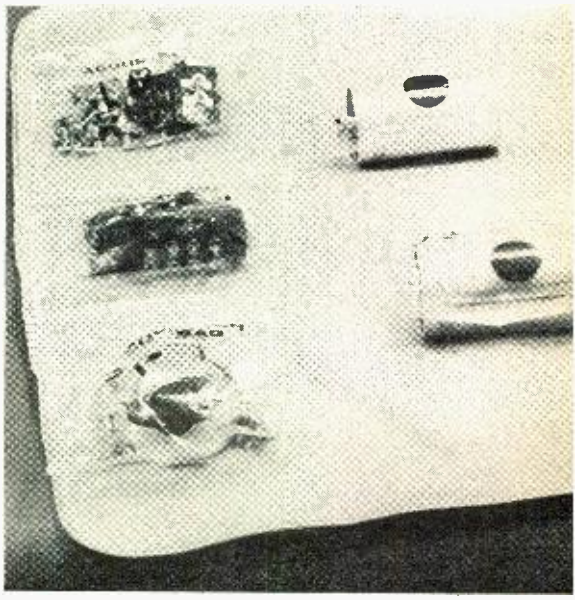
PUT TOGETHER A TRANSFORMERLESS STEREO POWER OUTPUT AMPLIFIER KIT—ADD A PREAMPLIFIER-CONTROL CENTER KIT AT ANY TIME

MOST AUDIOPHILES SEEM TO AGREE that a large sum of money must be invested in order to obtain the best hi-fi equipment. But for the kit builder, this in not the case. Some of the highest quality hi-fi/stereo amplifiers can be obtained in kit form at a considerable saving over similar factory-wired units. The all-transistor power amplifier-control center (Model XI/PM) by Acoustech* ranks among the best hi-fi kits available today.

This integrated amplifier actually consists of two kits that can be bought separately. The price tag for the stereo power amplifier (XI) is just $129.50. For an additional $89.50, the builder gets the stereo preamplifier section (PM) which consists of a pair of printed circuit card modules and a new front panel for the integrated amplifier-preamplifier.

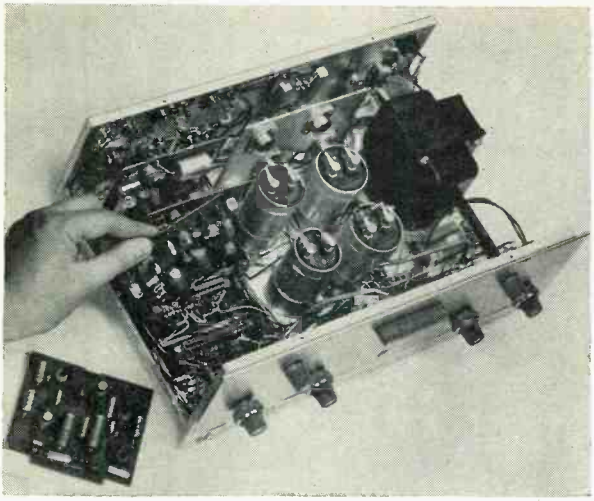
Both kits have been prepared with the builder's convenience in mind. For example, all small parts come in numbered bags that correspond to the wiring steps in the assembly manual; and the bags are pinned to Acoustech's exclusive "Kit-Kloth." The "Kit-Kloth" is a feature that will be welcome to those who have to work on a kitchen or dining room table; all construction is performed on the "Kit-Kloth," preventing any table top burns or scratches and gouges.

The critical circuitry for the power amplifier and preamplifier subsections comes already mounted on four computer-type plug-in printed circuit cards. This helps to keep construction down to a bare



Kit includes an exclusive "Kit-Kloth" which serves as a convenient work surface covering and keeps small parts within easy reach during construction.

*Acoustech, Inc., 139 Main St., Cambridge, Mass. 02142



Completed integrated amplifier-preamplifier has neat, uncluttered appearance. Massive computer-quality electrolytic capacitors are used exclusively in the power supply. Four computer-type plug-in printed circuit cards come factory-wired to provide the best possible sound reproduction and low distortion—and to facilitate the construction.

minimum. All that is really left for you to do is put the mechanical parts together, assemble the power supply, and wire the interconnections.

Even if you have never built a kit before in your life, you should have no trouble in assembling the power amplifier and power supply sections. Putting the preamplifier sections together, however, is a bit more difficult. But by carefully following instructions and the full-color assembly drawings, and having a little patience, you should be able to overcome any obstacles.

Another exclusive feature of these Acoustech kits can be found at the end of the assembly instructions. A "count-down system" tells how many (and which) components should be connected to every pin and solder lug in the part of the kit you build—added insurance against costly wiring errors.

TECHNICAL DATA

Output power per channel	35 watts
Transient power per channel	90 watts
Frequency response at normal listening level	±1 db, 5-70,000 Hz ±3 db, 2-120,000 Hz
Harmonic distortion at 20-20,000 Hz	Less than 0.25%
Hum and noise below rated output	Phono input: 55 dB High-level: 75 dB
I.M. distortion for 2-volt equivalent output	Phono: 0.15% High-level: 0.09%
Input sensitivity	Phono: 2.5 and 10 mV
Square wave rise time	1.75 μsec
Inputs in ohms	Phono: 47,000 High-level: 250,000
Output	4-16 ohms
Tone control range	8-db boost and cut

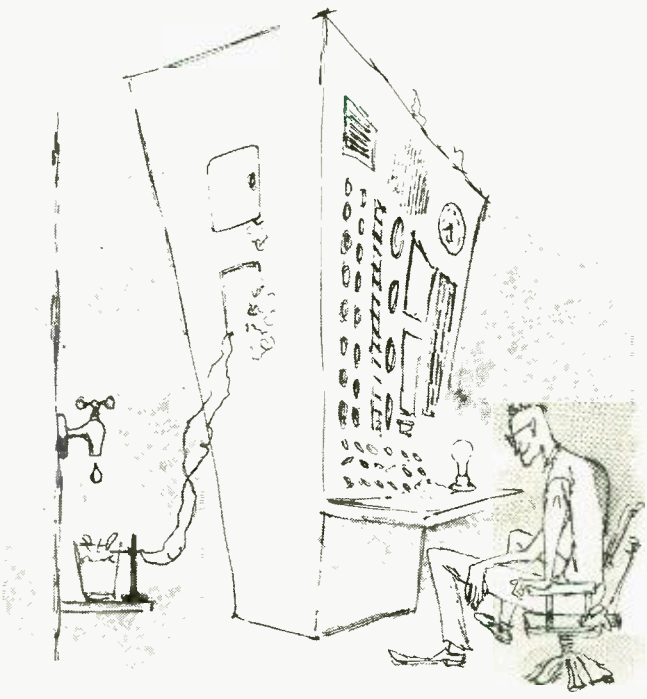
Subjective listening is perhaps the best test for an amplifier. Suffice it to say that the sound reproduction from the XI/PM is crisp with unstrained vocal and instrumental clarity. If you have any idea of what the "presence" of sound is, you can be sure that the XI/PM integrated amplifier has it—from whispering sounds to the roaring finale of an orchestral piece like Tchaikovsky's *1812 Overture*.

Some hi-fi enthusiasts may feel that the 8-db boost or cut range of the tone controls is inadequate. The limited range of the controls, however, makes it virtually impossible to distort the sound—unless it's already noticeably distorted before it reaches the XI/PM. In fact, the truest sound is obtained when the bass and treble controls are not even in the circuit; to achieve this goal of the perfectionist, the amplifier's control center has a facility to switch the tone controls out of the circuit.

Whether you are looking for a good amplifier to start your system, or one to move up to, the Acoustech XI/PM should satisfy you. And if you already have a good tube-type or transistorized preamplifier, you can buy just the XI power amplifier kit. Either way, 70 watts of power (35 watts per channel) will be yours for uncompromised sound reproduction. —30—

SENSITIVE LOW-COST INDICATORS

COMBINATION TRANSISTOR/PILOT LIGHT CIRCUITS ARE EASY TO ASSEMBLE



By JOHN L. BEISWENGER

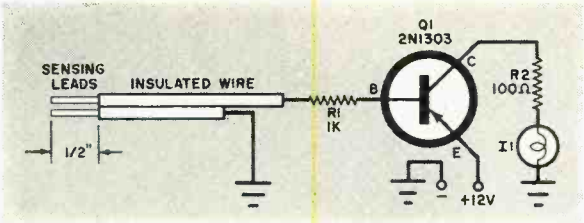
AN "INDICATOR" is usually a small gadget that can "tell" you if a piece of equipment is on or off, if the level of a liquid is high or low. if things are hot or cold, etc. An indicator can also alert you to a situation in time to allow you to avoid a major catastrophe—or even a minor one.

Generally, an indicator must be activated by some kind of switch, transducer, or other type of detector. Detectors can be mechanical, electro-mechanical, or electronic devices. Electronic detectors are usually faster-acting, more sophisticated, and more sensitive devices than their mechanical counterparts, and are able to monitor situations that might otherwise escape detection.

Electronic indicators can be inexpensive (less than $1), or they can be costly, complex affairs. Described here are a few low-cost units that can be put together with one or more transistors and with one or more low-current, low-voltage pilot lights. A 51-cent transistor (either a 2N1302 or a 2N1303) and a number 49 indicator lamp can be made to work with a sensor that for one reason or another cannot tolerate sufficient voltage or current to light the lamp directly. In a way, the transistor amplifies the action.

How They Work. A simple indicator circuit using only one transistor, an indicator lamp, and suitable resistors is shown in Fig. 1. The open pair of sensing leads

Fig. 1. Sensing leads can be replaced by any on/off switch type of transducer or detection probe. When the circuit is closed, the indicator light goes on.



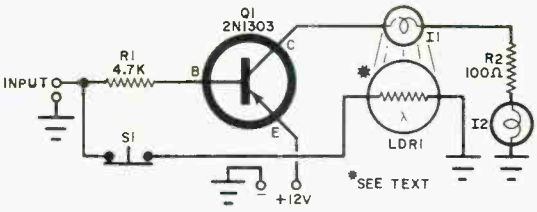


Fig. 2. Latching type of indicator circuit keeps the lamps on even after an "on" signal is removed. Lamp I1 in series with a 100-ohm resistor can be wired in parallel with I2 and R2.

can function as a liquid level indicator, just like a normally-open switch that closes when something happens. As a matter of fact, any switch that can sense a change in temperature, humidity, speed, etc., can be used.

When the sensing leads are open-circuited, no current can flow through the transistor and lamp. On the other hand, when the transistor's base circuit is completed, through the sensor, current flows and energizes the lamp.

Resistor *R1* serves as a base current limiter. Resistor *R2* drops the voltage enough to obtain safe operation of the indicator lamp. The indicator lamp remains on as long as the sensing leads form a closed circuit.

A few minor changes can be made in the basic circuit to produce an indicator that will latch on. The addition of a light-dependent resistor (*LDR1*) and another lamp connected into the circuit as well as a normally-closed, momentary-break switch, as shown in Fig. 2, are all that are needed.

Operation of the latching circuit is essentially the same as the basic indicator circuit except that *I1* illuminates *LDR1*. In the presence of light, the resistance of *LDR1* drops, effectively completes the base circuit, and keeps the transistor turned on. Once the circuit conducts, it remains on even after the sensor is returned to its open-circuit condition. The circuit can be turned off, or reset by depressing *S1* long enough to douse the light from *I1*.

You can obtain a greater degree of sensitivity by applying enough bias to the base circuit, as shown in Fig. 3, to just keep *Q1* in a nonconducting state. Should a liquid or any other substance bridge any of the gaps in the sensor enough to increase the forward bias, the transistor will turn on, and so will the lamp. Transistor *Q2* enhances circuit sensitivity only, and could be eliminated in some applications. Potentiometer *R1* serves as a sensitivity control.

(*Continued on page* 98)

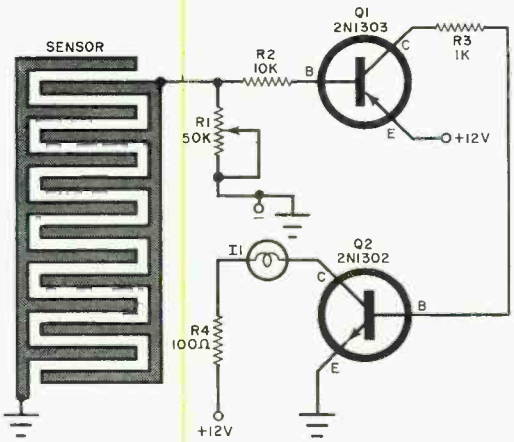


Fig. 3. Sensitivity can be increased by adjusting bias to just below Q1's conducting point. Any further decrease in resistance, as by moisture bridging sensor's elements, will turn on Q1, Q2, and I1.

BUILD THE QRP MIDGET

By **JIM WHITE,** W5LET

RETURN TO THE DAYS OF OLD WITH 2.5 WATTS INPUT

DO YOU STILL get a thrill out of hamming? Or is the spirit of adventure gradually disappearing? Maybe you have been considering taking up a new hobby, like chasing butterflies, or collecting stamps. Don't do it. There is nothing like switching to low power—very low power—to restore the thrill to hamming.

If you have done all of your hamming on a "store-bought" rig, maybe you should try your hand at building a transmitter—one that is really portable, with no power lines to worry about. The *QRP Midget* is a 2-tube, battery-powered transmitter that you can hold in the palm of your hand. It will work on 80-, 40-, or 20-meter CW. It can be built for less than $10 and, when connected to a good antenna, will give a good account of itself.

How It Works. The circuit uses two 3S4 tubes in parallel as a crystal oscillator. The filaments are wired in series so that a 6-volt battery can be used for the filament supply. By using plug-in coils, band-changing is as simple as plugging and unplugging a tube. The coils are tuned to resonance in each band by a single variable capacitor.

In addition to the 6-volt battery, two 45-volt B batteries are wired in series to provide 90 volts for the plates and screens of the tubes. The key is connected in series with the B-minus lead to the batteries. A small coil, *L2*, couples the r.f. in the plate circuit to the antenna.

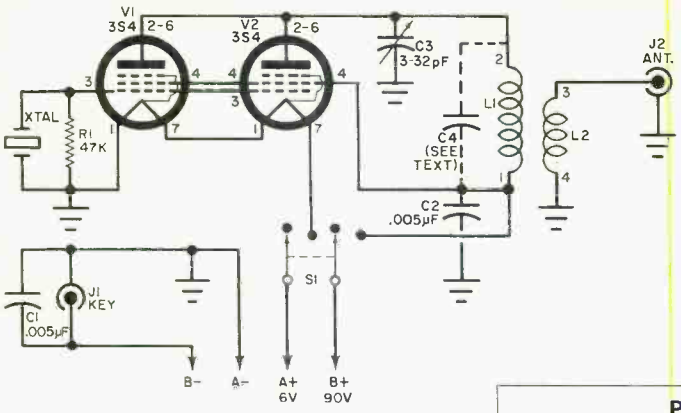
Construction. Since the *QRP Midget* is very small, the arrangement of parts is important. A good look at the photographs will show you just where each part is located.

After all of the necessary holes are drilled and punched, install the crystal socket. Then wire *R1* across its terminals. Leave enough excess lead wire to reach pin 3 of *V1* and the ground connection of *J1*. Now install the three tube sockets, phono (*J1*) and coax (*J2*) connectors, and variable capacitor *C3*.

Following the circuit diagram, carefully wire the balance of the transmitter. All wiring, with the exception of the leads to the batteries, is done with No. 20 solid hookup wire. The battery leads are made of 18″ lengths of No. 20 stranded hookup wire; it is a good idea to use different colored wire for these four leads to lessen the possibility of making a mistake when connecting them to the batteries.

The last three parts to be mounted are *S1*, *C1*, and *C2*. The two capacitors are wired across *J1* and the 4-prong coil socket, respectively. The four battery leads are connected to the switch, the ground connection of *J1*, and the "hot" side of *J1*.

Winding The Coils. On each of the coil forms, there are two separate windings, *L1* and *L2*, of No. 24 enameled wire. They are separated from each other by a



Rockbound transmitter for 80, 40, and 20 meters is small enough to fit into your glove compartment, complete with batteries. Note that pin 5 on 3S4, connected to screen grid and filament center tap, is not used, and is not shown here. Key plugged into J1 turns transmitter on and off for CW operation. Don't let the low power fool you non-hams—you must have a license to put this unit on the air.

distance of ⅛". For 80 meters, *L1* consists of 31 turns, close-wound, and *L2* is 8 turns, close-wound. The 40-meter coil has 21 turns on *L1* and 7 turns on *L2*, both close-wound.

The 20-meter coil has 12 turns on *L1*. This coil is wound so that the winding takes up about 1 inch, with the turns spaced equally to occupy this space. Coil *L2* on the 20-meter form consists of 3 turns, close-wound.

When you wind the 80-meter coil, be sure and solder *C4* in place as you solder the two wires from *L1* to the pins. This capacitor is mounted inside the coil form.

Going On The Air. Connect a key to *J1* and a good antenna for the band you intend to work to *J2*. With the power switch in the "off" position, insert the two 3S4's into their sockets. Plug a crystal into the crystal socket and a coil into the coil socket (they must be for the same band). Now, using a field strength meter, or a receiver S-meter, turn the transmitter on, press the key, and slowly rotate variable capacitor *C3* until you get an indication that the *QRP Midget* is oscillating.

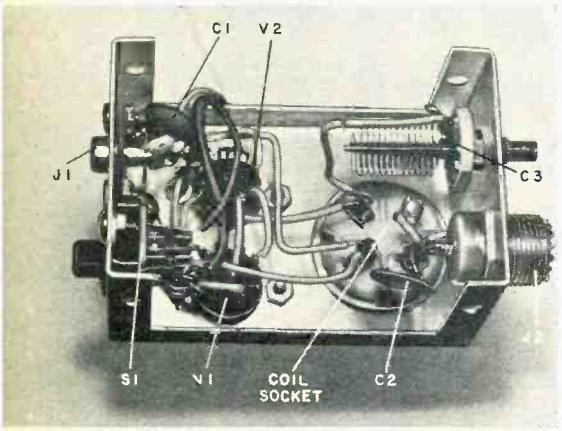
Tune *C3* to the peak reading. If you peak it too much, the keying may be erratic. Adjust *C3* for the best output consistent with good keying.

Keep in mind that you must have a good antenna when you use the *QRP Midget*. A makeshift antenna simply will not do the job with such low power. Put some time and energy into the antenna, and it will pay dividends. Also, the author has found that a few of the crystals for 20 meters are a little sluggish and do not oscillate very well; you might have to try several before you get a good one.

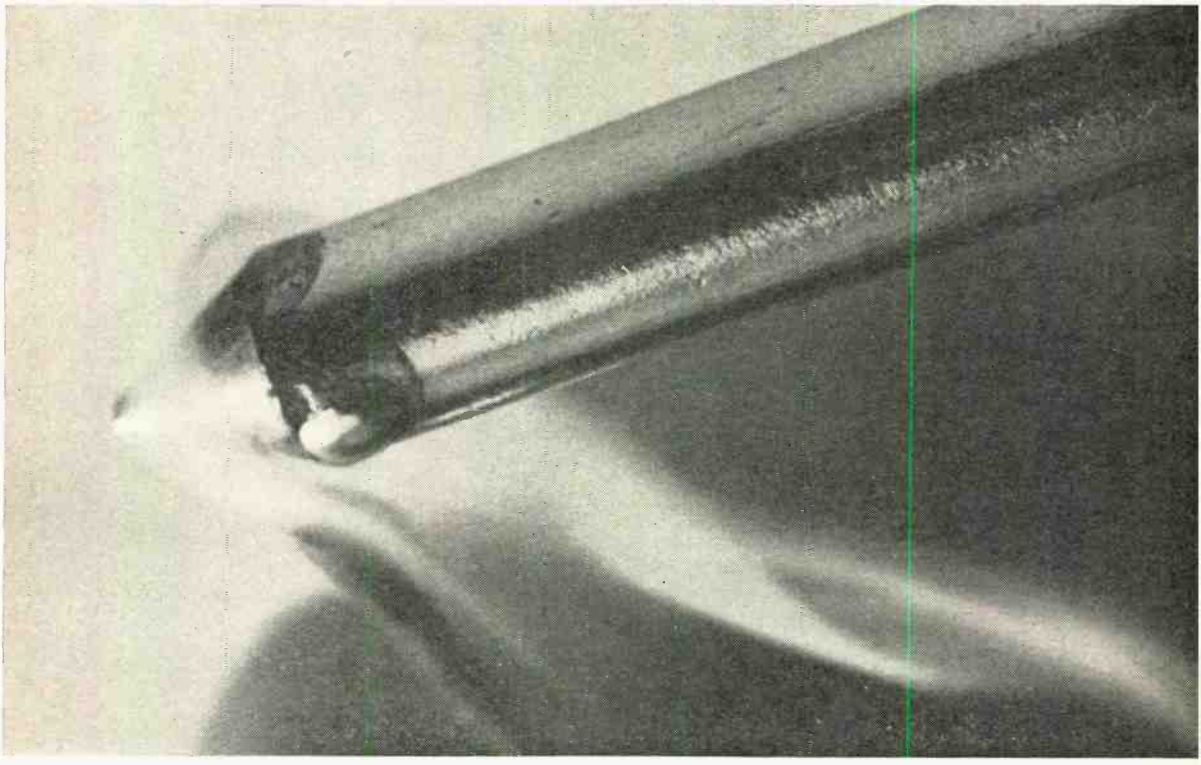
If you want to measure the input to the *QRP Midget*, just put a milliammeter in series with the B-plus lead. The input should be about 2½ watts. -30-

PARTS LIST

C1, C2—0.005-μF, 1000-volt disc ceramic capacitor
C3—3-32 pF midget variable capacitor (E.F. Johnson 160-130 or similar)
C4—50-pF silver mica capacitor
J1—Phono connector, female
J2—Coax connector, female
L1, L2—See text
R1—47,000-ohm, ½-watt resistor
S1—D.p.s.t. slide switch
V1, V2—3S4 tube
3—Coil forms (J. Millen 45004)
1—Crystal socket (National CS-6)
1—Coil socket (Amphenol 49RSS4)
Misc.—6-volt battery, 45-volt battery (2), tube sockets (3), wire, solder, nuts, bolts, etc.



