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This month's cover photo by Bruce Pendleton

VOLUME 20 FEBRUARY, 1964 NUMBER 2

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Construction Projects

Amateur, CB, and SWL

Electronic Features and New Developments

Departments

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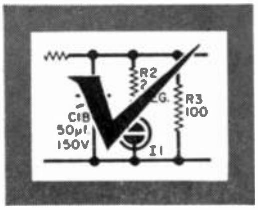
Operation Assist



THROUGH THIS COLUMN we try to make it possible for readers needing information on out-dated, obscure, and unusual radio-electronics gear to get help from *other* readers. Here's how it works: Check over the list below. If you can help anyone with a schematic or other information, *write him directly*—he'll appreciate it. If *you* need help, send a post card to OPERATION ASSIST, POPULAR ELECTRONICS, One Park Avenue, New York 16, N.Y. Give the maker's name, the model number, year of manufacture, bands covered, tubes used, etc. Be sure to print or type everything legibly, including your name and address, and be sure to state specifically what you want, i.e., schematic, source for parts, etc. Remember, *use a post card;* we can handle them much faster than letters. And don't send a return envelope; your response will come from fellow readers. Because we get so many inquiries, none can be acknowledged, and POPULAR ELECTRONICS reserves the right to publish only those requests that normal sources of technical information have failed to satisfy.

Schematic Diagrams

Philco type 38-2670A, code 325, using 6A8, 6K7, etc., no other data. (Gustow Albrecht, 5154 Tchendorp by Koln, Heerstrasse 201, W. Germany)

Panawade Model 5016 TV receiver, about 1952, no other data (M. D. Zimmer, Box 7856, Vandenberg AFB, Calif.)

BC-976-A military surplus receiver, 5 bands, 2 to 20 mc. (Sam Okuye, 10029 W. Olive Ave., Livingston, Calif.)

Zephyr AM-FM table model radio, ser. 8F508, 6 tubes, no other data. (M. Rodgers, 7301 Palais Rd., Stanton, Calif.)

Philco Model 3811 radio, 15 tubes, no other data. (George Flynn, 809 S. Greeley Highway, Cheyenne, Wyo.)

ERLA Model 203UL422 (E.R.L., Inc.) 2-band, 6-tube, a.c.-d.c. superhet, no other data. (Frank August, 412 John St., Braddock, Pa. 15104)

Atwater Kent Model 510, 10-tube superhet, 2-band, BC and s.w. to 3 mc., date unknown. (Walter Sobiesiak, 61-42 56th Drive, Maspeth 78, N.Y.)

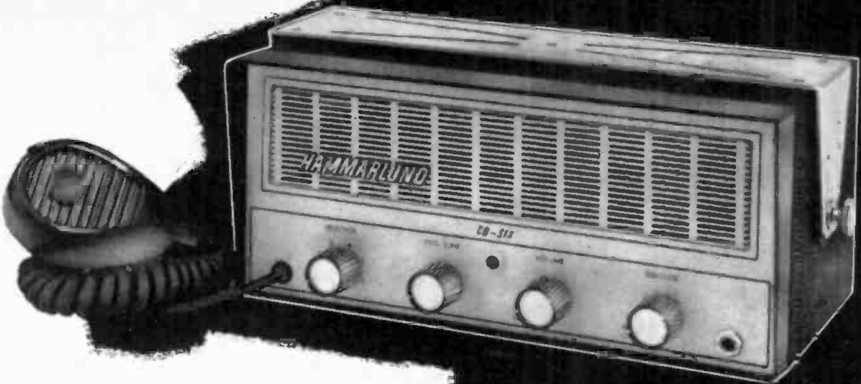
Hallicrafters S-20R "Sky Champion" communications receiver. (Manuel Lopez, 522 E. 138th St., Bronx 54, N.Y.)

United American Bosch Model 850 (or 810), ser. 129750, 10-tube, BC and two s.w. bands, date unknown. (H. G. Albrecht, RFD 3, Rd. 6, Newtown, Conn. 06470)

RCA Victor Model 18T, ser. 109850, BC and s.w. radio, pushbutton tuning (pre-war?) also alignment data. (R. Marek, 12518 So. McVicker, Palos Heights, Ill. 60463)

Altec Model P-518A power supply, no other data. (Judd Lewis, II, #4 Misima, Lexington Park, Md.)

(Continued on page 8)



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Operation Assist

(Continued from page 6)

Abbott Instrument TR-4B 2-meter transceiver. (Allan Jaworski, 42 Lucille Place, Passaic, N.J. 07055)

Breting Model 14 communications receiver, ser. 49346, no more data. (J. C. Roseberry, P.O. Box 2130, Orcutt, Calif.)

Radio City Multitester, Model 419. (Harold F. Weyl, 66 Merlin St., Rochester 13, N.Y.)

Emerson Model 1003, 6-tube radio, about 1943. (Tom Martin, 573 Woodview Dr., Dayton, Ohio.)

GE (Canada) Model A-70, 8-tube, BC and s.w. receiver, and **Electronics Labs, Inc.** (Indianapolis, Ind.) Model 801 25-60 cps converter. (Jack Shinono, 2489 Fifth Line West, Erindale, Ont., Canada)

BC 423 Radio Modulator, Signal Corps surplus. (Daniel A. Mann, 16 Queen St., Freeport, N.Y.)

Cal-Lee Mfg. Co. Model F-100 "Metronome" FM Tuner, no more data. (W. S. Rubin, 1663 S. Fairfax Ave., Los Angeles 19, Calif.)

Silvertone Model 7048 s.w. radio, ser. 141081, no date, also need parts list. (Mike Brubaker, 3159 Shroyer Rd., Dayton, Ohio 45429)

Crosley Model 516 2-band superhet, BC and one s.w., 5 tubes, data unknown. **RCA Victor** Model 76X11 6-tube, BC superhet, about 1950. (W. L. Adams, Jr., Rte. 2, Trenton, N.C.)

Hallicrafters S-20R "Sky Champion," about 1938. (Bob King, 4734 Cleveland, Apt. 200, Kansas City, Mo. 64130)

Atwater Kent Model 9780 8-tube, battery powered radio, BC and s.w., 1934. **Stromberg Carlson** 8-tube BC and s.w. superhet, chassis 14497 (no more data); also need speaker. (W. David Ferris, Rte. 2, Anadarko, Okla. 73005)

Magnavox Model A, type T.R.F. 5, battery powered radio, no date. (A. Tomaino, Jr., 18 Meadow St., Danbury, Conn.)

Radiotel Model 1500 5-tube set, Pacific Electron Prods., Long Beach, Cal. maker, ser. 1586. (L. J. Potter, 660 Union, N.E. Salem, Ore. 97301)

Philco Model 48-482 code 121, 9-tube BC, s.w., FM receiver, about 1948. (Earl H. Smith, Jr., 121 Hillcrest Drive, Eufaula, Ala.)

Abbott Instrument Model TR-4 transceiver. (Matthew Pruitt, P.O. Box 4096, Chase Hgts., S.C.)

CG 46117 Navy surplus receiver, 7 to 27 mc., ser. 1572. (Fred Mann, 5205 Page St., Marrers, La.)

Breting Model 12 receiver, no date. (James Lee, 39 Wedgewood Drive, Greenville, S.C.)

Zenith Model Y 515, 5 tubes, no date. **Zenith** Model R432T, 4 tubes, battery powered. **Philco** Model 46-250, 5 tubes, no date. (Jose Antonio Rojas, Pulperia Eduardo Perez, Alajuela, Costa Rica)

Majestic Model 7C11D AM-FM radio, no date. (Howard E. Fields, 10604 National Turnpike, Fairdale, Ky.)

Colin B. Kennedy Model 110 Universal receiver, no date. All-wave receiver (same maker), no model, ser. L7563W5. (Burton Mahan, 15075 Herring Ave., San Jose, Calif.)

Knapp Model TR-10 transceiver, also data for 12-volt use. (Max Boritz, 509 Ridge Road, Elmont, N.Y.)

Special Data or Parts

Superior Model TC-55 tube tester, replacement for meter. (S. A. Cooper, 1322 W. Jerome, Philadelphia, 40, Pa.)

RCA type 106B crystal receiver, ser. 8190, covers 200 to 3500 meters, and **Million** Model Q signal generator, any technical data on either. (Thomas Albright, 110 E. Delaware, Benton Harbor, Mich.)

Ecophone Model EC-1A 3-band s.w. receiver, operating and service manual needed. (Richard Mead, 832 N. First St., Alhambra, Calif. 91801)

Freshman Masterpiece 5-tube radio, ser. B92322, about 1938, need tubes, operating manual, schematic. (W. J. Hensel, 204 Odessa Ave., Wilmington 9, Del.)

AME-100 communications receiver (like National HRO) made for U.S. Navy by Amalgamated Wireless, Ltd.,

(Continued on page 10)

Operation Assist

(*Continued from page 8*)

(Australia), need 6G8G tube, alignment data, schematic. (Peter C. Brickey, 47B Fair Oaks, San Francisco 10, Cal.)

Silvertone radio-phono-wire recorder, chassis 110-466, need operating instructions and schematic. (Charles Fencl, 5620 W. 79th St., Oak Lawn, Ill.)

Phillips type ND593V, 5-band car radio, need U. S. equivalents for Telefunken tubes, any service data, schematic. (Norman L. Zinn, 1209 Langley St., S.E., Grand Rapids, Mich. 49508)

BC-453B plug-in coil bracket needed. (Richard Vogt, 1845 N. Kostner Ave., Chicago 39, Ill.)

Ecophone receiver, made by The Radio Shop, Sunnyvale, Calif., in 20's, need any technical, historical data, tubes, schematic, source of parts. (William Webb, Janssen Hall, Greenville College, Greenville, Ill.)

Type 1280 tube, or equivalent needed. (Harold Spring, 570 Lillie St., Elgin, Ill.)

Ballantine Model 300 VTVM, panel meter needed, any condition. (L. E. McCraw, 989 Echles St., Memphis 11, Tenn.)

BC 348-R receiver, maintenance manual needed. (Robert M. Bissell, DAFC, 405 CSG, Box 306, APO 74, San Francisco, Calif.)

Precision Model E-200-C signal generator, about 1948. Need alignment data. (C. Peacock, 3 Jenkins Drive, Indian Head, Md.)

Crosley Model 515 radio, need 6B5 tube, Miller #522 coil. (Rodney Babkirk, RFD 1, Scarborough 1, Maine.)

Weston Model 773 tube tester, date unknown, tube data charts needed. (N. Shyshuk, Box 744, Scranton, Pa.)

Knight KX-60 amplifier, assembly manual needed. (David G. Raymond, 493 Snyder MRH, Champaign, Ill.)

Type WE-10 Radio D Line (?) made by Western Coil & Electric Co., Racine, Wis., 6 tubes, battery-powered, tube types, battery voltages, schematic, etc., needed. (Ted R. Mize, 3738 East 6th St., Topeka, Kan.)

Montgomery Ward Model 62-194, 10-tube superhet, BC and s.w. to 18 mc., late 30's, any technical information, and schematic. (A. J. Eckhardt, 1311 Second Ave., Beaver Falls, Pa.)

RCA Model M-80605-15, 9-tube, BC and s.w., radio, using 6K7, etc., has phono input, any technical data, tube placement, alignment, etc., needed. (Lionel Kemp, P.O. Box 1701, Nassau, N.P., Bahamas)

Barker & Williamson HCL series coils, and 35-watt grid turret assembly, source of supply. (Gary Crane, 304 Virginia Ave., Santa Ana, Calif.)

Solar Model C-E capacitor analyzer, ser. E-5716, manual and schematic needed. (Richard Mead, 832 N. First St., Alhambra, Calif. 91801)

Electronic System Model E-10 science-electronics set, need instruction book and diagrams. (Richard Mead, 832 N. First St., Alhambra, Calif. 91801)

Silvertone Model 7224, 4-band receiver, need instruction book. (J. J. Carlin, 41 Hazelwood Ave., Newark 6, N.J.)

Heathkit "Sixer," need diagram of conversion to push-to-talk microphone for mobile use. (Barry M. Wilson, 7604 S.W. Capitol Hill Road, Portland 19, Ore.)

Solar Model CE capacitor analyzer, parts list, alignment data, and schematic needed. (C. Razgaitis, 1276 Eastwood Ave., Cleveland 24, Ohio)

Crosley Model 52, 3-tube, regenerative receiver, ser. 3839, about 1920 (?), need tubes and schematic. (William R. Maurer, 500 East North St., Cadillac, Mich. 49601)

BC 1066B 2-band, Signal Corps surplus receiver, need manual and schematic. (Terry M. Diggs, 209 North Ave., H. Haskell, Texas 79251)

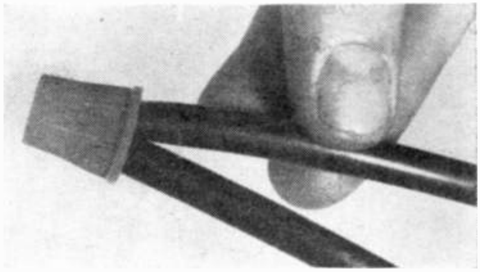
RCA Model R-320 SC-88, 6-band, 13-tube receiver, need alignment, calibration data, schematic. (Wayne E. Hertel, 3508 Mildred, Wichita 8, Kansas)

—30—

Tips and Techniques

EMERGENCY WIRE NUTS

Electrical supply stores sell the "wire nut" type of solderless connector in several sizes, but few such establishments are open on the week end, which is naturally the time you discover you need connectors. In a pinch, the cap from an old toothpaste tube

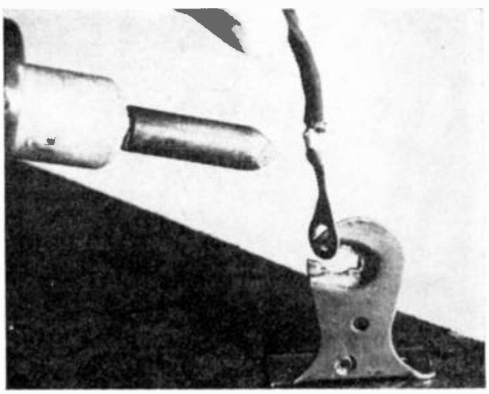


will serve almost as well, if you twist the wires together and trim them fairly short. For a permanent connection, put a little speaker cone cement or other adhesive in the cap before you screw it on.

—Charles Lang

HANDY AID FOR UNSOLDERING LUGS

When you have a lot of lugs to remove, the operation can be speeded by fastening a hook to the edge of a shelf or upright over your bench. A large cup hook is ideal, but you can even press a curtain hanger



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CIRCLE NO. 24 ON READER SERVICE PAGE

Tips

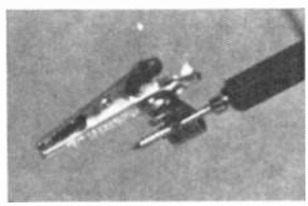
(*Continued from page* 12)

into service, as shown. Hooking the eye of the lug on the hook leaves one hand free to apply the iron, and permits the other hand to exert the pull needed to part lug and wire in the balky cases where the lug was crimped on before soldering.

—*John A. Comstock*

IMPROMPTU TEST PROD CLIP

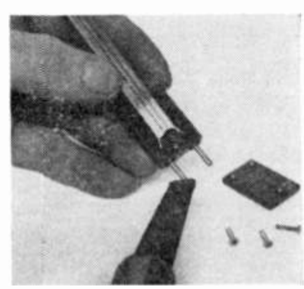
The lowly Fahnestock clip can be quickly pressed into service to convert a test prod to an alligator clip type, when the usual push-on clip is not at hand. Just fasten the Fahnestock clip to a spare alligator clip by means of the screw, and insert the end of the test prod in the spring connection of the Fahnestock clip, as shown, and you're in business.



—*Robert E. Kelland*

PLUG-IN CONNECTOR FOR 300-OHM TWIN-LEAD

Connectors for 300-ohm ribbon transmission line can be bought at reasonable cost, but there are plenty of times when you need one right away, and the shop shelf is bare. If you have a spare crystal holder of the FT-243 variety, the problem is easily solved. If the crystal is still in the holder, disassemble the unit and remove it. Heat each pin with the soldering iron and shake or blow out excess solder. Use a file to cut a groove in the Bakelite portion of the holder just wide and deep enough to fit snugly over the twin-lead you are using. Next, strip the conductors of the twin-lead back ⅝" to ¾", clean and pre-tin them. Push them fully home in the crystal holder pins, solder, and reassemble the holder. Any standard crystal socket serves as a female connector on the receiver chassis.



—*Waldo T. Boyd*

POPULAR ELECTRONICS

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VOID AFTER FEBRUARY 29, 1964

Why Fred got a better job . . .

I laughed when Fred Williams, my old high school buddy and fellow worker, told me he was taking a Cleveland Institute Home Study course in electronics. But when our boss made him Senior Electronic Technician, it made me stop and think. Sure I'm glad Fred got the break . . . but why him . . . and not me? What's he got that I don't. There was only one answer . . . his Cleveland Institute Diploma and his First Class FCC License!

After congratulating Fred on his promotion, I asked him what gives. "I'm going to turn $15 into $15,000," he said. "My tuition at Cleveland Institute was only $15 a month. But, my new job pays me $15 *a week* more . . . that's $780 more a year! In twenty years . . . even if I don't get another penny increase . . . I will have earned $15,600 more! It's that simple. I have a plan . . . and it works!"

What a return on his investment! Fred should have been elected most likely to succeed . . . he's on the right track. So am I *now*. I sent for my three *free* books a couple of months ago, and I'm well on my way to Fred's level. How about you? Will you be ready like Fred was when opportunity knocks? Take my advice and carefully read the important information on the opposite page. Then check your area of most interest on the postage-free reply card and drop it in the mail *today*. Find out how you can move up in electronics too.

POP'tronics Bookshelf

HI-FI PROJECTS FOR THE HOBBYIST

by Leonard Feldman

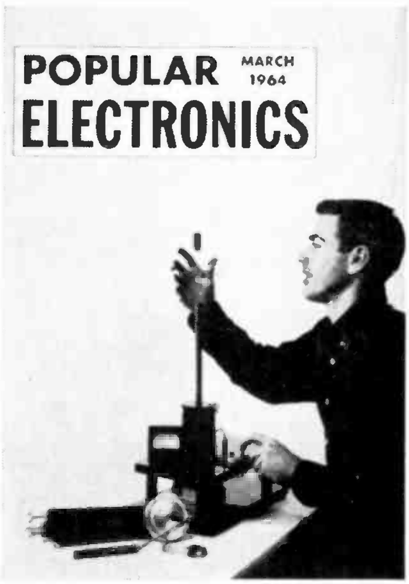
Approximately eight years ago, the Editor of POPULAR ELECTRONICS encouraged a budding audio specialist by the name of Len Feldman to design some gadgets for the hi-fi fan (monaural in those days). Len produced, and P.E. published, half a dozen projects that won excellent reader acceptance. During the interim from 1956 to 1963, Len remained very active in the hi-fi field, and as a part-time endeavor he assembled 20 build-it-yourself projects for this book. All of the projects are reasonably simple to construct, and each is complete within itself. Included are such items as a presence control, peak power indicator, scratch filter, stereo indicator, etc.—an excellent selection which should be enough to whet the appetite of any stereo fan with a home workshop. If your hi-fi setup is missing some gadget or circuit that the manufacturer "forgot to put in," take a look at Len's book. You'll buy it.

Published by Howard W. Sams, 4300 West 62 St., Indianapolis 6, Ind. 128 pages. Soft cover. $2.50.

A PROGRAMMED COURSE IN BASIC ELECTRICITY

Prepared by the New York Institute of Technology, this 7" x 10" publication carries the "workbook," or, in current terminology, the "programmed learning" idea to its ultimate extreme. Basically, the technique here is to present small bits of information and then ask a large number of questions that require a response from the reader. The chapters are devoted to the usual subjects up to, and including, a.c. circuit theory and resonance; they consist almost entirely of questions and answers. While anyone devoting the large amount of time required by the text to

HERE ARE THREE CONSTRUCTION FEATURES YOU WON'T WANT TO MISS... YOU'LL GET THEM IN THE NEXT ISSUE OF POPULAR ELECTRONICS



THE STRANGE WORLD OF 60-CYCLE RESONANCE: Every electronics experimenter is familiar with resonance and how it enables tuning in different radio or TV stations. But what happens when you build a device to resonate with the 60-cycle power line frequency? As well-known author, Walter Ford, relates it—all sorts of things can happen. You can build a "resonant motor" that operates without brushes. You can make an "electronic cannon" that will fire aluminum projectiles 10 feet into the air. Here's a construction project laced with useful theory that you'll want to build right away.

X-LINE BATTERY CHARGER: If you spent the last two months nervously watching the condition of your car battery—you're ready for the "X-line charger." It thinks for itself; just connect it to the car battery whenever you drive into the garage. You don't have to set the current or voltage and there's no chance of overcharging. Your "X-line charger" senses the condition of the battery automatically and charges it up to full-rate and then shuts itself off. When the battery goes down, the "X-line charger" goes on. This article describes how you can make this handy device from commonly available parts.

VHF AERO LISTENER: This VHF receiver is a little larger than the palm of your hand. It is self-contained, 100% transistorized, and drives its own built-in speaker. Tuning range is 108—132 megacycles, covering all of the VHF aeronautical channels. Besides this, it is ultra-sensitive and has an optional squelch adjustment. Unbelievable? Not really. Our do-it-yourself story will start you rushing for the workbench.

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On sale February 20th—Only 35¢ a copy

Bookshelf

(*Continued from page* 20)

"complete" it will certainly learn the subject thoroughly, your reviewer is among those who tend to look askance at this so-called method of teaching.

Published by McGraw-Hill Book Company, Inc., 330 W. 42 St., New York, N.Y. 333 pages. Soft cover. $6.95.

PRACTICAL PROJECTS IN RADIO-ELECTRONICS

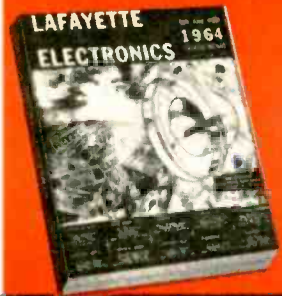
by Samuel L. Marshall and Irving Tepper

A listing of the chapter headings (or, rather, "Job" headings, to use this book's terminology) reveals its limited depth: "Forming Splices," "Fabricating a Speaker Grille," "Constructing a Diode Receiver," "Installing a Radio-Phonograph Switch," "Construction of a Mixer-Oscillator Circuit," etc. The title is somewhat misleading. The "projects" are practical only insofar as they serve as manual training devices (theory is introduced only where necessary) for the neophyte technician. The projects referred to are not practical in the sense of being especially useful. It is in the area of manual training—perhaps at the junior or senior high level—that this book would have its greatest usefulness.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis 6, Ind. Soft cover. 317 pages. $4.95.

CAPSULE REVIEWS

ESSENTIAL CHARACTERISTICS, tenth edition . . . G.E.'s handy reference text on tubes, CRT's, and capacitors features base diagrams on separate "strip" pages at the bottom of the book with this edition. Published by General Electric Co., 3800 N. Milwaukee Ave., Chicago, Ill. Soft cover. 302 pages. $1.50 . . . **ABC's OF MODERN RADIO** by Walter G. Salm . . . Written for the layman, this latest book in the Sam's "ABC" series gives the reader a quick look at modern AM and FM receivers. Published by Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis 6, Ind. 128 pages. Soft cover. $1.95 . . . **150 SCIENCE EXPERIMENTS STEP-BY-STEP** by Judith Viorst . . . Not in the field of electronics but of interest to science fair entrants, this paperback contains experiments in the fields of chemistry, physics, biology, weather, and numbers. Published by Bantam Books, Inc., 414 East Golf Rd., Des Plaines, Ill. Soft cover. 180 pages. $ .60.



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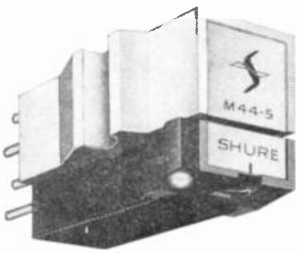
CIRCLE NO. 17 ON READER SERVICE PAGE

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 which appears on page 15.

STEREO 15° DYNETIC CARTRIDGE

75 Shure Brothers, Inc., has announced a radically new stereo dynetic cartridge with a no-scratch, retractile stylus that tracks at an effective vertical angle of 15 degrees. Called the M44, the new cartridge tracks records with the same effective vertical stylus angle major recording companies now use for cutting master records. This reduces IM and harmonic distortion due to vertical tracking error by 75 to 90 per cent. Frequency response is virtually flat from 20 to 20,000 cycles, channel separation is greater than 25 db at 1000 cycles, and compliance is 25×10^{-6} cm/dyne for the M44-5 with a .0005" diamond stylus, 20×10^{-6} for the M44-7 with a .0007" diamond stylus. Prices: M44-5, $49.50; M44-7, $44.50. (*Shure Brothers, Inc.*, 222 Hartrey Ave., Evanston, Ill.)



RELAY SERVICING TOOL KIT

76 Designed principally for adjusting and maintaining relays and telecommunications equipment, the new Jonard Model K-55 15-piece tool kit is also suitable for use in working on other types of electronic devices. All of the tools are made of high-quality carbon steel with heavy chrome plating. They consist of two spring adjusters, duck-bill pliers, inspection mirror, armature bender, contact burnisher, tension gauge, screwdriver, 4-way tool, stop bender, thickness gauge, tweezers, selector switch brush, contact spray, and 12 replacement blades for the contact burnisher. The kit is supplied in a heavy vinyl plastic case, with individual pockets for each tool. Price, $26.90. (*Jonard Industries Corp.*, Precision Tools Division, 3733 Riverdale Ave., Bronx 63, N.Y.)

AMATEUR TRANSMITTER

77 The HT-44 table-top transmitter announced by Hallicrafters provides the amateur radio operator with SSB, AM, and c.w. operation. It is systems-engineered to transceive with Hallicrafters' SX-117 receiver, but can be operated as an independent transmitter if desired. Features of the HT-44 include automatic amplified limiting control plus full VOX, press-to-talk, and full c.w. break-in In the AM position, carrier and both sidebands are transmitted for true AM. A stabilized phasing system is used for SSB generation. Price, $395. A companion power supply, the P-150, which contains a built-in speaker and sells for $99.95, is recommended for use with the HT-44. (*Hallicrafters*, 5th & Kostner Aves., Chicago 24, Ill.)

FM STEREO TUNER-AMPLIFIER

78 An FM stereo tuner and a 36-watt stereo amplifier have been incorporated on one chassis by EICO. The Model 2536 is available both as a kit and factory-wired. In the kit version, two of the most critical sections—the front end and the i.f. strip—are entirely prewired and prealigned

A high-quality circuit board is provided for the stereo demodulator and the coils supplied are also prealigned. The stereo amplifier provides 36 watts IHFM music power and 28 watts continuous power. Harmonic distortion at 10 watts per channel, 40 cycles, is 0.5%, and IM distortion at the 1 watt per channel level is down to 0.25%.

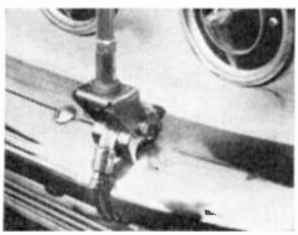
Magnetic phono or adapted ceramic phono, tuner, tape and auxiliary inputs are provided. Prices: $229.95 wired; $154.95 as a kit. (*Eico Electronic Instrument Co., Inc.*, 33-00 Northern Blvd., L. I. City 1, N. Y.)

SIX-CHANNEL CB TRANSCEIVER

79 The six-channel RAY-TEL TWR-4 CB transceiver has a built-in S-meter for monitoring transmitter and receiver performance, and is prewired with an external socket to accommodate a selective calling unit. Trim tabs provide precision frequency control. Automatic volume control and adjustable squelch combine to give the TWR-4 optimum reception. It's usable either as a mobile or a fixed installation. Price, $179.95. (*Raytheon Distributor Products*, 55 Chapel St., Newton, Mass., 02158)

HEAVY-DUTY BUMPER MOUNT

80 An extra-long stainless steel strap with worm adjustment enables Webster Manufacturing's new Band Spanner H-215 heavy-duty bumper mount for two-way radio antennas to be attached to all late-model auto bumpers. Made from rust-free metals, the base is a bronze die casting with a heavy chrome plating, and the bracket, of stainless steel, can be adjusted to a vertical position regardless of its placement on the bumper. Accepting all standard ⅜-24" butt antennas, the brass whip socket is secured to the bracket with a sturdy ⅜" stud. Price, $14.20. (*Webster Manufacturing*, 317 Roebling Rd., South San Francisco, Calif.)

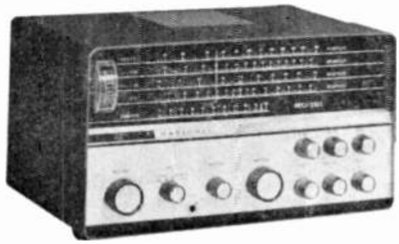


80-WATT STEREO AMPLIFIER

81 Each channel of the Sherwood S-5500-III stereo amplifier provides 40 watts of music power, or 36 watts continuous at 1½% IM distortion; there are speaker outputs for 16, 8 and 4 ohms. The phono channel features a filtered d.c. heater supply for very low noise and hum (measuring 72 db below rated output), and phono input sensitivity of 1.2 microvolts. Tape head sensitivity is 1.6 microvolts, tuner sensitivity 0.25 volt. The frequency response of the S-5500III is ±½ db from 20 to 20,000 cycles. Price: $174.50; walnut leatherette case optional at $7.50 extra. (*Sherwood Electronic Laboratories, Inc.*, 4300 N. California Ave., Chicago, Ill., 60618)

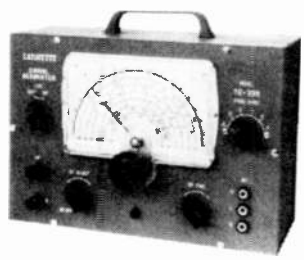
GENERAL-COVERAGE RECEIVER

82 National Radio's NC-121 provides continuous coverage from 550 kc. to 30 mc. in four bands, an illuminated edge-reading signal strength meter, and a peaking Q-multiplier for optimum selectivity. Other features include bandspread calibration charts for all popular foreign and amateur broadcast bands, separate r.f. and audio gain controls, SSB/c.w./a.g.c. control, product detector, automatic series-gate noise limiter, and a transformer-operated power supply. A 5" speaker is built in. Price, $129.95 with steel cabinet, $149.95 with oiled walnut cabinet. (*National Radio Co., Inc.*, Dept. P, 37 Washintgon St., Melrose 76, Mass.)



LOW-COST R.F. SIGNAL GENERATOR

83 The stable, wide-range design of Lafayette's low-cost (imported) TE-20A signal generator makes it especially useful for i.f.-r.f. alignment, audio signal tracing, TV linearity checks, etc. The selector switch gives instant choice of six overlapping frequency ranges covering 120 kc. to 130 mc. on fundamentals, with harmonics usable to 380 mc. Outputs are unmodulated r.f., modulated r.f., and 400 cycles audio. The r.f. output is in excess of 100,000 microvolts. Stability is insured by a circuit which uses a 12BH7 twin-triode cathode follower-buffer and a 6AR5 a.f. oscillator. The a.f. output is 2-3 volts, a.f. input 4 volts across 1 megohm. Price, $27.95. (*Lafayette Radio Electronics Corp.*, 111 Jericho Turnpike, Syosset, L.I., N.Y.) —30—



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1 4" L Handle
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1 Plastic Socket Holder Box
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6 Combination Wrenches: 3/8" to 3/4"
5 Open End Wrenches: 5/16" x 11/32" to 13/16" x 7/8"
9 Allen Type Wrenches: 1/16" to 5/16"
1 Plastic Carrying Roll
1 6" Combination Plier
2 Offset Screwdrivers: ¼" Regular, $2 Phillips type
1 Hacksaw
10 Coarse Hacksaw Blades
10 Medium Hacksaw Blades
2 Cold Chisels: ½"-9/16"
1 Long Taper Punch
2 Plastic Handle Electrician's Screwdrivers
1 Plastic Handled Phillips Type Screwdriver
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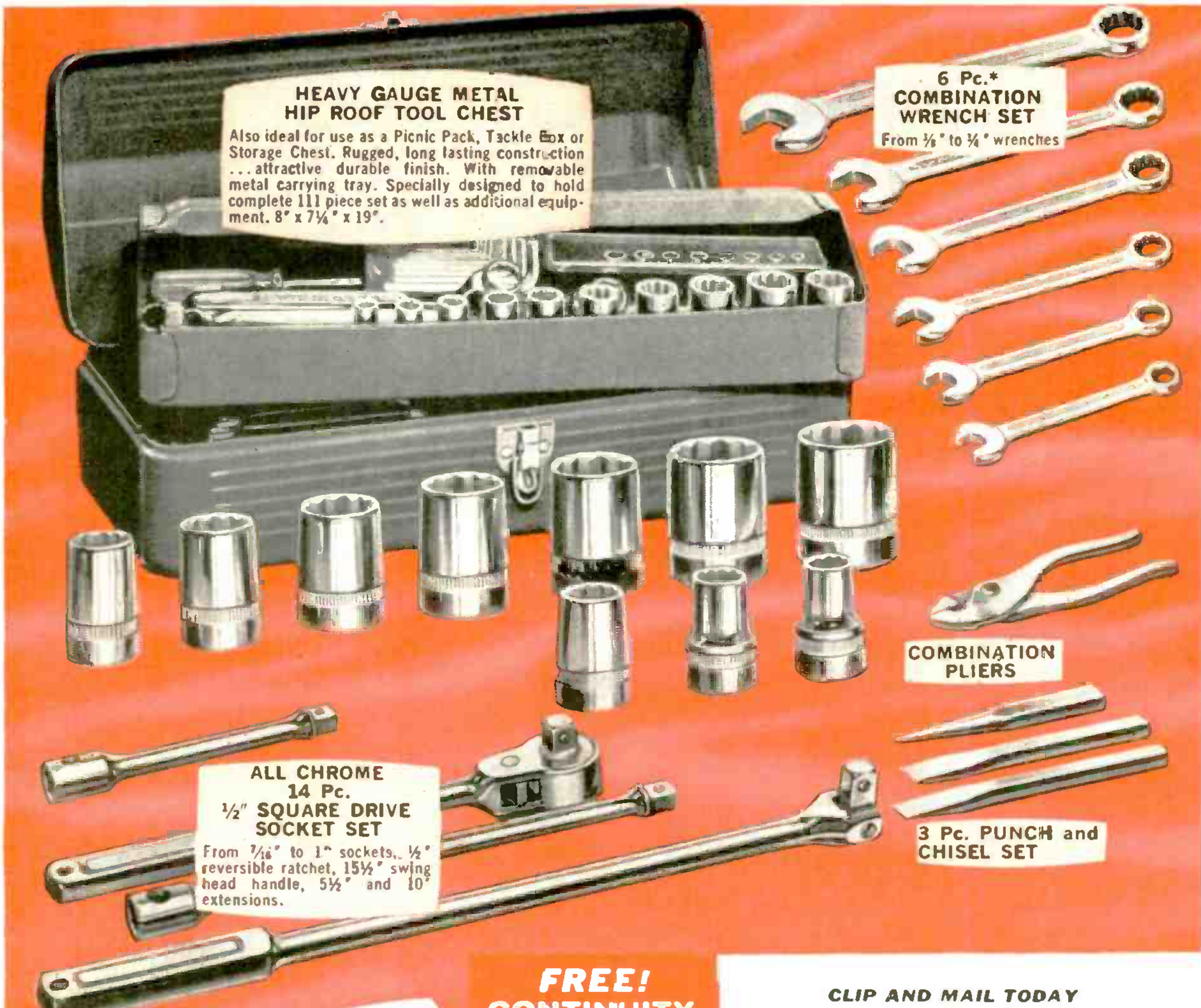

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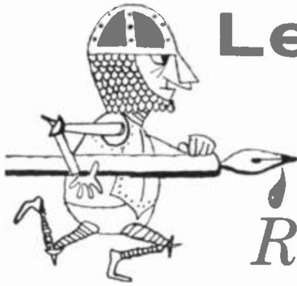


Letters *from our Readers*

Address correspondence for this department to:
Letters Editor, POPULAR ELECTRONICS
One Park Avenue, New York 16, N. Y.

Monitoring Satellite Transmissions

■ I plan to build "The NASA-136" converter (June, 1962) for satellite listening, but I have a question: How can you tell which satellite is transmitting, and how do you go about getting a report verified? I faithfully read the "Satellites On The Air" column in POPULAR ELECTRONICS.

ROBERT DOCKERY, WPE4EPE
Asheville, N.C.

Good questions, Bob. About the only way to tell satellite transmissions apart is by frequency. Unfortunately, the accuracy required at the receiving end is of a high order—a frequency meter for setting the receiver (in the 15-meter band, since the receiver acts as a tunable i.f.) is almost a "must." To the best of our knowledge, satellite reception reports are not now being acknowledged.

"Rock-Bottom" Receiver Wanted

■ I enjoyed the article on VLF radio ("How We're Using 'Rock-Bottom' Radio," December, 1963) and would like to build a receiver for these frequencies. In addition to plans for a VLF receiver, how about publishing information on a frequency standard with output at 1, 10, and 100 kc., and at 1 mc., using a single 100 kc. crystal?

DALE A. POBLENZ, WA8FRD
Wyandotte, Mich.

A VLF receiver is in the works, Dale, and we hope to feature it in the near future. On the frequency standard, the circuitry required would be complex and expensive, requiring at least several multivibrators. Adjustment would also be critical. We feel that such a project would be of limited appeal in view of the problems involved.

Improved Mobile Rigs?

■ After reading the "CB Equipment Buyers Guide" in the August, 1963, issue, I'm prompted to ask why some manufacturer can't come up with a CB transceiver expressly for MOBILE use. Every year more and more big boxes turn up, and they keep getting heavier, larger, and more expensive. A mobile user doesn't need a lot of fancy added features such as variable tuning, crystal spotting, tuning meters, r.f. gain controls, and other things designed for the sit-at-home knob-twister. Taking a cue from the other mobile services, the ideal mobile CB rig should consist of: (1) a small speaker housed in a metal box with mounting bracket; (2) control box with

Letters

(*Continued from page* 28)

on-off, crystal, squelch and volume controls; (3) trunk-mounted transceiver chassis. The control box could be quite small—very easy to mount on or under the dash. The coax run to a bumper-mounted antenna could be kept short for good efficiency with the transceiver in the trunk.

LAWRENCE W. CONFER, Capt., USAF
Warner Robins, Ga.

We agree that some of the features suggested by Capt. Confer are highly desirable, but there are also a number of drawbacks. A separate control box-transceiver arrangement means that a multi-conductor control cable must be strung through the car back to the trunk; ditto for power cables. Lastly, crystal switching could be a real problem. Conclusion? A de luxe mobile could be designed along these lines, but the price would be high and installation awkward.

Using Salvaged Components

■ As a devoted reader of your magazine since 1960, I have just one complaint. All of your projects are built from new, and often expensive, components. Even projects termed "inexpensive" can be quite costly to a student who has only a small allowance to work with, and there are a great many students among the ranks of electronic hobbyists. How about publishing projects which can be assembled from old TV sets, radios or surplus equipment?

DANIEL L. RAISKIN, WB2DWL
Far Rockaway, N.Y.

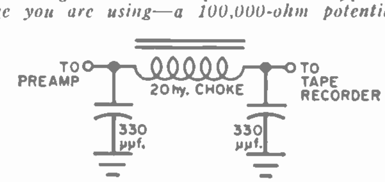
We agree with you in principle, Dan, but the practicalities go a bit deeper. Actually, a large percentage of the projects published in POPULAR ELECTRONICS *can be built with salvaged components. The only problems are that the builder must have test equipment (a VOM is minimal) and a good knowledge of components to be able to make such substitutions. By specifying exact parts, we hope to please everybody—those who have a well-stocked junk box and know how to use it, and those who must buy parts because they lack the knowledge or materials to make substitutions.*

Scratch Filter for 78 RPM Records

■ I have several hundred old 78 rpm records that I would like to record on tape, but most of them have too much surface scratch to make this worthwhile. Can you tell me how to build a scratch filter to solve this problem? Also, should it be placed in the pickup leads or between the phono preamp and the input of the tape recorder?

GUY H. ALBRIGHT
Idledale, Colo.

While it would be impossible to recommend a specific filter arrangement—this depends on the type of cartridge you are using—a 100,000-ohm potentiometer



across the pickup leads will work with some magnetic cartridges (G.E. types, for example). Actually, though, you should be able to achieve about the same effect by setting the amplifier treble control at a low level. Another possibility would be to try the capacitor-

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CIRCLE NO. 12 ON READER SERVICE PAGE

Letters

(*Continued from page* 30)

choke combination shown in the schematic between your preamp and tape recorder. The values of the capacitors can be determined experimentally.

Short-Wave Receiver Picks Up TV Sound

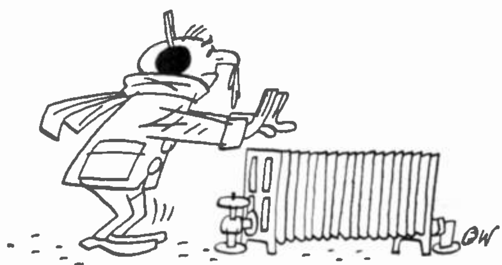
■ While tuning in the vicinity of 4.5 mc. with a portable short-wave receiver recently, I heard the sound portion of the TV program that another member of the household was watching. When the channel was changed, I heard the different sound portion. Could you explain this?

CHARLIE BRICE
Chester, S. C.

Glad to, Charlie. The sound i.f. frequency in your TV set is 4.5 mc. This i.f. signal is being radiated by the set's wiring, and possibly by the power line and TV antenna.

Furnace Control System Wanted

■ How about some ideas on an electronic control system using an indoor sensing unit, or thermostat, and an outdoor sensing unit for those of us who heat our homes with steam, hot water or hot air? Such a system (sometimes called an anticipating control system) could turn the heat on or



off in advance as the outside temperature rises or falls. The advantages would be many where there is a large variation between daytime and nighttime temperatures and the heating system is a bit sluggish in its pickup or has a tendency to overshoot the desired temperature in the morning.

H. S. COMMONS
Albany, Oregon

Anyone have a control circuit for reader Commons?

AREC Applauded

■ Recently a small tornado tore through an outlying community causing great damage and loss of life. Since our regional broadcast network is a news and communications media, we were flooded with calls concerning the welfare of people and property in the disaster area. As phone lines were down, I called both the local CB club and the local chapter of the Amateur Radio Emergency Corps for assistance. Within 15 minutes an AREC member arrived packing a complete homemade portable station with him. The first report from the disaster area came in exactly 46 minutes after aid was requested—by amateur radio. I was told later that many AREC members had left the shelter of their cars, carrying 12-watt 40-meter transceivers they had designed themselves on their backs. A report from the CB club took two hours; the reason given for the delay was that messages had to be relayed over the 12 miles from the tornado area

(*Continued on page* 38)

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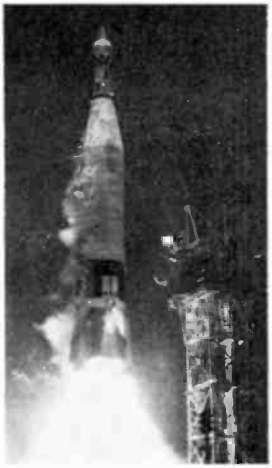

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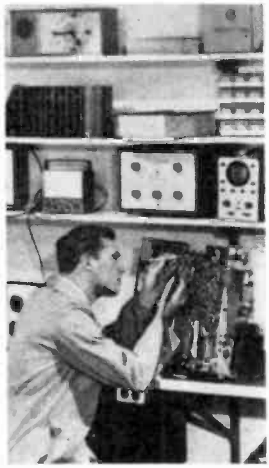

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W. F. Fitzpatrick, Waco, Texas

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ACCREDITED MEMBER—NATIONAL HOME STUDY COUNCIL

Letters

(Continued from page 32)

to the city, where they were finally relayed via telephone to me. At this point, the AREC boys had it all sewed up. They did the best job of reporting I have ever seen, and with great efficiency. In regard to Mr. Hamilton's letter ("Letters From Our Readers," November, 1963), I think he has his gun pointed in the wrong direction, don't you?

EDWIN PETZOLT
Gardner, Mass.

Two-Meter Simple Transmitter?

■ The "2-Meter Simple Superhet" (September, 1963) is just what I have been looking for, and the instructions on how to build it are excellent. How about a companion transmitter? The ideal one for me would be a low-cost, crystal-controlled c.w.-AM job capable of about 25 watts input.

DON ROASCH
Saginaw, Mich.

Thanks for the letter, Don. We hope to have a transmitter project along the lines you mention sometime in the near future.

Medal Offered for "Transitips"

■ Our village idiot hung a lamp socket on a single seven-strand wire behind a translucent screen, and produced a light by taking three strands of the wire and fastening them under one screw of a plug and the other four strands under the other screw. When we removed the screen, we found he had a candle burning behind it. For this feat we gave him a tin medal of which he is very proud. We would like to send a similar award to Lou Garner for his "Transitips" circuits ("Transistor Topics," November, 1963, page 107) in which he shows one input wire and one output wire with no return circuit. All Lou has to do is disclose the secret.

MARTIN KULISEK
Youngstown, Ohio

The return wires in both the input and output circuits would go to the positive side of the battery, Martin. Incidentally, this type of diagrammatic shorthand is by no means uncommon. Lou Garner conveys his thanks for your offer of the medal, but he has already received so many that he's clean out of chest-room. —30—

Out of Tune

CONVERTING YOUR FIRST "COMMAND" RECEIVER (*June*, 1963, *pages* 47, 48). In the schematic on page 47, the heater pins of the 12A6 should be 2 and 7, not 7 and 8. In last paragraph on page 48, "pin 7 of the 12SR7" should be "pin 8."

THE CODE BANDER (*August*, 1963, *page* 46). In the Parts List, B & W 3015 should be used for *L1*, not B & W 3014. —30—

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CIRCLE NO. 33 ON READER SERVICE PAGE

THE AMAZING "BUG" BATTERY

By D. S. HALACY, JR.

Want to build a biological fuel cell? Fantastically economical, they're the power source of the future

Illustrated on this month's cover is a radically new kind of power converter called a biocell. To drive the electric motors, it is changing a fuel directly to electricity with no intermediate steps. As with any new system or device, there are "bugs" in the biocell. But engineers are not trying to eliminate all the bugs, or more accurately, the bacteria, because they are generating the electricity. Far past the gimmick stage, a number of more refined biochemical fuel cells, to use their proper name, are demonstrating their potential as a new power source for the space age. Investigations are under way with a view toward using biocells in the "closed-cycle" of a spacecraft like Apollo to convert waste material into fresh water

COVER STORY

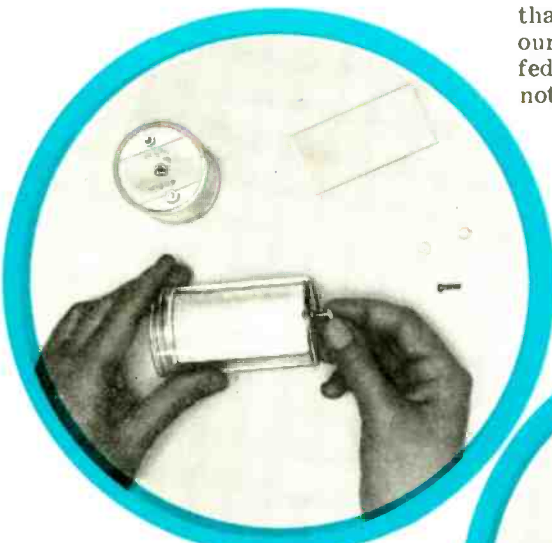
THE AMAZING "BUG" BATTERY

and food and, at the same time, generate electricity to power radios, radar and telemetry gear, and other on-board auxiliary equipment.

Land-based biocells have powered radio transmitters, driven model boats, and lighted fluorescent tubes. A Navy-sponsored design floats in the sea and generates a multi-watt output. Thus, although the biocell is not yet rolling off the production line for general use, the promise of this newest and most exotic fuel cell seems tremendous.

Up to the present time, man has produced the electricity he uses by mechanical or electrochemical means. Biochemistry now looms as a major producer of power for us, and it is not the science-fiction or Sunday supplement writers but scientists themselves who suggest such "way-out" possibilities as turning the Black Sea into a gigantic "bug battery" to light parts of the country surrounding it. A more modest idea is that of using sewage, garbage, or wastes like those from paper mills to feed bacteria. This not only produces power heretofore untapped; it also gets rid of the waste material much more efficiently than conventional means.

Whether or not the biocell will ever produce power for a mill per kilowatt-hour remains to be seen. One of the pioneer developers has predicted such a bonanza, and there is general agreement that bio-power will figure importantly in our future. After all, biochemistry has fed and clothed us all this time. Why not let it furnish the power too?



The aluminum and copper electrodes are bolted in the plastic containers (left), which are then filled with the carrier (below). The biocells begin producing electricity when activator is added—12 are enough to run a small electric motor, power a transistor radio, or light a small pilot lamp.

Build your own bug battery? It's perfectly feasible with the Electron Molecule Research kit illustrated in these two photos. Distributed by Allied Electronics (the industrial branch of Allied Radio Corp.), 100 N. Western Ave., Chicago 80, Ill., the kit sells for $16.95 under stock number 7E658, and includes material for 12 cells—plastic containers, copper and aluminum electrodes, harmless bacteria in a carrier, activator (powdered brown rice husks), hardware, wire.