Neatness counts; proper parts location and lead dress are important for clean operation. Keep the leads short. Terminal strip to accommodate battery leads can be mounted on the other half of the box.



ELECTRONIC SOLDERING

DO YOU MAKE GOOD CONNECTIONS THE FIRST TIME, EVERY TIME?

By JOHN McNARNEY

THERE IS NOTHING DIFFICULT about soldering. Yet most kits returned to the manufacturer and many home-built projects sent to the repair shop usually suffer from little more than poor soldering. Although the bulk of all soldering troubles can be attributed to cold soldered connections, there are also other types of soldering faults; heat damage, short circuits, corrosion, etc.

Cold soldered junctions have different effects on a circuit. They can appear as open, intermittent, high resistance and normal connections. They can fool you into thinking that you have noisy and otherwise defective components.

It doesn't take much time or effort to learn and put into practice good soldering habits. Nor does good soldering require any expensive tools or difficult-to-master skills. If you stick to a few common sense rules, you will be able to produce well soldered connections.

Types of Soldering Tools. There are all kinds of non-specialized soldering tools designed for general-purpose work. There are soldering irons (including soldering pencils), soldering guns, and soldering pistols. They are all rated according to electrical power consumption. High efficiency factors make it possible to disregard losses and think of the wattage rating as heat power.

Heat power is either light duty (20 to about 50 watts), medium duty (50 to about 125 watts), or heavy duty (125 watts and higher). Manufacturers' duty ratings are often misleading, however, since their designations are based on comparisons of the same types of soldering tools. For example, some soldering guns may be designated as light-duty tools, even though few—if any—guns develop less than 100 watts of heat power.

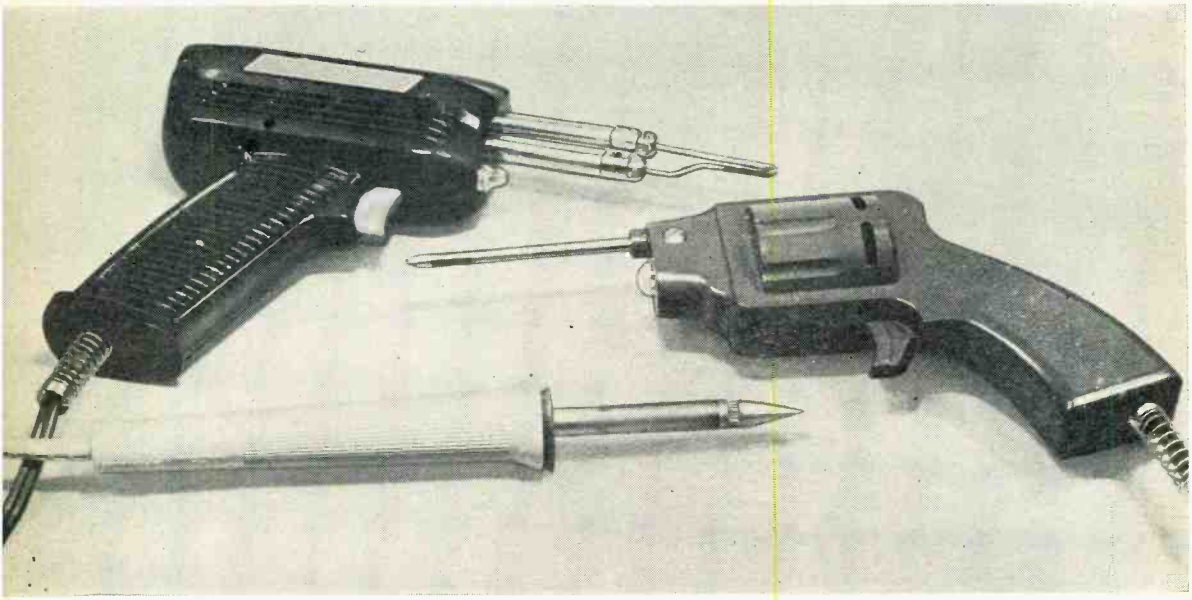
Soldering Irons. Soldering irons and pencils, taken as a group, are characteristically lightweight and compact, weighing in at less than a half-pound, (without power cord). These tools cost from as little as $1.50 up to about $20 for elaborate or precision units and kits complete with special attachments.

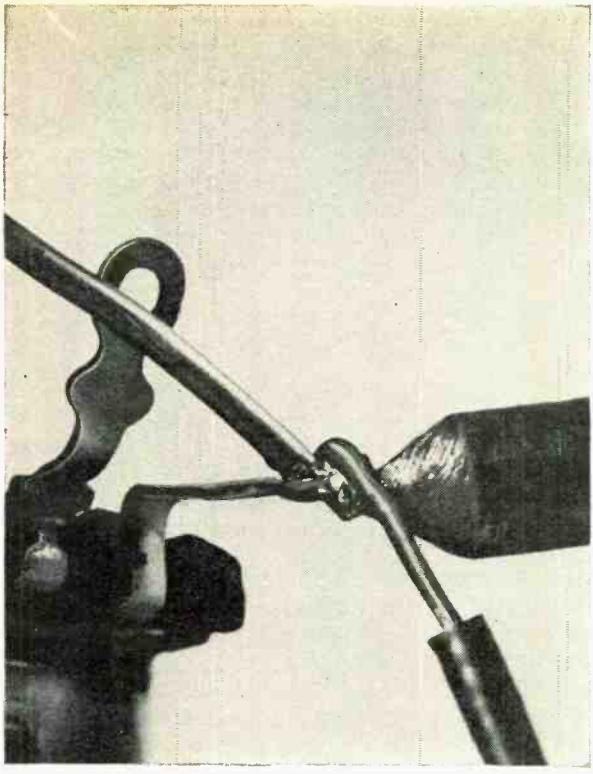
The soldering iron and pencil are designed for constant use over a long period of time and with a minimum amount of tip deterioration. As such, this type of tool is especially adapted for extensive project work and kit building.

Soldering irons and pencils have a heat-generating device (resistance element) which is electrically isolated from the soldering tip, but closely thermally coupled. The size and weight of the tip affect the tool's initial heating and heat recovery times. Different kinds of metal and a multitude of shapes and sizes are available. A simple copper tip having one or more flat faces at the pointed end is generally used.

A new type of soldering iron, constructed in such a manner as to provide a selection of different heat power ranges, has recently become popular among hobbyists. This type of tool employs a separate step-down transformer, the secon-

Clockwise from bottom, pencil soldering iron, transformer soldering gun, and soldering pistol are most often used types of soldering tools. Each type of tool is available with different heat power ratings plus a variety of specialized tip configurations.





Heat and solder should be applied to opposite sides of connection for best results. This allows solder to flow properly into and around joint. Use only enough solder to insure a good, solid connection.

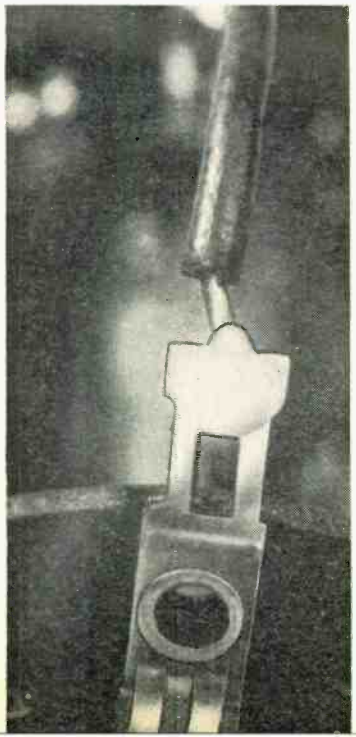
dary of which is tapped in several places, to provide the correct amount of low voltage and high current for the heat power range selected.

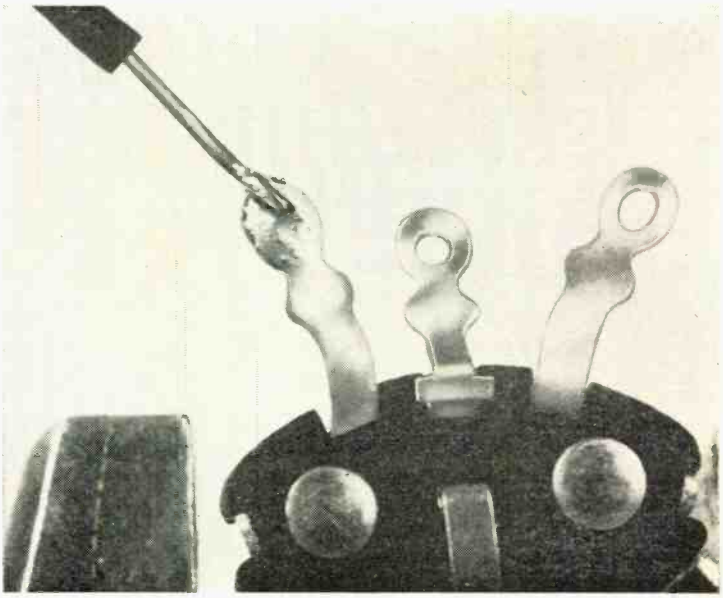
Soldering Guns. The soldering gun, because of its built-in transformer, is a rather heavy and bulky device, but its unique pistol-like construction makes it comfortable to use and easy to manipulate. Soldering guns can be purchased for from $4 to about $14.

The built-in transformer of the soldering gun provides low voltage and high current directly to the tip. The tip appears to be a short circuit across the transformer's secondary, and comes up to soldering temperature almost instantly.

Because of the instantaneous heating —and cooling—feature of the soldering gun, this type of tool is often preferred for intermittent applications. It is also used by those advocates of get in and get out fast with high heat to prevent damage to transistors and other solid-state components.

Photos below show examples of good (left) and poorly (right) soldered connections. Good connection is usually bright and smooth, while poorly soldered connection is more often than not dull and grainy due to improper application of heat and/or solder.





Soldering Pistols. The soldering pistol has about the same shape as the soldering gun. The pistol is a hybrid affair, combining features of both the soldering iron and the soldering gun. For example, this type of tool employs both a heating element and a step-down transformer, and its soldering tip resembles those found on many soldering irons.

The step-down transformer serves the same basic function as in the soldering gun; it provides a low voltage-high current source for almost instantaneous heat.

As a general rule, soldering irons and pencils are light- to medium-duty tools, soldering guns are medium- to heavy-duty, and pistols can be obtained in either light-, medium-, or heavy-duty units. Take your choice; but remember, the tool you do choose must be capable of producing enough heat power to efficiently solder the connection in the shortest possible time. This doesn't mean that the higher the power the better. On the contrary, excessively high power tools are more likely to cause more damage in the hands of a person who doesn't have experience in using them.

Solders and Fluxes. Solder is simply a tin-lead alloy that flows at a relatively low temperature (about 370°F). Because of this low melting temperature, solder connections can be made quickly and economically.

Most solders are identified by their tin-to-lead combination. A solder alloy that contains 60% tin and 40% lead is described as 60/40 solder—with the percentage of tin always shown as the first number in the ratio.

Solder is most convenient to use in 16- or 18-gauge strand form. The small cross-sectional area allows conservatively rated tools to make it flow quickly, and the quantity of solder used for each terminal can be easily controlled.

In order for solder to adhere properly to a connection, the joint must be clean, free of oxides, and properly heated. The most effective way to combat oxidation is to use an oxide-reducing flux. However, solder flux will not remove dirt, grease, paint, etc.

Acid and chloride salt fluxes are highly corrosive and have no place in electronics. Use a rosin-type flux for general-purpose soldering and an aluminum oxide-reducing flux for soldering components to aluminum. (Yes, you can solder to some types of aluminum alloys.)

Solder and fluxes are so closely related that solder manufacturers have combined the two in precisely balanced proportions for general and specialized applications by fabricating the solder so that it contains one or more cores of rosin flux.

How To Solder. The cardinal rule is to "keep it clean." That goes for your soldering tools as well as for the connection to be soldered. If the soldering tool you use is a pencil or iron that has a large copper tip, the tip must be coated (tinned) with a thin film of solder to prevent deterioration resulting from oxidation. Tinning also helps heat transfer from the tip to the work.

Even before you proceed to make a connection, the components and terminals to be soldered must be clean. A dirty solder lug or component lead can be quickly cleaned by rubbing it with medium-grade emery cloth or coarse steel wool.

Once the components and terminals to be soldered are cleaned, they are connected together in such a way as to form a good electrical and mechanical joint. The unsoldered connection should be electrically conductive and mechanically solid.

Heat-sink the leads of heat-sensitive components. (The heat sink can be a commercially available item, the jaws of long-nose pliers, or even a paper clip in a pinch.) The heat sink serves as a heat radiator and should be placed as close to the component as possible.

Finally, apply the heat to the connection to be soldered—not the solder! When the connection is hot enough to cause the solder to flow, apply just enough of the solder to form a thin coat. To improve the efficiency of the heat transfer from the soldering tip to the terminal, or connection, many electronics enthusiasts allow a bead of solder to form on the soldering tip. When this bead of solder "surrounds" the connection, heat flows into the joint from "all" sides.

Remove the solder feed first, then the heat, and do not allow the newly soldered connection to move while the solder is in a mobile state. That's all there is to it. —30—

VOM + FET = TVM

BUILD SIMPLE ADAPTER TO MAKE YOUR VOM ACT LIKE A $200 TRANSISTORIZED VOLTMETER

By JAMES RANDALL

WOULD YOU USE an ordinary low-input impedance VOM (volt-ohm-milliammeter) to make essential voltage measurements in high-impedance circuits while your VTVM (vacuum-tube voltmeter) was sitting idly on your workbench? Of course not. But what do you do if you don't have a VTVM? You can step up the input impedance of your VOM by interposing a suitable device between the circuit under test and the VOM. Such a device—a FET VOM-to-TVM converter—can be built for about $10.00.

So long as your present VOM has a 0-50 or 0-100 μA d.c. full-scale range, it can be made to exhibit an input impedance on the order of 10 megohms even on low d.c. voltage ranges with the aid of this converter. If you want to measure a.c., you can achieve an input resistance of about 1 megohm by simply using a rectifier probe with the converter.

Battery operation of the converter and the VOM make the combination into a portable "VTVM" independent of a 117-volt power line—an advantage most VTVM's do not have.

How It Works. Figure 1 shows the circuit diagram for the converter. Resistors *R1* through *R4* comprise a 10-megohm voltage divider used for range selection. The N-channel field-effect transistor (FET), *Q1*, in a source-follower configuration isolated by *R5*, acts like a high-impedance to low-impedance matching device, and also forms one leg of a bridge circuit.

The other legs of the bridge are made up of source resistor *R6*, potentiometer *R9*, and resistors *R8* and *R10*. Potentiometer *R9* zero-sets the meter (balances the bridge) to compensate for the current through *R6* and *Q1* when no voltage is applied to the test probes.

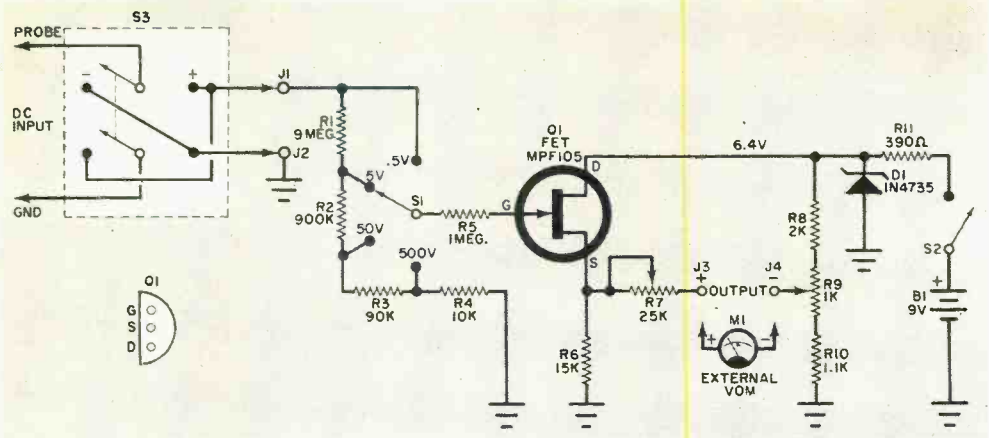


Fig. 1. High-impedance characteristic of field effect transistor permits 10-megohm voltage divider to come between the circuit under test and a VOM. Divider sets up 5 voltage ranges from 0.5 volt to 500 volts.

Operating power is supplied by *B1*, and stabilized by zener diode *D1*, to maintain calibration accuracy for a longer period during the life of the battery. Battery end voltage in this instance is about 6 volts.

To measure a.c. voltages with any d.c. instrument, it is first necessary to convert the a.c. into d.c., which is then measured by the instrument. A suitable circuit for making this conversion is shown in Fig. 2.

PARTS LIST

B1—9-volt battery
C1—0.05-μF, 600-volt capacitor
D1—6.2-volt, ¼-watt zener diode
D2—1N4003 diode, or similar
J1, J2, J3, J4—Input and output jacks or binding posts
Q1—Motorola MPF105 field-effect transistor
R1—9 megohms, ±5% } ALL *resistors ½-watt*
R2—900,000 ohms, ±5% } ALL *resistors ½-watt*
R3—90,000 ohms, ±5% } ALL *resistors ½-watt*
R4—10,000 ohms, ±5% } ALL *resistors ½-watt*
R5—1 megohm, ±20% } ALL *resistors ½-watt*
R6—15,000 ohms, ±5% } ALL *resistors ½-watt*
R7—25,000-ohm miniature potentiometer
R8—2000 ohms, ±5%
R9—1000-ohm miniature potentiometer
R10—1100 ohms, ±5%
R11—390 ohms, ±10%
R12—270,000 ohms, ± 1%
R13—680,000 ohms, ± 1%
S1—Single-pole, 5-position, non-shorting rotary switch
S2—S.p.s.t. slide switch
S3—D.p.d.t. slide switch—optional
1—3" x 4" x 5" utility cabinet—see text
1—2½" x 2½" perforated circuit board—see text
Misc.—Rubber feet (4), cabinet handle, battery clip, knobs, wire, solder, "L"-brackets (2)

The r.m.s. values of a.c. voltages from power line frequencies to r.f. can be measured by using this circuit ahead of the voltage divider in the FET converter. The limit of the maximum voltage which can be measured is determined primarily by *D2*, which is used as the rectifier. Input coupling capacitor *C1* can have a 400-volt rating or higher, as desired. Resistors *R12* and *R13* should be precision 1% types, or selected from 5% resistors to obtain accurate values.

Construction. You have a number of choices in constructing the FET VOM-to-TVM converter. The unit can be built in the form of a probe, or built as a plug-in unit, or as a bench-type accessory and housed in a small utility cabinet. The choice is a matter of convenience, and depends essentially on the availability of the necessary miniature components as well as on the particular VOM with which it will be used. For example, if you can get a miniature selector switch—not over one-half inch in diameter—for *S1*, as well as miniature po-

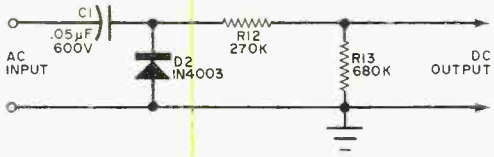


Fig. 2. This simple rectifier probe can be assembled to measure a.c. voltages. The probe's impedance (about 1 megohm) varies inversely with frequency.

tentiometers for *R7* and *R9*, then all of the components can be put in a probe case no bigger than 1" x 1" x 7".

However, the simplest, and most economical approach is to use a 3" x 4" x 5" utility cabinet in which standard components can be assembled with plenty of room to spare. Such a box will provide room for a polarity reversing switch (*S3*) enabling you to measure either positive or negative voltages without physically reversing the input leads. But while this feature is handy to have, it is not really necessary.

You can duplicate the author's model by following the general layout which is shown in the photographs. Then you can mount the range switch, *S1*, the balance control, *R9*, the polarity reversing switch (optional), and the input and output jacks on the panel.

Divider resistors *R1* through *R4* are mounted directly on the range switch (*S1*), which has an *off* position. However, you may find it more convenient to control the battery power with a separate slide switch (*S2*).

Mount the calibration potentiometer (*R7*), the zener diode, the FET (*Q1*), and the remaining resistors on a 2½"-square piece of perforated phenolic circuit board, and secure the board to the rear of the front panel by means of two small L-shaped brackets. The battery can be put in a holder and clamped to the base of the unit. Then complete the circuit wiring according to Fig. 1.

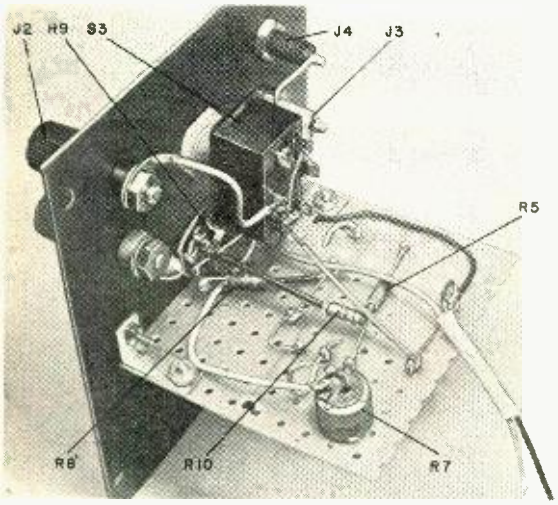


Fig. 3. All of the converter's parts can be fitted into a hand-held probe, or mounted inside a small cabinet. Parts layout and wiring are not critical.

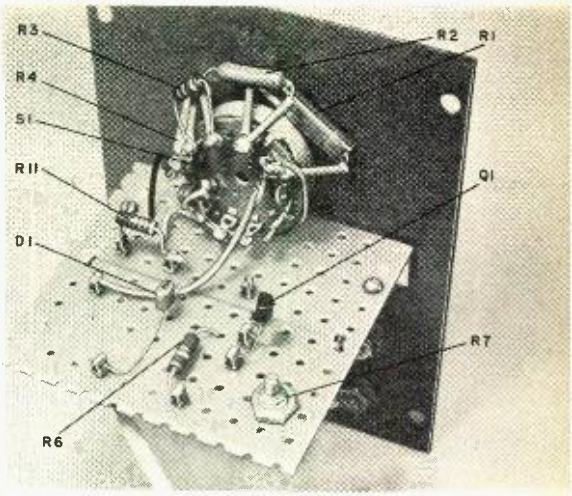


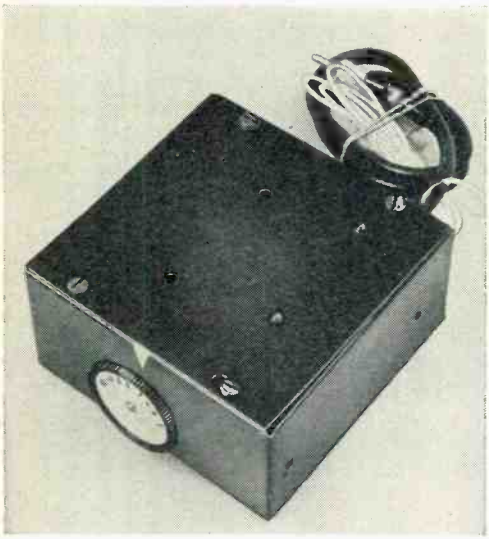
Fig. 4. Inside top view of converter shows voltage divider resistors mounted on the range-selector switch. "Breadboard" type construction can be used to hold the other components in place. A phenolic perforated board and small clips were used here.

The front panel controls can be lettered, using dry transfers, and then sealed in with a clear plastic spray. If your VOM has a 0-50 μA scale, mark the range positions from left to right as follows: OFF—0.5—5—50—500 volts. If a 0-100 μA meter scale is used, mark the ranges: OFF—1.0—10—100—1000 volts.

Calibration. To calibrate the instrument, connect a pair of test leads from its output jacks to the input of the VOM, setting the VOM on its 50-μA or 100-μA d.c. current range. Turn switch *S1* to its lowest range and adjust the balance control (*R9*) for zero indication on the VOM.

Apply an accurate calibrating voltage (0.5 volt for a 50-μA meter or 1.0 volt for a 100-μA meter) to the converter's input and adjust calibration potentiometer *R7* for full-scale reading (50 or 100 μA). To check linearity, reduce the applied voltage in small increments while observing that the VOM tracks with the calibrating voltage. Linearity and voltage divider accuracy depend upon the accuracy of the 5% resistors. Use precision 1% resistors if possible. You can also make comparison readings with a known accurate VTVM. —30—

AAH-CHOOO! NOT ANOTHER



QUITE A FEW READERS have built "Pepper," the outboard r.f. amplifier to increase the sensitivity of automobile AM broadcast band receivers. Although the "Pepper" circuit that appeared in the May 1966 issue (page 56) of POPULAR ELECTRONICS could add 8 to 10 dB of gain, it just didn't behave properly for many project builders. Some readers complained of increased sensitivity to ignition noise or susceptibility to motor boating.

The original "Pepper" circuit has been revised as shown in Fig. 1. In the modified circuit a coil/capacitor combination (*L1/C3*) has been added and the new design calls for installation in a metal or shielded container.

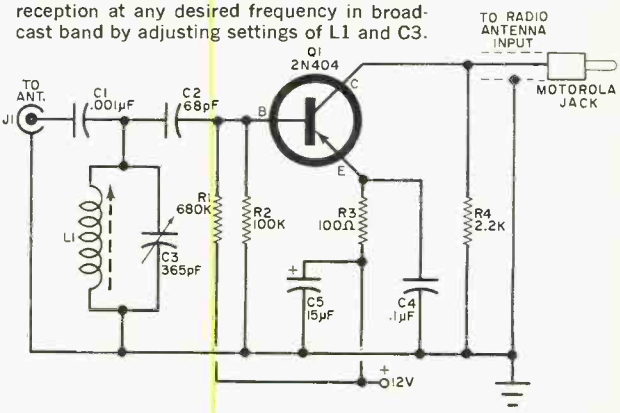
The modified "Pepper" unit need not cost more than $5 and will obviously cost much less if you have constructed the original circuit. If your car has a positive ground, substitute an *npn* transistor for *Q1* and reverse the polarity of capacitor *C5*.

Construction. Although parts layout is not critical, the "Pepper" circuit must be shielded on all six sides. The connection to the AM radio input must be via a coaxial cable.

Drill the appropriate size holes in the box to mount *J1*, *C3* and *L1* as shown in Fig. 2. You can use a perforated phenolic board to lay out the circuit components; if you do, use ½" long spacers to provide adequate clearance between the circuit board and the metal box.

Run the coax cable through a rubber grommet in the side of the box, and solder the cable directly into the circuit. If possible, connect the 12-volt power lead to the on-off switch in your car radio. However, the current drain is so low that the "Pepper" circuit can be left

Fig. 1. R.f. amplifier Q1 can be tuned for best reception at any desired frequency in broadcast band by adjusting settings of L1 and C3.



PEPPER?

OUTBOARD BCB PREAMP PEPS UP AUTO RECEPTION

By GARY MC CLELLAN

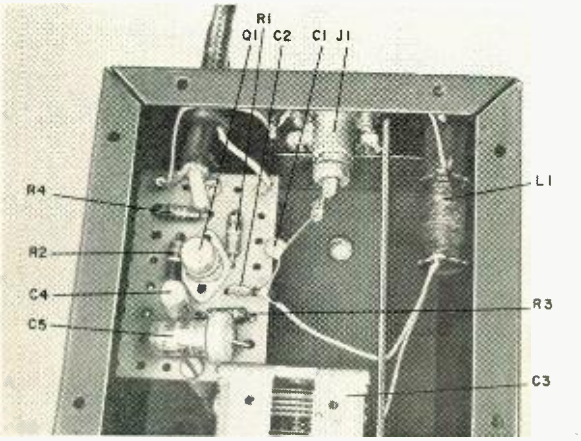


Fig. 2. Optional metal plate shields L1 from rest of circuit. Be careful not to short out trimmers on tuning capacitors. Solidly ground box to car frame.

PARTS LIST

C1—0.001-μF disc capacitor
C2—68-pF disc capacitor
C3—365-pF variable capacitor
C4—0.1-μF, 100-volt paper capacitor
C5—15-μF, 15-volt electrolytic capacitor
J1—Motorola antenna jack
L1—Ferrite loopstick antenna coil (similar to Lafayette 32R4108)
Q1—2N404 transistor—see text
R1—680,000-ohm resistor } *all resistors ½-watt*
R2—100,000-ohm resistor } *all resistors ½-watt*
R3—100-ohm resistor } *all resistors ½-watt*
R4—2200-ohm resistor—see text
Misc.—Metal box, coaxial cable, hookup wire, perforated phenolic board, spacers, hardware, solder, rubber grommet, etc.

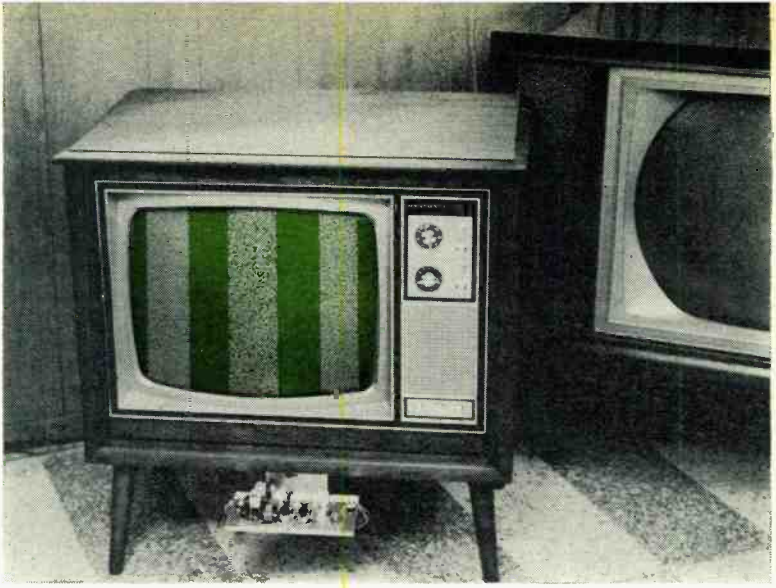
Fig. 3. Circuit must be built inside metal box to provide effective shield against r.f. interference that can be caused by ignition and other noises.

operating even when your radio is turned off by simply tying into the "Accessory" side of the ignition switch.

Tuning and Use. Disconnect the antenna from your car radio and plug it into the "Pepper" input jack, *J1*. Turn on the AM radio and adjust *L1* until at one setting you can tune *C3* through the entire AM broadcast range. Once set, *L1* is not readjusted; but peaking of the circuit is left to *C3*. On strong local signals, additional peaking of *C3* may be unnecessary and you may find that an arbitrary setting of peaking capacitor, *C3*, will serve your everyday needs. On long trips and when you are away from strong AM broadcasting stations, have "Pepper" positioned so that you can tune *C3* for best reception.

For additional gain, try substituting a 2.5-mH radio frequency choke for the collector load resistor, *R4*. -30-

180 SQUARE INCHES OF COLOR TV

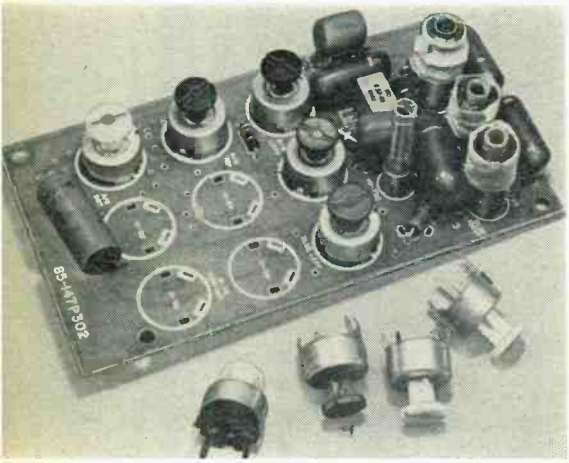


HEATHKIT "180" IS VAST IMPROVEMENT OVER ORIGINAL 21" COLOR TV KIT

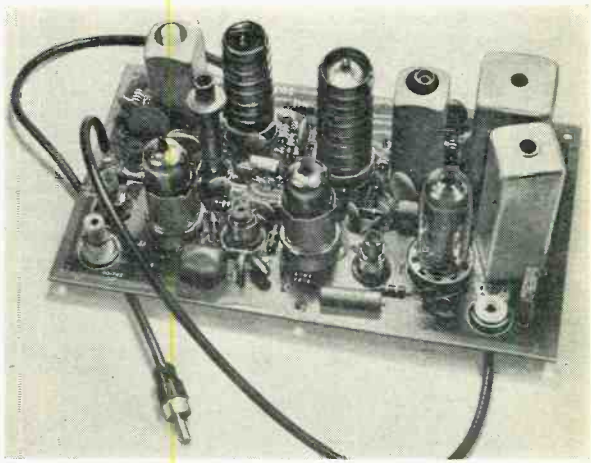
IF THE PROOF is in the doing, the Heath Company has another winner in its "180" color TV kit. By taking practically all of the essential ingredients from the huge "295" color TV kit*, substituting a smaller picture tube, and adding an appropriate size cabinet, Heath has come up with the GR-180 kit ($379.95, plus cabinet). Using a 19" rectangular tube (180 sq. in. of viewing area), the GR-180 replaces the first Heath color TV kit—the 1964 GR-53A.**

It is natural to compare the new kit

*POPULAR ELECTRONICS, *May, 1966, page 62.*
**ibid., May, 1964, page 81.*



Convergence board is assembled on a printed circuit card in about 20 minutes. Each knob is color-coded.



Three-stage i.f. strip is shipped to builder pre-assembled, tested, and aligned to insure best pictures.

with the older 21″-round picture tube kit. By 1967 standards, the 1964 receiver is getting near the antique category. For only a modest sacrifice of picture tube viewing area, the cabinet volume has been more than sliced in half for the "180" (see photo above, left). And the "180" is considerably sturdier—due primarily to the metal wrap-around box shield that encloses the bulb of the picture tube and screens off stray magnetic fields which upset the color purity.

It is impossible to itemize all of the circuitry changes between the "180" and the 1964 kit. However, some of the major changes are reflected in the kit assembly itself. For example, the builder now receives a completely wired, tested, and pre-aligned i.f. strip. This strip is crucial in reproducing faithful color, and the pre-wired unit eliminates a possible major trouble spot. The circuits surrounding the high voltage rectifiers have been vastly improved and all of the components associated with the horizontal output, damper, regulator, and rectifiers are delivered to the builder intact in another pre-wired package.

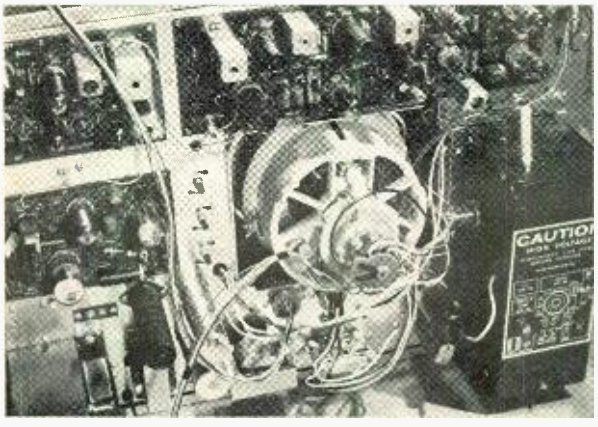
Two significant new circuits appear in the "180." One circuit involves automatic degaussing and the other the pin-cushion adjustments necessitated by the 90° picture tube. Degaussing occurs whenever the receiver is turned on from a cold start. Pin-cushion elimination is a minor but stable adjustment; once made, it will retain its setting indefinitely.

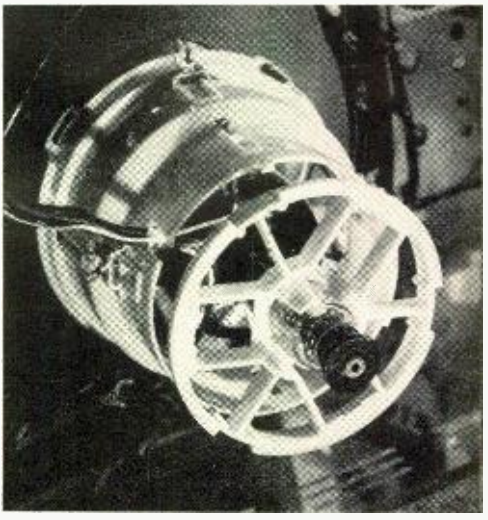
Wiring It Up. The hundreds of individual parts for the "180" flow together without a trace of trouble. Three printed circuit cards are worked up as subassemblies. Two of these, plus the pre-assembled i.f. strip, are mounted on the main chassis frame and a specially prepared cable harness is soldered in place to interconnect the boards and the operating controls.

When the picture tube is mounted and the metal shield assembled, the main chassis is swung into place (it is mounted on hinges for easy servicing). After initial degaussing, the yoke and pole pieces are positioned around the neck of the picture tube. Then you add the knobs and panel trim—total construction time should be between 23 and 24 hours.

The Proof Is In The Viewing. Side-by-side comparison of the older 21″ receiver and the new "180" confirmed what we would have suspected—the pictures in the "180" were sharper, uniformity of color was excellent, controls were more positive in action and somewhat more flexible (greater tint and color range), and there appeared to be substantially less "noise" or "snow" on all channels.

No review of a Heath color TV kit would be complete without mentioning that each receiver has a built-in dot generator to enable the builder to converge the color without extra test equipment. -30-





Pole piece assembly is partially fabricated by the builder. View at right shows yoke in position and the plastic pole piece retaining ring being slipped along neck. Above is overall view of rear of TV set.

INFORMATION CENTRAL

By CHARLES J. SCHAUERS, W6QLV

MOST letters and postcards from readers of POPULAR ELECTRONICS addressed to this column are brief and the questions well presented. However, many letters are too long, go into too much detail, and frequently ask too many questions—with lots of "if's, and's, and but's". Your columnist appreciates receiving short succinct communications with sufficient background electronics information to permit reasonable evaluation of the problems.

The volume of mail addressed to this column is increasing at an alarming rate. Although a percentage of the queries are now being answered on a personal basis, it may soon be impossible to continue this service. Please check your local sources of information before writing to *Information Central*. With a few electronics handbooks at your fingertips, plus all of the mail order catalogs, you'll be surprised how many questions can be answered with a minimum of research. Also, bear in mind that there is an intrinsic delay in your mailing a question, it being routed through the magazine's editorial offices, and finally being placed in my hands.

Time does not permit the redesign or modification of communications equipment for the benefit of an individual reader, but this column will provide such data (in print) if there is a sufficiently large number of requests for the same information. Nor can we lend instruction manuals or supply complicated wiring diagrams for ham, CB, TV, or SWL equipment. Wherever possible, however, we will tell you where the diagrams are available and how you may obtain the replacement for your construction or operating manual. In the future, we hope to establish a means of duplicating some of this "out of date" material.

Power Line Noise. *I am an SWL and I recently moved to a location which forces me to use a vertical antenna. A big power line near my home gives me no trouble when the weather is dry, but when it rains I hear nothing but a lot of hash on my receiver. Is there anything I can do about it?*

You can try calling the power company and ask them for help. If the power line carries high voltage, there is little that can be done if the noise spectrum is wide. However, if there is a major power leakage path caused by dirty insulators, or other defects, the power company may want to cut their losses.

CB To Intercom. *My neighbor is an avid CB operator. I can tell, because I hear her on the intercom in my house. If I switch off the intercom, she does not come through, but then I have no intercom. What can I do?*

Try inserting a 75,000-ohm resistor in series with the grid of each of the first two intercom amplifier stages and bypass the grid to ground with a 0.001-uF capacitor.

CB To Ham. *I am a CB'er and have decided to become a radio amateur. How do I go about it?*

Contact the American Radio Relay League (ARRL), 225 Main St., Newington, Conn. 06111. Ask them to send you information on becoming a ham.

Neon Lamp Life. *Which small neon lamps have the longest average life? I am not too concerned about brilliance.*

The following neon lamps have an average useful life of about 25,000 hours: NE-2, NE-2D, NE-2E, NE-2H, NE-2J, NE-51H, NE-2P and NE-2M.