The Biocell's Past. Although even the ancient Romans were aware of electricity in living things and actually used the torpedo ray fish in shock treatment of the mentally ill, the idea of putting bacterial metabolism to work as an electrical power plant dates back only about 50 years. In 1912 a British botanist, M. C. Potter, put together a half-dozen "cells" using yeast around carbon electrodes. This primitive bacterial battery generated a current Potter measured at 1.25 milliamps.

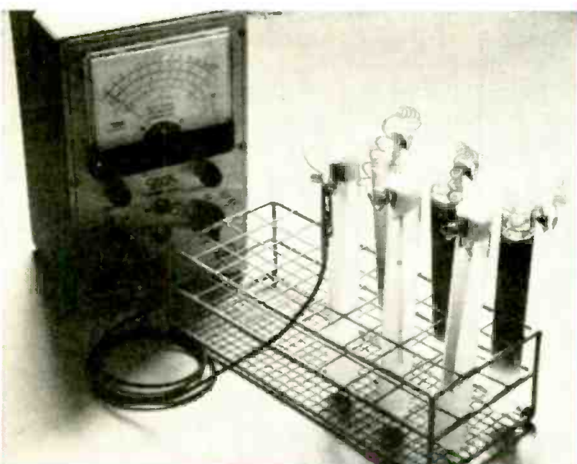
The feat caused no sudden selling of utilities stocks. Other researchers conducted similar experiments at irregular intervals, however, and in 1931 B. Cohen at Johns Hopkins Medical School here in the United States reported on a bacterial battery that upped Potter's output to about 2 ma. It was not until about 1960 that biocell research got into high gear, with several groups pushing the idea at the same time.

In his work for the Department of Interior's Geological Survey, biologist Dr. Frederick Sisler became greatly interested in the fact that decomposition of organic matter on the ocean bottom, plus the chemical and physical conditions in the ocean, led to production of a weak electric current. He began to work toward developing a biocell exploiting this phenomenon.

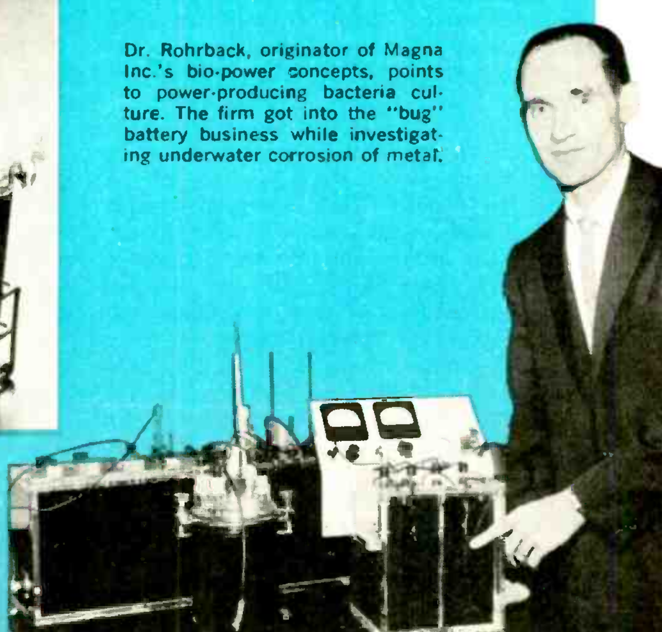
Dr. John Welsh and his associates at Joseph Kaye and Company, a Cambridge, Massachusetts, research firm, noted that all fuel cells had certain common denominators—fuel, plus a catalyst to accelerate the electrochemical reaction. And since enzymes from living cells are the ultimate in catalysts, Welsh felt that biochemistry might speed some reactions a million-fold.

A third group, Magna Industries, Inc. of California, came onto the biocell idea in a roundabout way. Investigating the corrosion of oil wells and pipe lines under the sea, they found that bacteria were the culprits. They found too that these bacteria were generating tiny amounts of electricity while doing the dirty work. So Magna began to investigate the possibility of setting these tiny workers at a more useful task: that of producing electric power for seagoing equipment.

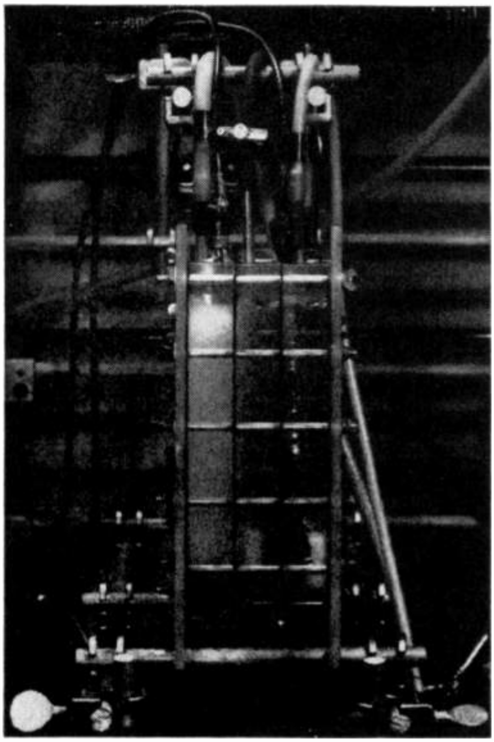
So immediately successful was biocell work that predictions were made in 1961 that a 1-watt cell was feasible and that



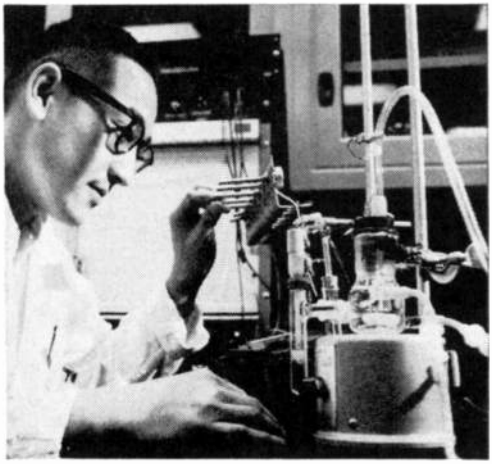
Another type of biocell kit is the one above made by Rowland Labs, 345 E. Forsyth St., Jacksonville, Fla. ($14.95). Making use of anaerobic sulphate-reducing bacteria (dark tubes) and artificial sea water (light tubes), the cells produce 1.5 volts at 100 microamperes.



Dr. Rohrback, originator of Magna Inc.'s bio-power concepts, points to power-producing bacteria culture. The firm got into the "bug" battery business while investigating underwater corrosion of metal.



The elaborate apparatus at left is an experimental hydrocarbon biocell being tested at Socony Mobil Oil Company Field Research Laboratory.



Reversing the usual procedure, power can be fed to a biocell to produce chemical reactions. Above, Dr. Y. H. Inami does so in a NASA study to simulate reactions that occur in biocells.

a radio might be powered with bacterial electricity within a few years. These things materialized even sooner than hoped for. In 1962, Sisler and his associates in a newly formed private firm demonstrated a small transmitter with a range of 15 miles, and also a model boat operating on biocells, tapping the water it floated in.

The first biocell conference was held in 1962 in Corvallis, Oregon. About a dozen firms were active by then in the new field, both with company-funded studies and work backed by the Army, Navy, Air Force, and NASA. In just a couple of years the biocell had jumped from laboratory test tube to serious contender as a new power source.

How It Works. Every living thing, man, mouse, or microbe, is a biochemical fuel cell. It takes in food or "fuel" and breaks the material down to a lower form, extracting energy in the process. Some of this energy appears in the form of electricity. Luigi Galvani was intrigued by the animal electricity he found in frogs, but his countryman, Volta, turned scholars of electricity in another direction with his Voltaic pile, a device considered the original battery.

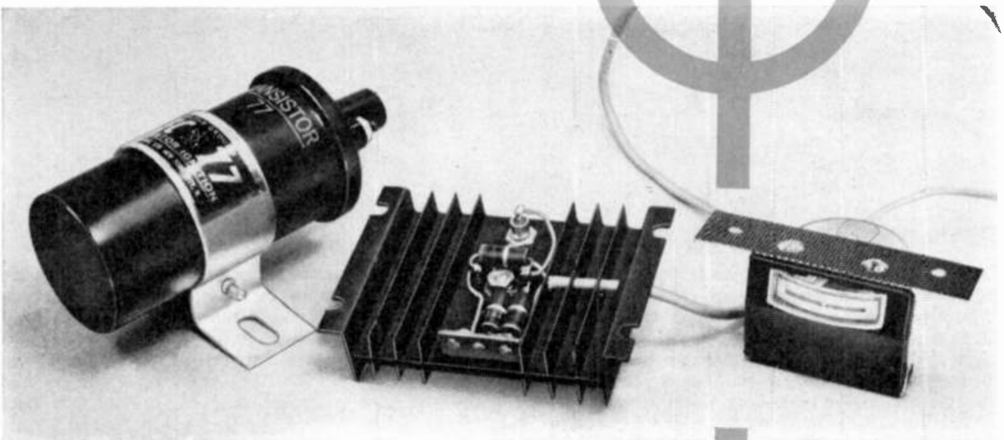
Make electrodes of two dissimilar materials, place an electrolyte between them, and current flows. This is the same "oxidation-reduction" process that goes on in living things that breaks down fuel into energy and waste. Oxidation, familiar as burning, is made, in a battery, to push electrons around a circuit instead.

The battery is a handy device, but expensive. It would be better to be able to "burn" cheaper fuel in it to produce electricity, and in 1839 an Englishman named Grove did just that. His battery used hydrogen gas instead of zinc or other metal as a fuel, and was the forerunner of today's "hydrox" fuel cells. Before the turn of the century other workers had improved Grove's idea and coined the name "fuel cell." But another means of generating electricity was making its debut. Called the dynamo, it ushered in the age of the mechanical production of electric power.

Since even the most efficient turbine generators are doomed by the inexorable laws of thermodynamics to waste

(*Continued on page* 103)

BUILD



SIMPLEX TRANSISTORIZED IGNITION

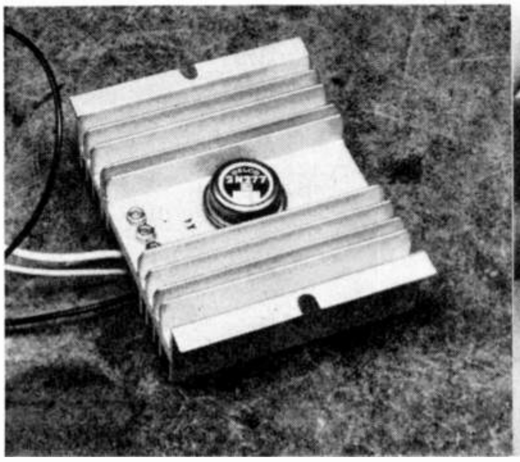
By EDWARD P. NAWRACAJ

Single transistor with zener protection works best with 400:1 turns ratio ignition coil; dwell meter accessory is described in detail

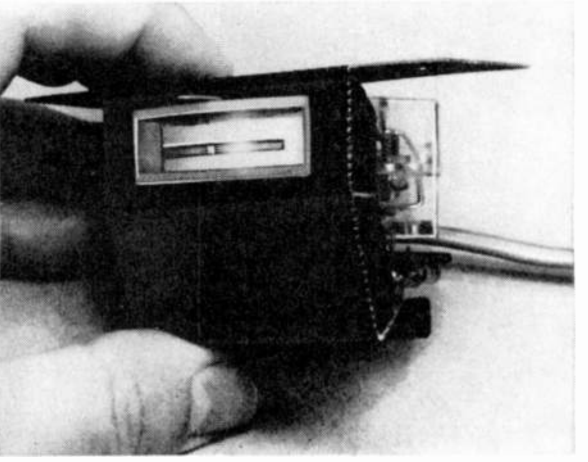
EDITOR'S NOTE: The first excursion of POPULAR ELECTRONICS into the field of building transistorized ignition systems (June and October, 1963, issues) continues to elicit hundreds of letters and postcards. Since many readers have expressed an interest in experimenting with a basic system using a 400:1 ratio ignition coil, we present this month a project which will fulfill their requests. The SIMPLEX has been in operation in half a dozen cars for the past six months. We are pleased with its performance, and are happy to say that its construction entails only a modest investment.

THE ADVANTAGES of transistorized ignition systems are not to be lightly dismissed. A 95 per cent reduction in current flow through the breaker points virtually eliminates this sore spot in engine tune-ups. Changing the ignition coil ratio from 100:1 to 400:1 means greater spark voltages and more efficient engine operation at higher speeds. Greater gas economy and reduced engine maintenance result.

The question of whether *every* car on the road can—or should—be converted to transistorized ignition remains unanswered. Nevertheless, every electronics experimenter with a car in his garage will find it worthwhile to try it. The SIMPLEX is an easy, foolproof method of finding out how much advantage you'll gain in converting to transistorized ignition—and if it does work as well as you hope (this should be the case



The arrangement of components here differs from that shown on preceding page. In this photo, the transistor has been inverted and all connections made on the top side of the heat sink. In the lead photo, all connections appear on the underside. In an earlier prototype, paralleled resistors were used to obtain the necessary wattage rating at R3.



A special scale and bracket were fashioned by the author for his dwell meter. After checking the meter readings with the graph on page 48, a new scale was drawn. A heavy red line is divided so that a white spot is equivalent to 2° of dwell angle—this indicates the "safe" range, and the red line indicates that the points are bad.

with nine out of ten cars), you can go a step further and build a dwell meter to continuously monitor your car's performance.

Circuit Description. Three resistors, one zener diode, one transistor, and a new ignition coil comprise the SIMPLEX circuit. A commonly available 15-amp germanium power transistor is used in a grounded-base circuit, which functions as a switch. Collector current flow is limited to 10 amps by ballast resistor *R1* and the primary winding resistance of *T1*. At normal operating temperatures, the current transfer characteristic of a 2N277 results in a base current (through the breaker points) of only 250 ma. Since the usual current flow through the points without transistorized ignition is 5-6 amps, this results in a very substantial reduction in point erosion.

Resistor *R2* shuts the transistor switch off when the breaker points open. A 1-watt zener diode, *D1*, is connected between the *base* and *collector* of transistor *Q1*. This diode has a breakdown voltage below that of the collector-base circuit. Should an abnormal transient back voltage develop in the automotive electrical circuits, the diode will limit the reverse voltage applied to *Q1*. This is one of the most economical means of protecting a transistor ignition system.

Simplex Construction. Only a few points need elaboration when it comes to constructing the SIMPLEX circuit. A good-size heat sink should be used, such as a Delco 7276040, Astro 2504, Delta NC-403, Wakefield NC621B, etc.* Insulated terminals or a barrier strip are required to mount the zener diode and two resistors, and number 16 stranded wire should be used for wiring.

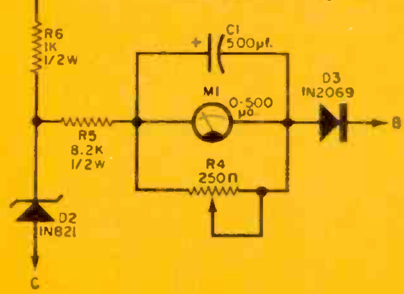
Transistor *Q1* must be electrically insulated from the heat sink. Mica wafer insulation is required. Before mounting *Q1*, a light coat of silicone grease should be applied to both sides of the larger mica insulator. This will enhance the heat transfer between the transistor and the heat sink.

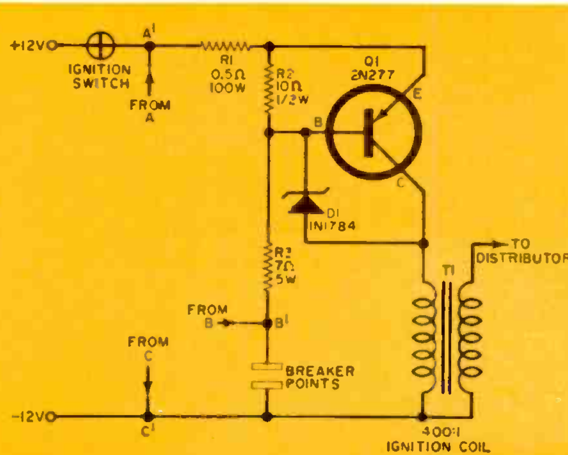
Transistor or Diode Substitution. There are several possible substitutes for the 2N277 transistor. In selecting one, however, consideration must be given to the 15-amp, 40-volt power ratings in relation to the current transfer characteristics of the 400:1 turns ratio coil, and the value of the ballast resistor. An excellent replacement is the 2N1554A.

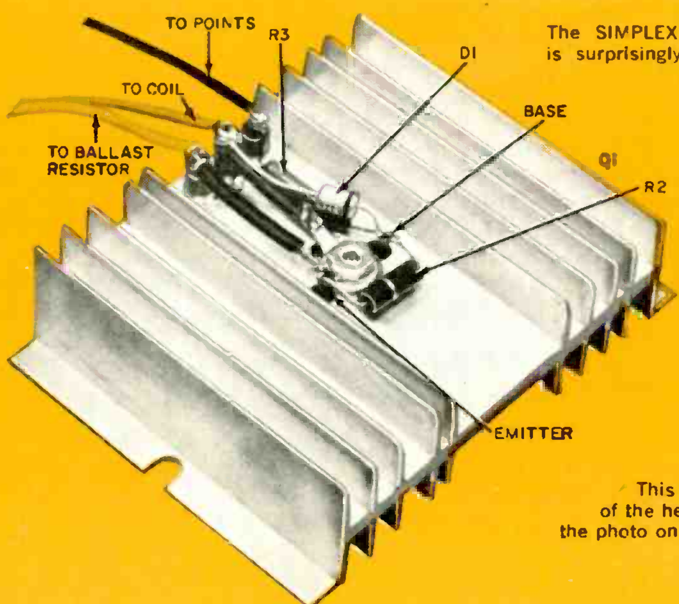
If a substitution is made for the transistor, one must also be made for diode

**At this writing, a bargain combination heat sink and 2N277 transistor was being sold by John Meshna, Jr., 19 Allerton St., Lynn, Mass. It is shown in the photo above and on page 47. Write for price information.*

Dwell meter circuit can be constructed and connected up at a later date. This circuit will work with most transistorized systems.







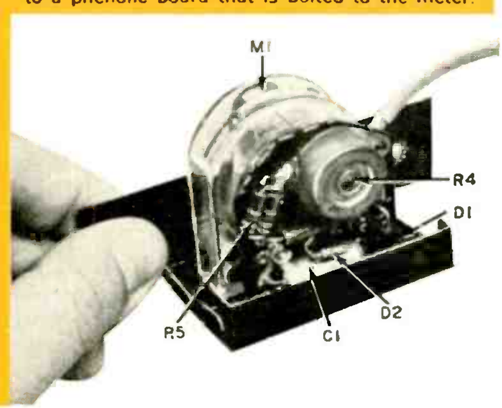
The SIMPLEX ignition circuit is surprisingly easy to build.

This is the underside of the heat sink shown in the photo on the facing page.

PARTS LIST

C1—500-µf., 3-w.v.d.c. capacitor
D1—Zener diode (type 1N1784A, 1N2990A, or 1N3033B when used with a 2N277 transistor at Q1; type 1N3037A, 1N3038B, or 1N2995A when used with a 2N1554A transistor at Q1)
D2—Zener diode, 6.2 volts, type 1N821
D3—Silicon diode, 200 PIV, 750 ma., type 1N2069
M1—500-microampere meter—see text
Q1—Transistor, 2N277 or 2N1554A; must complement zener diode D1
R1—Ballast resistor, 0.5 ohm, 100 watts
R2—100-ohm, ½-watt resistor
R3—7-ohm, 5-watt resistor
R4—250-ohm, wire-wound miniature potentiometer, screw-driver adjustment
R5—8200-ohm, ½-watt resistor
R6—1000-ohm, ½-watt resistor
T1—Ignition coil, 400:1 turns ratio (This circuit has been tested with AEC 77, Palmer T-400, and Slep F-400T coils, all of which performed satisfactorily)

All components for the dwell meter are attached to a phenolic board that is bolted to the meter.



D1. Permissible zener diodes when using a 2N277 transistor are the 1N1784A, 1N2990A, and 1N3033B. If a 2N1554A transistor is used, the zener diode should be either a 1N3037A, 1N3038B, or 1N2995A.

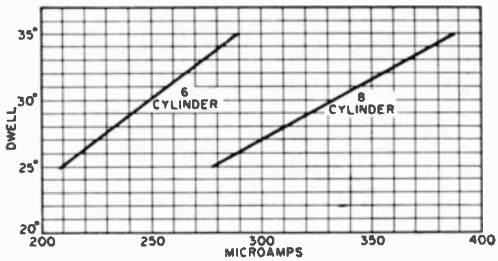
Dwell Meter. Of the four readily monitored characteristics of the modern six- or eight-cylinder engine (engine revolutions, timing, dwell angle, and vacuum pressure), only the dwell angle and the timing of the distributor breaker points are directly related to the use of a transistorized ignition system. Once installed and calibrated, the dwell meter in the diagram on page 47 will indicate wear of the distributor rubbing block or malfunctioning of the points. The battery current consumed in operating the dwell meter is very small, and the entire meter assembly can be built on a miniature chassis and installed on the lower edge of the dashboard.

Operation of the dwell meter is not limited to use with the SIMPLEX ignition system—it can be attached to almost any other transistorized system. For convenience, the SIMPLEX and the dwell meter can be built at different times as two separate projects. Interconnections are shown in the two diagrams on page 47—simply attach A to A', B to B', and C to C'.

The dwell meter is voltage-sensitive, necessitating the use of a small zener diode at *D2* to regulate this circuit. Resistors *R4* and *R5* limit the current flow through the meter and capacitor *C1* smooths circuit action to prevent meter pointer oscillation at slow engine speeds.

In operation, the dwell meter circuit is completed by the closing action of the breaker points. The meter indicates current proportional to the ratio of the time the breaker points are closed to the total time lapse between one spark and the next. This dwell time is proportional to the angle through which the distributor cam turns between closing of the points and their reopening, which is called the dwell angle.

Building the Dwell Meter. Any 0-500 microampere meter can be used in this circuit. The author was fortunate in obtaining a "surplus" edgewise meter that made a very neat package. The meter terminals are used to hold a small phenolic board in position—the board supports the remaining components in this circuit. An aluminum wrap-around was fashioned to attach the meter to the underside of the dash panel.



When a 500-microampere meter is set up according to procedures outlined in text, dwell angle readings will correspond to above current readings.

When you're ready to calibrate the dwell meter, ask your garage mechanic for the correct dwell angle setting for your car. This is usually between 25° and 35°, but varies in different makes and models. When you have this figure, you can determine your actual dwell angle by noting the current indicated by the dwell meter, finding where a vertical line for this current intersects the plotted line in the graph,* and mentally drawing a horizontal line to the dwell angle scale.

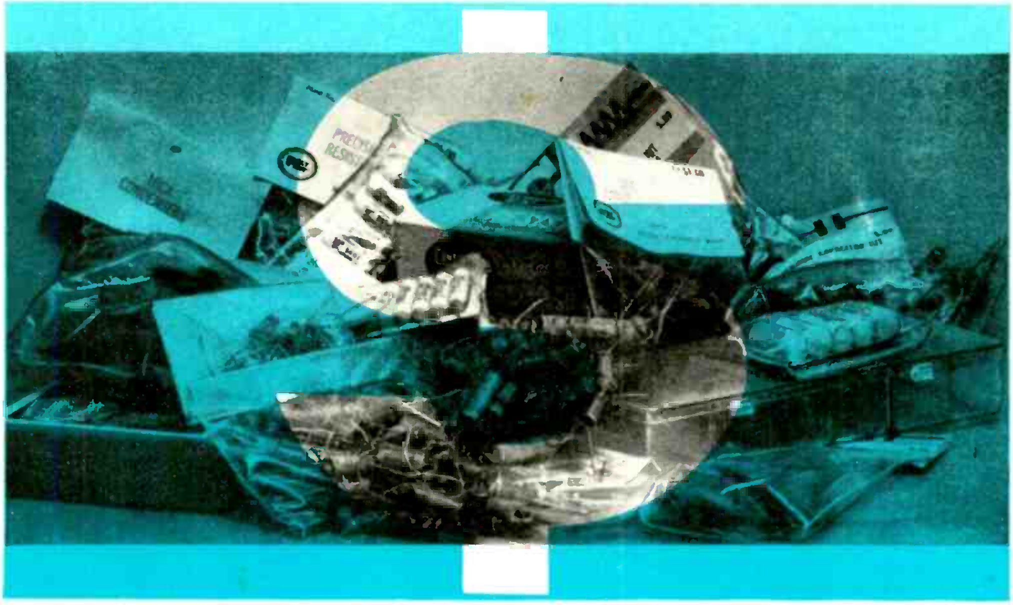
If you prefer not to use the graph and want to mark the meter dial directly in dwell angle, slip off the meter case carefully, and mark a white "okay" band centered on the correct scale point for your car. Make the band just wide enough to indicate the plus or minus 1° tolerance of the dwell angle, and add a red band above and below the white band, extending out another 4°. As an example, consider a six-cylinder car designed for a 30° dwell angle. From the graph it is clear that the correct dwell angle is indicated by a current of 250 μa. For 29° the current is about 242 μa. (actually 241.6+ μa.), and for 31° it is about 258 μa. This gives the upper and lower limits of the "okay" band, and the edges of the red "out of tolerance" band can be determined in the same way.

To adjust the dwell meter on first in-

(*Continued on page* 96)

**The graph lines are based on multiplying the dwell angle in degrees times the number of cylinders, dividing by 360°, and multiplying the resulting fraction times the full-scale (500-μa.) current.*

BARGAINS



BY THE BAGFUL

With a few careful purchases, you can stockpile many of the resistors and capacitors you'll need for project building

By **OLIVER P. FERRELL**, Editor

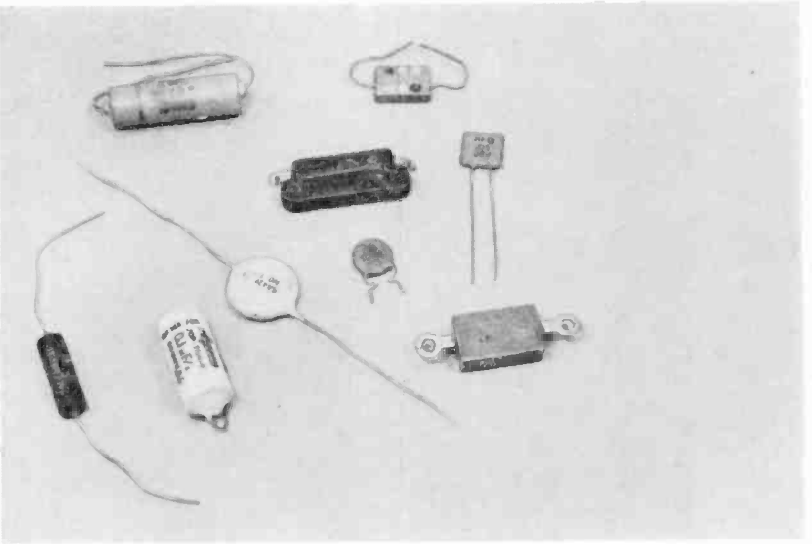
PART I RESISTORS AND CAPACITORS

EVERY radio parts store worth its salt these days offers a variety of "poly" bags full of capacitors, resistors, potentiometers, transistors, diodes—everything but the kitchen sink. Mail-order catalogs and flyers are full of assortment offers and several companies specialize in selling nothing but bags of various radio components.

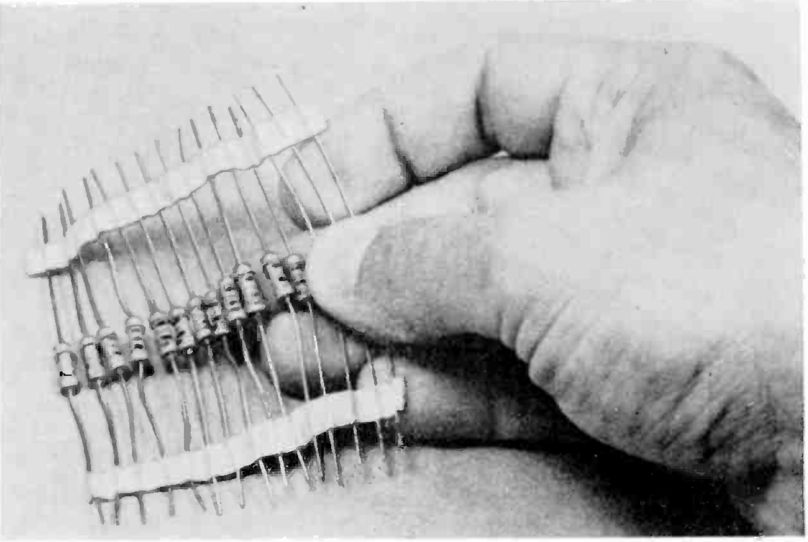
POPULAR ELECTRONICS has spent several months quietly investigating poly bag assortments of resistors and capacitors. These two categories of *bargain bags* are discussed below; a subsequent article will deal with potentiometers, chokes, and hardware.

First of all, why buy assortments at all? Inveterate electronic project builders are well aware that there are numerous ways and means of cutting project costs. The so-called "junk box" of re-usable parts is one method. A second is stocking up resistors and capacitors obtained in poly bag assortments. As opposed to buying each resistor or capacitor in a project individually, a stockpile can shave these costs by 70-80 per cent.

We found that poly bag assortments included everything from floor sweepings of some unknown manufacturer to carefully packaged, top-quality merchandise. The buyer has no recourse (*caveat emptor*) but to accept what the poly bag contains without question. The only firm guideline that we could uncover as to the possible worth of a bargain bag is to know with whom you are dealing. Mail-order companies with business reputa-



These are a few of the different types of capacitors (mica, ceramic, molded paper, etc.) culled from poly bag assortments. The two mica capacitors with eyelet leads are over 15 years old. They are not color-coded; values are hot-stamped on bodies of the capacitors.



In disposing of these tubular ceramics, no effort was made to even separate them from an adhesive strip. Obviously, they are all the same value.

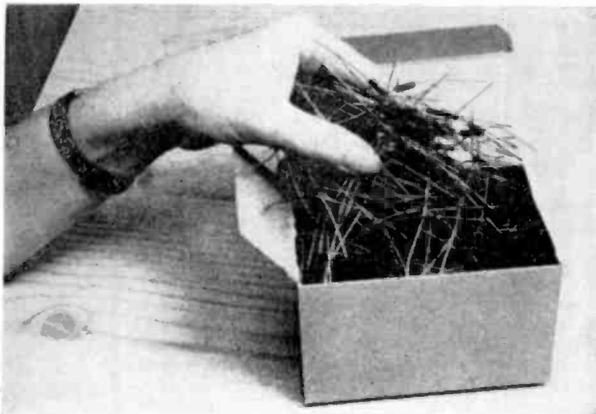
tions at stake and speciality houses dealing in bargain bags will nine times out of ten sell exactly what they advertise.

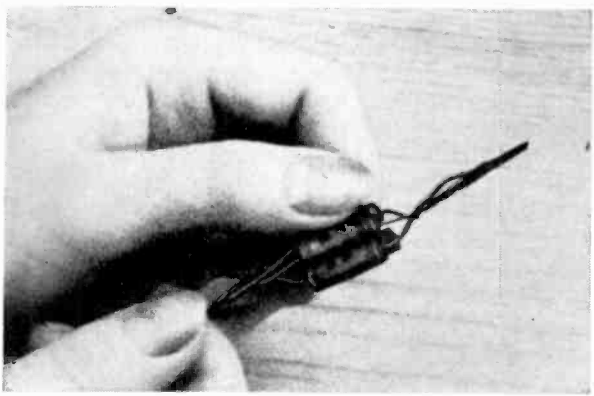
The same cannot be said for at least one-third of surplus or distress equipment mail-order houses, or most of the inhabitants of "radio row" stores in major metropolitan areas. The latter stores—specializing in a walk-in-off-the-street trade—offer very tempting bargains that are difficult to resist. But, resist them you should, even though the investment is almost always under $2. Often as not, you'll be glad you did.

Bargains, Bargains, Bargains? As examples of "radio row" transactions, here are two instances that occurred during our poly bag hunts in lower Manhattan. In one store a sign proclaimed drastic price reductions in resistor assortments from $1.98 to $1.49 to a new final "low-low" of 99¢—an irresistible bargain. A sealed box (poly bag inside) was purchased and from its weight appeared to be packed. It was—with 481 resistors of the same value!

A second store offered precision wire-wound and carbon-film resistors—30 for $1.29. The count was correct and we

This was our prize purchase. All 481 resistors are of the same value although the exterior wrapping of this assortment said it contained 100 different resistors.





In the politest terms, these four resistors can be called "floor sweepings." Twisting the leads together was done by a technician, eliminating the chance that the resistors would be new stock.

"BAD" ASSORTMENT

25 Mica Capacitors for 89¢

4	3.7 μμf.	2	68 μμf.
1	7.5 μμf.	1	680 μμf.
1	25 μμf.	1	800 μμf.
3	27 μμf.	2	900 μμf.
8	60 μμf.	2	1000 μμf.

Although far from obsolete, this assortment clearly established that mica capacitors are "on their way out." Capacitors from five different manufacturers were represented and all showed distinct signs of aging. Seven capacitors had pre-World War II color coding (nearly invisible) and two of the 27-μμf. capacitors were unmarked. This was a local (New York City) purchase.

"EXCELLENT" ASSORTMENT

50 Tubular Capacitors for 98¢

19	0.001 μf., 60 w.v.d.c.
6	0.0015 μf., 600 w.v.d.c.
1	0.0018 μf., 400 w.v.d.c.
6	0.002 μf., 150 w.v.d.c.
6	0.002 μf., 400 w.v.d.c.
1	0.0022 μf., 400 w.v.d.c.
1	0.0022 μf., 600 w.v.d.c.
4	0.0027 μf., 600 w.v.d.c.
1	0.003 μf., 400 w.v.d.c.
5	0.005 μf., 200 w.v.d.c.
1	0.007 μf., 600 w.v.d.c.
2	0.01 μf., 100 w.v.d.c.
1	0.01 μf., 600 w.v.d.c.
1	0.015 μf., 200 w.v.d.c.
2	0.1 μf., 200 w.v.d.c.
1	0.2 μf., 400 w.v.d.c.
1	0.5 μf., 600 w.v.d.c.

This mail-order assortment contained 59 capacitors instead of the advertised 50. All were in good shape, although obviously "over-runs" from TV set manufacturers. All were clearly imprinted, and all tested "good."

found values ranging from a low of 100 ohms to a high of 3.32 megohms. However, four of the 30 resistors were unmarked and if you can describe a more worthless electronic item than an unmarked "precision" resistor we'd like to hear about it.

Purchases via mail order from any of the five top distributors, plus one speciality mail-order house, were satisfactory. With few exceptions, the components were clean, well-marked, of fairly recent manufacture and of good quality. A sampling of capacitors indicated that only one out of a possible 50 would be leaky, shorted or open on being tested.

Some of the problems that *do* beset bargain capacitors, especially those purchased from doubtful sources, are old, obsolete or indistinguishable color codes and markings. Fortunately, these troubles do not usually affect resistors. Our sampling showed that only one out of every 90 resistors would either be open or have indiscernible markings.

On the other hand, precision resistors are *always* a poor buy in poly bag assortments. The offerings are generally overproduction runs of highly irregular values used in test equipment manufac-

"BAD" ASSORTMENT
50 Resistors for 99¢

2 0.33 ohm, ½ watt
3 3.3 ohm, ½ watt
1 15 ohm, ½ watt
2 180 ohm, ½ watt
2 390 ohm, 2 watt*
1 470 ohm, 3 watt*
1 560 ohm, 1 watt
1 680 ohm, 1 watt*
1 820 ohm, ¼ watt, 20%
2 910 ohm, ½ watt, 5%
1 2700 ohm, 1 watt
1 4700 ohm, 1 watt
1 4700 ohm, 4 watt*
3 4700 ohm, 2 watt
1 6800 ohm, ¼ watt, 20%
2 6800 ohm, ½ watt
1 6800 ohm, 1 watt
1 7500 ohm, 1 watt
1 8200 ohm, ½ watt
2 8200 ohm, 3 watt*
2 10,000 ohm, 1 watt
1 10,500 ohm, precision
1 18,000 ohm, 2 watt
1 68,000 ohm, 2 watt, 20%
1 75,000 ohm, ½ watt
2 44,000 ohm, 2 watt
2 330,000 ohm, 1 watt
1 750,000 ohm, 1 watt, 5%
1 1.2 meg., 1 watt
1 2.2 meg., 1 watt
2 20.0 meg., ½ watt

At first glance—while the resistors were still in the poly bag—this looked like a promising purchase. Unfortunately, the assortment was more of a hodge-podge containing all wattage values from ¼ to 4 watts. Particularly bad in this assortment was the absence of values in the range of 75,000 to 330,000 ohms. All resistors identified by the asterisk had no color code. This was a "radio row" purchase.

ture. Wattages are rarely indicated (perhaps on one unit out of ten) and you take a chance in using a precision resistor in any circuit that draws more than a watt. Also, the *need* for precision resistors in everyday electronic experimenting is unbelievably small.

What To Buy. There are several rules-of-thumb in buying poly bags. If you can see the bags be sure that component leads are uncut and have not been shortened for use in printed circuit wiring. In the case of resistors, check that the one-half-watters have either a silver or gold tolerance color-coding band. Also, ancient 2-watt resistors were much longer and thinner than present-day units—they are not a good buy.

Capacitors must be watched carefully, although the signs of age are more obvious (see photo) than with resistors. Ceramic disc capacitors should be checked for signs of poor dipping—the colored ceramic insulation does not cover all of the capacitor body. Units of this type are "seconds" and are not safe to use.

"EXCELLENT" ASSORTMENT
40 Disc Ceramic Capacitors for $1

2 12.0 μμf.
1 15.0 μμf.
1 18.0 μμf.
3 22 μμf.
3 27 μμf.
2 33 μμf.
1 39 μμf.
2 47 μμf.
1 56 μμf.
2 68 μμf.
1 82 μμf. (2 kv.)
3 100 μμf.
1 120 μμf.
7 470 μμf.
1 390 μμf. (1.5 kv.)
1 680 μμf.
4 1000 μμf.
2 0.005 μf.
6 0.01 μf.
3 0.02 μf. (1.6 kv.)
1 0.05 μf. (25 v.)
1 0.047 μf. (50 v.)

Even though this assortment contained a few "seconds" there was a surplus of nine extra capacitors—plus an unusual 27/27 μμf. duo-ceramic not listed above. The distribution of values was remarkable in this poly bag—note the volume of most-used values (470 and 1000 μμf.).

In the great welter of assortments, special "buys," and "good deals," the average buyer of poly bags has reason to be hopelessly confused when it comes to determining just what he's getting for his money. In early December, as this article was written, the following average prices (cents-per-unit) were computed from our survey.

Resistors:

Top-grade ½-watt	.03
Second grade ½-watt	.015
1- and 2-watt	.035
3-watt, or higher (carbon)	.05
3-watt, or higher (w.w.)	.08
Precision	.07

Capacitors:

Ceramic discs	.03
Ceramic tubulars	.02
Top-grade mica	.03
Second grade mica	.02
Paper or molded	.035

The experimenter will find that an $8-$10 investment in poly bag resistor and capacitor assortments will be money well spent. We suggest that the following components be purchased as a start: two good ½-watt resistor assortments, one good 1-watt resistor assortment, one ceramic disc assortment, and two bags of mica or molded capacitors. Unless you need them for some specific purpose, defer buying precision resistors or electrolytic capacitors until a later date. However, if you expect to try out transistor circuits, a good assortment of high-capacitance, low-voltage electrolytics can be added to the above list. —30—

Here's the first in a series of construction articles planned to test your "Ingenuity Quotient." Study it carefully, develop an improved model, and tell us how and why your version is better.

LIGHT-CONTROLLED POWER SUPPLY

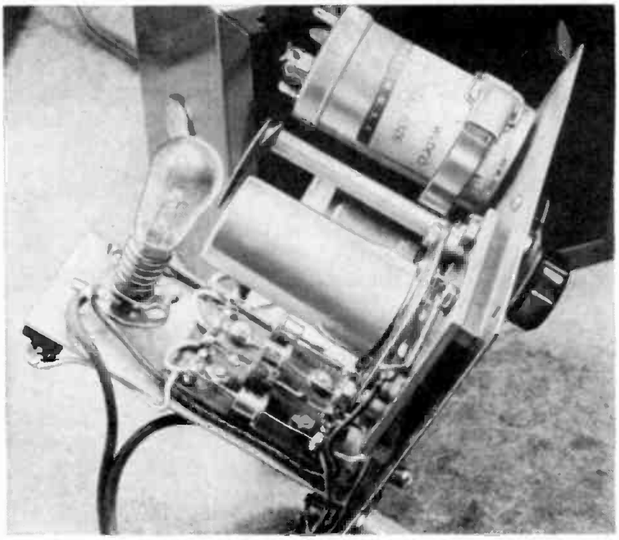
A BENCH POWER SUPPLY providing up to 500 ma. at a potential adjustable from 0 to 25 volts d.c. is a handy thing to have around if you experiment with transistors. Here is one that provides stepless control of the output voltage, without use of a costly variable transformer, or a big, heat-producing power rheostat. It's no bigger than a desk phone, can be built in a couple of evenings for under $13.00 and, though very useful as is, can be readily modified and improved upon by circuit-wise experimenters.

About the Circuit. The basic circuit is a conventional full-wave bridge rectifier made up of diodes *D1*, *D2*, *D3*, and *D4*. Power to the bridge at 25 volts a.c. is supplied from the secondary of transformer *T1* through fuse *F1*, which is included to protect the supply from damage by overloads.

The unique feature of the supply is the means for controlling the output voltage. This consists of photocell *PC1* in series with the primary winding of *T1*, lamp *I1* (which illuminates the photocell), and a metal vane controlled mechanically by means of a panel knob with a calibrated dial. The vane acts as a shutter to control the amount of light reaching the photocell. The resistance of the photocell is high when it is not illuminated, and decreases as the light reaching it increases, becoming less than 20 ohms under strong light flux.

Lamp *I1* is a 115-volt type, connected directly across the a.c. supply line. It

Position of lamp on support bracket must line up with light shield and photocell. Note location of diode terminal board, and mounting of heat sink. Insulate capacitor C1 can from support clamp with tape wrap if negative lead is to be off ground. Vane shaft is aluminum.



YOUR "INGENUITY QUOTIENT" CAN PAY OFF

As a POPULAR ELECTRONICS reader, you demonstrate a more-than-average interest in technical knowledge and progress. And if mail is any indication, you and other readers have more than the average share of inventiveness and electronic know-how.

With this article, P.E. is launching a series designed to give all readers a chance to test their technical prowess against some typical product improvement problems, with recognition and reward for the better solutions, as judged by the editorial staff.

Here's the deal. Each article in the series will describe a useful electronic device that works after a fashion, but not as well as we think it could. It may be too touchy and critical in adjustment, too costly for the job it does, or not usable for as many jobs as the basic idea suggests it might be. Whatever its defects in your eyes, your task is to study the design, note its shortcomings, and redesign it to do its job better or cheaper, or both, or to serve added purposes not covered in the original design.

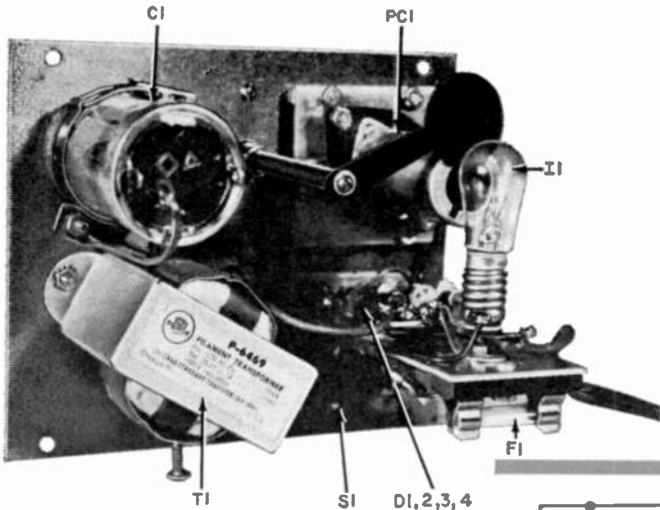
Give your Ingenuity Quotient free rein, and when you've got your improved model working, draw a schematic, make a photograph or drawing, and write us about 250 or 300 words describing it. Tell what it does better, how it does it, and what parts you changed or added (if any), and why. Be sure to use parts available from regular mail-order distributors (no gold-plated "frammisses" from $10,000 war-surplus "turbo-encabulators"), tell us where you got them, and what they cost.

You'll be paid at our regular editorial rates, your article will be published, and you'll receive full credit for your accomplishment. Okay, men, crank up those soldering irons. Let's go!

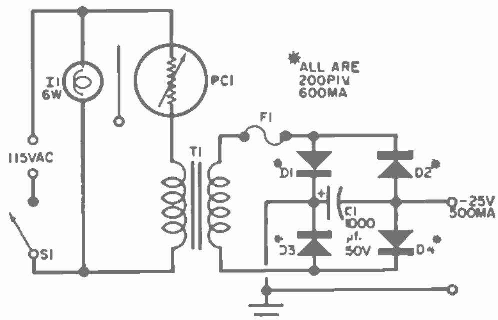
therefore burns at full brightness whenever *S1* is closed. The photocell is enclosed in a light shield consisting of an open-top tube shield, which minimizes the amount of stray light that can reach the cell. When the shutter vane is turned to completely cover the opening in the light shield, the photocell resistance is high, and the output voltage is minimum. As the vane is swung aside, allowing an increasing amount of light to reach the cell, the output voltage rises, reaching maximum when the cell is fully illuminated.

Photocell Facts. The heart of this controllable power supply circuit is the photocell, which is a recently developed unit of the photoconductive type. The resistance of this type of cell is high in darkness, and decreases as the light striking the sensitive element is increased. The essential feature of this cell, designated the LDR-25 by the maker, is that it can handle a considerable amount of power as compared to most other available photocells. Also, it sells at a modest $1.50.

Mounted on an adequate heat sink, the LDR-25 can handle up to 500 ma., and it is rated at 25 watts total dissipation. Up to 200 volts a.c. or d.c. may be applied across the cell, as long as the current and dissipation ratings are not exceeded. It is the relatively high power-handling capability of the LDR-25 that makes it applicable to this circuit, and



Mount all parts far enough in from panel edge to clear lip of box during assembly. Shutter vane is shown clear of shield hole for maximum light on cell.



Vertical line between lamp and photocell in schematic diagram represents shutter vane. Circuit is shown with plus side of output grounded, but may be left floating if both output terminals are insulated from box.

PARTS LIST

C1—1000-µf., 50-volt electrolytic capacitor
D1, D2, D3, D4—600-ma., 200-PIV silicon diode
F1—1-ampere glass fuse
I1—115-volt, 6-watt, screw base lamp
PC1—Photocell (Delco LDR-25)
S1—S.p.s.t. toggle switch
T1—Power transformer: primary 115 volts; secondary 25 volts, 1 ampere (Stancor P-6469 or equivalent)
1—6" x 5" x 4" metal box (Bud CU-729 or equivalent)
1—Miniature vernier dial and knob assembly, (Lafayette F-348 or equivalent)
1—9-pin tube socket and shield
2—Binding posts (if used)
Misc.—Line cord, lamp socket, fuse holder, terminal board, scrap aluminum, hardware, hookup wire, etc.

that suggests many other uses which we hope our ingenious readers will explore.

Construction. This prototype unit was built in a 4" x 5" x 6" metal box having removable front and back panels. All parts are mounted on the front panel as shown, making it easy to assemble and wire the unit. The rectifier diodes are mounted on a small piece of terminal board, which is supported by a bracket made from a scrap of aluminum. This bracket also supports the lamp base and the fuse holder for *F1*.

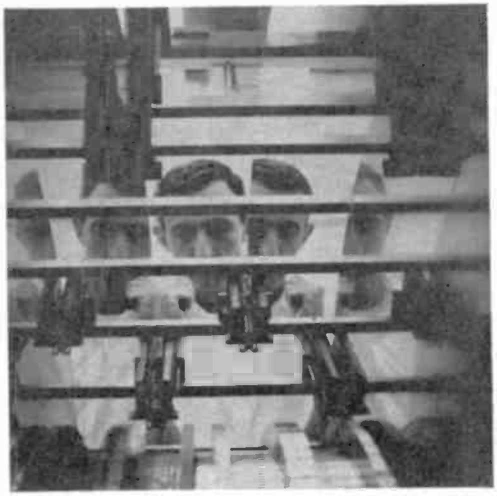
The photocell is mounted in firm contact with a piece of 3/32"-thick aluminum, 2" square, which serves as a heat sink. The heat sink is fastened to the front panel with four screws, but is held away from the panel enough to clear the inside end of the dial mounting screw, by means of two strips of aluminum that serve as spacers.

The positioning of the lamp, photocell and dial shaft must be done so as to put the lamp filament directly over the opening of the cell's light shield, and allow the vane to swing clear of the light shield opening. Other parts may be mounted as convenient, since their placement is not critical.