Electronic Flash Problem. *I own a Braun Hobby Model EF-3 electronic flashgun. While overseas I accidentally plugged the unit into a 220-volt outlet. Since then the gun has not worked. Would it be difficult to repair?*

It could be, but first check the 400-mA slow-blow fuse. I'll bet a blown fuse is your only trouble.

Indoor Reception Problems. *I live reasonably close to FM and TV transmitting sites (within 5 miles) and use a line cord antenna for one FM receiver and a hank of wire about 3' long for the other FM set. My portable TV receiver has its own built-in antenna. Since moving to this location, I have noticed that when I walk around the room the FM sets will distort or even jump frequency, and the TV picture will always change when I walk away from the receiver. What is the cause of these effects, and is there a cure?*

Literally speaking, the cause consists of

very strong reflections and those things called "standing waves." You're probably so close to the high-powered transmitters that reflections from your body sometimes overpower the direct signal from the transmitter. The only solution is to erect a simple outdoor antenna and feed the TV set and FM receivers from a suitable splitter.

Electric Fence Transformer. *In your February 1967 column you gave information on an electric (transistorized) fence. The transformer recommended was referred to as the Triad F-14X. I cannot buy one in my city. What are the recommended primary and secondary voltages?*

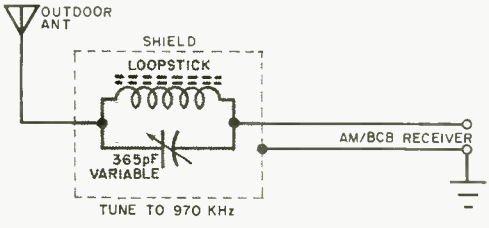
There is nothing too critical about this transformer. Most readers duplicating the suggested circuit will find that a power transformer with a primary suited to their line voltage and with a secondary voltage of 6.3 volts will be perfectly adequate.

National NCX-3 Improvements. *I have just purchased a secondhand NCX-3 transceiver. Can you suggest any improvements to soup up this rig?*

I can give you three suggestions. For improving your receiver sensitivity, remove resistor *R44* (the resistor at the screen grid *V10*). Do not replace it. Secondly, for improved tracking on 80 meters, change *C18* from 240 pF to 220 pF (5% tolerance) and then repeak the 80-meter grid coil. Finally, to improve the receiver audio on SSB, change capacitor *C82* from 0.01 μF to 0.02 μF.

Local AM BCB Blanking. *My AM BCB receiver uses a loopstick for an antenna. I would like to listen to a station on 620 kHz that has a transmitter 40 miles away. Unfortunately, a local station on 970 kHz blanks it out. In fact, the local is so strong it can be picked up all over the AM dial. I have tried an outdoor antenna without success. What can I do?*

Really not too much. It sounds as though you're so close to the station on 970 kHz that you have r.f. saturation, and even the best AM receiver would have trouble. Before



giving up, however, I would try a trap tuned for the 970 kHz station—if your receiver has a separate antenna input connection.

Simple BCB Tuner. *I don't have much money to spend on my hi-fi hobby, but I would sure appreciate the diagram of a simple inexpensive AM tuner that I can feed into my hi-fi amplifier. I only want to tune one of two local stations. Can I build one for about $5?*

You certainly can, and a simple tuner that you should be able to plug into your hi-fi setup is shown in the accompanying

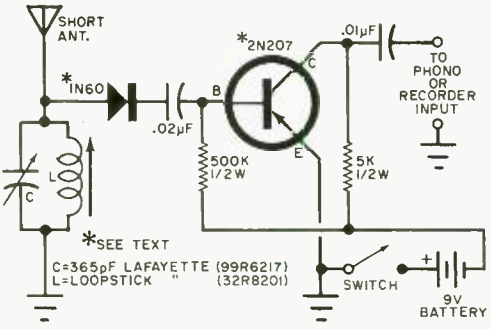


diagram. The diode can be just about anything, including a 1N34A, 1N38A, 1N54A, etc. The transistor can also be a 2N404, 2SB32, 2N217, or GE-2.

Air Conditioner Interference. *I have a rather large 240-volt air conditioner in my house rated for a heat exchange of 18,000 BTU. At about 6 or 10 seconds before the air conditioner shuts off, it creates an electrical interference to the FM and TV. This just doesn't seem right and I was wondering if I could do anything about it?*

Obviously the interference is coming from an improperly operating thermostat. Sometimes the thermostat contacts do not break cleanly (as they should) and there is a lingering contact that results in bounce and arcing. Try a replacement thermostat, or an arc suppressor across the contacts. This suppressor could simply be a 0.1-μF capacitor in series with a 25-ohm, ½-watt resistor. If possible, you might also juggle the starting and stopping relay contact adjustments —there may not be enough tension for the stopping contact to break free at the proper temperature setting.

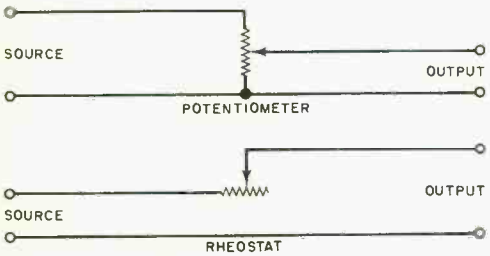
Hi-Fi Speaker Quality. *If we are to believe the ads on hi-fi loudspeakers, each manufacturer makes at least one "perfect" speaker. What determines speaker quality?*

The best article I have seen on this subject appeared in the November, 1965, issue of POPULAR ELECTRONICS (p. 47). The author pointed out that a good hi-fi speaker must have a smooth frequency response, good transient response, adequate power handling capacity, fair sensitivity, broad directivity,

and sufficient damping at the lowest resonant frequency. There is probably no "perfect" hi-fi speaker because all of the above characteristics are interdependent. When choosing a hi-fi speaker, the choice must be personal, for a speaker that may please my ear may not please yours.

Rheostats Vs. Potentiometers. *How do I distinguish between a rheostat and a potentiometer? Is it the resistance, physical appearance, or wattage that separates these two components?*

There is a tendency to use the terms "rheostat" and "potentiometer" interchangeably, but although these components are both variable resistors, their purpose and circuits are different. Note in the accompanying wiring diagram that the potentiometer is a continuously variable voltage divider. The rheostat is not as versatile as a potentiometer although rheostats are seen frequently in TV receivers—particularly time base circuits, height and linearity controls, etc. Potentiometers are simply connected as two-terminal devices and the third terminal ignored when they are used as rheostats.



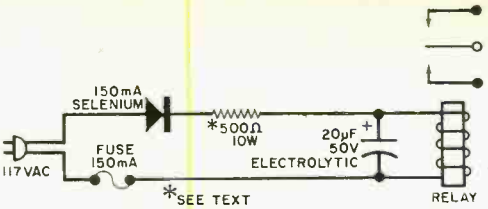
The term "rheostat" was popular in the days of the antique radio receiver wherein the operator controlled the filament brightness of such tubes as the 199, 200, 201A, etc.

Muting 75S-1 With KWS-1. *How do I mute my Collins 75S-1 while using a KWS-1? I bought these sets secondhand and have no specific information on muting this combination.*

When you tie these two rigs together, you can mute the 75S-1 by connecting pins 5 and 6 on jack *102 (receiver disable)* to *mute* on the 75S-1. Connect the 75S-1 *antivox* jack to the 500-ohm audio (pin 7) on *J102* of the KWS-1.

28-Volt Relays on 117 Volts. *I have a number of very fine surplus 28-volt d.c. relays. It hurts not to be able to put them to use in my shack. How about suggesting a suitable power supply?*

The power supply shown here should work as long as you adjust the 10-watt resistor to secure the best relay operation. The



value of this resistor depends upon the coil resistance and may be anything from 500 ohms (the usual minimum) to as high as 1500 ohms. If the relay should start chattering, increase the value of the electrolytic capacitor.

CB Splatter. *A couple of other CB stations in my locality have told me that my signals are splattering over part of the band. Each time I have been told this, I have gone off the air and checked tubes and meter readings, but everything appears to be okay. Are these other operators putting me on?*

You didn't mention if you were using an outboard—or built-in—modulation booster. If so, you may be putting more audio into the final r.f. amplifier of your CB rig than necessary and exceeding the 100% modulation limit. Splattering results from trying to put too much modulation on too weak a carrier. The cure is simply less modulation. Also, don't scream into the mike. And you might find it advantageous to buy an EICO 715 CB tester which contains a very accurate modulation meter.

It's Illegal. *One of my SWL friends told me that it is illegal to repeat the radiotelephone conversations I hear on my shortwave receiver. What I am referring to are the ship-to-shore telephone conversations. Is this true?*

Yes, the Communications Act specifically prohibits the interception, use, and publication of radio communications not intended for the public. Broadcasting (AM or FM), TV, and ham radio are not included in this so-called "secrecy" act. All radiotelephone conversations that are not intended for the general public are supposedly private. You can't help hearing them, but don't divulge what you have heard. The penalty for divulging communications not intended for public use is a fine not exceeding $10,000, or imprisonment for a term not exceeding two years, or both.

In Closing. My thanks to the many readers who have sent in kind comments about this department. They've gone a long way toward convincing the Editor that it is being read. Send your questions to: Information Central, % POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. —30—

SHORT-WAVE LISTENING

By HANK BENNETT, W2PNA/WPE2FT
Short-Wave Editor

"SOUND RECORDING—DO NOT X-RAY"

IN RECENT YEARS the practice of sending tape recordings to foreign broadcasting stations in lieu of the more conventional written reception reports has been gaining increased acceptance by the stations. Many broadcasters today look for tape recordings of their transmissions. This method of reporting is the best way of letting a station know exactly how it is being received in a particular location.

However, several broadcasters have written to tell us that some tape recordings are arriving at their destinations with little or nothing on the tapes. In such cases, it would seem that the listener had done nothing more than send the station a blank roll of recording tape.

Little known by many SWL's is the fact that customs offices, both in the United States and many foreign countries, x-ray packages to partially determine their contents rather than go to the trouble of opening them. An x-ray will erase a magnetic recording.

To overcome this problem, when you send a tape recording to another country, you should clearly label the package "Sound Recording—Do Not X-Ray." This will enable the customs officials to avoid damaging your recording through the use of x-rays.

Clandestine Stations In The News. For the benefit of new readers of this column, we might explain that a clandestine broadcasting station is one that operates without a license, or at a secret location, or both. Monitors are urged to listen for any new clandestine stations and report on them. But before sending the information in to this column, please be sure that your data is correct, especially so far as the frequency, time, and identification of the stations are concerned.

The often-heard *R. Euzkadi,* which customarily broadcasts in Spanish and Basque, is now announcing as *Radio Scalli, Le Voice of the Basque Underground,* as noted from their only Eng. identification at 2200 on 15,083 kHz. However, reports should still be addressed to *Radio Euzkadi, La Voz de Basque Underground,* B.P., Paris, France. The location of this station, according to their QSL card, is on the border between Spain and France.

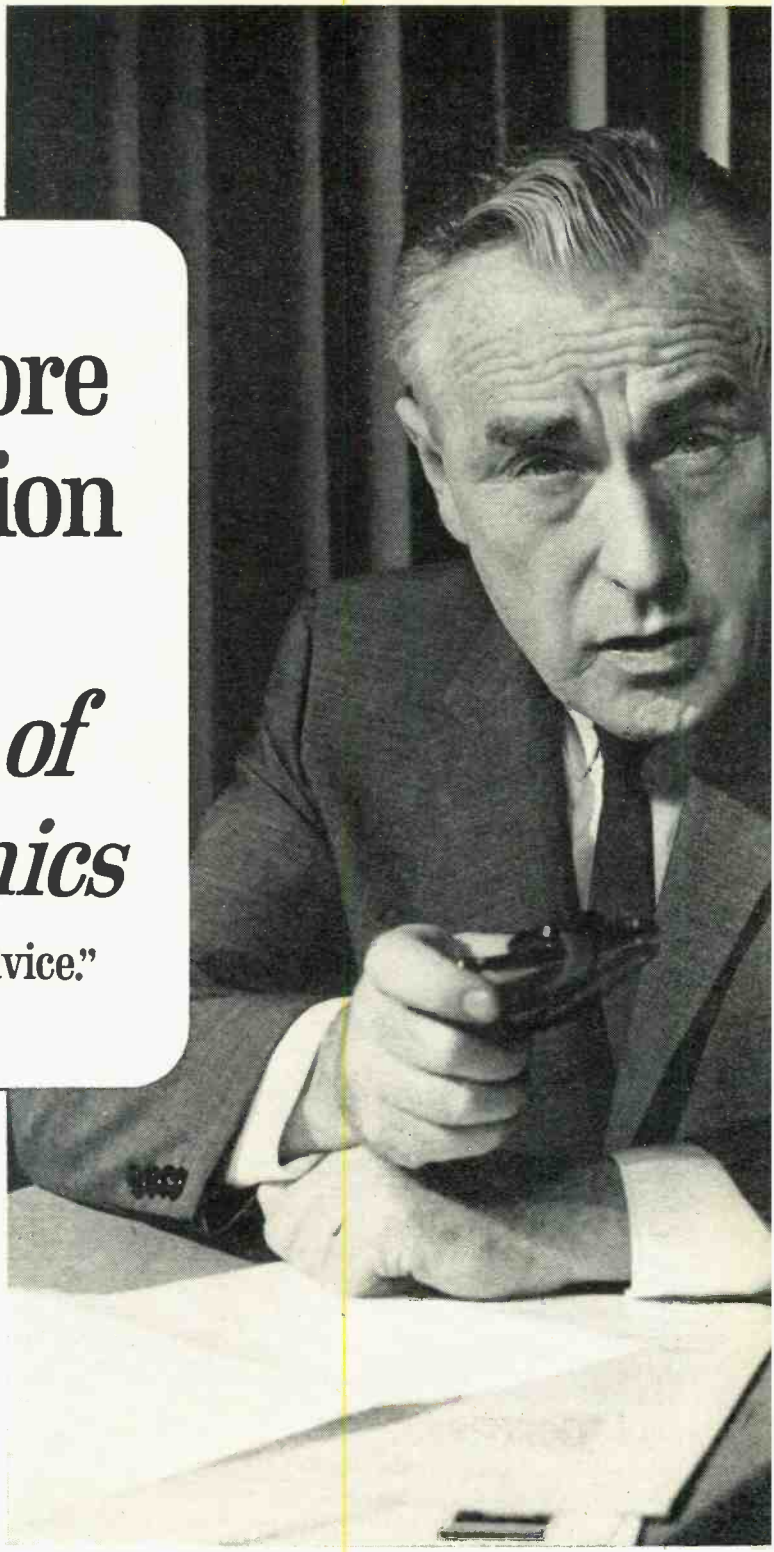
Radio Portugal Livre is another station that currently is being widely logged. Look

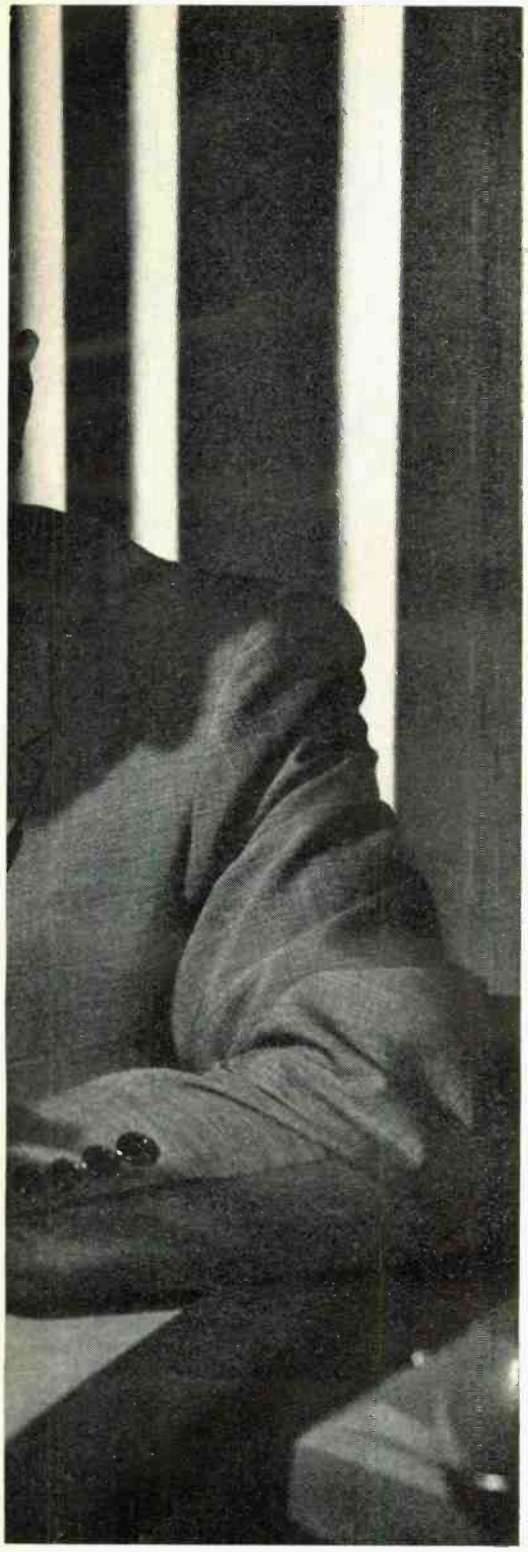
(*Continued on page 92*)

Well-equipped listening post of Wallace Glavich, WPE6EPX, Eureka, Calif., boasts four receivers: National's HRO-50T, HFS-VHF, and RBL-5VLF, plus a Hallicrafters SX-88. Wallace has 50 countries verified out of a total of 101 countries logged.

Ted Vodde, WPE4JBE, of St. Petersburg, Fla. (at right) uses a Hallicrafters TW-1000 receiver. Ted's record is 44 countries logged, 39 verified.

"Get more education or *get out of electronics* ...that's my advice."





Ask any man who really knows the electronics industry. Opportunities are few for men without advanced technical education. If you stay on that level, you'll never make much money. And you'll be among the first to go in a layoff.

But, if you supplement your experience with more education in electronics, you can become a specialist. You'll enjoy good income and excellent security. You won't have to worry about automation or advances in technology putting you out of a job.

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☐ Industrial Electronics for Automation
☐ Computer Systems Technology

APPROVED FOR VETERANS ADMINISTRATION TRAINING

ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA

FOR THE MONTH OF JULY

PREPARED BY ROBERT LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

TIME—EST	TIME—GMT	STATION AND LOCATION	FREQUENCIES (MHz)
7:15 a.m.	1215	Melbourne, Australia	11.71
		Montreal, Canada	9.625, 15.365
9 a.m.	1400	Stockholm, Sweden	17.84
3 p.m.	2000	Accra, Ghana	11.85
4 p.m.	2100	Hilversum, Holland	11.73, 15.425
5 p.m.	2200	London, England	15.26, 17.79
		Moscow, U.S.S.R.	9.685, 11.955, 15.15
6:30 p.m.	2330	Johannesburg, South Africa	9.705, 11.90
7 p.m.	0000	London, England	9.58, 11.78, 15.26
		Moscow, U.S.S.R.	9.685, 11.955, 15.15
		Peking, China	15.06, 17.68
		Sofia, Bulgaria	9.70
		Tirana, Albania	7.263
7:30 p.m.	0030	Budapest, Hungary	9.833, 11.91, 15.16
		Stockholm, Sweden	11.805
7:50 p.m.	0050	Vatican	9.69, 11.76, 15.285
8 p.m.	0100	Berlin, Germany	9.73, 11.89
		Havana, Cuba	6.17, 11.76
		Madrid, Spain	6.13, 9.76
		Prague, Czechoslovakia	7.345, 11.99, 15.368, 17.84
		Rome, Italy	11.81, 15.41
8:15 p.m.	0115	Berne, Switzerland	6.12, 9.535, 11.79
8:30 p.m.	0130	Bucharest, Rumania	11.94, 15.25
		Cairo, U.A.R.	9.475
		Cologne, Germany	9.64, 11.945
		Hilversum, Holland (via Bonaire)	9.59
		Johannesburg, South Africa	9.705, 11.90
8:45 p.m.	0145	Copenhagen, Denmark	9.52
9 p.m.	0200	Lisbon, Portugal	6.025, 6.185, 9.68
		London, England	9.58, 11.78, 15.26
		Moscow, U.S.S.R.	9.685, 9.70, 11.955
		Stockholm, Sweden	11.805
9:30 p.m.	0230	Beirut, Lebanon	15.355
10 p.m.	0300	Bucharest, Rumania	9.57, 11.94, 15.25
		Budapest, Hungary	9.833, 11.91, 15.16
		Madrid, Spain	6.13, 9.76

TO WESTERN NORTH AMERICA

TIME—PST	TIME—GMT	STATION AND LOCATION	FREQUENCIES (MHz)
6 p.m.	0200	Melbourne, Australia	15.32, 17.84
		Tokyo, Japan	15.135, 15.235, 17.825
7 p.m.	0300	Moscow, U.S.S.R. (via Khabarovsk)	15.14, 15.18, 17.76
		Peking, China	9.457, 11.82, 15.095
		Seoul, Korea	15.43
7:30 p.m.	0330	Stockholm, Sweden	11.805
7:45 p.m.	0345	Berlin, Germany	11.875, 11.92
8 p.m.	0400	Sofia, Bulgaria	9.70
8:30 p.m.	0430	Budapest, Hungary	9.833, 11.91, 15.16
8:45 p.m.	0445	Cologne, Germany	9.735, 11.945
9 p.m.	0500	Berne, Switzerland	9.695, 11.715
		Moscow, U.S.S.R.	9.54, 11.755, 11.85

AMATEUR RADIO

By **HERB S. BRIER**, W9EGQ
Amateur Radio Editor

FCC ACTION ON INCENTIVE LICENSING—WHEN?