The light shield for the photocell was made from a 9-pin tube base and shield assembly by removing the tube base from the shield mounting ring, and the spring from inside the shield. The

(*Continued on page* 106)

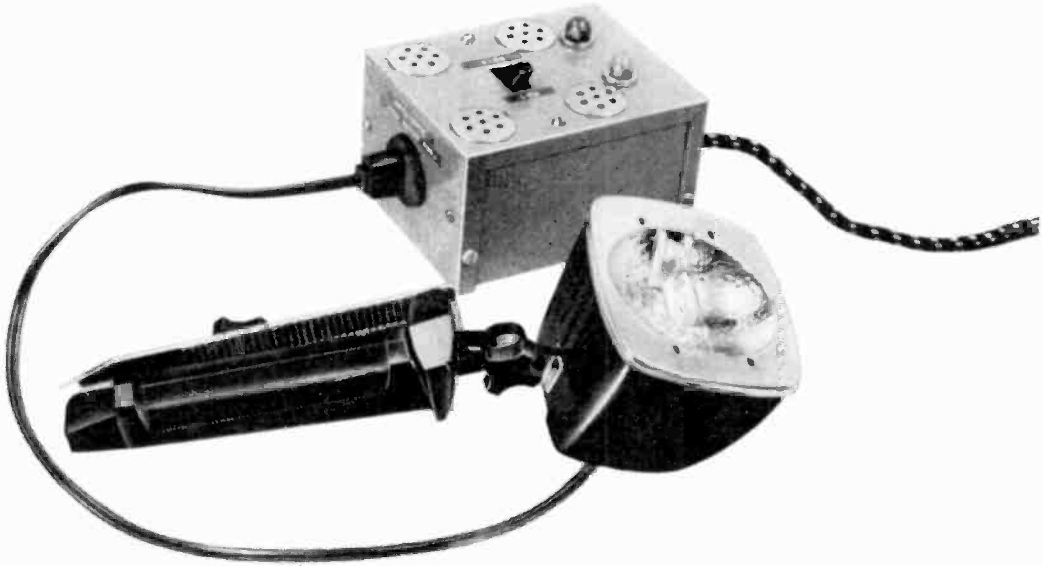
NEW GI RADIO—Two units weighing just 1½ lb. total will replace the Army's 7-lb. "Handie-Talkie." Helmet-mounted receiver has 13 transistors, 7 diodes; hand-held transmitter 12 transistors. Miniature dry batteries are used.

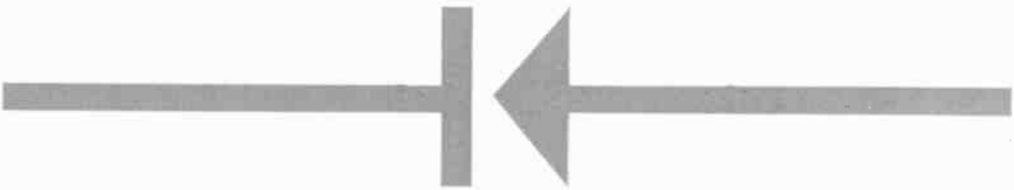


MEMORY DISCS—The five technicians in the photo are one: his image is reflected from two 47" shiny, magnetic cobalt-covered computer memory discs recently developed by General Precision. Each stores 51 million bits of data.

RADAR GUARDS MOTORISTS—Radar antenna, left, looks out over the world's longest causeway spanning 24-mile-wide Lake Pontchartrain near New Orleans. To safeguard motorists who "go to sea" in foggy weather, Raytheon radar keeps an electronic lookout for loose, drifting barges or disabled vessels.

CORONA SPOTTER—This Little League Eliot Ness is aiming a corona detector—not a gun—developed by Westinghouse. Corona from high-voltage lines, which wastes electricity and develops radio interference, may be spotted 75 feet away by aiming through the telescopic sight. Trigger turns on circuitry which makes corona static audible in speaker.





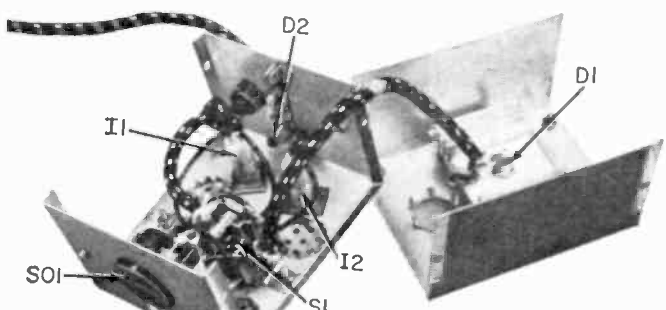
HIGH WATTAGE REDUCER

Use low-cost, high-amperage silicon diodes for easy power control

THIS HANDY PROJECT is a by-product of our space age. Without the impetus to develop high-amperage, solid-state rectifiers necessary for the space program, electronics experimenters would not have been able to buy "over-runs," surplus or seconds. As it is, silicon diode rectifiers with 20-ampere ratings are being offered for about $3. The multiple household uses for these devices have never been fully explored, so here are a few ideas on how to use them—you'll probably find many more.

As shown above, you can extend the life of your home movie high-intensity lighting equipment. You can halve the output of a 1000-1200 watt electric heater (as long as it does not incorporate a motorized fan), giving you controlled warmth and "reserve" heating power. The same applies to a soldering iron (no guns), or perhaps your electric cooker (again, no motor). You'll find the "Reducer" inexpensive and easy to build. Best of all, the unit itself consumes no power—it simply saves it.

Construction is simple, requiring only that the heat sink be well insulated from the aluminum box. The author used surplus ceramic bushings about ¾" high, threaded on both ends. A 20-amp diode will run hot



Mount parts as indicated here; D2 is wired to insulated tie strip.

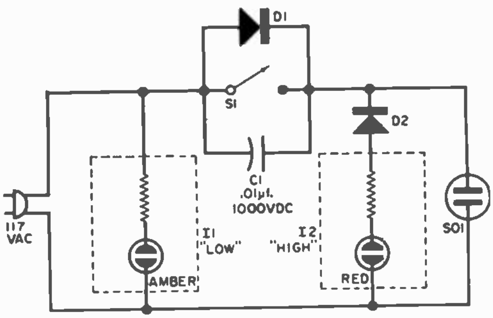
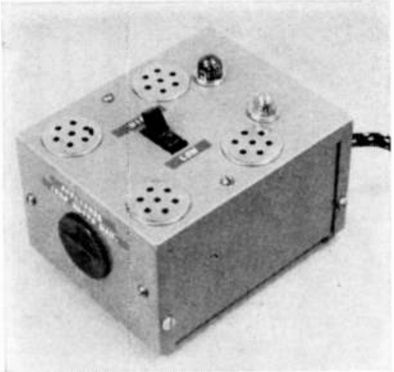


Diagram shows simplicity of High Wattage Reducer.



In addition to mounting D1 on heat sink, ventilation holes should be provided to dissipate heat generated in operation.

PARTS LIST

C1—0.01-µf., 1000-volt ceramic disc capacitor
D1—20-ampere, 400 PIV silicon diode, stud mounting
D2—50-ma., 200 PIV silicon diode
I1—Neon lamp assembly with built-in resistor, amber color lens
I2—Neon lamp assembly with built-in resistor, red color lens
S1—S.p.s.t. switch, heavy-duty (15-ampere minimum rating)
SO1—Chassis-mount a.c. socket
1—3" x 4" x 5" Minibox
1—Heat sink (Carl Cordover HSR-4 or equivalent)
Misc.—Four threaded ceramic bushings to hold heat sink, heavy-duty a.c. cord, terminal strip, wire, solder, hardware

in series with appliances that have a rated power drain of 1400-1500 watts, so the heat sink is a must—it also makes a convenient mount for the diode.

Holes for ventilation should be punched in the aluminum box as in the photos. Two neon lamps (optional) were incorporated in the circuit to show operation. When switch *S1* is open, *D1* and *D2* are back-to-back, and *I2* will go out. When switch *S1* is closed, both neons go on and the silicon diode is switched out of the "Reducer" circuit.

—Frank A. Parker

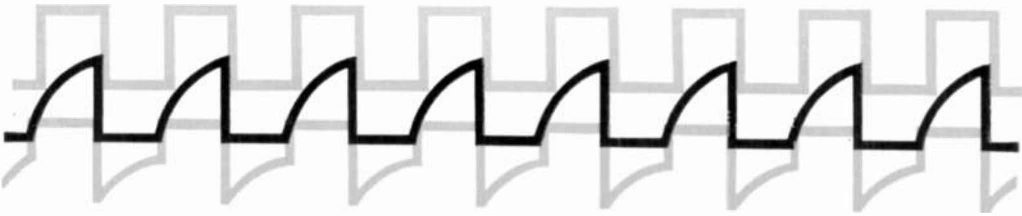
CB Dummy Load

CITIZENS BAND regulations prohibit the practice of tuning up your transmitter while putting a "dead" carrier on the air. The commonly-used light bulb dummy antenna prevents this, but it changes resistance with brightness.

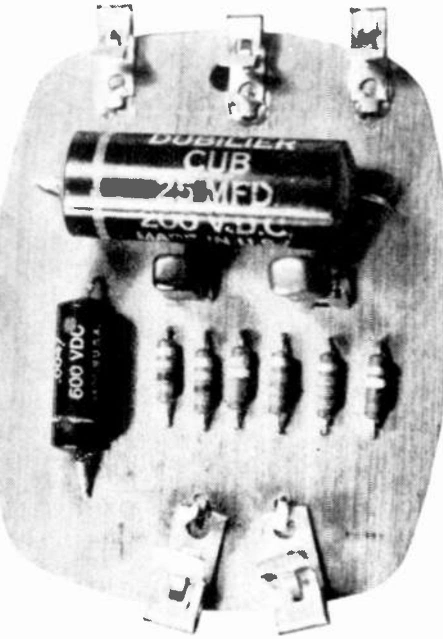
The dummy load shown at right is easily made by soldering a bus bar to the center post of a coax connector and two resistors between the bus bar and the shell. If your CB transmitter uses 52-ohm coax line, make the load of two 100-ohm, 2- or 3-watt resistors. For 72-ohm line, use two 150-ohm, 2- or 3-watt resistors. Be sure that the resistors are carbon and not wire-wound. Wire-wound units will introduce inductance and upset readings.

Tune up with the dummy load using the internal metering in your CB unit or the r.f. probe of a VTVM clipped across the load. A reading of 13-13½ volts corresponds to 3.5 watts output with 52-ohm line.

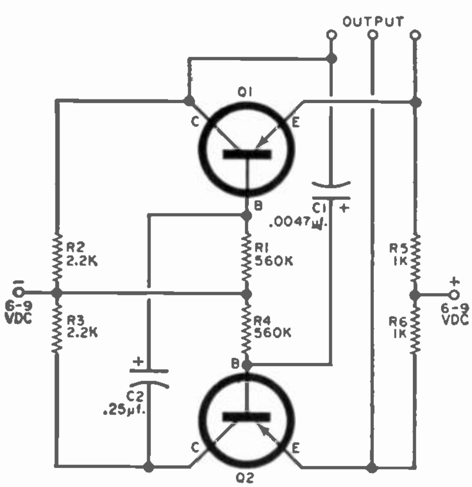
—Alex F. Burr, 16W2941



Four-Way Oscillator



Almost nothing is critical about this one—parts values may be varied to give different frequencies and waveforms. CK722's were used for Q1 and Q2.



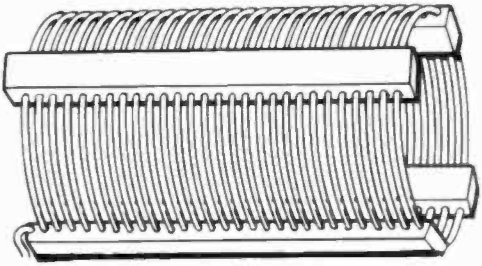
IF YOU'D like to try your hand at a very intriguing, easy to build, inexpensive transistor project, the "Four-Way Oscillator" is for you. As indicated in the drawings above, it generates square waves (comparable in quality to those produced by a commercial audio square-wave generator), and at least several other waveforms of different frequencies, shapes and strengths. The unit can also serve as a CPO, a grid dipper modulator, or as a go—no-go transistor tester.

A quick look at the schematic tells the story—the Four-Way Oscillator is actually a simplified free-running multivibrator, unusual in that only ten components are required. With the parts values shown, square-wave output of about 800 cps can be taken from the first two terminals at the top. Varying the value of *C1* will change the output frequency. Taking the output from different combinations of terminals will give different waveforms and different frequencies. Actually, output can be taken from almost any point in the circuit—it's fascinating to experiment while watching a 'scope or while monitoring the signals with a pair of headphones.

The Four-Way Oscillator makes an excellent tester for small-signal *pnp* transistors. Defective units—including those with excessive leakage—will simply not work when used to replace either *Q1* or *Q2*—CK722's in the author's unit. Power supply voltage is not critical, but better square-wave linearity was obtained with 9 volts than with 6. The value of *C2* can be made considerably smaller without affecting the circuit; changing resistor values will change the waveforms obtainable.

To keep the cost down, the author's unit was built on a small chip of Formica (kitchen cabinet dealers use them for samples, and they should be available for the asking) measuring 2¼" x 3". Holes were drilled to accommodate component leads, transistor sockets, and Fahnestock clips for battery leads and output terminals.

The oscillator makes a handy addition to any test bench. —*L. E. Byfield, K9ADD*



R.F. Coil

No more hit-or-miss coil

WHILE there's nothing wrong with the time-honored cut-and-try technique of winding coils for a receiver or transmitter, you can save yourself a lot of time and trouble by building this simple "R.F. Coil Frequency-Finder" for use with an external signal source such as an r.f. signal generator, a VFO, or a grid dipper.

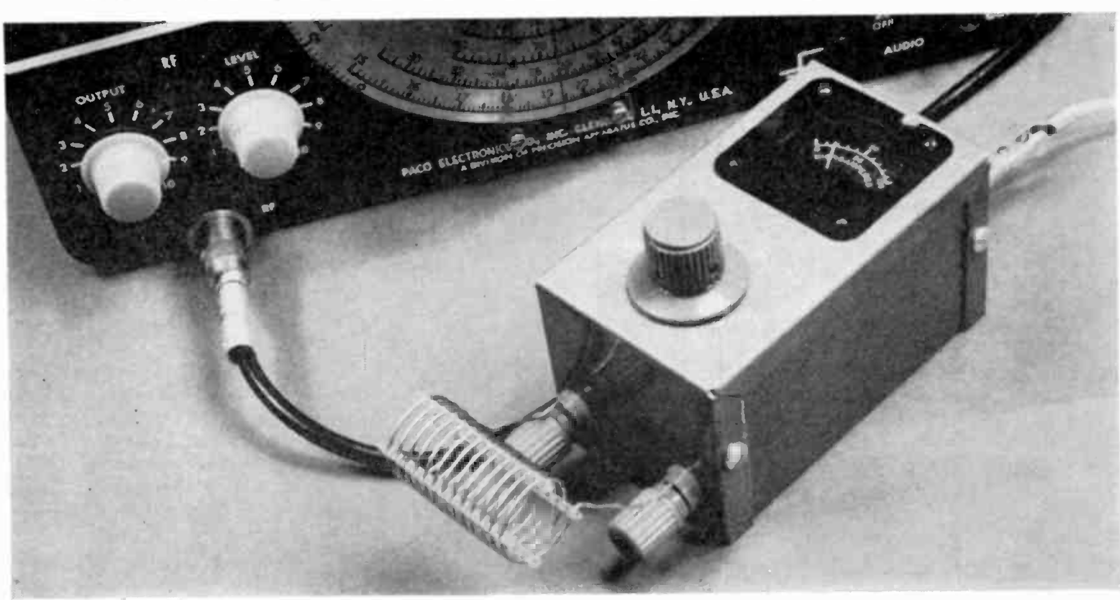
The design of the unit is straightforward. The unknown coil is connected in parallel with *C2*, a midget 140-μμf. variable capacitor, through *J2* and *J3*. The only power required is the r.f. furnished by the signal source through *J1-C1*. When the coil and *C2* resonate with the external r.f. source, energy is absorbed by the circuit and rectified by *D1*, giving a reading on the 50- or 100-μa. meter, *M1*.

Construction. Cut a hole for *M1* near one end of the 2¼" x 2¼" x 4" Minibox. Drill a hole to mount *C2* close to the other end of the box. Locate holes for the coil jacks, *J2* and *J3*, in the end of the box near *C2*. Terminal *J1* is mounted at the opposite end near the meter. Both *J1* and *J2* must be insulated from the metal box. Wiring is done point-to-point, keeping leads as short as possible; use a heat sink when soldering *D1*.

Although a 100-μa. meter was used in the author's model, a 50-μa. movement will give better sensitivity (although possibly at greater cost). In any case, a miniature meter of the relatively inexpensive imported variety should prove perfectly satisfactory.

Install a knob with a pointer on *C2*'s shaft, and calibrate *C2*, marking the minimum point (*C2* fully open) 10 μμf. and the maximum point 150 μμf. (*C2* fully closed). From these two points, estimate the 75 and 100 μμf. points

External r.f. source—signal generator or VFO—is the only power required to operate the unit.



Frequency-Finder

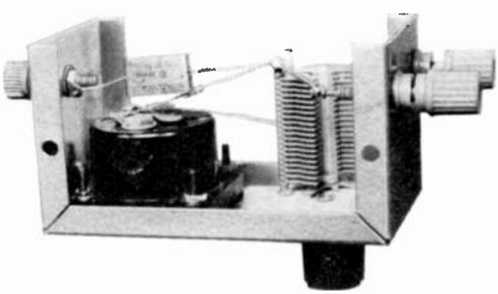
winding—all it takes is a meter, a few parts, and r.f. source

By LEON A. WORTMAN

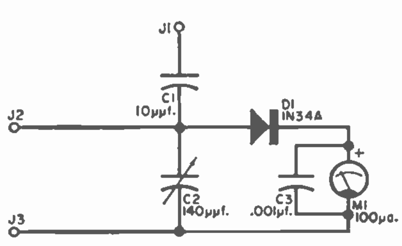
and mark them on the panel. Decals, if available, will make a professional-looking scale. The markings (slightly greater than *C2*'s maximum and minimum capacities to compensate for the unit's internal capacity) will be only roughly accurate, but quite adequate in this application.

Operation. To use the Frequency-Finder with an r.f. generator, simply connect the center conductor of the output cable to *J1*, leaving the shield unconnected. Connect the unknown coil to *J2-J3*, keeping leads as short as possible. If the coil is to be used with a capacitor of any type, set *C2* to that value; otherwise, at minimum.

Sweep across the desired frequency range with the r.f. signal generator until you find the resonant point indicated by a maximum reading on *M1*. The resonant frequency of the coil and *C2* can then be read directly on the dial of the r.f. generator. Keep the output low, consistent with a readable indication on *M1*. A VFO can be used in the same manner. If the r.f. source is poorly calibrated, you can double-check by tuning its signal in on an accurate receiver.



Frequency-Finder is mounted in small Minibox; all wiring is done point-to-point to keep leads short.



To use the Frequency-Finder with a grid-dip oscillator, plug the appropriate coil into the dipper, set it in the oscillating mode, and bring it to within a few inches of the unknown coil. Adjust the tuning dial of the grid dipper for peak indication on *M1*. Read the resonant frequency from the dial of the grid dipper, ignoring, for this test, the dipper's own meter and sensitivity control.

Other Uses. Another method of using the Frequency-Finder is to set the r.f. source at a predetermined frequency, and adjust *C2* to determine how much capacitance is required to make the unknown coil resonate.

The value of a small capacitor can be estimated with the unit. Connect a coil to *J2-J3*, set *C2* at 150 µµf., and tune the r.f. source for maximum indication. Connect the unknown capacitor in parallel with the coil at *J2-J3*, and reset *C2* for maximum indication. The value of the unknown capacitor is approximately equal to the maximum value of *C2* (150 µµf.) minus the new setting of *C2* that restores *M1* to maximum reading.

Coils are easy to add to, or subtract from, if you use the Frequency-Finder first—try it. -30-

PARTS LIST

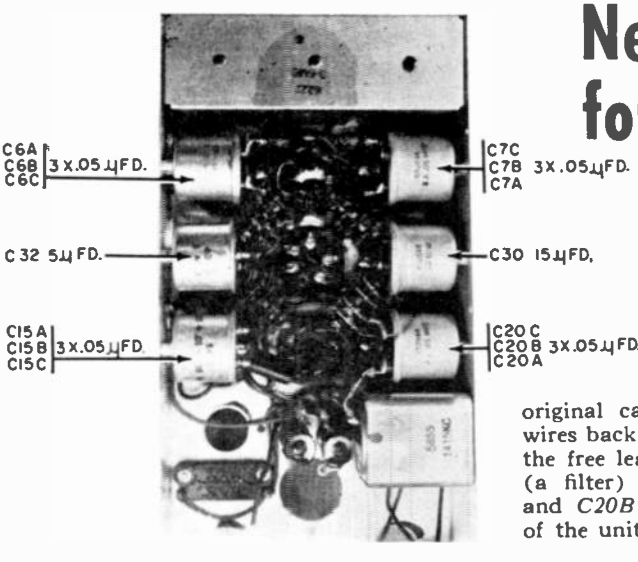
C1—10 µµf. mica or ceramic capacitor
C2—140 µµf. midget variable capacitor
C3—.001 µfd. ceramic disc capacitor
D1—1N34A diode or equivalent
J1, J2, J3—Insulated binding posts or jacks
M1—50 or 100 µa. d.c. microammeter
1—2¼" x 2¼" x 4" aluminum box
1—Knob with pointer

Build-It-Yourself TV Camera Kit

ONE OF THE HITS of a recent London trade show was this transistorized TV camera kit that sells (in England) for just $200 complete with lens and vidicon tube.

Called the "Beukit," the camera is made by Beulah Electronics, a London firm, and is designed to work with any TV set through a connection to the antenna terminals. Incorporating 13 transistors and 6 diodes, the unit is said to provide a resolution of about 2.5 megacycles—adequate for closed-circuit and experimental work. Most of the wiring is done on a printed circuit board, and non-critical circuitry is employed to obviate the need for test equipment to adjust the unit.

To keep cost down, the firm has introduced a low-cost lens with fixed iris and wide focus range. Changes in lighting are compensated by adjusting camera target or beam controls. The vidicon is an "experimenter's" type, but provides good-quality pictures as the photo at the left shows. The camera will be distributed in the United States by Olson Electronics, 260 S. Forge St., Akron, Ohio. -30-



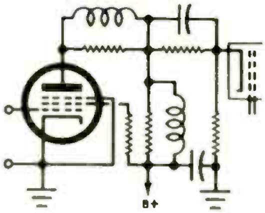
New Capacitors for the ARC-5

IF YOU own a weary Command receiver with electrically or physically leaky bypass capacitors, you can easily restore it with ten .02 μf., 600-volt ceramic discs (they work as well as the old .05 μf. units and are readily available) and a midget 15 μf., 30-volt electrolytic. Clip original capacitor leads one by one, trace wires back, and install new units, grounding the free lead to the nearest ground lug. *C32* (a filter) can be discarded; *C15B*, *C15C*, and *C20B* are not used in some versions of the unit. —*E. H. Marriner*

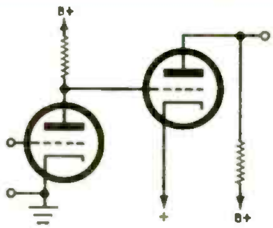
AMPLIFIER QUIZ PART I

By ROBERT P. BALIN

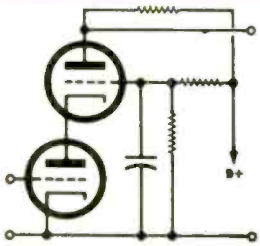
Over the years many types of vacuum tube amplifiers have been devised for specific uses. Here are six that range from easy to tough in difficulty of recognition. Try your hand at matching up the circuits (A-F) shown with the names (1-6) commonly given them in electronics handbooks. Even old-timers may have trouble recognizing all six without guesswork. Next month Part II will offer six transistor circuits to tax your memory.