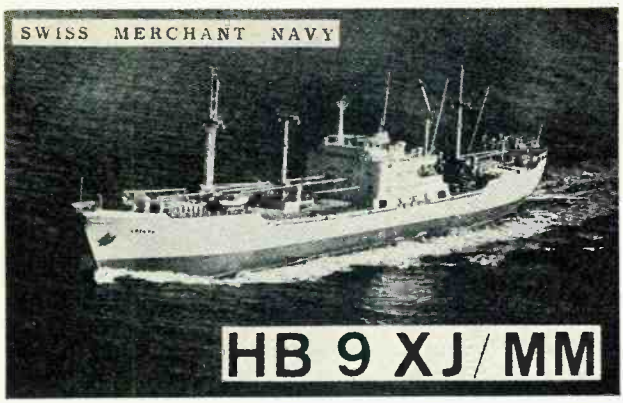
IN A SHORT ADDRESS at the annual Quarter Century Wireless Club banquet in Washington, Mr. Rosel H. Hyde, Chairman of the Federal Communications Commission, stated that the Commission had not yet taken action on FCC Docket 15928, the so-called "incentive licensing" proposal. But he reported that the commission staff was in the process of preparing its recommendations on the docket to present to the commissioners, so that the latter could make their decision—in a matter of weeks (?).

Actually, of more importance than the exact date when the FCC will release its decision on Docket 15928 were Commissioner Hyde's complimentary remarks about the Eye Bank Network, the Amateur Radio Emergency Corps, RACES, and amateur radio in general. He suggested that old-timers should do what they could to stimulate the interest of youngsters in amateur radio as a lifetime hobby which can enlarge their educational horizons, and concluded by saying, "Whatever the docket number, the objective of the Federal Communications Commission in relation to amateur radio is to improve the status of the amateur service in the public interest."

After reading Commissioner Hyde's speech, William I. Orr, W6SAI, Menlo Park, Calif., made some cogent remarks about the reduced growth rate of amateur radio in his privately published newsletter "Amateur Radio Facts." Bill noted that after a drop

AMATEUR STATION OF THE MONTH

Henry F. O'Meara, WB2NRX, Brockport, N.Y., is one of those hams who believe that you do not need elaborate equipment to enjoy amateur radio. Using a Hallicrafters HT-40 transmitter and SX-140 receiver, and a simple antenna, Hank has worked 40 states, Canada, and Mexico on 40 meters. Also to be seen in his shack is a Hallicrafters SX-110 receiver for short-wave listening, which he has been doing—off and on—since 1940. WB2NRX will receive a one-year subscription for submitting the winner for July in our Amateur Station of the Month photo contest. To enter the contest, send a clear picture of your station with you at the controls and some details on the equipment you use and your ham career to Amateur Radio Photo Contest, c/o Herb S. Brier, Amateur Radio Editor, Box 678, Gary, Ind. 46401.



This is the QSL card (actual size, about 9¼" x 3½") of Hans Buhler, HB9XJ/MM, who operates CW, SSB, and RTTY aboard the MS "Ariana" in the Swiss Merchant Navy. His equipment includes a Hallicrafters HT-42 transmitter, a Collins 51J-4 receiver, a Model 15 teleprinter, and assorted antennas around the ship. HB9XJ/MM's biggest thrill is giving a RTTY addict a rare "maritime-mobile" contact.

Novice Joe Bills, WN8TDN, of Delaware, Ohio, works the lower frequency bands with a Heathkit DX-60A transmitter and HR-10 receiver, and 50-MHz with a Gonset "Communicator." Joe is a member of RACES, the ARRL Emergency Corps, and Air Force Junior ROTC! He has 15 states confirmed so far.

from 252,300 to 245,100 individual amateur licenses extant between 1965 and 1966 there was a slight increase in the past year. But the increase has been in General and Extra Class licenses, not in Novice and Technician licenses, the type that most new amateurs begin with; *they* continue to decrease in number.*

W6SAI places the blame for these conditions on several factors, including the Citizens Radio Service, which he says short-circuits many prospective amateurs. Bill reasons (with much truth) that the main attraction of amateur radio to prospective hams would be to work DX on phone, although many of them become interested in other facets of amateur radio—including code operation—after becoming hams. And DX phone work is obviously impossible with a Novice license; so why study for it?

In view of these facts, Bill recommended to the American Radio Relay League that it petition the FCC to authorize Novice phone operation between 29.5 and 29.7 MHz in the amateur 10-meter band. The present requirement of passing a 5-wpm code test and a simple written examination to obtain a Novice license would still be valid, and the license would continue to be issued for a limited, non-renewable term—one year at present.

Bill admits that his proposal has some bad points, but its good points may outweigh the bad. And it is a proposal that might be looked upon with considerable favor by the FCC, because—if enacted—it would relieve considerable "hobby" pressure on the CB channels. And if we amateurs cannot make a qualified, fully-licensed ham out of any Novice during his license term, his license will expire, and he will be automatically off the air.

Simplified Station Identification. In a surprise move, early in April, the FCC proposed that hams be permitted to simplify station identification procedures. The FCC said that this new rule would reduce the unnecessary burden for "multiple" identifications—but all DX men know that the rule would legalize the current practice of "tail-ending."

The present rule for identification requires that all calls start with the letters of the

(*Continued on page* 91)

These figures are close, but not wholly accurate. During the first week of April the FCC computerized operation read out that there were 256,442 licensed hams. Of these, 11,542 were Novices and 58,409 were Technicians—a drop of 3000 in the Novice ranks, but only 300 for the Technicians. Both General Class and Extra Class licenses have climbed in the past two years.

SOLID STATE

By LOU GARNER, Semiconductor Editor

ALTHOUGH ALL solid-state image sensors are in the developmental stage, as reported in last month's column, and solid-state operation does offer many advantages, it may well be that in the near future the TV camera tube will be a hybrid device representing a combination of both solid-state and vacuum-tube technologies. Such a device has just been developed by the Bell Telephone Laboratories (Murray Hill, N.J.).

The function of any TV image sensor is to convert an optical image into a corresponding electrical signal. This is accomplished by first changing the light image into a pattern of electrical charges that are stored on some type of mosaic structure. The pattern is then read out as a signal, either by means of a scanning electron beam or through use of digital switching techniques.

BTL's new TV camera tube, developed primarily for use in its Picturephone® visual telephone equipment, employs a target structure that is smaller than a nickel, yet contains a square array of more than a quarter-of-a-million silicon photodiodes. The diameter of each photodiode is less than one-quarter the diameter of a human hair.

The main elements of the target structure used in the new TV camera tube are illustrated in Fig. 1. *P*-type semiconductor islands are diffused into an *n*-type silicon substrate. The substrate itself is isolated from the electron scanning beam by a silicon dioxide coating. A gold overlay on each *p*-type island increases the effective beam landing area of the individual photodiodes. Electrical contact to the substrate is provided by a small region of heavily doped *n*+ silicon, coated by a gold contact.

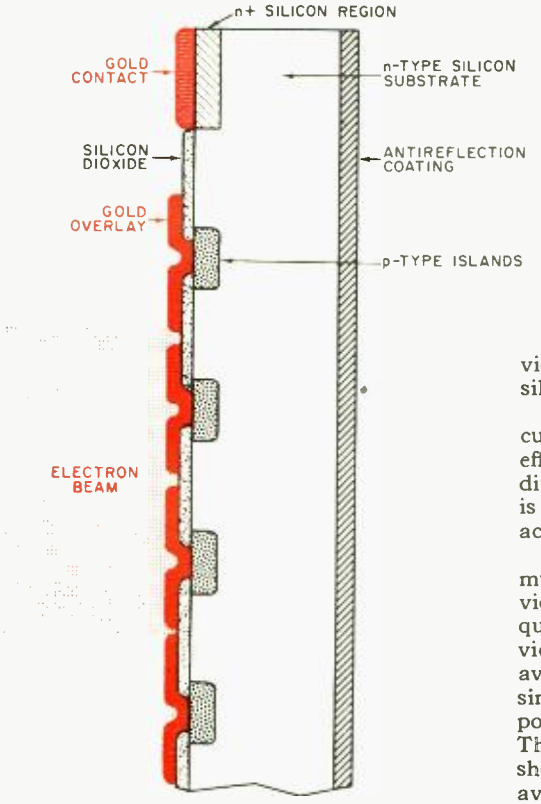
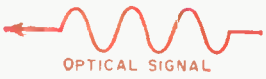


Fig. 1. Hybrid solid-state/vacuum-tube vidicon developed by Bell Labs features a semiconductor mosiac structure which is scanned by an electron beam to provide a video signal. More than 0.25 million silicon photodiodes are formed on a target smaller than a nickel. The tube operates under average light levels.



Light reflected by the object scene is focused on the solid-state target structure to effectively change the conductivity of the individual photodiodes. An output video signal is developed when the electron beam scans across these diodes.

Because BTL's new TV camera tube is much more sensitive than presently used vidicon-type tubes, less illumination is required for the scene being televised. The device produces acceptable video signals under average light levels in homes, offices, and similar locations. In addition, the unit has a potential operating lifetime of several years. The new tube, when in full production, should be comparable in price to currently available vidicons.

Reader's Circuit. Recognizing the low power requirement and long-operating life of the neon night light, reader Gordon Richmond (1045 Inglewood Ave., West Vancouver, B.C., Canada) decided to build a battery-powered version for camping, fishing and similar outdoor applications. Unfortunately, neon lamps require from 60 to 90 volts for operation, and thus cannot be used in ordinary low-voltage battery applications. To overcome this "high-voltage" requirement, Gordon devised the simple, but effective, night light illustrated in Fig. 2. A transistor (*Q1*) is employed in a simple tickler-feedback type of circuit, and the stepped-up a.c. voltage developed by oscillator action powers the neon lamp (*I1*).

Gordon built his battery-powered night

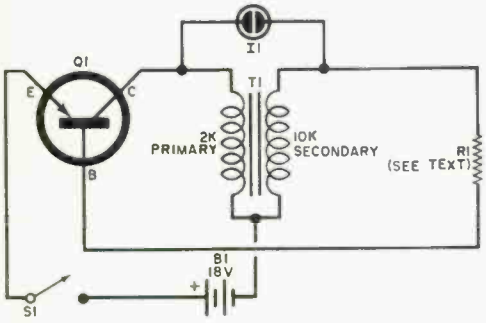


Fig. 2. Reader Gordon Richmond's simple oscillator circuit chops and hikes up the 18-volt d.c. to the more than 60 volts needed to fire the neon lamp.

light using parts salvaged from his "junk box." Transistor *Q1* is an International Rectifier TR-04 general-purpose audio unit, and *T1* is a small interstage coupling transformer having a 2000-ohm primary and a 10,000-ohm secondary winding. The neon lamp is an NE-2. Resistor *R1* is a half-watter, the value of which is determined experimentally; for optimum performance the value should be between 10,000 and 15,000 ohms. Power is supplied by two 9-volt transistor batteries connected in series, and *S1* can be any on/off switch.

Neither layout nor wiring is critical, and you can assemble the unit in a small plastic or metal box. To obtain the best value for *R1*, start with about 20,000 ohms and work up, until you are able to get the maximum amount of light. If the lamp does not light when *S1* is closed, try reversing *T1*'s primary or secondary connections (not both).

Manufacturer's Circuit. A growing number of experimenters are discovering the advantages of using integrated circuits (IC's), and the 5-to-10 MHz oscillator circuit shown in Fig. 3 should be of value to both students and experimenters. Employing an MC1550 linear IC amplifier, this circuit is one of several featured in Vol. 4, Issue No. 4, of the "Motorola Monitor" (published by Motorola Semiconductor Products, Inc.). Other circuits described in the same issue include a 60-MHz tuned amplifier, a video amplifier, and a wide-band 45-MHz amplifier.

The components within the dashed enclosure are part of the IC amplifier; the other components are connected externally to provide a customized design. Included are transistors *Q1*, *Q2* and *Q3*, diode *D1*, and resistors *R1*, *R2*, *R3* and *R4*. The numbered leads help identify connections.

When the IC is operated as a linear amplifier, the input signal is applied to *Q1*'s base, while the amplified output signal is obtained from *Q3*'s collector. Total circuit gain is proportional to the cascaded gain of *Q1* and *Q3*. Transistor *Q2* provides a.g.c. capabilities, and in this application *Q1* functions as a constant-current source with its collector current shared by *Q2* and *Q3*. Since the gain of a transistor is proportional to its emitter current, *Q3*'s gain can be varied by adjusting *Q2*'s bias. Voltage-divider *R1*-*R2* determines the bias applied to *Q2* and *Q3*.

When the IC is used in an oscillator circuit, it functions as a simple regenerative temperature-stabilized high-gain amplifier Transistor *Q3*'s collector load consists of a tuned circuit comprised of *T1*'s primary shunted by a tuning capacitor (*Ct*). The feedback necessary to sustain oscillation is obtained from *T1*'s secondary winding, which goes to *Q1*'s base circuit. Capacitors designated *C* serve as bypass devices. Operating power is furnished by *B1*, and is controlled by switch *S1*.

Except for the IC package, standard components are used. Transformer *T1* is a hand-wound r.f. unit with the primary and secondary windings made up of #36 enameled wire wound on a T-12-2 ferrite core. The primary winding has 21 turns, while the secondary winding has 7 turns. Capacitor *Ct* is a 170-780 pF variable unit while *C1* and all other capacitors (*C*) are 0.1-μF disc ceramic types. Load *RL* is a half-watt resistor.

The circuit layout and wiring technique followed will depend on the intended application of the completed unit. For general experiments and tests, breadboard construction is preferred. On the other hand, if the completed oscillator is to be used as a signal generator or low-power transmitter, you may want to assemble the circuit in a small metal box or chassis. Regardless of the assembly technique used, good r.f. wiring practice should be followed.

According to Motorola, neither the d.c. supply voltage nor the load resistor (*RL*) values are overly critical. Satisfactory per-

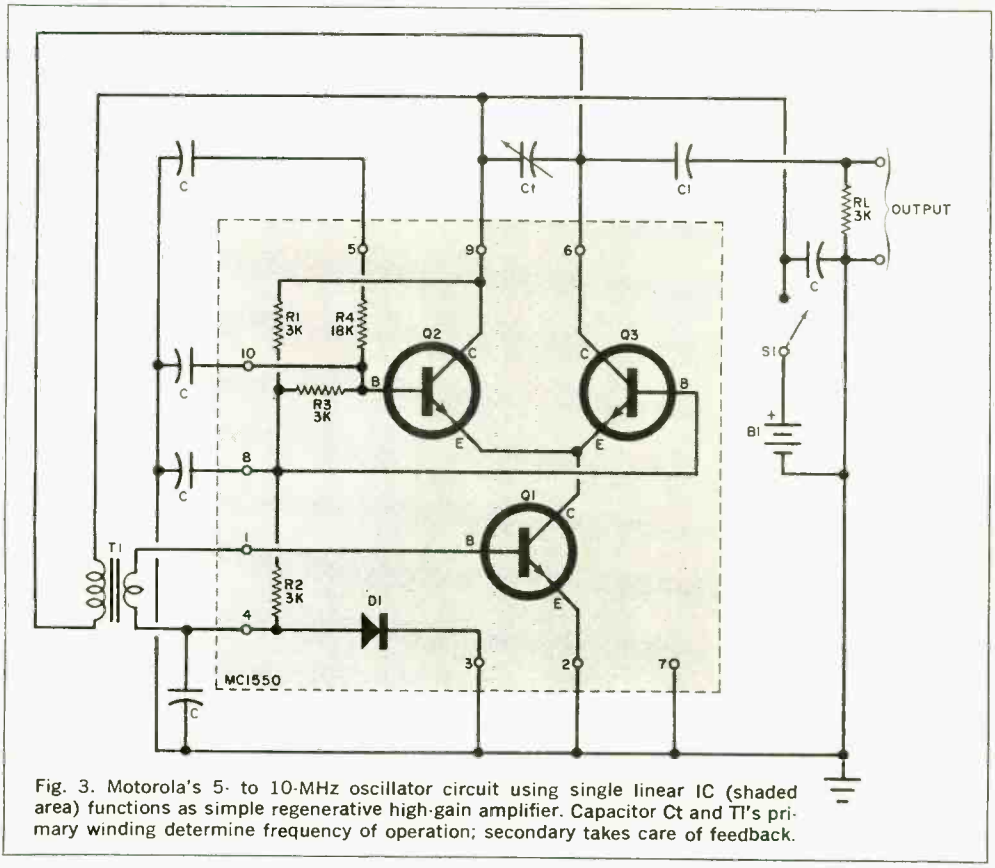


Fig. 3. Motorola's 5- to 10-MHz oscillator circuit using single linear IC (shaded area) functions as simple regenerative high-gain amplifier. Capacitor Ct and T1's primary winding determine frequency of operation; secondary takes care of feedback.

formance is achieved with load resistances from 1000 to 10,000 ohms and with battery potential ranging from 6.0 to 12.0 volts. Typically, the circuit can supply signals of approximately 9 volts, peak-to-peak, across a 3000-ohm load with a 10-volt d.c. source.

Product News. Texas Instruments, Inc. (Dallas, Texas), well known as a semiconductor manufacturer, has now entered the power systems market with a line of sealed, rechargeable nickel-cadmium batteries and power packs. The new product line will be produced at TI's Control Products plant in Attleboro. Mass.

A unique semiconductor device capable of indicating the position of a light spot on its face through the use of X-Y voltage coordinates, has been introduced by United Detector Technology (P.O. Box 2251, Santa Monica, Calif.). The device, called PIN-SPOT/10, is essentially a sensitive silicon photodetector equipped with five output terminals; the center terminal is common, while each of the two remaining pairs provide X and Y position voltages. A typical PIN-SPOT/10 circuit is illustrated in Fig. 4. Battery *B1*, between the photodetector's center terminal and circuit ground, provides operating power, and resistors *R1*, *R2*, *R3*, and *R4* act as output loads. Voltmeters *M1* and *M2* provide indications of the coordinate voltages. The device can be used in test instruments, optical inspection equipment, homing devices, machine control systems, and servo system installations.

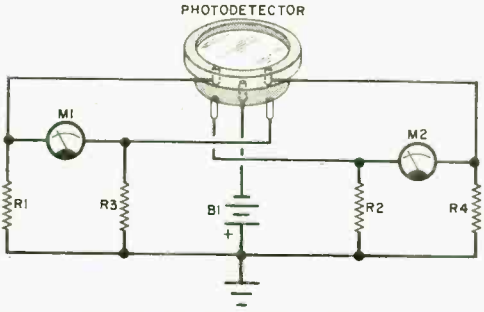


Fig. 4. Photodetector by United Detector Technology can indicate the position of a light spot on its face through the use of X-Y voltage coordinates.

(*Continued on page* 85)

ON THE CITIZENS BAND

By MATT P. SPINELLO, KHC2060, CB Editor

AT THE HEIGHT of the Citizens Band Radio Jamboree season, when hundreds of two-way radio clubs throughout the United States and Canada sponsor get-togethers in their areas, it seems appropriate to spotlight a CB club that has annually used its jamboree celebration as a vehicle to aid the unfortunate.

The Windy City CB Radio Club, Tullahoma, Tennessee, was first organized by Franklin "Mutt" Ashby and Chuck Reeves, in October, 1962. Membership in those days totaled three. Today the club boasts 50 active participants in all projects undertaken by the club.

Following the club's first jamboree in 1964, a check for $50 was written from the proceeds and presented to the local cerebral palsy organization. The following year, Windy City CB'ers donated $500 to the fund from the money accumulated during a jamboree held as a memorial to the late Jim Reeves, a Grand Ole Opry entertainer who lost his life in an airplane crash in 1964.