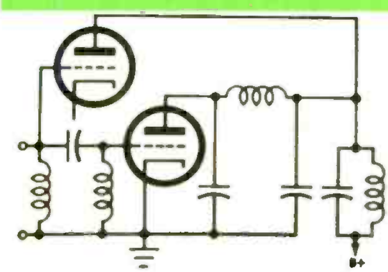
A



B



C



D

1 Cascode amplifier ____

2 Cathode follower amplifier ____

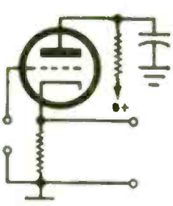
3 Direct current amplifier ____

4 Video amplifier ____

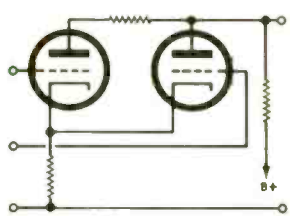
5 Differential amplifier ____

6 Doherty amplifier ____

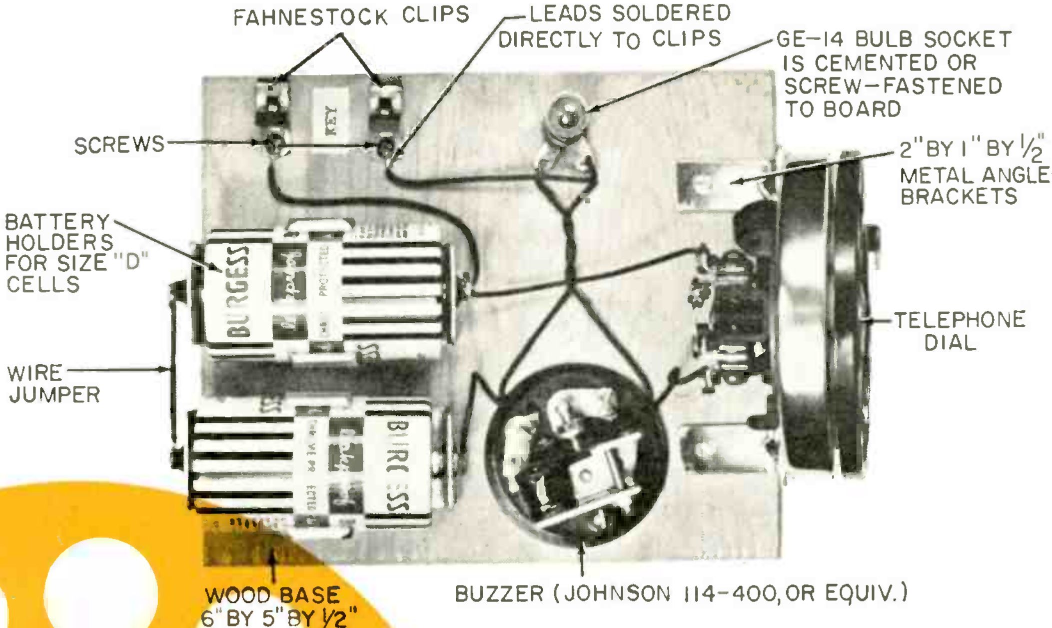
(*Answers on page* 94)



E



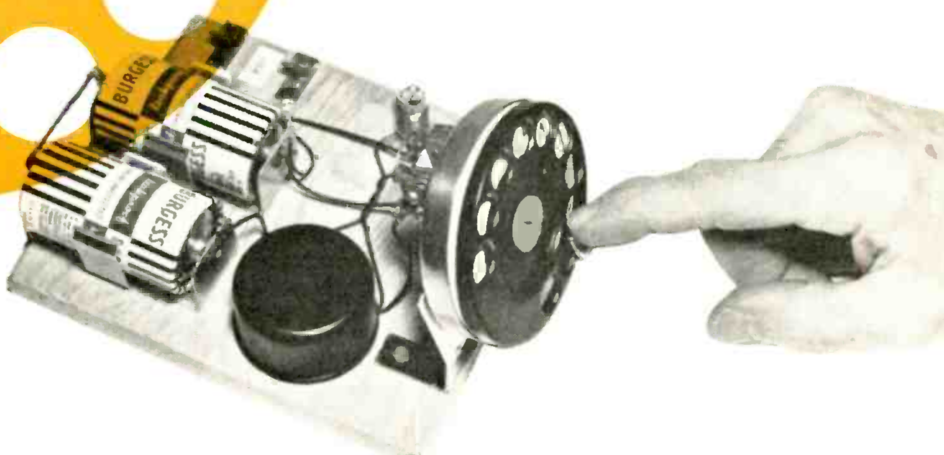
F

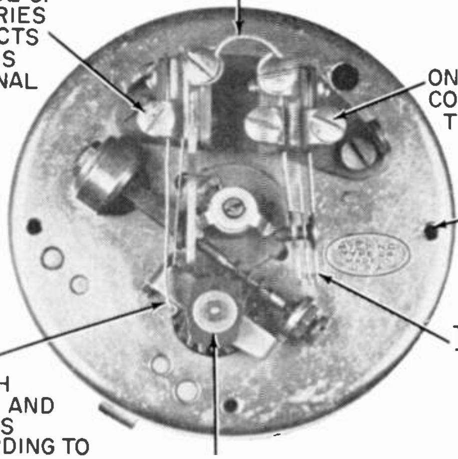


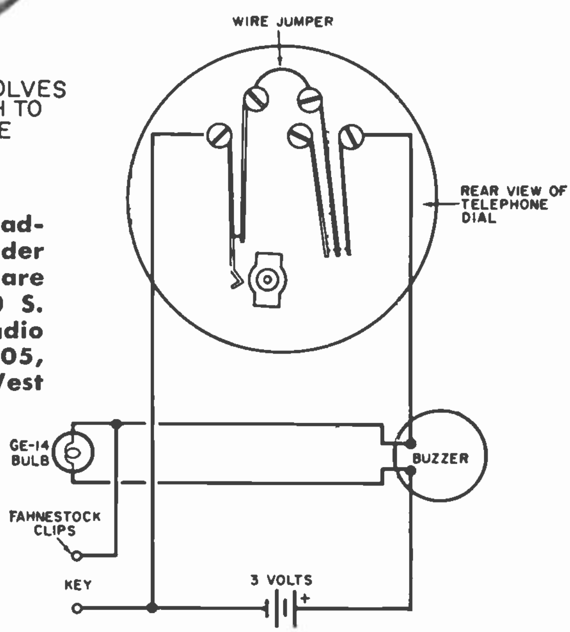
DIAL, BUZZ and BLINK

HERE'S a project that accomplishes two objectives: It demonstrates how a dial telephone mechanism operates and makes a wonderful plaything for the kids. There's no tricky wiring involved, and you can probably throw it together in an hour.

The illustrations show how the dial mechanism, flashlight batteries, buzzer, flashlight bulb, and a couple of Fahnestock clips are connected. If you want to, you can put a telegraph key in the circuit to make a code practice setup.

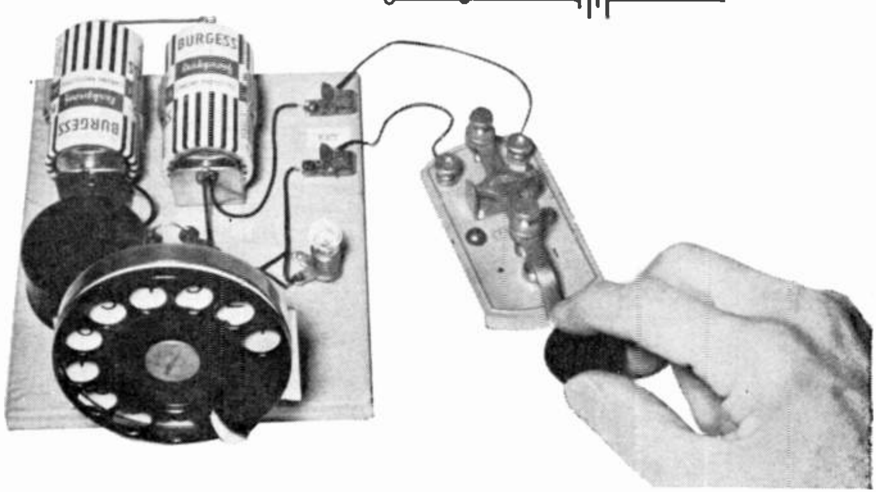


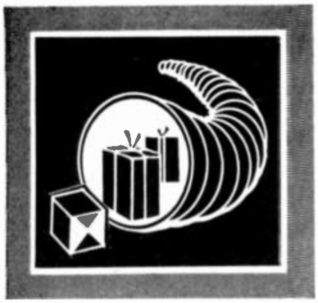




Dial mechanisms are currently advertised by the following mail-order houses. At this writing, they are listed by: Olson Electronics, 260 S. Forge St., Akron, Ohio; Fair Radio Sales, 2133 Elida Rd., Box 1105, Lima, Ohio; Surplus Center, 900 West O St., Lincoln, Nebr.; and MDC Industries, 923 W. Schiller St., Philadelphia 40, Pa. Prices range from $1 to $2.15, depending upon the condition of the mechanism.

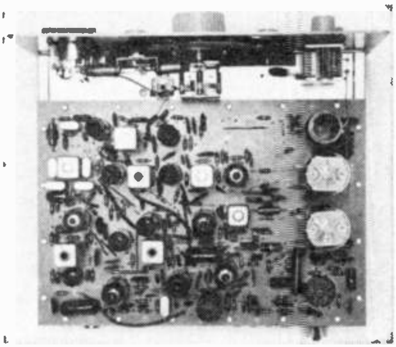
—Art Trauffer



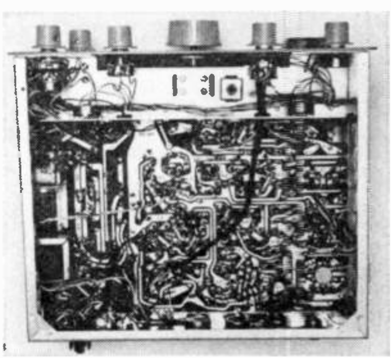


Product Reviews

HEATHKIT HW-22 40-METER SSB TRANSCEIVER



Reader Service No. 84—see page 15

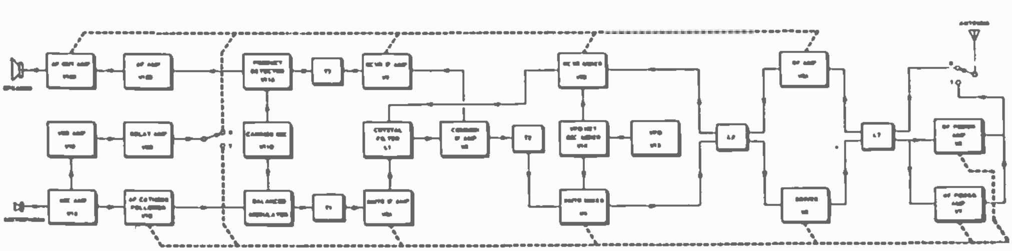


IF YOU WANT to go to sideband transceiver operation without straining the budget, there's now a way to do it: Heath Company's line of $119 (less power supply) single-band, 200-watt PEP sideband transceiver kits. These 12-pound, go-anywhere lightweights—ideal for mobile or portable use—pack a large amount of communications capability into a small package, as the Editors of POPULAR ELECTRONICS discovered during construction and testing of the 40-meter unit, the HW-22.

Designed purely for SSB (lower sideband), the HW-22 covers 7.2 to 7.3 mc. Front panel features include selectable PTT, VOX, or tune operation; r.f. and a.f. gain, VOX sensitivity, final tune, and large VFO (tuning) knob. Other controls include S-meter adjust, VOX delay, mike gain, tune level, and final bias. The S-meter reads relative output on transmit, and final cathode current with a switch.

Fourteen tubes are used in the crystal-filter rig, plus a four-diode balanced modulator. Common to both receiver and transmitter (see diagram) are the VFO—keeping receiver and transmitter locked on the same frequency—i.f. amplifier V3, crystal filter, carrier oscillator V11B, and a number of passive components. Two 6GE5's driven by a 12BY7 are at the business end of the transmitter; a 6EA8 serves as the receiver r.f. amplifier/mixer, followed by two i.f. stages, product detector and audio output. Receiver sensitivity is rated at 1 μa. for a 15 db signal plus noise-to-noise ratio; selectivity 2.7 kc. at 6 db.

Construction and adjustment of the HW-22 is easy. All parts (except outboard controls) are mounted on the large printed circuit board (see photos). A dummy load and VTVM are sufficient to align the unit. Voice intelligibility and carrier and unwanted sideband suppression are excellent. Universally good reports were received on the air. -30-



Rx for the Amateur/SWL

Prescription for the reception problems that plague both the ham and the SWL? Much of it lies in receiver design

DESPITE the thousands of advanced SWL's and hams whose interest in radio does not stop at the edges of the ham bands, ham-band-only receivers have gained much ground in recent years. The reasons are easy to understand: Crowded band conditions and the growth of single sideband (SSB) put a larger premium on selectivity, stability, and ease of tuning. These qualities are a lot easier to achieve over the limited ham bands than they are over the entire short-wave spectrum.

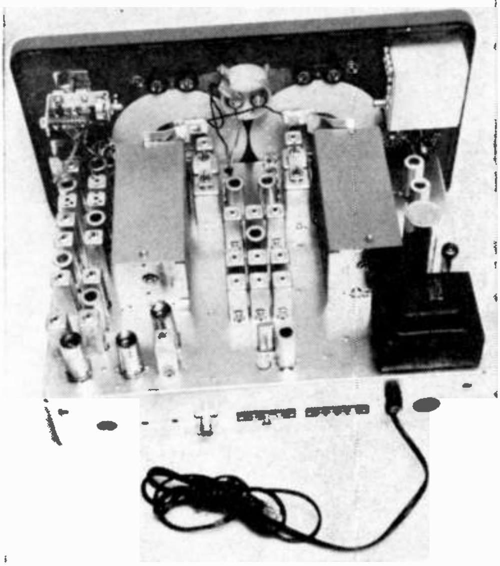
Nevertheless, among the general coverage receivers now available, there are a few that extend most of the advantages of the limited-coverage specialized amateur receiver to the amateur/SWL. The Hammarlund HQ-180AX is one of them.

The trend in popular ham-band-only receivers has been toward dual or triple conversion, with separate first oscillator crystals used for each band covered; tuning, over a limited i.f. range, is done in the second mixer oscillator.

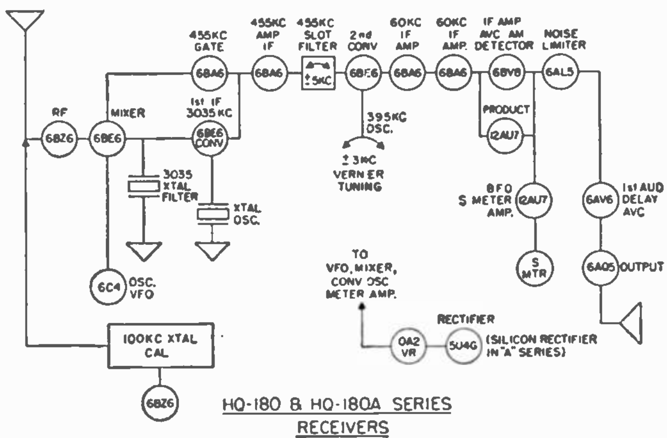
The HQ-180AX, like most general-coverage receivers, has a tunable, wide-range first mixer oscillator following a r.f. stage that is "peaked" from the front panel. A unique feature in the "A" versions of the HQ-180 is a separate filament transformer that keeps the filaments of the first oscillator and mixer tubes heated as long as the receiver is plugged into an a.c. socket. The effect of this—together with the rugged construction, voltage regulation and temperature-compensated circuitry—is a receiver with crystal-like stability free from significant warm-up drift.

Molding the Passband. One of the interesting assets of this receiver is the extent to which the operator can tailor the passband (selectivity) of the receiver to different modes of transmission and to band conditions.

Frequency coverage of the HQ-180AX



Rugged, heavy construction, characteristic of Hammarlund designs, is evident above, as is the complete shielding and "openness" of chassis. The cabinet wraparound is made of perforated stock for better heat dissipation. The HQ-180AX performs as expected under the "drop test"—jarring does not change the frequency.



The basic circuitry of the receiver is evident from the block diagram at right; 17 tubes are used in the triple-conversion unit. In late "A" and "AX" models, the rectifier tube has been replaced by two semiconductors.

is from 540 kc. to 30 mc. with double conversion to 7.85 mc., and triple conversion from 7.85 to 30 mc. As shown in the block diagram on this page, a crystal filter is permanently installed at the first i.f. Following is a crystal-controlled converter (or i.f. "gate" on the lower bands where dual conversion is utilized), a highly effective slot filter in the 455-kc. i.f. section, and a final converter that heterodynes signals down to 60 kc., the frequency at which detection takes place.

In the 60-kc. section are a vernier tuning control that varies the frequency of the last converter over a 6-kc. range, a sideband selector switch (upper, lower, or both), and a four-position selectivity control that permits the receiver bandwidth to be varied from .5 to 3 kc. on either sideband, or from .5 to 6 kc. on both sidebands.

The effect of these controls plus the slot filter is to allow the receiver passband to be precisely adjusted to eliminate heterodynes, splatter, and QRN, and to greatly simplify SSB tuning. With the selectivity control, the passband can be easily narrowed to the point where the intelligibility of the received signal is best and interference least—.5 or 1 kc. for c.w., 2 or 3 kc. for phone. An interfering signal within this passband or close to its edges can be removed with the slot filter which, in effect, is a "hole" which moves across the passband as the slot is adjusted.

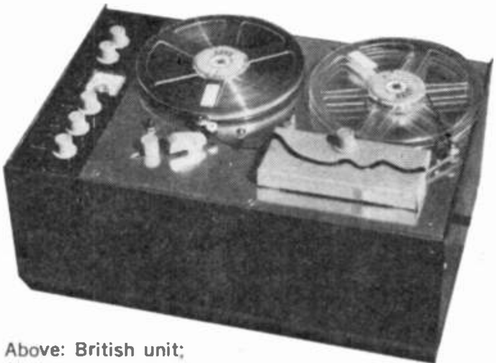
Speaking of heterodynes, the HQ-180AX's excellent selectivity curve does a good job of picking off one sideband of a regular AM signal in a manner akin to a "signal splitter." If you find that there's a station practically on top of the one you're after, you simply move over to the side of the carrier opposite the interfering station by flipping the sideband selector switch and slightly retouching the tuning.

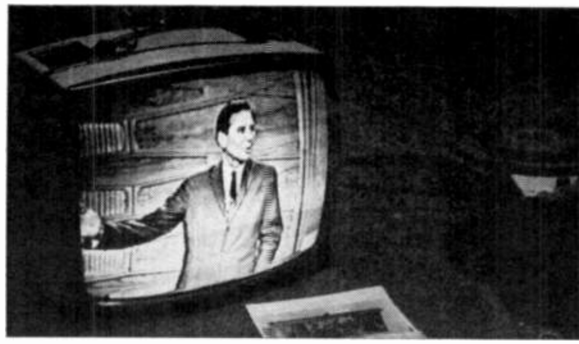
Four Detectors. The HQ-180AX includes four "detectors"—a conventional AM diode detector, a product detector for c.w. and SSB signals, and two a.v.c. (automatic volume control) circuits. Fast attack a.v.c. is applied to the sec-

(*Continued on page* 102)

Telcan–TV Tape Recorder Progress Report

By W. STEVE BACON
Feature Editor





Above: British unit; American model differs in detail only. Right: N.Y.C. TV program being taped (top) and then played back (bottom). Taped picture is of good quality.

BACK in the month of September, 1963, POPULAR ELECTRONICS was the first nationally circulated monthly magazine to announce a new home TV tape recorder selling for peanuts compared to units then on the market. In the weeks that followed, stories on the new Telcan unit appeared in every conceivable medium—some laudatory, some as straight news reports, and at least one downright skeptical.

Now, we are pleased to report that the Telcan unit, which recently crossed the Atlantic for a New York demonstration under the sponsorship of Cinerama, the concern which will market it in the U.S., is everything the inventors say it is. Not only is Telcan good, but it will shortly be available in this country, perhaps as soon as April, 1964. A maximum U.S. price estimate—mass production may drive costs down—is put at "somewhere under $300—including a TV camera." According to an unconfirmed report, a kit version may also be made.

What exactly can Telcan do? As we reported in September, the unit can tape sound and pictures from an ordinary TV set; in conjunction with a TV camera costing about $150, it can be used to tape home movies. The American model of the machine records up to 44 minutes of sound and video on an 11" reel of ordinary audio tape using two tracks at 22 minutes per track.

While the quality of the picture off the tape is not quite as good as a picture off the air—there are a few lines in the taped picture and definition is slightly reduced—the quality is adequate and can be expected to improve with further development.

Technical Details. We term Telcan "spectacular" for several reasons—largely due to the technical prowess displayed by Norman Rutherford and Michael Turner of Telcan, Ltd., its inventors. The unique feature is the single stationary recording head assembly which is made in two parts. As the tape passes between the two sections, a video signal two megacycles wide is recorded on it. Exactly how this is accomplished has not yet been revealed, but details will be forthcoming in the near future when patent arrangements have been completed.

Following, point by point, are the mechanical features of the recorder.

- Controls—recording contrast, playback contrast, head alignment, sound

(Continued on page 88)

Short-Wave Broadcast Predictions

FEBRUARY 1964

BY STANLEY LEINWOLL, Radio Propagation Editor

SHORT-WAVE LISTENERS who collect rare QSL cards will be interested in a special card being offered by *Radio Liberty*, a private, non-profit-making organization that broadcasts to the U.S.S.R. in 17 languages of the Soviet Union. To celebrate its tenth anniversary on the air, *Radio Liberty* has had printed a limited number of these special QSL cards, which show a projection of the organization's target area. The cards will be sent to anyone who reports reception of their programs. For complete schedule information, write to Jason H. Smith, Jr., Engineering Department, *Radio Liberty*, 30 East 42 St., New York 17, N. Y.

TIME (EST)

Between Eastern USA and:	00	02	04	06	08	10	12	14	16	18	20	22	24
Western Europe	6	6	7	7	15	17	17	11	9	7	6	6	
Eastern Europe	6	6	6	7	15	17	11	9	7	7	6	6	
South & Central America	11	11	9	11	17	17	17	17	17	17	11	11	
Near East	6	6	7	9	15	15	11	9	9	9	7	7	
North Africa	6	6	6	7	17	17	17	11	9	9	7	7	
South & Central Africa	9	9	9	11	21	21	21	21	17	15	9	9	
Australia & New Zealand	9	9	11	9	11	11	*	17	21	17	11	9	

TIME (CST)

Between Central USA and:	00	02	04	06	08	10	12	14	16	18	20	22	24
Western Europe	6	7	7	7	17	17	11	9	7	7	6	6	
Eastern Europe	7	7	7	7	11	11	9	7	7	7	7	7	
South & Central America	9	9	9	15	17	17	17	17	17	15	11	9	
North Africa	7	7	7	9	17	17	15	9	9	9	7	7	
South & Central Africa	7	7	7	11	17	21	21	21	17	11	9	7	
Far East	7	7	7	7	7	9	9	11	15	15	9	7	
Australia & New Zealand	9	11	11	9	11	17	*	21	21	21	15	11	

TIME (PST)

Between Western USA and:	00	02	04	06	08	10	12	14	16	18	20	22	24
Western Europe	6	7	7	9	15	15	9	7	6	6	6	6	
Eastern Europe	7	9	9	7	9	7	7	7	7	7	7	6	
South & Central America	9	11	9	15	17	17	17	17	15	11	9	9	
Africa	7	7	9	9	15	15	15	15	15	11	9	9	
Far East	7	7	7	9	7	9	7	15	17	15	9	7	
South Asia	6	6	6	7	9	9	9	9	15	15	9	7	
Australia & New Zealand	9	9	9	7	11	17	21	21	21	17	11	9	

To determine the frequencies and times for best short-wave reception in the United States, select the table for the area you are located in, read down the left-hand column to the region you want to hear, then follow the line to the right until you are under the figures indicating your approximate local time. The boxed numbers will tell you the frequency band (in megacycles) to listen to during any 2-hour interval. Asterisk (*) indicates that signals will probably not be heard.

Monthly Short-Wave Report

By **HANK BENNETT**, W2PNA/WPE2FT
Short-Wave Editor

OLD STATION RETURNS TO THE AIR

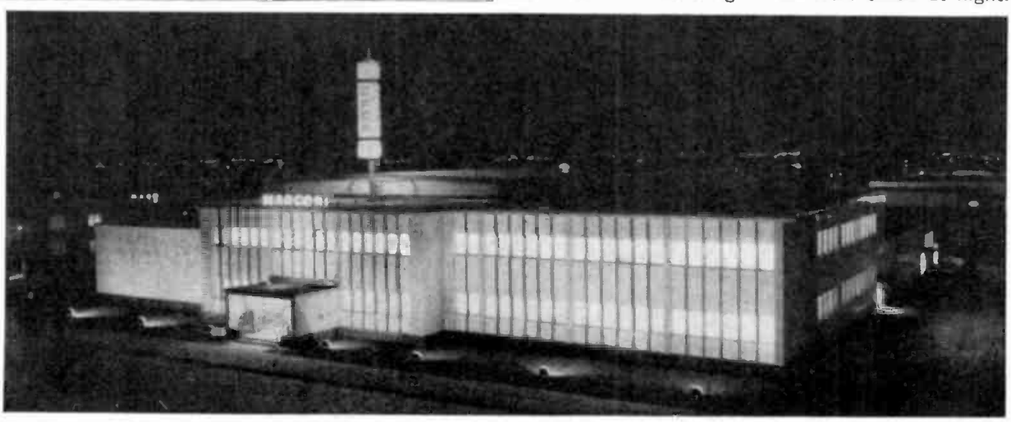
ON SEPTEMBER 28 of last year, your Short-Wave Editor was one of the first listeners to tune in CFCX operating from Montreal, Quebec, on 6005 kc. There had been no advance notice that CFCX was planning to return to the air, and it took several hours of listening to determine the identity of the station. Announcements revealed that it was in the Montreal area and the signal strength indicated that it was much lower-powered than CFRX, Toronto, and CHNX, Halifax, both of which were operating in the same frequency band.

We dropped a report to the station—at the time we correctly guessed that it was the short-wave counterpart of CFCF since the announcements left little doubt that the programs were originating from that medium-wave station. Shortly thereafter, we received a cordial letter and verification card from the Canadian Marconi Company signed by George Bowden, VE2IF, studio supervisor for CFCF-TV. Their address is 405 Ogilvy Ave., Montreal 15, Quebec.