Last year Windy City club members drew $700 from their jamboree proceeds to help pay for a new bus for the cerebral palsy school to transport children back and forth from Coffee, Moore, and Bedford counties, and they also presented the school with a piano. At the 1966 jamboree, the club was lauded by the then Tennessee Governor Frank Clement who stated that he was "proud to be associated with an organization that does such a fine job . . ." and ". . . it is good to know that there are people in the world like these who are willing to help those who need it the most."

The Windy City group has been equally active in emergency work. As an assistance group to the Civil Defense agency, the club has helped locate missing persons and to drag lakes in search of drowning victims. As a team attached to the Civil Air Patrol, club members have been on duty during flood emergencies and on missions in search of

CB JAMBOREE FLASHBACK

At the 1966 Windy City CB Radio Club Jamboree, Frank G. Clement, then governor of Tennessee (left, below) proclaimed petite Jackie Robinson queen of the jamboree. Standing next to Jackie is her brother, Marty, waiting to be crowned king. Below, Burl Shelton, past president of the club, looks over toys the group collected for distribution with food and clothing to needy children on Christmas Eve.

Photo below courtesy of Tullahoma News & Guardion. Photo at right, taken by Bob Couch, courtesy of the Tullahoma News.

crashed aircraft. The group has also sponsored toy and clothing drives for distribution to needy families during the Christmas season.

Last year's Windy City jamboree drew large groups from Huntsville, Nashville, Chattanooga, Birmingham, and Memphis, as well as distant CB'ers from clubs in Arkansas, Kentucky, Texas, and California. If you expect to be within range on September 3-4, and are interested in what makes a veteran CB club "tick," we suggest that you drop in on the Windy City CB Radio Club's 1967 Jamboree to be held Labor Day weekend. The profits will undoubtedly go to a worthy cause. If you'd like the scoop in advance, drop a request in the mail to Mutt Ashby, KDD2134, vice president, WCCBRC, 316 S. Frankline St. (Box 12), Tullahoma, Tennessee. Tell Mutt "Matt sent you."

HELP Blasted By Michigan CB'ers. Although the Automobile Manufacturers Association petition for two additional CB channels has been dangling for nearly two years, it was only a few months ago that the Federal Communications Commission solicited comments from interested parties. The AMA petition would add the 27.235- and 27.245-MHz channels to the Citizens Band, to be used exclusively by motorists to request information or assistance en route.

The AMA calls their program HELP (Highway Emergency Locating Plan) and obviously has the support of the automotive industry. However, not everyone is convinced that HELP is all that the AMA says it could be. Some months ago the International Association of Chiefs of Police stated that they saw no good in the HELP program. And in April the Michigan Citizens Band Council and the Citizens Radiophone Association (Michigan) both told the FCC that they believed HELP to be "impractical and inoperable." Chaos and confusion could only result from implementing HELP, according to these clubs. In addition, both clubs recommended that the FCC spend more time correcting the present ills of CB instead of adding hundreds of thousands of new CB stations.

CB Emergencies. On an early Sunday morning last March, United REACT, Denver, Colorado, initiated an emergency transmission to alert CB'ers of a missing 16-year-old boy who was possibly suffering from a cerebral hemorrhage. The Rocky Mountain REACT team was notified and units merged to form a major search of the Denver area in conjunction with the Denver Police Department. They were ham-

(*Continued on page 85*)

Current officers of the Windy City club are (left to right): Mutt Ashby, KDD2134, vice president; Charles Haynes, KDD4690, projects officer; Jesse Ledford, KMM2821, president; Mrs. Alberta Ledford, KMM2821, secretary/treasurer; Charles Warren, KDD5140, sergeant at arms; and Clyde Hatchett, KKM1606, in charge of refreshments.

1967 OTCB JAMBOREE CALENDAR

Planning a jamboree, get-together, banquet or picnic? Send the details to: 1967 OTCB Jamboree Calendar, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. For more information on the jamborees listed below, contact the clubs or club representatives at the addresses given.

Tillsonburg, Ont., Canada — **July 1-2**
Event: Fourth GRS-CB Campout. Sponsor: South Western General Radio Association. Contact: Gearld Inch, Campout '67 Chairman, 283 Talbot St., St. Thomas, Ont., Canada.

Painesville, Ohio — **July 29-30**
Event: CB Campout and Jamboree. Sponsor: Five Watters of Lake County. Location: Lake County Fairgrounds. Contact: Jamboree, P.O. Box 213, Painesville.

Melbourne, Fla. — **Aug. 4-6**
Event: Fourth Florida National Jamboree. Location: Civic Auditorium. Sponsor: Thunderbird Citizens Band Radio Club, Palm Bay, Fla. Contact: Mel Fender, President, P.O. Box 474, Palm Bay, Fla. 32905.

Sydney, N.S., Canada — **Aug. 19**
Event: Third Annual Nova Scotia CB Jamboree. Sponsor: Cape Breton Citizens Band Radio Club. Contact: Cape Breton CB Radio Club, P.O. Box 471, Sydney.

Fowlerville, Mich. — **Aug. 19-20**
Event: Annual Great Lakes CB Jamboree. Sponsor: Oakland Social C-Bees, Inc. Contact: Ron Hulbert, Jamboree Chairman, P.O. Box 922, Pontiac, Mich. 48056.

Norwalk, Ohio — **Aug. 19-20**
Event: Fifth Annual Weekend for CB'ers Jamboree. Location: Huron County Fairgrounds. Sponsor: Sheriff's Huron County Emergency Net, Inc. Contact: Helen L. Nestor, Publicity Chairman, 24 Townsend Ave., Norwalk 44857

ELECTRONICS LIBRARY

PRINCIPLES OF AMPLITUDE MODULATION

Amplitude-modulated AM radio transmission is used in almost every walk of life now, but Citizens Band radio alone accounts for the largest portion of the AM transmitter market. So CB'ers will be particularly interested in this easy-to-read, well-illustrated, simple text (it is directed towards those who have a high school education). Amateur radio operators and experimenters in general should also find this book informative. Material covered includes: types of modulation, heterodyning, bandwidth, basic modulator circuits, plate modulation, AM waves, modulation percentage, modulation systems, and checking modulation.

Published by TechPress, Inc., Brownsburg, Ind. 46112. 78 pages. Soft cover. $1.95.

DICTIONARY OF RADIO AND TELEVISION

by W. E. Pannett, M.I.E.E.

Although much of the basic information in this volume will be familiar to many of our readers, recent developments in radio-communications have resulted in a great increase in the number of terms likely to be encountered in the field. The author has brought together the well-established terms and the many new ones. Actually, this is more of a pocket encyclopaedia than a dictionary in certain respects: elementary principles are covered briefly but new and complex devices are described in detail where necessary to clarify the underlying principles or mode of operation. Also, the book is spotted throughout with illustrative diagrams. To supplement the "definitions," a list of technical abbreviations is included at the back of the book.

Published by Philosophical Library Inc., 15 E. 40 St., New York 16, N.Y. 373 (7¼" x 4¾") pages. Hard cover. $15.00.

BASIC MATHEMATICS FOR ELECTRONICS

by Frank L. Juszli, Norman Mahler, James M. Reid

The authors of this text are well qualified to be so—they have a combined experience of 20 years of teaching in technical institutes with particular emphasis on mathematics and electricity. A working knowledge of arithmetic is the only prerequisite to a thorough understanding of the material; no background in electricity is presumed (although an acquaintance with certain electrical fundamentals should be helpful). *Basic Mathematics for Electronics* provides a systematic approach to the application of algebraic, logarithmic, exponential, and trigonometric functions in the solution of electric circuit problems, and is suitable for study concurrently with most electrical and mathematical courses.

Published by Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632. 450 pages. Hard cover. $12.00.

101 WAYS TO USE YOUR VOM AND VTVM, Second Edition

by Robert G. Middleton

In addition to explaining and illustrating the many possible uses of the versatile VOM and VTVM, this book presents procedures and tests for checking the accuracy of the equipment itself. In this new edition, the meter circuitry explanations have been expanded to show various means of protection against overload damage, and calibration procedures are detailed more extensively. Frequency-compensated multipliers in a.c. VTVM's are discussed and illustrated. Also, since semiconductor testing has become more important since this book was first released in 1959, this topic has been given greater coverage. Finally, the making of decibel measurements is thoroughly delineated.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, Ind. 46206. Soft cover. 144 pages. $2.95.

FUNDAMENTALS OF VACUUM-TUBE AMPLIFIERS

While the basic fundamentals of all types of modern vacuum-tube amplifiers and circuitry are thoroughly covered in this book, the emphasis is on audio amplifiers. The four classes of audio amplifiers (A, AB, B, and C) are treated in detail, and there is a special section on decibels and their use in audio equipment. The book is a condensation of one of the U.S. Navy Training Manuals in the "Fundamentals of Electronics" series.

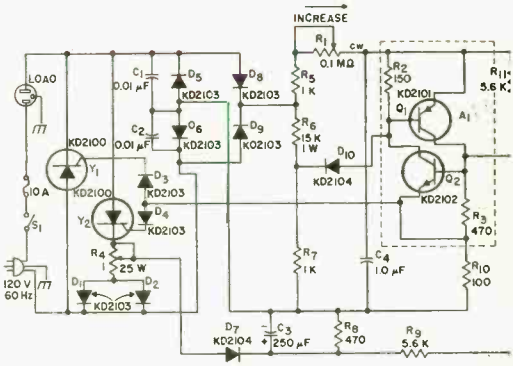
Published by TechPress, Inc., Brownsburg, Ind. 46112. 305 pages. Soft cover. $3.95.

RCA SILICON POWER CIRCUITS MANUAL, SP-50

Despite the fact that SP-50 is intended primarily for designers of solid-state power circuits, much of the information contained in it will be of use to students and hobbyists interested in solid-state electronics. The manual should answer just about every question that might arise concerning such silicon power devices as transistors, diodes, SCR's, etc. And it is profusely illustrated with graphs and useful circuits. Anyone who has occasion to use power transistors and diodes will find SP-50 valuable as a reference source for design hints and for a quick brushup on theory.

Published by Electronic Components and Devices, Radio Corporation of America, Harrison, N.J. Soft cover. 416 pages. $2.00. —30—

Build your own motor speed control with RCA experimenter kits



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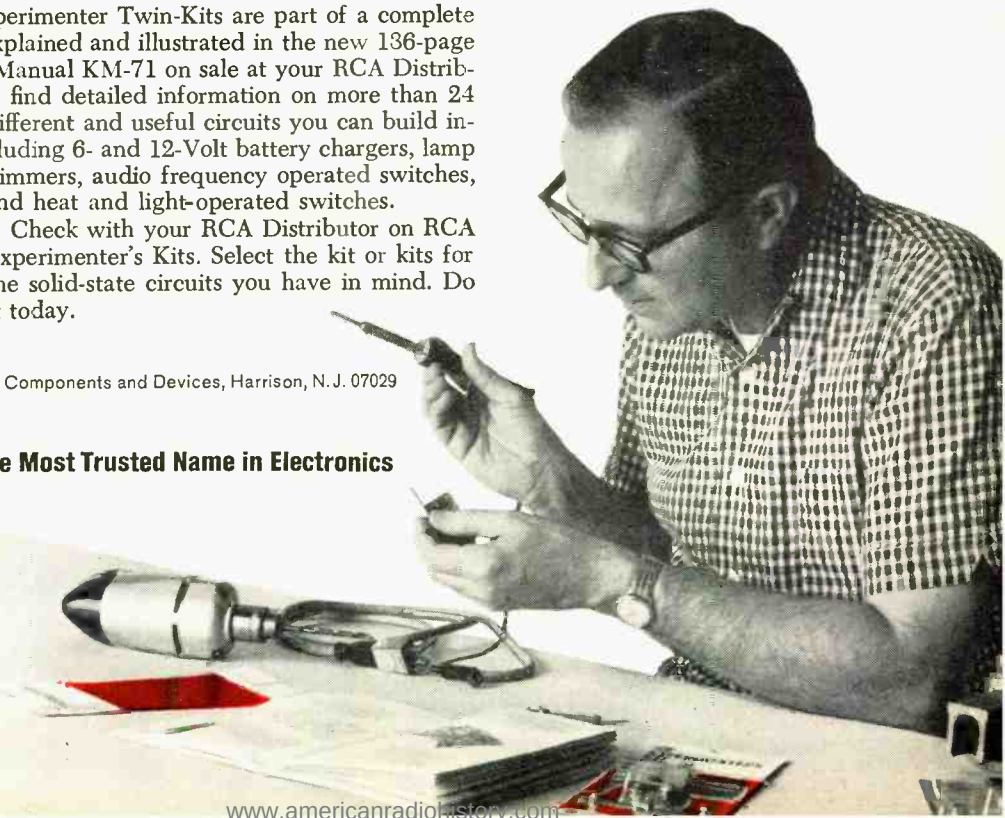


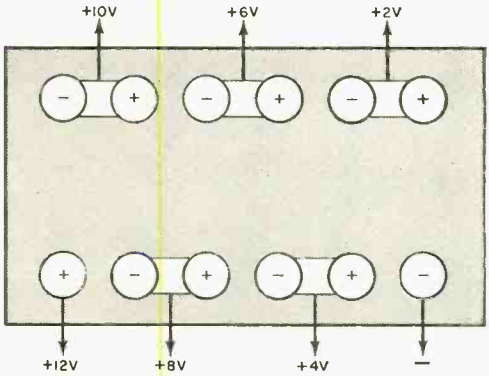
RCA Electronic Components and Devices, Harrison, N.J. 07029

The Most Trusted Name in Electronics

TIPS

(*Continued from page 16*)

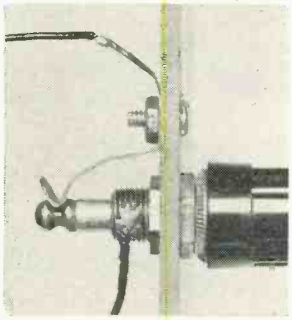
able, you can drive a nail or sheet metal screw into each cell-connecting strap. These straps are usually about ⅛" below the surface of the pitch covering the top of the battery. If in doubt about the exact location of a strap, scrape some of the pitch away; do *not* employ excessive force or hammer blows, and watch out for acid splatter. You can use any cell or



any combination of cells to achieve the desired voltage. You can even use a battery with a dead cell that is no longer suitable for car use—just avoid the dead cell in your hookup. Of course, you can recharge the battery as needed. —*Vincent F. Allen*

MAKE-IT-YOURSELF PHONE JACK FROM SCRAP PARTS

For those who like to home-brew everything for a project, here's a simple and reliable phone jack that can be added to the list. It's made from a short length of threaded iron or brass pipe, a pair of hex nuts, and a length of springy brass. The actual length of the threaded pipe depends on the thickness of the panel on which the jack is to be mounted; the thicker the panel, the longer the pipe (about ¾" long for a ¼"-thick panel). After the pipe is cut, secure it to the panel with the hex nuts as shown in the photo. Solder hookup wire directly to the pipe, or to a solder lug placed under the hex nut. Now bend a ⅜" wide by 2"-long (approx.) piece of springy brass strip as shown, and drill a hole in it for mounting on the panel. Then solder another piece of wire to the brass strip. If you mount the newly made jack on a metal panel, be sure to insulate the brass strip from the chassis by using one extruded and one flat fiber washer. —*Art Trauffer*



NOW: PACE 2-WAY RADIO IN YOUR CAR $69.95

USE THE NEW PACE "AUTOMATE" ALL SOLID STATE 5-WATT TRANSMITTER to call for help when you're in trouble • Receive messages over your AM car radio . . . and get assistance in a hurry • Communicate up to 10 miles even on a weak battery • Just flip on the transmitter switch, tune your car radio to 1505, pick up the microphone, and make a call • Takes no more current than an electric clock • 12 channels available for business or personal use • Write for complete information and the name of your nearest PACE dealer.

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Also available in Canada

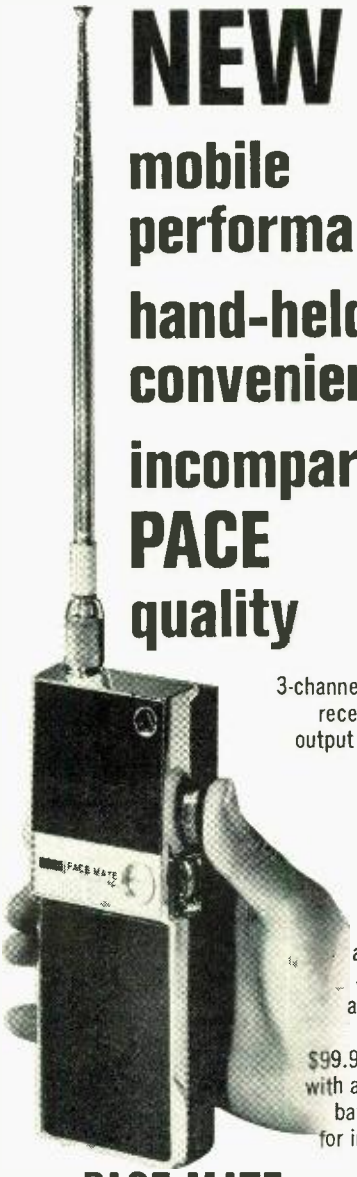
CIRCLE NO. 21 ON READER SERVICE PAGE

NEW

mobile performance

hand-held convenience

incomparable PACE quality



3-channel transmit/receive • 2-watt output • 18 silicon transistors • double conversion receiver • automatic noise limiter and squelch • for mobile and portable use • only $99.95 complete with antenna and battery. Write for information.

PACE-MATE CB transceiver

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Also available in Canada

CIRCLE NO. 29 ON READER SERVICE PAGE

NEW LITERATURE

To obtain a copy of any of the catalogs or leaflets described below, simply fill in and mail the coupon on page 15.

"Goof-proof" single-post-type soldering guns are featured in a 4-page, 4-color catalog by *Wen Products, Inc.* Described and illustrated are the "slim-line" long-reaching Model 75 "pistol" for beginners (25-100 watts); the Model 222 "Hot-Rod" medium-range gun for the home craftsman (25-200 watts); and the Model 450 heavy-duty gun (25-450 watts). All three guns have a built-in working spotlight and a trigger switch for instant heating.

Circle No. 85 on Reader Service Page 15

New items in *Edmund Scientific's* Catalog 674, their 25th anniversary issue, include nickel-cadmium cells, polarizing material for experimental purposes, a 16' weather balloon, color filter sheets, and an electrical engraving pencil. There are more than 3800 items in all. This catalog is free to industrial purchasing agents who request it on a company letterhead.

Circle No. 86 on Reader Service Page 15

"What Is An Electronic Organ" is the title of a booklet published by the *Schober Organ Corporation* which explains, in nontechnical terms, what the many parts and controls of an organ are for and how they are used by the player. Photographs are keyed to the text, and a glossary of organ terms is included. Twenty-five cents.

Circle No. 87 on Reader Service Page 15

World Radio Laboratories is putting out a "first of its kind" Citizens Band catalog. Said to be one of the most complete catalogs for CB'ers that has ever been assembled, it features "everything" in equipment and accessories. Multi-color.

Circle No. 88 on Reader Service Page 15

A "Special Product Technical Bulletin," CVT-104, entitled "Small Automatic Voltage Regulating Transformers," has been published by the *Central Transformer Company*. These regulators are now available with power ratings as low as 1.0 VA (to as high as 5 kVA) and can be designed to solve specific problems.

Circle No. 89 on Reader Service Page 15

Some 200 electronic kits and factory-assembled instruments are featured in EICO's 1967 36-page catalog. Completely new in this edition are the "Cortina" solid-state stereo amplifier and tuner; #888 universal engine analyzer; "Nova-23" solid-state CB transceiver; and EICOCRAFT solid-state electronic kits.

Circle No. 90 on Reader Service Page 15

Described in the 52-page 1967 *Mallory Distributor Products Company* catalog are more than 1400 precision electronic components: batteries and flashlights, capacitors, controls, jacks and plugs, semiconductors, switches and circuit breakers, timers and vibrators. Performance charts and product diagrams are included.

Circle No. 91 on Reader Service Page 15

Issue Number 43 of "MICRO Tips," published by *MICRO SWITCH*, a division of Honeywell, describes eight cost-saving ideas in unique applications of various types of switching mechanisms. A form is provided for the reader to present an idea of his own and submit it for possible publication in future issues.

Circle No. 92 on Reader Service Page 15

THE "BEACHCOMBER"

(*Continued from page* 32)

Operating Notes. Do not attempt to use the Beachcomber with the two oscillators operating at zero beat (the same frequency). This will reduce sensitivity by about half, due to the slight locking action caused by stray coupling. If you note any sudden changes in pitch when the search coil bumps the ground or vegetation, check the wiring and loop mounting for loose parts. Any movement of parts or wire, inside or outside, on or near the search coil can cause changes in pitch. The better the construction, the more reliable the indications.

If you are primarily interested in smaller objects, coins—for instance, you can make the detector more sensitive by using a smaller-diameter search coil. A 4" loop will work nicely. The only change necessary is to add two turns to the search loop coil. Keep in mind that the smaller loop will not penetrate as deeply as a larger one.