What is now station CFCX was originally licensed as VE9DR and operated from Drummondville, Quebec (how many of our readers ever verified that one?) from 1930 to 1932, when the location was changed to the Mt. Royal Hotel in Montreal. The call-sign became CFCX in 1936 and the station operated from Montreal until 1948 with only 75 watts. In late 1963 CFCX once again commenced operations, testing with 75 watts, and later increasing power to 500 watts. Their transmitter is now located at Caughnawaga, Quebec.

Station CFCX, owned and operated by

Station CFCX, off the air since 1948, has been revived by the Canadian Marconi Company; it's the short-wave counterpart of the medium-wave station CFCF. Photo at left shows a portion of the present CFCF-CFCX transmitting facility at Caughnawaga, Quebec. Below is a view of the outside of the Canadian Marconi building in Montreal taken at night.



the Canadian Marconi Co., is in service to help give listeners in Canada's northlands "something to listen to other than stations from behind the Iron Curtain." The antenna at CFCX is beamed 320-360 degrees north and 140-180 degrees south, which puts the New York-New Jersey area directly in the southern beam. According to Bowden, numerous reports from the southern areas show excellent signal strengths, and encouraging reports are coming in from the north as well. The latter territories will have much improved service now that the power has been raised to 500 watts.

Voice announcements are aired from time to time giving frequency, mailing address, reception report requests, and other timely information. Stamps or International Reply Coupons are not required for confirmation —just a sincere and honest report of reception.

In addition to CFCX, Canadian Marconi also operates CFCF on 600 kc., with 500 watts; CFCF-FM on 92.5 mc., with 41,500 watts ERP; and CFCF-TV, channel 12, with 325,000 watts ERP.

Prior to the time when VE9DR was licensed, the station operated under the temporary call-sign of XWA. This was in 1919 and operations shortly ceased for a few weeks or months. During the period when XWA was off, KDKA in Pittsburgh, Pa., started broadcasting. XWA, therefore, may have actually been one of the first broadcast stations with regular programs in North America. However, in fairness to everyone concerned, CFCX is claiming only to be the first station in Canada. Should any of our old-time readers actually have a verification or other positive proof that XWA was on the air before KDKA, it might be of interest to both parties.

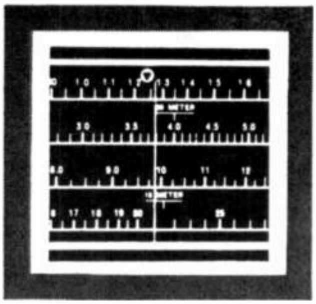
We are grateful to George Bowden for his assistance in the preparation of this article.

(Continued on page 108)

ENGLISH-LANGUAGE NEWSCASTS TO NORTH AMERICA

All of the stations below specifically beam English-language newscasts to the U.S.A. The times may vary a few minutes from day to day.

COUNTRY	STATION	FREQUENCY *(kc.)*	TIMES *(EST)*
Australia	Melbourne	17,840, 15,220	2030, 2130, 2330
		9580	0745
Bulgaria	Sofia	6070 (and/or 9700)	1900, 2000, 2300
Canada	Montreal	11,720, 9625, 5970	1800 (Caribbean)
East Congo	Leopoldville	11,755	1630, 2100, 2230
Czechoslovakia	Prague	11,990, 9795, 9550, 7345, 5930	2030, 2230
Denmark	Copenhagen	9520	2100, 2230
Finland	Helsinki	15,185	1530 (Mon., Fri.)
West Germany	Cologne	15,405, 11,795	1010
		9640, 6160	2035
		9735, 9575, 6145	0000
Hungary	Budapest	11,910, 9833, 7220	1900
		9833, 7220	2230
Italy	Rome	11,905, 9575	1930, 2205
Lebanon	Beirut	11,890	1630
Netherlands	Hilversum	17,810, 15,445	1030 (Tues., Fri.)
		11,950, 9590	1415 (Tues., Fri.)
		9715, 6085	1630 (exc. Sun.)
		6035, 5985	2030 (exc. Sun.)
Portugal	Lisbon	6185, 6025 (and/or 9740)	2105, 2305
Spain	Madrid	9360, 6130	2215, 2315, 0015
Sweden	Stockholm	17,840	0900
		11,805	2045, 2215
U.S.S.R.	Moscow	9740, 9730, 9700, 9680, 9660, 9650, 9620, 9610, 9570, 7320, 7310, 7240, 7200, 7150 (may not all be in use at any one time)	1730, 1900, 2000, 2100, 2300, 0040
Vatican City	Vatican City	9645, 7250, 6145	1950



Across the Ham Bands

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

HOW MUCH DOES IT COST TO BE A HAM?

MOST HAMS have had the experience of hearing a visitor say that he would like to become a ham, but couldn't afford it. Is there any truth in the belief, common outside the amateur ranks, that ham radio is an expensive hobby? Let's look at the facts.

Statistics indicate that the average ham spends about $150 a year on his hobby. Possibly this figure is a little on the low side; nevertheless, we know that an effective low-power station consisting of a receiver, transmitter, antenna, and necessary accessories can be put together for under $150. We also know of course that some hams spend far more than $150 a year on their hobby, but most of us recognize that $100 to $150 a year can build up a very effective amateur station within a few years.

How do these figures compare with the cost of other popular habits, hobbies and recreations? Smoking? A pack of cigarettes a day comes to over $100 a year. Even a single Coke or Pepsi a day amounts to enough in a year ($36.50) to keep a low-power station going, once you've got it set up.

What about bowling? If you bowl two nights a week, it probably costs you at least $4—without any of the extras like a soft drink or two, and maybe a snack afterward. Is $200 a year spent on bowling considered an extravagance? Even the fellow who has no specific hobbies at all, who merely permits himself a congenial night on the town once or twice a month, spends more on his pleasure than many a ham spends on his hobby.

Of course radio amateurs have no objection to the other fellow spending what he pleases on his own recreation, whatever it may be. But let's put an end to the fiction that amateur radio is an expensive hobby. By the way, have you

Novice Station of the Month

This efficient-looking station belongs to Terry Neifeld, KN3VJY, Baltimore, Md. His equipment includes a National NC-270 receiver, and Globe Chief De Luxe and Heathkit Two-er transmitters. Forty-three states and six countries grace Terry's log book. For submitting this photo in our Novice Station of the Month contest, Terry will receive a one-year subscription to POPULAR ELECTRONICS. If you would like to enter the contest, send us a clear picture of your station—preferably showing you at the controls—along with some information about yourself, your equipment, and operating achievements. Entries go to Herb S. Brier, Amateur Radio Editor, Box 678, Gary, Indiana.

priced a set of golf clubs, or a two-week hunting trip to Canada or the Rockies? And how about skeet shooting, yachting, skiing, outboard racing, and photography, to name a few other hobbies? Do they cost less per year than amateur radio?

NEW RULES FOR HAM LICENSES

Even before they went into effect, the new procedures for obtaining a Novice, Technician, or Conditional class license described last month have been modified by the FCC.

As the rules now stand, when you are ready for the exam, you select a volunteer examiner. He must be at least 21 years old, and must hold an amateur license of General Class or higher grade, a commercial radiotelegraph license, or be employed in the service of the United States as the operator of a manually-operated radiotelegraph station. Also, you must write to the Federal Communications Commission, Gettysburg, Pa., 17325, or to the nearest FCC field office and request Amateur Application Form 610.

Upon receipt of the form, the examiner will give you the international Morse code test. If you fail, the examination ends at that point. If you pass, the examiner will mail your filled-in Form 610 and his own signed statement that you passed the code test to the FCC at the address given above. In his statement, the examiner must describe his qualifications for conducting the examination, and must include with the statement and Form 610 your $4 license fee in the form of a check or money order payable to the FCC. Of course, in the case of a Novice license application, there is no fee. In a few weeks, your license will be mailed to you.

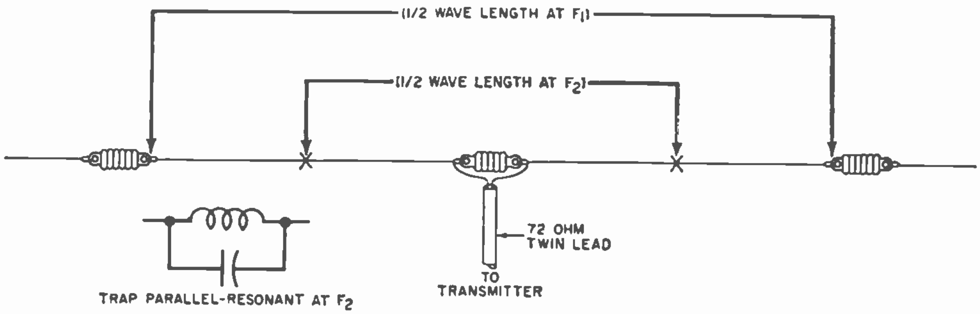
CLASSIC HAM CIRCUITS

Probably two-thirds of the hams on the 10-, 15-, and 20-meter bands who use beam antennas have "tri-band" arrays. In fact, a large portion of all antennas in the ham bands from 3.5 to 29.7 mc are multi-frequency types, whether or not they are beams. The reason for the great popularity of such antennas is that they permit effective operation on several bands with a single antenna, and usually without requiring any adjustments, switches, or more than one transmission line. Introduced to radio amateurs by Chester L. Buchanan, W3DZZ, the multiband antenna makes band-hopping easy; just switch the transmitter to the new band and you're ready to go with no further fuss or bother.

How Multi-Frequency Antennas Work. The principle on which most multiband antennas are based is surprisingly simple. Basically, it is merely that a high-Q tuned circuit looks like a very high resistance at its parallel-resonant frequency, but like a moderate value of inductance at frequencies well below resonance.

In the schematic drawing, the antenna is assumed to be one-half wavelength long at the operating frequency. For an antenna made of wire, the length is

Anthony A. Mirra, K1ZFV, Roslindale, Mass., a triple-threat man, sports additional calls of WPE1AOB and 1W9389. His Johnson Viking drives a four-element Telrex beam supported 45 feet above ground. A Hallicrafters SX62A and Hammarlund 170A inhale the incoming signals. Tony's record: 50 states, 21 countries.



By substituting traps for insulators at "X" points, one dipole will work on two bands.

about 130 feet at 3.6 mc., and the impedance seen by a feedline connected at the center is about 60 ohms, varying somewhat with the proximity of other objects, such as the ground. At either end of such an antenna, the impedance is several thousand ohms. A transmission line of 50 or 75 ohms impedance will make a good match to such an antenna if connected at the center, resulting in a low standing wave ratio and easy loading at the transmitter end.

But if we try to drive this same antenna at 7.2 mc., each half of the antenna is a half-wave long at the new frequency, and the transmission line is in effect connected to the ends of two separate half-wave antennas strung in a line. Since the impedance at the end of a half-wave antenna is so high, there is a mismatch of as much as 100:1, or greater.

Most of the energy will, therefore, be reflected back toward the transmitter, the SWR will be high, and it will be impossible to load the transmitter properly. Attempts to drive the final amplifier to full output will probably result in arcing over the final amplifier tuning capacitor, high losses in the transmission line, and the risk of permanent damage.

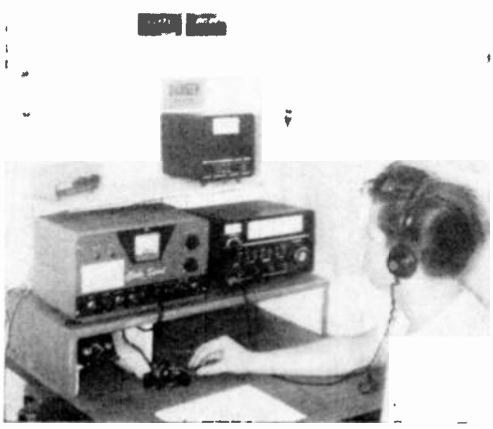
Of course, if we cut each of the antenna halves in the middle at the points marked "X" in the drawing and insert insulators, the two parts of the original antenna still connected between the insulators to the feed line will then be a half-wave long at the new operating frequency, the impedance at the feedpoint will be again about 60 ohms, and operation will be the same as at 3.6 mc.

Obviously it wouldn't be very practical to lower an antenna and insert or take out insulators every time we changed bands. Suppose, however, that we put a high-Q tuned circuit in series with the antenna at the two points marked "X." If these tuned trap circuits are parallel-resonant at 7.2 mc., they will act as two very high resistances, isolating the center half of the antenna from the two end quarters. The result is that the center half radiates as a resonant half-wave dipole at 7.2 mc.

If we again try to drive the whole antenna at 3.6 mc., the tuned traps at the "X" points look not like high resistances but like small inductances. Therefore, by trimming enough wire from the end portions of the whole antenna to compensate for the effects of the trap inductances at 3.6 mc., we can again get half-wave resonance at that frequency. And by inserting additional pairs of tuned traps in the same manner, other bands can also be covered with the same antenna.

(*Continued on page* 100)

The station of Paul Zolig, WN9HHF, Chicago, Ill., is an excellent example of a compact arrangement that still permits good ventilation of equipment.



A Carl and Jerry Adventure in Electronics

Pi in the Sky and

By
JOHN T. FRYE
W9EGV

Big Twist

THE FEBRUARY AFTERNOON was unseasonably warm. Low clouds scudded across the sky and a gusty, damp wind was blowing from the southwest as Carl parked the car at the Parvoo University Airport.

"There's Bill's Cessna parked on the apron," Jerry said, climbing out of the car, "but I don't see Bill. You sure he wanted us to fly up-river with him to see the ice jam this afternoon?"

"Sure I'm sure," Carl retorted. "There he is now over by that hangar. He's motioning to us. Let's see what he wants."

Bill Vardon, a senior at Parvoo, had a wealthy father back in Texas who had the poor taste to make his fortune in neither cattle nor oil. Instead, he had piled up dimes from a chain of root beer and hot dog stands extending clear across the country, but those dimes had bought Bill his own airplane and had made him a BMOC. He was, though, a "very right guy" in both Carl's and Jerry's eyes.

"Before we take off, I thought you electronic buffs might like a close-up look at the DC-six MPATI plane in the hangar here," tall, lanky Bill drawled. "I've got permission for us to go inside."

"We sure would," Jerry said promptly.

Both boys, of course, knew about MPATI, the Midwest Program on Airborne Television Instruction, that now was in its third year of operation. They knew that every Monday through Thursday morning of the school year a big DC-6 took off from its base at the Parvoo University Airport and climbed to its station at 23,000 feet over the little town of Montpelier in northeastern Indiana. There, staying within a ten-mile circle, it flew for better than five hours in a shallow figure-eight pattern so that turns could always be made into the wind. During this time two complete UHF TV transmitters inside the plane telecast simultaneous but different programs on channels 72 and 76. The video-taped educational programs telecast had been prepared by the finest TV instructors discovered in a nation-wide talent search, and they covered such subjects as English, French, Spanish, history, literature, music, dramatics, science, and math. Because of the last subject, some wag had dubbed the program "Pi in the Sky." The educational telecasts were picked up and used by schools in six states within a 200-mile radius of Montpelier.

"THERE SHE IS, fellows," Bill said as they stopped beneath the wing of the plane that looked much larger inside the hangar than it did outside. "This plane is kept standing by in case something goes wrong with the other one flying on station. It's stocked with duplicate tapes and could take over the telecast as soon as it takes off and climbs to position."

"What's that long thing in the plastic cover sticking back beneath the belly of the plane?" Carl wanted to know.

"That's the twenty-four-foot transmitting antenna," Bill answered. "When the plane is on station, this is moved hydraulically to a straight-down position and a gyro keeps it within one degree of the vertical during all normal flight maneuvers. If it wasn't for that, the transmitted signal pattern would be tilting all over the place when the plane banks or climbs, and reception in many places would be pretty bad."

"One antenna for two transmitters?" Jerry queried with raised eyebrows.

"That's right. The klystron final stages of both transmitters—which operate at about five kw each—feed the same antenna through a diplexer arrangement that prevents interaction. That's just one of some of the 'firsts' the MPATI engineers have worked out."

"Must be a lot of valuable electronic gear inside that plane," Carl observed wistfully.

"I'm sorry I couldn't wangle permission for us to go inside the plane today," Bill replied, "but it's really something to see. Six and a half tons of transmitters, video tape equipment, operating consoles, and test equipment are bolted down in there. I say 'bolted down' because every bit of equipment has to be mounted solidly enough to take the

(*Continued on page* 88)

On the Citizens Band

with **MATT P. SPINELLO,** KHC2060 CB Editor

THE ELEVENTH ANNUAL FLY-IN Convention of the Experimental Aircraft Association was held at Greater Rockford (Illinois) Airport last August. A hefty responsibility for coordinated safety was placed on the shoulders of airport authorities and Citizens Band radio during the five-day event. More than 2000 EAA members and guests saw to it that control-tower workers charted some 13,000 flight operations—take-offs and landings—4725 of them in just one day. By the second day of the get-together 113 amateur-built planes had checked in along with 40 antique aircraft. More than 125 factory-built planes were also tied down at the airport.

Any day is a busy day at a controlled airport. Add approximately 200 additional planes and several thousand extra take-offs and landings per day and everybody's got their hands full: pilots, control tower, ground crew, mechanics, the works! EAA officials stated that Robert Selfridge, Greater Rockford Airport manager, and his crew —with the help of CB radio—set an all-time record of operations for any airport anywhere in the world with their EAA Fly-In performance.

CB: Fly-In Work-Horse. To facilitate the control tower's communication overload during the fly-in, ten Citizens Band transceivers were employed to handle as much of the EAA's operations as possible. Two 5-watt rigs were used, one in the control tower and one roving unit in an automobile, while eight hand-held transceivers covered the airstrips and grounds. Regular airport facilities were closed during nightly airshow and stunt-flying performances by the EAA. During these events the hand-held units were used in jeeps and carryalls to control flight traffic. These vehicles, including the familiar "follow me" jeep, covered ground control traffic and taxiing aircraft.

Citizens Band communications were actually put to work from 9 a.m. to 9 p.m. daily during the week-long event. The roving unit participated as a trouble-shooter, handling requests for parts, gasoline and covering problems of a general nature. Combined, the ten-unit system was also used to relay information from planes in the air. handled EAA traffic pertaining to possible hazards on the field or in the area, and covered EAA committee messages regarding upcoming events, times, etc.

Airborne Radio Discussed. Najeeb E. Halaby, administrator of the Federal Aviation Agency, was among the dignitaries who attended the fly-in. Chief Halaby did some "hangar flying" with about 1200 EAA members, explaining government regulations which have restricted their flying.

One of the major issues discussed was the question of barring pilots without two-way radio equipment from landing at controlled-area airports with control towers. Halaby reminded them that safety was a prime target in writing the "laws of the

This is how the eleventh annual Fly-In of the Experimental Aircraft Association looked to EAA members in the air. Ten CB transceivers were used to handle much of the EAA's communication operations on the crowded airstrips.

Rockford Register-Republic Newsplane Photo by Don Holt

sky, or, as you know them, the FAA regulations." He said, "all rules but the law of gravity can be waived on occasion by the FAA if you request a waiver ahead of time."

Other questions raised pertained to why pilots could not get approval for transistorized equipment or radios operated by dry batteries, and what could be done for those who could not afford required two-way radio equipment. Halaby's reply indicated that the rules are specific but are subject to change if manufacturers meet FAA specifications on lower cost models.

Illinois Governor Otto Kerner was so impressed by what he saw during an hour-long tour of the 175 aircraft on the field, he proclaimed the following day as Experimental Aircraft Day in Illinois.

They were all there: antique hand-builts from the early '20's, original renovated craft, biplanes, mini-mustangs, a homemade delta-wing and even a privately-owned twin-fuselage jet. A 12-year-old youngin' from California, hardly able to reach the pedals on a bicycle, handled his dad's low-wing plane like a vet at 130 m.p.h. He has close to 300 hours of flying time in!

Our thanks to Rockford Newspapers, Inc. for use of material in this column; to Dick Glynn for his contributions; and to Preston Aylesworth for a spot of epoxy cement at a critical moment. It replaced our walkie-talkie antenna enabling us to monitor the EAA control tower!

C.A.P.—CB. Many fine comments have been received across this desk since our October OTCB coverage of the Civil Air Patrol. It has been gratifying to note the number of CB'ers interested in joining the C.A.P. to be of some service with their equipment.

It was set up differently in the beginning. 26.62 mc. had been allocated to the C.A.P. so they might incorporate Citizens Band equipment into their activities and needs. Now a reverse! Experienced CB operators realizing the scope of public service possibilities as C.A.P. members have begun to join with C.A.P. organizations across the country. This not only qualifies them to add that 26.62 mc. crystal to their equipment to be used in search and rescue operations; it also gives them a chance to get a well-rounded education in search and rescue procedures from the air and on the ground, gives them first-aid training, and exposes them to the experience of a national service organization that has been around for over 22 years. What's more, C.A.P. membership furthers the interests and education of the air-minded who might not otherwise be able to afford training or flight time.

Art Nagy, 7W3659, a long-time contributor of CB information to this column, has informed us of the Broward Citizens Radio Club's (Fort Lauderdale, Fla.)

(*Continued on page* 107)

Don Hart, assistant communication coordinator during EAA Fly-In Week, is shown with one of eight handie-talkies used between the airport control tower and EAA members on the ground and in the air.

When thunderstorms and high winds threatened the Fly-In one day, EAA pilots made a mad dash with their craft for the nearest hangar facilities.

Rockford Register-Republic

Transistor Topics

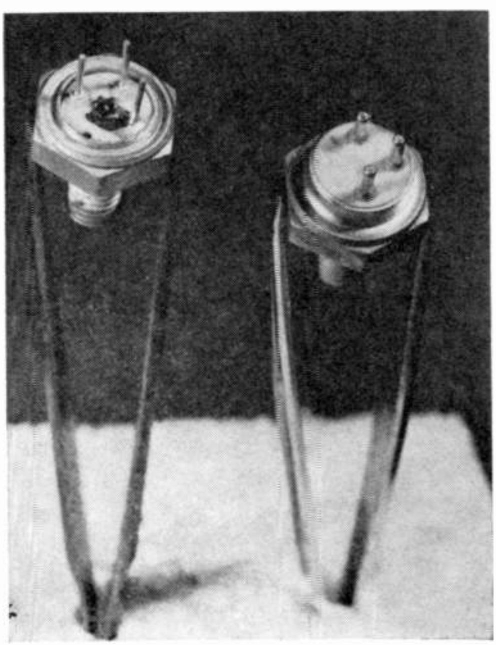
By LOU GARNER, Semiconductor Editor

THE DEVELOPMENT of a new UHF silicon transistor with a high-frequency power output five to ten times greater than that of earlier types has been announced by the Radio Corporation of America. The experimental unit, identified as type TA-2307, was developed under the technical direction of the U.S. Army Electronics Research and Development Laboratories at Ft. Monmouth. N.J. Although the TA-2307's first applications are expected to be in military and satellite transmitters, lightweight radar, and microwave relay equipment for TV and telephone communications, this is probably the first of a new "generation" of high-frequency power transistors which, one day, will be available to hams and home experimenters for use in transmitters, transceivers, and similar UHF projects.

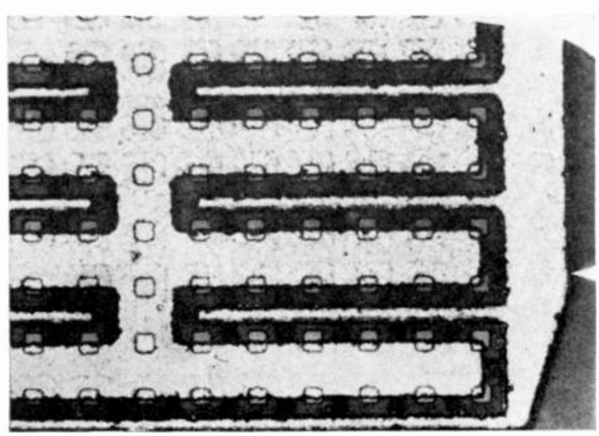
As shown in the photograph on this page, the new UHF transistor's external appearance differs from that of more familiar units in that it is hermetically sealed in a stud-type, ceramic-metal case. This recently developed package design combines the advantages of lead isolation, good thermal conductivity and low parasitic reactances.

Called an *overlay* transistor because of its construction. the TA-2307's "heart" is a tiny checkerboard structure far smaller than the head of a pin. It consists of a mosaic made up of 156 individual microscopic high-frequency transistors which are integrated by means of the overlay structure and applied on a tiny silicon wafer by a photo-etch process. Each emitter element is a square measuring only 0.0005 inch on the side. The emitter-base regions are interconnected by both metallic and semiconductor materials to spread the current flow uniformly. The individual emitter squares are clearly visible in the accompanying photomicrograph.

The TA-2307's average performance characteristics are illustrated graphically in Fig. 1. As a class C common-emitter



Held by tweezers in photo at left are two of RCA's new UHF "overlay" transistors; the unit at the right is hermetically sealed in a ceramic-metal case. In the enlarged photomicrograph below you can see a section of the transistor showing the individual emitter "squares" and connecting metalized overlay.