If you are interested in finding larger objects at a greater depth than the Beachcomber's maximum range, you might look into the deep-searching metal locator described in the January 1967 issue of POPULAR ELECTRONICS. —30—

ON THE CITIZENS BAND

(*Continued from page 79*)

pered by the extensive amount of territory that had to be covered, and by the limited use of two-way communications due to skip conditions. But finally, after some 15 hours, the boy was found and rushed to the Colorado General Hospital by his family for immediate treatment. The Rocky Mountain group and United REACT have extended their thanks to the following units for their unlimited participation: Rocky Mountain Rangers; St. Anthony's Emergency Unit; Denver Metro Auxiliary REACT; and all independent CB'ers from the Metro area who took part in the search.

Most people in the Chicago area would like to forget about the big snow that all but crippled the "Windy City" last winter. But Kenneth Shirk, KLK1186, will not forget the blizzard too soon. Ken was stranded for 12 hours while on his way home from his office at radio station WIND, Chicago. When he became bogged down in heavy snowdrifts, he kept the car motor and heater running until the gas supply gave out. His CB call for help was relayed from Willard Sutton, KPJ1052, in Aetna, to Chet Haas, KPJ1989, in East Gary, Indiana. Haas and his three grandsons, equipped with toboggan, eventually rescued Shirk—who then became a house guest at the Haas home until the worst of the storm was over.

I'll CB'ing you!

—Matt, KHC2060

SOLID STATE

(*Continued from page 77*)

A complementary unijunction transistor made in IC form is now being produced by General Electric's Semiconductor Products Department. Identified as CU-5K1, the new UJT is fabricated with a *p*-type rather than a conventional *n*-type emitter junction, and thus requires d.c. operating voltages of a polarity opposite to that employed by the more familiar types. In addition to its reverse d.c. biasing characteristics, the device has much better temperature stability than *n*-type units, and boasts an accuracy of ±5% when used as an oscillator.

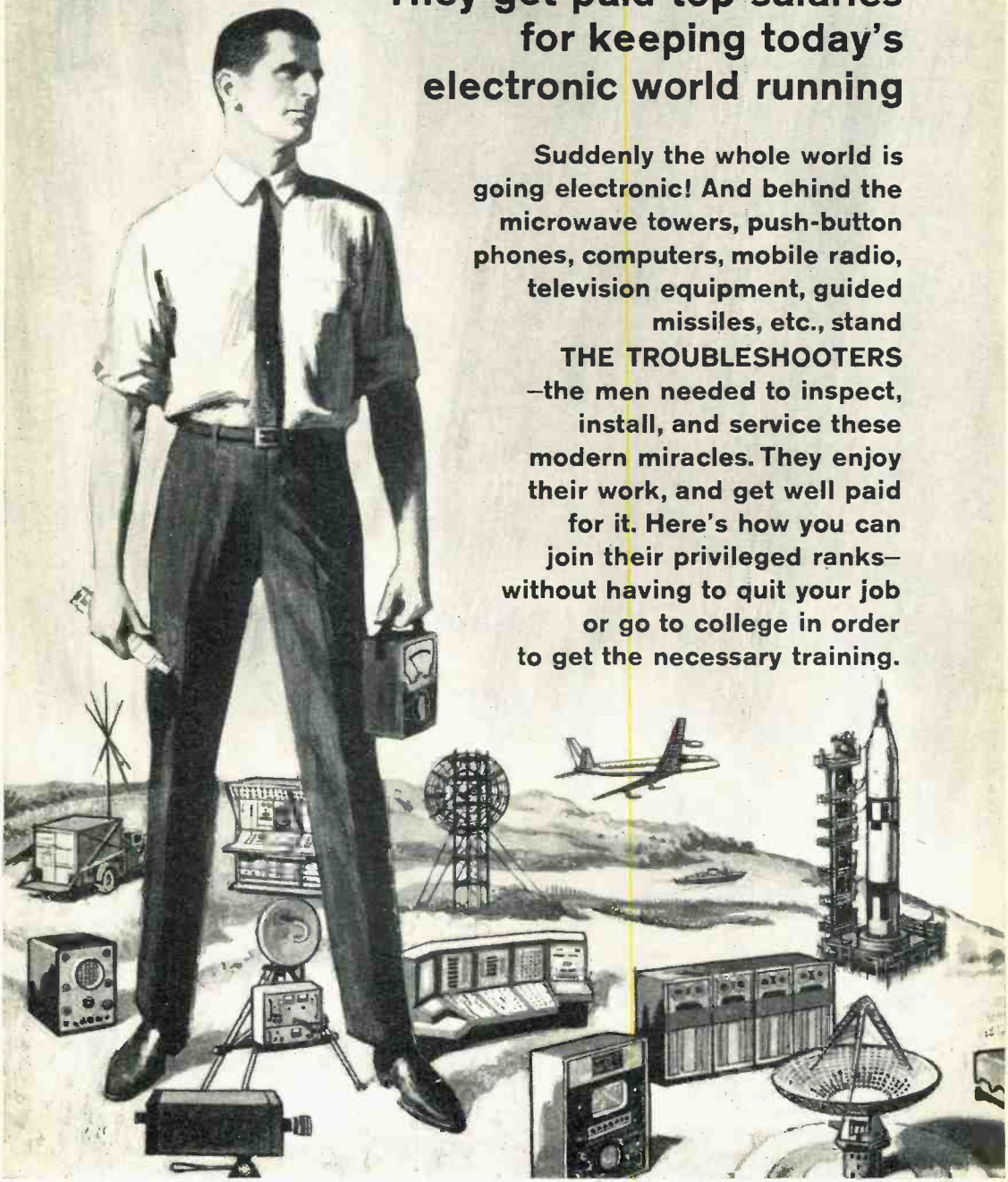
Transitips. When you are troubleshooting a multistage receiver or amplifier, the signal

(*Continued on page 90*)

Join "THE TROUBLESHOOTERS"

They get paid top salaries for keeping today's electronic world running

Suddenly the whole world is going electronic! And behind the microwave towers, push-button phones, computers, mobile radio, television equipment, guided missiles, etc., stand THE TROUBLESHOOTERS —the men needed to inspect, install, and service these modern miracles. They enjoy their work, and get well paid for it. Here's how you can join their privileged ranks— without having to quit your job or go to college in order to get the necessary training.



JUST THINK HOW MUCH in demand you would be if you could prevent a TV station from going off the air by repairing a transmitter...keep a whole assembly line moving by fixing automated production controls...prevent a bank, an airline, or your government from making serious mistakes by repairing a computer.

Today, whole industries depend on electronics. When breakdowns or emergencies occur, someone has got to move in, take over, and keep things running. That calls for one of a new breed of technicians—The Troubleshooters.

Because they prevent expensive mistakes or delays, they get top pay—and a title to match. At Xerox and Philco, they're called Technical Representatives. At IBM they're Customer Engineers. In radio or TV, they're the Broadcast Engineers.

What do you need to break into the ranks of The Troubleshooters? You might think you need a college diploma, but you don't. What you need is know-how—the kind a good TV service technician has—only lots more.

Think With Your Head, Not Your Hands

The service technician, you see, "thinks with his hands." He learns his trade by taking apart and putting together, and often can only fix things he's already familiar with.

But as one of The Troubleshooters, you may be called upon to service complicated equipment that you've never seen before or *can't* take apart. This means you have to be able to take things apart "in your head." You have to know enough electronics to understand the engineering specs, read the wiring diagrams, and calculate how a circuit should test at any given point.

Now learning all this can be much simpler than you think. In fact, you can master it without setting foot in a classroom and without giving up your job!

AUTO-PROGRAMMED™ Lessons Show You How

For over 30 years, the Cleveland Institute of Electronics has specialized in teaching electronics at home. We've developed special techniques that make learning easy, even if you've had trouble studying before.

For one thing, our AUTO-PROGRAMMED™ lessons build your knowledge as you'd build a brick wall—one brick at a time. Each piece rests securely on the one that came before it.

In addition, our instruction is personal. When your teacher goes over your assignment, no one else competes for his attention. You are the only person in his class. He not only grades your work, he analyzes it to make sure you are thinking correctly. And he returns it the day it's received so that you can read his comments and corrections while everything is fresh in your mind.

Always Up-To-Date

To keep up with the latest developments, our courses are constantly being revised. This year CIE students are getting new lessons in Laser Theory and Application, Microminiaturization, Single Sideband Techniques, Pulse Theory and Application, and Boolean Algebra.

In addition, there is complete material on the latest troubleshooting techniques including Tandem System, Localizing through Bracketing, Equal Likelihood and Half-Split Division, and In-circuit Transistor Checking. There are special lessons on servicing two-way mobile equipment, a lucrative field in which many of our students have set up their own businesses.

Your FCC License—or Your Money Back!

Two-way mobile work and many other types of troubleshooting call for a Government FCC License, and our training is designed to get it for you. But even if your work doesn't require a license, it's a good idea to get one. Your FCC License will be accepted anywhere as proof of good electronics training.

And no wonder. The licensing exam is so tough that two out of three non-CIE men who take it fail. But CIE training is so effective that 9 out of 10 of our graduates pass. That's why we can offer this warranty with confidence: *If you complete one of our license preparation courses, you'll get your license—or your money back.*

Mail Card for 2 Free Books

Want to know more? Mail the postage-paid reply card bound here. We'll send our 40-page catalog describing our courses and the latest opportunities in Electronics. We'll also send a special book on how to get a Commercial FCC License. Both are free. If the card is missing, just send us your name and address.

ENROLL UNDER NEW G.I. BILL

All CIE courses are available under the new G.I. Bill. If you served on active duty since January 31, 1955, or are in service now, check box on reply card for G.I. Bill information.

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A Leader in Electronics Training . . . Since 1934

CIRCLE NO. 7 ON READER SERVICE PAGE

injection test technique is one of the fastest and simplest methods to use. All you need is one of the many solid-state "buzzers" now on the market which produce a harmonically rich audio signal capable of penetrating audio, i.f., and r.f. stages.

The procedure calls for applying a test signal successively to various parts of the receiver or amplifier under test, and then picking up the signal at another point. Generally, you should start at the output stage and work back to the input (or antenna, in the case of a receiver).

An output signal (a buzz or tone) should be heard in the speaker at each test point. When no output signal is obtained, the trouble has been isolated to the stage being checked. Further tests can then be made in that stage to isolate the faulty component, using an ohmmeter or voltmeter, or both.

That's it for now.

—Lou

QUIZ ANSWERS

(*Quiz appears on page* 46)

1—F The first practical industrial dynamo was built by Zenobe Theophile Gramme of BELGIUM in 1876.

2—J The wire recorder was invented by Valdemar Poulsen of DENMARK in 1898.

3—B The principle of the transformer was discovered by Michael Faraday of ENGLAND in 1831.

4—I The piezoelectric effect in crystals was discovered by Pierre and Jacques Curie of FRANCE in 1880.

5—D The X-ray tube was invented by Wilhelm Conrad Roentgen of GERMANY in 1895.

6—G The Leyden jar, forerunner of the modern capacitor, was discovered by Pieter Van Musschenbroek of HOLLAND in 1746.

7—A The so-called voltaic pile, the earliest battery known, was invented by Count Allesandro Volta of ITALY in 1800.

8—H The "Yagi" antenna was invented by Hidetsu Yagi of JAPAN in the early 1900's.

9—C The first electronic television device was actually developed by Boris Lvovitch of RUSSIA in 1907.

10—E The radio telescope was invented by Karl Janski of the UNITED STATES in 1933.

AMATEUR RADIO

(*Continued from page 73*)

station being called, followed by those of the caller (e.g., WA2HDQ de W9EGQ). DX men frequently delete the call of the DX station and simply rattle out, "de W9EGQ de W9EGQ." The new rule—in Docket 17377—would require full calls only at the end of an established contact.

However, RTTY men would have to sign more frequently, and mobiles would be allowed to delete present designators or location descriptions.

Humorous Certificate Available. If you would like to dress up your radio shack with a humorous 8½" x 11" green-bordered certificate, the Rockaway Amateur Radio Club, P.O. Box 205, Rockaway Park, N.Y. 11695, will mail you one if you send the club 25 cents—no stamps. The certificate is entitled "Notice to All Visitors," and answers facetiously various questions a non-amateur might be inclined to ask an amateur. It will not improve your position in the certificate race, but should act as a conversation piece in the shack.

The Rockaway Amateur Radio Club also has a small booklet on TVI filters which it will send to anyone who asks for it. If you want *only* the booklet, include a stamped, self-addressed envelope with your request.

NEWS AND VIEWS

Ted Rockwell, WA5RFH/4, Box 1151, Station B, Vanderbilt University, Nashville, Tenn., was a Novice at nine, but with moving, and one thing or another, it was 10 years before he went for his General. With a Heathkit "Comanche" and "Cheyenne," transmitter-receiver twins, Ted has worked 18 states, mostly on CW on 15 and 20 meters; he likes CW better than phone. Living in a college dorm introduced antenna problems, which he solved with a 57-inch "Vacationeer" vertical on the roof of the dorm . . . **Mike Martz, WA8RQA,** 808 Foraker Ave., Sidney, Ohio, in nine months as a Novice and six months as a General has worked 41 states and eight foreign countries on 40-meter CW. His equipment consists of a Hallicrafters HT-40 transmitter and a S-108 receiver, plus a Hy-Gain 18V vertical antenna about 40' high . . . **Vadim, UA6PE1A,** Novocherkassk-30. G.P.O. Poste Restante, Rostov Region, Ignatov V. A., U.S.S.R., is trying to figure out how to earn a "Witches Certificate" (described in the September, 1966, column) by working Pauline, WA9CNV, Yolanda WA9CCP, and Roberta, K9IVG, on CW. As Vadim is an SWL, and one of the girls has never worked a DX station, and another one doesn't own a telegraph key, he has set himself a real goal!

Chuck Hallett, WA7EGZ, 1609 East Turney, Phoenix, Ariz., feels that many Novices and Generals overlook the DX possibilities of the 40-meter band. As evidence, he listed 22 countries he has worked on 40 meters, half of them in the Novice band. Among the countries on the list were China, Korea, Russia, and Finland. Chuck runs 150 watts to a Heathkit DX-100 transmitter and receives on a Hallicrafters SX-140. He didn't mention what kind of an antenna he uses . . . **Doug Tabor, WN7GFB,** 1964 John St., Layton, Utah, runs 50 watts to a Gonset "Commander" transmitter feeding either a dipole antenna or an oversized inverted-V antenna and a Lafayette KT-340 receiver. He will sked anyone needing Utah on weekends on any of the three lower frequency Novice bands. As he expects to be signing a WA7 call by the time you read these words, he may even sked outside the Novice bands. Doug has 27 states worked himself . . . **Jim Andrews, WN8UYP,** 4240 Otis Dr., Dayton, Ohio, goes on 40 meters with a Heathkit DX-35 transmitter feeding a 32' antenna and a Heathkit HR-20 receiver; he has a total of 20 states worked. On 2 meters, Jim ionizes the atmosphere with a Heathkit "Twoer" exciting a halo antenna, and has made 21 contacts so far.

Richard D. Landis, WA3FVE, 36 Wartman Rd., Graterford, Pa., worked 18 states on 80 meters as a Novice with his Johnson "Ranger" transmitter and a National NC-109 receiver. Then he passed his General Class exam, bought a National NC-303, and an Astatic D-104 microphone. Now he has 49 states and 15 countries worked. He is usually on 75-meter phone in the daytime and 10-meter phone late evenings. But Dick must have plans, because he has a tri-band beam on the way up to supplement 75-, and 40-meter dipoles and a 10-meter ground plane antenna. He'll tape-record your signal for you on request . . . **Charles Rankin, WA2HMM,** 11 Palm Lane, Westbury, L.I., N.Y., who got out of the Army last August, has been working 20-meter phone with a Heathkit HW-32 SSB transceiver driving a pair of 813's and a Mosley TA-33 tribander. Since then, he has 70 countries and 47 states—all confirmed . . . **Robert L. Nichols,**

WN4DWI, 873 Norview Ave., Norfolk, Va., learned the code the hard way. He was in the Naval hospital with pneumonia and finally buckled down to studying the code through sheer boredom. It is hard to keep up with exactly what equipment he has in the shack from day to day, but he seems to be using a Hammarlund HQ-100-AC receiver, Hallicrafters HT-40K or EICO 720K transmitter, and a Hy-Gain 14-AVQ vertical antenna at present. Bob has 37 states and six countries to show for his efforts, with most of the DX worked on 15 meters. His General ticket is on the way.

Arthur J. Arruda, Jr., WA1GOV, 63 Gifford Ave., North Dartmouth, Mass., uses both a transmitter and a receiver older than most of our readers. The transmitter is a Stanco 100-MB running 80 watts, and the receiver is a Hallicrafters "Sky Challenger." His antenna is a 40-meter dipole, 25' high. With the combination, Art has worked 36 states and 16 countries, all on 40-meter CW, although he does work some AM phone . . . **Thomas W. Byers, WA4TMC**, 3232 Wickersham Ct., Orlando, Fla., and his Dad, WA4FKA, share the same ham shack. Using AM, CW, and SSB on 80 through 2 meters, Tom has worked 45 states and all continents. His main gear consists of a Heathkit HX-10 transmitter, a Hallicrafters SX-115 receiver, and a 3-band beam which he uses on the lower frequencies. He didn't mention what he uses on 2-meter SSB, but a Heathkit "Twoer" takes care of AM.

Remember that the first step toward representation in "News and Views" is sending us a letter. Include a clear picture of yourself at the operating position, if you have one. Thanks for forwarding your club bulletins, and keep us informed about your code and theory classes. Address all mail to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Ind. 46401.

73, *Herb, W9EGQ*

SHORT-WAVE LISTENING

(*Continued from page 67*)

for it on 7410 or 8333 kHz with talks in Portuguese around 2340-2352 s/off.

The *Voice of the People of Thailand* is being heard by West Coast monitors on 9425 kHz from 1430 s/on to 1600 s/off in Thai. This station employs an interval signal consisting of high-pitched chimes.

Also from the West Coast comes word of a Vietnamese clandestine station operating on 9433 kHz from 1400 s/on to 1545-1550 s/off. Instrumental Vietnamese folk music is used as their interval signal, and is also played periodically throughout the program. They may also use an interval signal consisting of a drum and cymbals. There is a news program at the beginning of the broadcast, and towards the end of the period they provide announcements at dictation speed.

CURRENT STATION REPORTS

The following is a resume of current reports. At time of compilation all reports are as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. All times shown are Greenwich Mean Time (GMT) and the 24-hour system is used. Reports should be sent to SHORT-WAVE LISTENING, P.O. Box 333,

SHORT-WAVE ABBREVIATIONS

annmt—Announcement	QRM—Station interference
BBC—British Broadcasting Corporation	QSL—Verification
B/C—Broadcasting	R.—Radio
Eng.—English	s/off—Sign-off
ID—Identification	s/on—Sign-on
IS—Interval signal	V.—Voice
kHz—kilohertz	VOA—Voice of America
kW—Kilowatts	xmsn—Transmission
N.A.—North America	xmtr—Transmitter

Cherry Hill, N.J., 08034, in time to reach your Short-Wave Editor by the fifth of each month; be sure to include your WPE identification, and the make and model number of your receiver.

Bolivia—DX'ers who need this country should try for either of these relatively easy to log stations: CP75, *R. La Cruz del Sur*, La Paz, 4985 kHz, from before 0200 to s/off with an Eng. ID just after 0240; or CP38, *R. Altiplano*, La Paz, 5045 kHz, at 0130-0500 with local music, some with French lyrics, commercials, and time checks. Reports indicate that CP38 is the easier one of the two to log.

Cambodia—*Radiodiffusion Nationale Khmere*, Phnom-Penh, is noted in the West on 6090 kHz around 1500 in Cambodian with both male and female speakers. Reports should go to 28 Avenue Preah, Mohaksatryany Kossomak, Phnom-Penh.

Colombia—Station HJZP, Bogota, is being logged on 15,330 kHz at 0305-0333 with talks, information bulletins, and operatic music, all in Spanish. This *R. Nacional* station has listed parallel frequencies of 3290 (HJAB); 4955 (HJCQ); 6030 (HJZJ); 6180 (HJWT); 9635 (HJZM); 11,795 (HJZN); 11.825 (HJZO); 17,865 (HJZQ); 21,510 (HJZR); and 25,750 kHz (HJZS). Has anyone logged any of the latter three?

Czechoslovakia—Prague has been noted on a new frequency of 21.740 kHz at 1530 with Eng. news in the African Service; this was followed by a commentary and music until past 1600. Two more-often logged channels are 7345 kHz at 0100-0155 and 7115 kHz at 0330-0425, both directed to N. A. and in English.

Egypt—A new frequency for Cairo is 12,005 kHz, replacing 11,965 kHz; a German xmsn was heard at 2145, and Eng. from 2200-2230 with news at 2210. Another outlet, on 11,915 kHz, is noted at 0415-0630 in Arabic, and 0630-0700 with Eng. dictation-speed news; listen for a clock to strike 16 times at 0600. The generally reliable 9475-kHz channel is good from 0131 to 0158 in Eng. with Arab-type music; a newscast is given at 0147.

England—The BBC World Service to N.A. is now on 15,260 kHz (2115-0030); 11,780 kHz (2115-0330); 9580 kHz (2245-0000); and 6110 kHz (0000-0330). News is given at 2200, 2300, 0000, 0200, and 0300.

Formosa—*Voice of Free China*, Taipei, is carrying Eng. to N. A. at 0250-0350 on BED7 (7130 kHz); BED69 (11,825 kHz); BED60 (15,125 kHz); BED49 (15,345 kHz); BED39 (17,720 kHz); BED52 (17,775 kHz replacing 17,780 kHz); and BED40 (17,890 kHz).

Guatemala—Evening (local time) reception of medium-wave station TGJ, Guatemala City, 880 kHz, has been reported by numerous readers in the South, Southwest, and West. DX'ers in the East will generally find WCBS, New York, on this channel; those in the Southeast may encounter QRM from one or more Cuban stations.

Guyana—*R. Demerara* has Eng. commercial programs on 5980 kHz, as noted with a poor-to-fair signal around 0930. This country was formerly known as British Guiana.

Hawaii—Our 50th state is needed by many DX'ers. Tune for KORL, Honolulu, 10 kW, on 650 kHz during the 0700-1000 silent period of WSM, Nashville, Tenn. This station carries the "Top Forty Rock & Roll" format.

Hungary—Three new channels are in use by *R. Budapest* at press time: 5902 kHz. around 2215 with an Eng. commentary: 11.910 kHz. with Eng. to N.A. at 0430-0500; and 15.160 kHz, around 0350 with English. Some listings show the latter to be a lower-powered 15-kW outlet.

Italy—Rome has been found on 11.810 kHz at 2335 with sports news and a press review, and from 2340 with instrumental music. A new outlet on 15.310 kHz is being heard in Italian at 0210 with native pop music, at 0230 with a play, and in Eng. from 0400 to 0410 s/off: an Eng. anmt gave the frequencies only as 7275 and 6050 kHz, with the broadcasts beamed to Mediterranean areas. A new 16-meter outlet is on 21.560 kHz. heard at 2020-2040 with sports and music, dual to 15,400, 17.770, and 17.800 kHz.

Jamaica—This is another difficult country to log on the short waves. Try for medium-wave stations on 550 kHz (Montego Bay, 5 kW. *R. Jamaica*) around 0300; or 700 kHz (Montego Bay, 5 kW. Jamaica B/C Corp.) at 2330-0125 with American pop music. For the latter station, you will probably have to cut through a hefty signal from WLW, Cincinnati, Ohio.

Japan—*R. Japan's* newest schedule (with Eng. on all xmsns) reads: to N.A. at 2345-0045 on 15.135 and 17,825 kHz; to North America and Latin America at 0100-0300 on 15.135. 15.235, and 17,825 kHz; to Hawaii at 0630-0730 on 15.235 and 17.725 kHz; to Europe at 0630-0830 on 15,135 and 17.825 kHz and at 1930-2030 on 9700 and 11,965 kHz; to Australia and New Zealand at 0930-1030 on 11.875 and 15.235 kHz; to Philippines, Indonesia, and Malaysia at 1130-1300 on 9525. 11.780, and 11.940 kHz; to S. E. Asia at 1230-1530 on 9675. 11.705, and 11.875 kHz; to S. Asia at 1330-1500 on 9525. 9765, and 11,780 kHz; to Africa at 1600-1700 on 9670 and 11.780 kHz; to Middle East and N. Africa at 1730-1900 on 9525 and 11.780 kHz. The General Service is scheduled for: 0000-0030 on 9700, 15.105. and 15.425 kHz; 0100-0130 on 15.105. 15.300. and 15.425 kHz; 0200-0230, 0300-0330. 0400-0430. and 0500-0530 on 15,105, 15,195, and 15.300 kHz; 0600-0630, 0700-0730, 0800-0830, and 0900-0930 on 9505. 15,195. and 15.300 kHz; 1000-1100 on 9505. 11.815, and 15.300 kHz; 1200-1230, 1300-1330. 1400-1530. 1600-1630. 1700-1730, 1800-1830. and 1900-1930 on 9505. 9560. and 11.815 kHz; 2000-2030 on 9560. 11,815, and 15.195 kHz; 2100-2130 and 2200-2230 on 9700. 11,815, and 15.195 kHz; and 2300-0000 on 9700, 15.105, and 15.425 kHz.

Lebanon—*R. Lebanon*, Beirut, was on a new frequency of 11.765 kHz when noted at 0230-0300 with Eng. to N. A.; Arabic follows at 0300. The station was also noted recently on 11.715 kHz, apparently testing.

Liberia—Dick Reed, General Manager of ELWA, Monrovia, recently visited one of our monitors and revealed that future plans for the station include a new 20-kW xmtr local to Liberia, a 50-kW xmtr to be beamed to West Africa, and a pair of 100-kW xmtrs to be beamed to the Middle East and for Arabic service. No date has been set for completion of this expansion.

Mexico—Station XESG, Guadalajara, Jalisco, has been logged on 4820 kHz at 0216-0230 with a relay of the *VOA* program, and from 0330 with classical music. The ID is lengthy; the location is often easier to catch than the slogan.

Netherlands—*R. Nederland*, Hilversum, is broadcasting on three new channels: 11.730 kHz (replacing 9590 kHz) and 15,425 kHz (replacing 6085 kHz) to N. A. in Eng. at 2055-2150; and 25,610 kHz in Dutch at 1630, beginning a language newsfeed to Bonaire.

Nigeria—There is still considerable confusion concerning *R. Nigeria* on 4932 kHz and the *Voice of Kenya* on 4934 kHz. Both open at 0600 with a commercial service; and both stations begin with an Eng. newscast—the news from Nigeria runs to 0610, Kenya's to 0615. Recent tunings indicate that the location of the Nigerian station may be Ibadan

rather than previously thought Lagos: it parallels the National Service on 4990 kHz.

The outlet of *V. of Nigeria* on 11.920 kHz has a music program at 2145-2200 in Eng., and s/off after a frequency anmt at 2205.

Norway—"Norway This Week" in Eng. is beamed to East Coast N. A. at 1400-1430 on 21.730 kHz; to N. & Central America at 1600-1630 on 17.825 kHz; and to the U. S. East Coast and South America at 2200-2230 on 15.175 and 15.345 kHz: Sundays only.

Peru—Station OAX1A, *R. Delcar, la Voz del Norte,* Chiclayo, is still on 6700 kHz, despite a listing in some publications of 6140 kHz. This 200-watt station can be noted with typical Latin American programming around 0120-0230.

Poland—Warsaw is noted on 9675, 11.840, and 15.275 kHz to Australia in Polish at 0700-0730 and in Eng. to 0800. Signals usually run fair on 11.840 kHz, and poor on the other channels. *R. Warsaw* is now issuing seven new QSL cards which will form a complete map of the country.

Portugal—Lisbon has been found on a new channel, 9585 kHz, in Portuguese at 0030.

Ryukyu Islands—The VOA, Okinawa, broadcasts to the Far East from 0900 to 1930. The "Breakfast Show" is aired at 1300.

At press time, the *Voice of United Nations Command*, Deragawa, Okinawa, is on 9840 and 13.820 kHz with the Chinese and Korean Service; West Coast monitors report that both channels are usually jammed, but best reception appears to be before 1330 and after 1500. The listed 9814-kHz channel is not being heard.

Solomon Islands—Barry Whitehall, Broadcasting Officer for Solomon Islands B/C Service, informed us on a QSL that the power of VQO4, 3995 kHz, will be increased from its present 5000 watts around the middle of 1968—but he neglected to state how much of an increase it would be. The outlet was noted at 0945-1000 on the East Coast.

South Africa—The new schedule for Eng. from *R. RSA, The Voice of South Africa,* Johannesburg, in effect until Sept. 2, reads as follows: 0415-0427 to Kenya, 0430-0442 to the Middle East, and 0515-0527 to Egypt on 15.220 and 11.900 kHz; 0500-0512 to Rhodesia on 9525 and 7270 kHz; 0645-0657 to Ghana, 1600-1655 to Rhodesia, and 2100-2155 to Ghana on 11.900 and 9525 kHz; 1700-1755 to Egypt and 1800-1855 to Kenya on 21.495 and 17.805 kHz; 1900-1955 to United Kingdom on 11,785 and 9525 kHz; to N. A. (Eastern Zone) at 2330-0025, (Central Zone) 0030-0125, (Mountain Zone) 0130-0225, and (Pacific Zone) 0230-0325 on 11,900 and 9675 kHz. Other xmsns include: Dutch to Holland at 2130-2225 on 11,785 and 9720 kHz; German to Germany at 2030-2125 on 15.200 and 11.785 kHz; Portuguese to Africa at 0545-0557 on 9525 and 7270 kHz, and at 0615-0627 and 2000-2055 on 11,900 and 9525 kHz; Portuguese to Portugal at 2230-2325 on 11.785 and 9720 kHz; French to Africa at 0530-0542 on 15.220 and 11.900 kHz, at 0630-0642 on 11.900 and 9525 kHz, and at 1900-1955 on 17.805, 15.220 and 11,900 kHz; French to France at 1800-1855 on 15.245, 11.900, and 9525 kHz.

Switzerland—Berne has been noted with Eng. at 0220 and Italian at 0230 on 11,790 kHz, and Eng. to West Coast N. A. at 0500-0615 on 9655 kHz with a signal that is much better than the one on the previously used 5955-kHz frequency.

Thailand—*R. Bangkok* was noted, in a non-Eng. xmsn, at 0100 with a clock striking eight times. Tune deeply for this one: you may encounter QRM from HCJB, Ecuador, on 11.915 kHz and/or Rome on 11,905 kHz.

U.S.S.R.—Several Russian regional stations are being received well on the West Coast. One is a station on 21,475 kHz from 0300 to past 0400 with Home Service relays; s/on is at 0300 with a bell IS and a clock striking six times. A current listing indicates that this station is in Novosibirsk; the clock strike would indicate Simferopol, possibly.

Vatican City—Three new channels are being used by *R. Vaticano:* 11,780 kHz, in native language, at

2205; 15.145 kHz, also in native language, from 1845 to past 1900; and 17.880 kHz in Hindi to India and S. E. Asia from 1440.

Vietnam (North)—*R. Hanoi*, on 9830 kHz (a move from 9840 kHz to avoid QRM from *R. Baku* and *Voice of United Nations Command)* has Chinese at 1430-1500, Laotian at 1500-1530, and Eng. at 1530-1600; on 11.755 kHz (a move from 11.760 kHz to avoid a Russian regional station there) at 1430 in Vietnamese—and from 1530 in Eng. dual to 9760 and 9830 kHz (prior to 1530 dual to 9760 kHz only). Another channel, believed to be used by Hanoi, on 15,044 kHz, has been tuned at 0724-0732 with Oriental music and talks.

Unidentified—A station has been noted irregularly on 12,000 kHz on Sundays with closing at 0248. The program consists of an exceptionally technical explanation by a non-British accented man in Eng. on the spirituality of the human soul, quite unlike the usual religious sermon programs. The signal is weak but steady; it is not believed to be Asian in origin although there is considerable S-meter "bounce." —30—

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LOW-COST INDICATORS

(*Continued from page* 50)

By adding a third transistor, *Q3*, as shown in Fig. 4, two lamps can be activated alternately. While *I1* is on, *I2* is off, and vice versa.

Construction. The indicator circuits described here can be assembled on a small piece of phenolic board. Parts layout is not critical except when mounting *LDR1* and *I1* (Fig. 2). Both of these components must be closely coupled and shielded from outside light. The light from *I1* should shine directly on *LDR1*. The fully constructed indicator device—minus its power supply or battery and sensor—need not be larger than about 1" square.

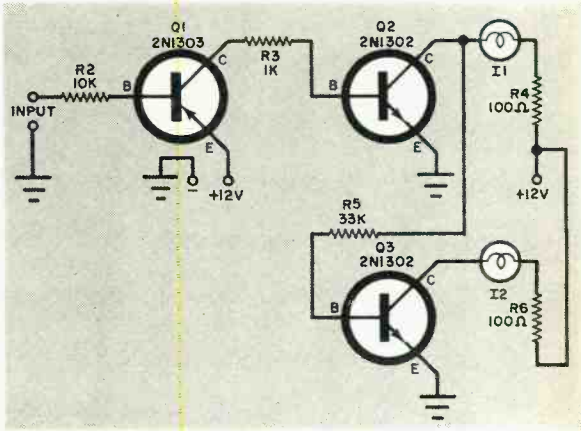

Fig. 4. Flip-flop indicator is foolproof in that it lets you know that the circuit is functioning; when lamp I1 is on, lamp I2 is off, and vice versa. The bias circuit shown in Fig. 3 can be included.

Any well-filtered 12-volt d.c. power supply or a 12-volt battery will suffice to power these indicators. Note that only one 12-volt supply is needed, and that all points marked +12V on the schematic can be tied together. Power drain under the worst conditions for a one-transistor indicator circuit is about 3 milliamperes. At normal room temperatures (about 72°F), average drain can can be measured in microamperes. –30–

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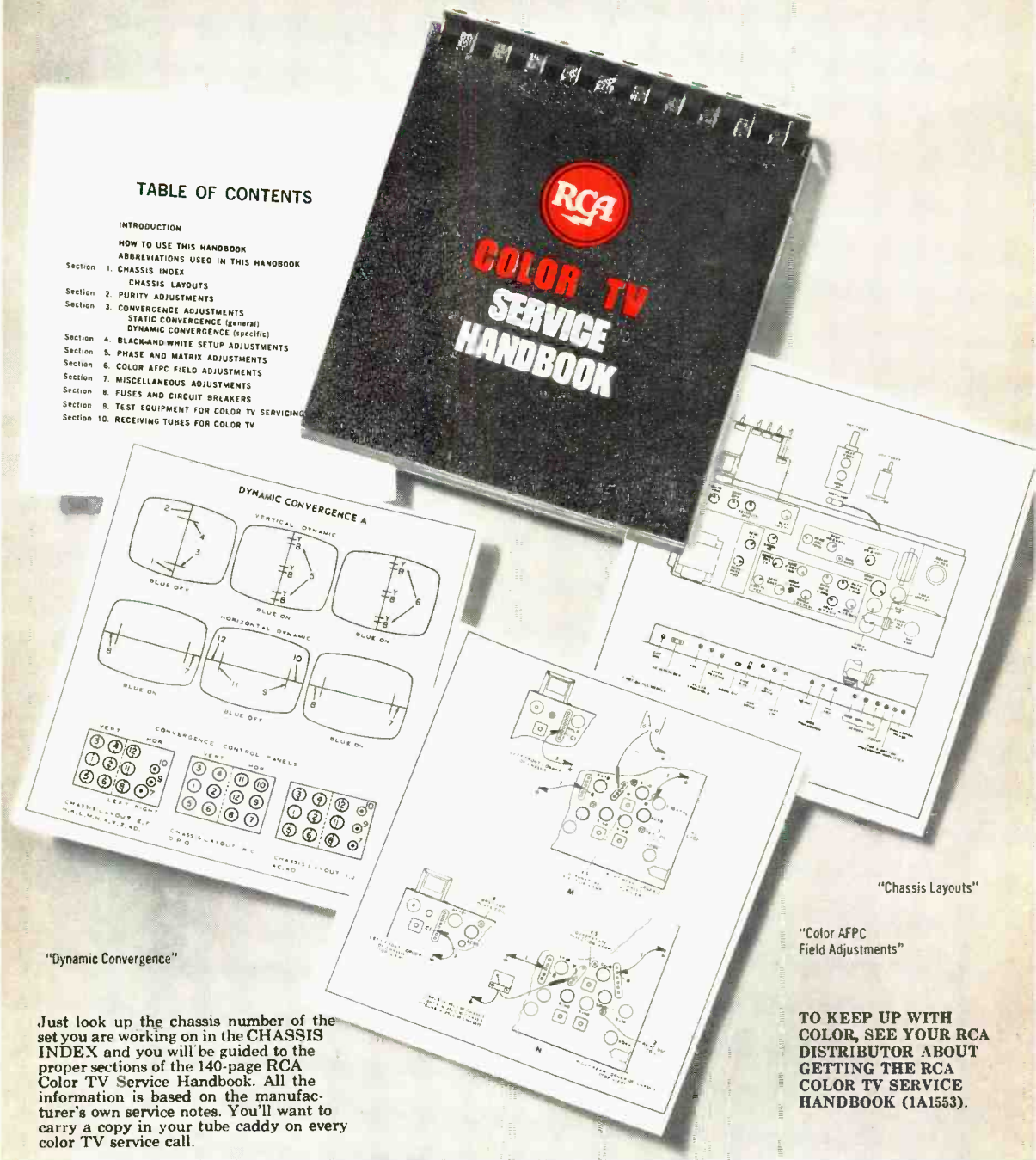

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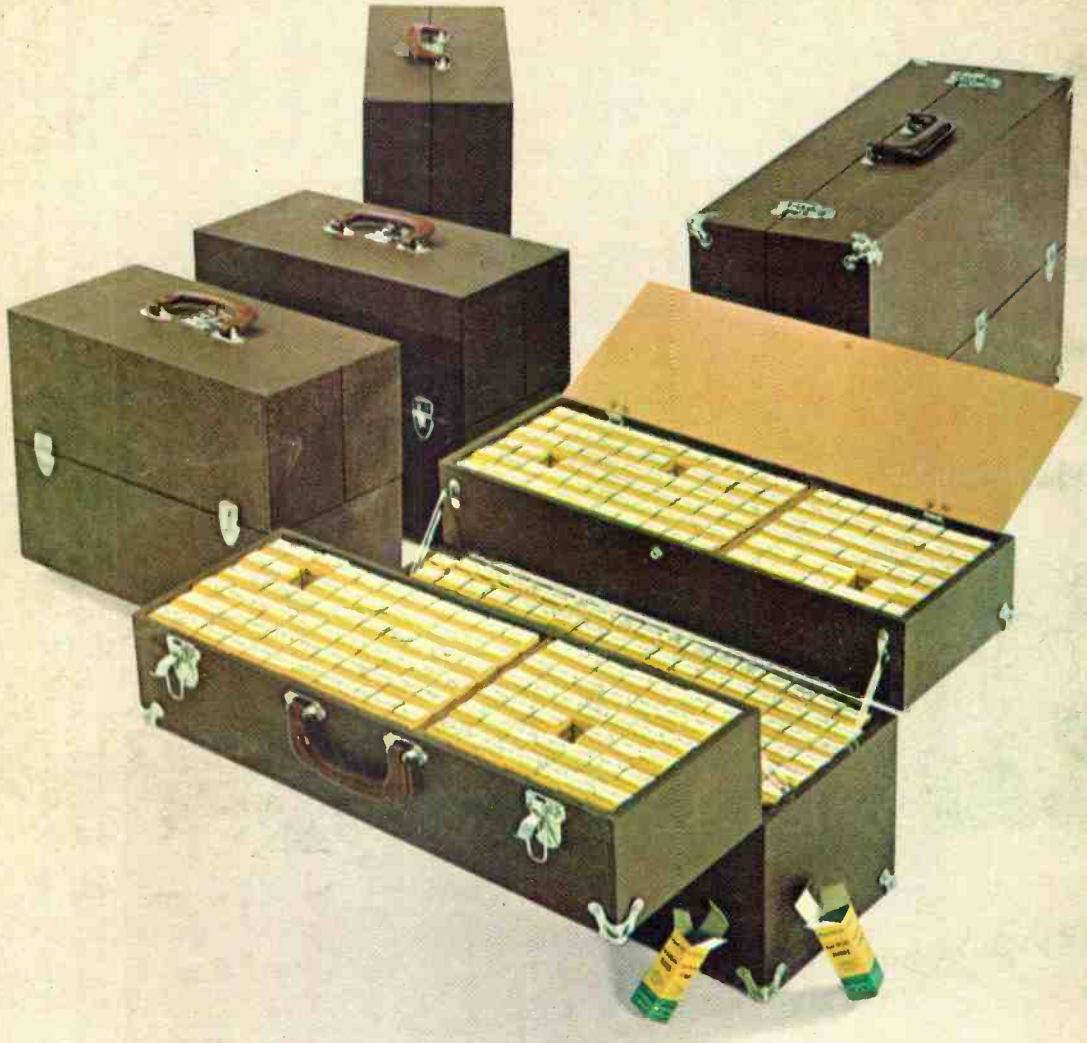

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