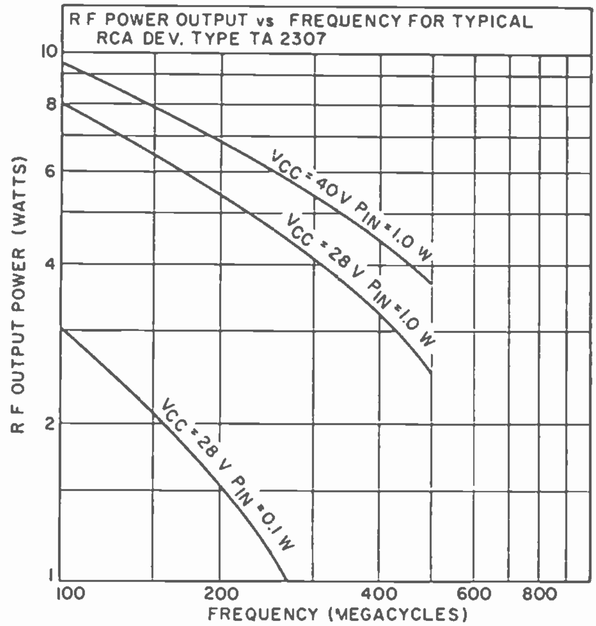


Fig. 1. Typical performance characteristic curves for RCA's "overlay" transistor. Note that several watts can be delivered at frequencies up to 500 mc.

amplifier, for example, a typical unit can provide 4.5 watts output at 400 mc. with 40 volts collector voltage, while selected units can deliver as much as 5 watts at 500 mc. with 7 db gain. In comparison, the maximum power output achieved heretofore by transistors at 500 mc. was considerably less than one watt.

Readers' Circuits. If a dozen experimenters were asked to develop a circuit for any given project, chances are they would present just as many different designs. As an example, two different receiver circuits are shown in Figs. 2 and 3. Both employ two transistors, cover the AM broadcast band, have loudspeaker output, require moderate-length external antennas, are battery-powered, and feature diode detectors—yet in all other respects the two designs are as different from each other as night is from day.

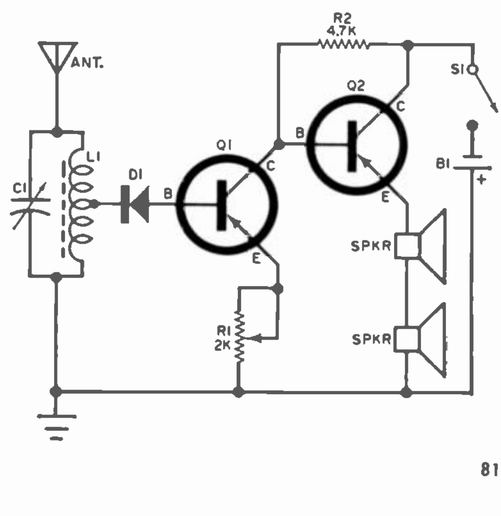
The circuit in Fig. 2 was submitted by reader George Fraser (512 W. Third St., Moscow, Idaho). According to George, "This is a dandy little radio, if you don't mind low fidelity. It gives surprising (although moderate, of course) volume with a modest aerial (window screen) and ground on local stations."

Referring to the diagram, r.f. signals picked up by the antenna-ground system are selected by tuned circuit *L1-C1* and applied to diode detector *D1*. The resulting audio signal is applied to a two-stage, direct-coupled audio amplifier, *Q1-Q2*, which, in turn, drives a pair of series-connected loudspeakers. Both stages employ *pnp* transistors, with *Q1* in the common-emitter configuration and *Q2* as an emitter-follower. Potentiometer *R1* serves as a combination bias and gain control, while resistor *R2* acts as *Q1*'s collector load. Operating power is furnished by a single battery, *B1*, controlled by s.p.s.t. switch *S1*.

George used "on hand" components in assembling his model. Potentiometer *R1* is a 2000-ohm unit and *R2* is a 4700-ohm, ½-watt resistor. Capacitor *C1* is a standard 365-μμf. tuning capacitor and *L1* a familiar broadcast-band loopstick with a center tap added. Diode *D1* is a general-purpose type—typically, a 1N34. The transistors, too, are general-purpose *pnp* units; George used Lafayette SP238's. The loudspeakers are 4" units with 3.2-ohm voice coils. Any s.p.s.t. switch may be used for *S1*—toggle, slide or rotary. Finally, the battery is a single 1.5-volt cell, such as a standard flashlight battery.

You should have no difficulty in duplicating George's circuit, for neither layout nor wiring is critical and a number of parts

Fig. 2. Although neither layout nor wiring is critical in the receiver circuit submitted by reader George Fraser, diode and battery polarities are.



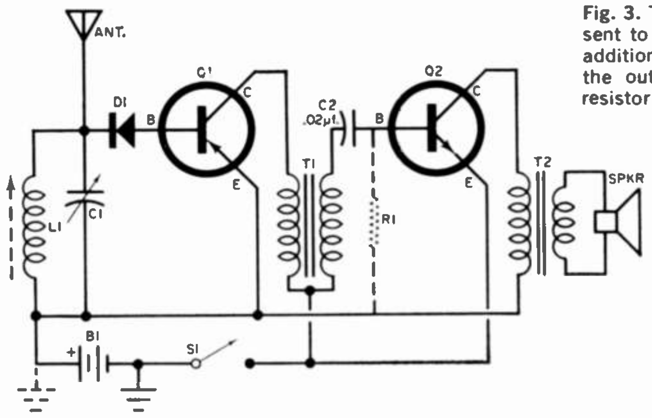


Fig. 3. This receiver circuit was sent to us by Kenneth Baer. If additional bias is necessary for the output stage, a half-watt resistor can be added as shown.

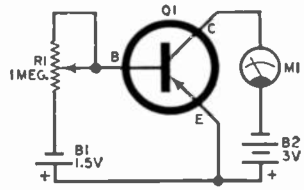
substitutions can be made. A variety of transistor types may be substituted—2N111's, 2N139's, 2N218's, 2N409's, or 2N410's, for example. A single loudspeaker with an 8-ohm voice coil can be used in place of the series-connected units; if series units are used, however, make sure that the speakers are wired in phase. Both diode and battery polarities are critical.

Our second receiver circuit, shown in Fig. 3, was submitted by reader Kenneth J. Baer (2902 Anderson St., North Bellmore, N.Y.). Ken has contributed to this column before. His current design features transformer-coupling and both *pnp (Q1)* and *npn* (*Q2*) transistors in the common-emitter configuration.

The receiver's "front-end" is generally similar to the one used in George's circuit. The r.f. signals picked up by the antenna-ground system are selected by tuned circuit *L1-C1* and detected by diode *D1*. The resulting audio signal is amplified by a two-stage transformer-coupled amplifier, *Q1-Q2*, and used to drive a loudspeaker. In operation, *Q1*'s base bias is furnished by the d.c. component of the detected signal while *Q2*'s bias is supplied by its inherent leakage. Transformer *T1* is used for interstage coupling and *T2* to match *Q2*'s collector impedance to the loudspeaker voice coil. Coupling capacitor *C2* isolates *Q2*'s base and thus prevents a short of its leakage bias through *T1*'s secondary winding. Circuit operating power is supplied by a 3-volt battery, *B1*, controlled by s.p.s.t. switch *S1*.

Standard, readily available components are used throughout. Coil *L1* is a broadcast-band ferrite loopstick coil and *C1* a 365-µµf. variable capacitor. Capacitor *C2* is a 0.02-µf. ceramic or paper unit—its working voltage is not critical. Diode *D1* may be a 1N34, 1N34A or 1N60. Type CK722 or 2N107 is suitable for *Q1* and type 2N229 for *Q2*. Transformer *T1* should have a 5000-ohm primary and 3000-ohm secondary (the center-tap, if provided, is not used), while *T2* should have a 2000-ohm primary and 10-ohm secondary. Ken used an Argonne AR-173 and AR-114 for *T1* and *T2*, respectively. Any size speaker with an 8- to 10-ohm voice coil should give acceptable performance. The power supply is made up of two flashlight or penlight cells in series, but, if preferred, can be a single 3-volt battery *(B1)*. A slide or toggle switch is used for *S1*.

Fig. 4. With this simple circuit, received from reader Charles Rakes, you can easily check a low-power transistor's d.c. gain. See Transitips.



Ken's circuit can be assembled breadboard fashion or on a conventional chassis as preferred by the individual builder. Again, neither lead dress nor layout is critical. In some cases it may be necessary to provide additional bias for the output stage, *Q2*. This can be accomplished by adding a half-watt resistor, *R1*, as shown in dotted outline in Fig. 3. The resistor's value should be determined experimentally for optimum performance, but, in general, should fall between 100,000 ohms and 1 megohm.

Transitips. We've received a number of requests for additional information on testing semiconductor devices. As you may recall, last month we discussed a simple diode tester suggested by reader Ronald Wilensky. Another reader, Charles D. Rakes (Oak Grove, Mo.), has written to pass on his useful technique for checking a low-power transistor's d.c. gain.

Charles's basic method is illustrated in Fig. 4. The only items needed are a VOM, a 1-megohm potentiometer (*R1*), a few

(*Continued on page* 98)

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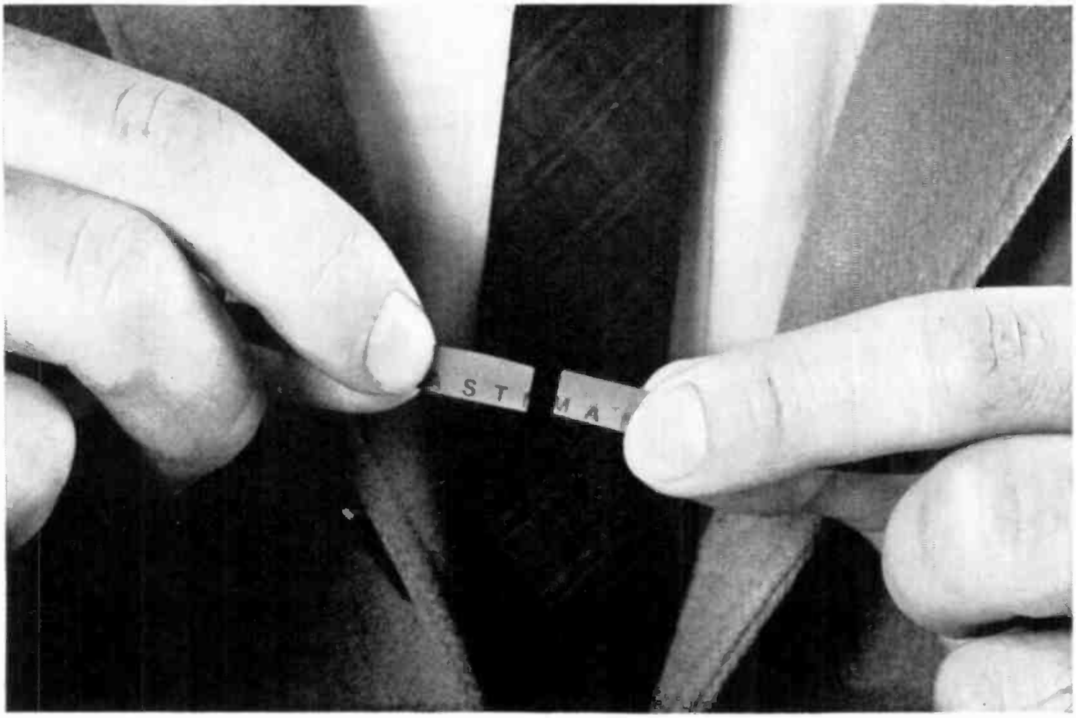

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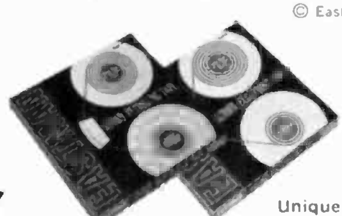

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CIRCLE NO. 7 ON READER SERVICE PAGE




Telcan—Progress Report

(*Continued from page* 69)

volume, rewind, start, stop. The contrast controls are gain controls for the video record and playback circuits.

- Circuitry—all transistorized on three printed-circuit boards. A total of 30 transistors are used in the three modules, one of which is for sound, one for recording video, and one for playback. It is contemplated that servicing will be done, at least initially, by simply replacing a defective module with a new one.
- Tape speed—120 ips; to simplify the tape transport mechanism, the unit is designed to climb to full speed from rest in five seconds; braking is also done over a five-second slow-down.
- Tape and recording head life—tape life is in excess of 500 playings. The tape comes in contact with one part of the two-section head which is wearable. The life of this wearable section is put at 100 hours, with replacements available at an estimated cost of $2.
- Head alignment—as might be expected, this is critical; however, the head azimuth can be easily adjusted (much like focusing a movie projector) by means of a simple knob control.

Problems of Invention. In conversations with Rutherford and Turner, we noted that the time that had elapsed between the first announcement of the machine and the New York demonstration had led to a number of skeptical comments. "Yes," Rutherford replied, "the disclosure of the machine was premature—and this showing is also. Unfortunately, they were necessary to finance further development." He also conceded that production estimates had been on the optimistic side—to date, only 25 of the British version of Telcan, carrying an estimated price tag of about $160, have been produced.

It appears, however, that the problems the inventors have had in manufacturing and marketing the TV tape recorder are on the verge of being solved. A number of successful prototypes are in existence, and they demonstrate a recording technique heretofore considered impossible. —30—

Pi in the Sky

(*Continued from page* 77)

stress of a very rough landing. Aviation authorities insist on this. At the same time, the stuff has to be shock-mounted to prevent the vibration of the plane from knocking the sensitive, high-gain circuits out of whack."

"It must take a lot of power to feed two complete TV transmitters," Jerry said thoughtfully. "Where does it come from?"

"Back in the non-pressurized tail section are gas-turbine-driven, four-hundred-cycle generators that put out seventy-five kw. The standard TV transmitters had to be modified to use the four-hundred-cycle a.c., but they had to do it—higher-frequency power means a lot less iron in the generators and transformers, and a lot less weight."

"How many guys does it take to man this flying TV station?" Carl asked.

"Six. Three are flight crew, and the other three are technicians who operate the transmitters and keep an eye on performance. The signals are monitored all the time by technicians right here in the hangar, and they keep in touch with the TV guys in the plane through a radio circuit entirely separate from the one used by the pilot and the control tower. Any time the received signal gets bad, it's seen by the technicians on the ground and corrected by those in the plane if possible. Right now no live programs are shown, but they have a camera in the plane for transmitting test patterns between programs and to make slide announcements on program changes, transmission quality, and so on."

"How would you like this kind of set-up for ham TV experiments?" Carl asked Jerry.

"Great, but a little expensive to operate," Jerry replied laughingly.

"Well, men, we'd better be shoving off for a look at that ice jam," Bill broke in. "The flying weather is not so hot, and I want to be back at the airport before dark. The air is unstable, and there's an alert out for possible tornadoes up until midnight. I don't think there's anything

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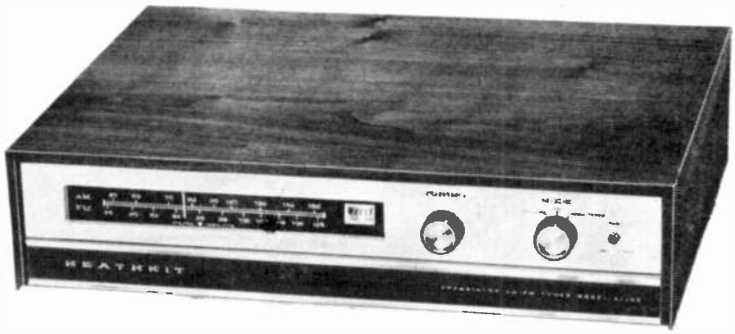

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CIRCLE NO. 14 ON READER SERVICE PAGE

to worry about, or I wouldn't go up, but I don't want to be up there in the dark playing blindman's buff with some twisters I can't see."

A FEW MINUTES LATER the boys were in the Cessna four-place plane waiting for permission to take off. Jerry sat to the right of Bill; Carl took one of the seats behind them. Permission was given, and they were off down the runway, gathering speed as melted snow-water splattered from beneath the wheels of the tricycle landing gear up against the bottom of the plane.

Bill, an expert pilot, took the plane off the ground quickly and smoothly. He circled and then leveled off well below the clouds and set a northeast course that followed the twisting ribbon of the Wabash River. The air was rough and bumpy, but a tail wind sped them along upstream until they reached the jam in the river some thirty miles from their starting point.

As Bill dipped a wing and circled lower, the boys could see the jam was a big one. Great cakes of ice had humped up to a height of several feet above the normal level of the river, and the dammed-up water had spread out across the fields on either side and was cutting new channels back into the river below the jam. Broken cakes of ice stood on end as far upstream as the boys could see, and Bill flew on up-river to find out how far the jam extended. No open water was seen until they were almost to the town where Carl and Jerry lived, nearly seven miles above where the jam started.

"Guess I'll fly south a ways and then cut across to fifty-two and follow that back into Parvoo," Bill said, banking the Cessna away from the river. "Say, what school's that down there?"

"Lincoln Township Consolidated School," Jerry said, looking down at the brick school building surrounded by soggy cornfields. "Look at the parabolic antenna on top of the building pointing over to the east. They must watch the MPATI programs . . ."

"Hey, Bill, look over to the right!" Carl interrupted. "Is that what I'm afraid it is?"

Bill took one look at the dark funnel that had suddenly lowered from the

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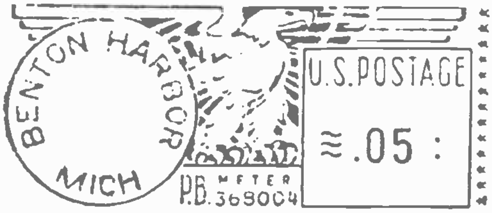

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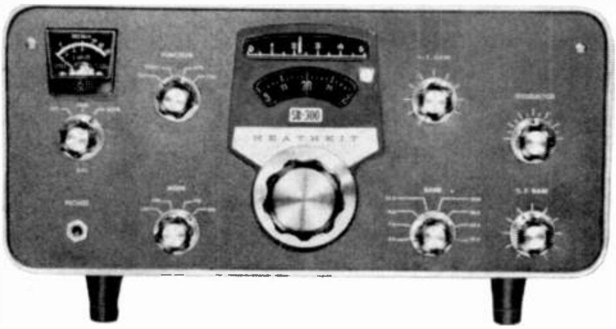

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clouds two or three miles to the southwest and then banked the plane sharply away from the course he had been flying.

"It's a twister, all right," he said grimly, "and we don't want to tangle with it."

With awe the boys watched the slender, writhing column of the tornado and the path of destruction it was leaving behind it. "It's sure traveling in a straight line," Carl remarked. "Look at it chewing up that telephone line! Say, if it keeps going the way it's headed, that school is going to be right in its path!"

Bill was already on the plane's radio calling the control tower at Parvoo and asking the operator to call the school and warn them of the approaching tornado. In a few seconds—they seemed like minutes to the boys watching the relentless advance of the evil thing—the tower reported it was impossible to get through to the school. The telephone lines were down. Probably they were the same lines the boys had seen destroyed.

"Maybe I can buzz the school and get someone's attention," Bill suggested, heading back toward the building.

"Not a prayer of a chance," Carl said, shaking his head. "With that big SAC base only ten miles away, there's hardly a minute of the day or night without the sound of some kind of plane around here. Even if you got someone outside, that grove of trees southwest of the school screens off the sight of anything coming from there. Could you land, maybe?"

Bill shook his head. "I can't land along the road because of the power lines. The fields are so soupy with this thaw that we would flip over as soon as our wheels touched. I sure hate . . ."

"Wait! There's still a chance!" Jerry exclaimed. "Call the control tower and have them phone the guys in the MPATI hangar. Ask them to have the technicians in the plane put warning slides in front of the announcement cameras for both transmitters. It's a slim chance, but it's all we've got."

BILL WAS ON the radio before Jerry finished. The alert control tower operator immediately grasped the plan. By the time he radioed back to tell the boys the MPATI plane was telecasting the warning, the tornado was scarcely half a mile away. Bill flew away from the storm at right angles to its path, and the boys watched helplessly as the funnel cut through the grove of trees, uprooting them and tossing them about as though they were straws, and then advanced directly on the school building.

For several minutes after the funnel struck the building nothing could be seen but flying debris; then, suddenly, the funnel was sucked back up into the clouds as though satisfied with the devastation it had wrought. As the dust settled, the boys saw that a whole wall of the upper story on the north side had been torn out. Most of the roof was gone. As Bill circled the building at a low level, the boys could not see a single unbroken pane of glass.

But even as they watched, sick at heart, students and teachers came pouring up an outside basement entrance and spread out over the brick-strewn yard. A young man, apparently the principal, noticed the plane flying anxiously overhead and suddenly began shoving the

students into groups. At first the boys in the plane were puzzled; then they saw what he was doing. The groups of students spelled out in ragged letters: "O.K." The plane carried three light hearts as it turned toward Parvoo.

When the boys landed, they learned the rest of the story that had been relayed to the MPATI people by the principal as soon as he had been able to get through on the telephone. A class had

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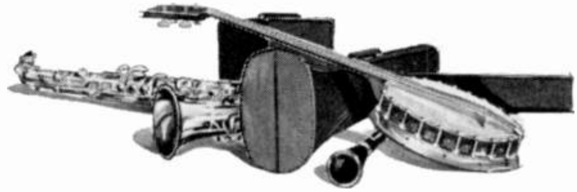

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been watching a French telecast when the hastily-printed warning flashed on the screen of the receiver. The teacher told the principal, and he immediately herded all students into the southwest corner of the basement according to a prearranged disaster plan. Not a single child received a scratch.

"Everything and everybody got into the act today," Carl mused as he and Jerry drove back to their residence hall. "Ice jam, Bill's Cessna, the DC-six, the airborne transmitters, the receiver in the school, two-way radio circuits, telephone lines, the three of us, the MPATI crew and technicians, the tower operator, the school teacher, the principal—take away any one of these essential links, and I hate to think of the results.

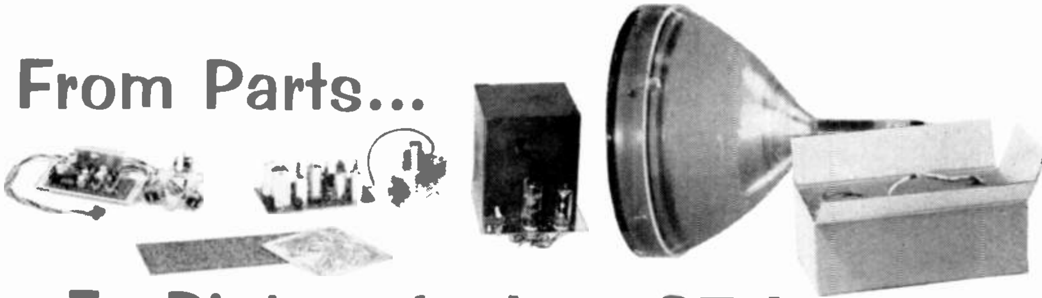
"Yep," Jerry agreed. "Roles ranged from the hero, Pi in the Sky, to the villainous Big Twist!" —30—

Amplifier Quiz Answers

(*Quiz on page* 63)

1 - C	The CASCODE amplifier uses one triode as a grounded-cathode amplifier driving the cathode of a second triode in a grounded-grid circuit. It has the good signal-noise ratio of a triode, and the gain of a pentode.
2 - E	A CATHODE FOLLOWER amplifier has very high input impedance, low output impedance, and provides power gain, but a voltage loss.
3 - B	A DIRECT CURRENT amplifier is direct-coupled (uses no coupling capacitors), and can amplify a change of the d.c. voltage between its input grid and cathode.
4 - A	The VIDEO amplifier is broadbanded by means of a complex network in its plate circuit, to pass the entire band of video frequencies to the cathode of the TV picture tube.
5 - F	A DIFFERENTIAL amplifier has two inputs, and provides a single output proportional to the difference between the two input signals.
6 - D	The DOHERTY amplifier used in some fixed-frequency broadcast transmitters employs one tube to provide normal carrier level output, and a second tube for the added carrier output needed to transmit the positive peaks of the modulation wave.

From Parts...



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CIRCLE NO. 14 ON READER SERVICE PAGE

SIMPLEX Transistorized Ignition

(Continued from page 48)

stalling it, remove the coil lead from the center of the distributor cap (to prevent starting) and turn the engine over to a crankshaft angle at which the breaker points are firmly closed. Now turn on the ignition key (engine at rest) and adjust potentiometer *R4* to make the dwell meter read exactly full-scale. Cement or otherwise lock the shaft of potentiometer *R4* to prevent accidental change of adjustment, and your dwell meter is calibrated.

If you find the meter cannot be made to read full scale by means of *R4*, use a slightly lower value of *R5*.

Note that for eight-cylinder engines the correct dwell angle current reading is well above the center of the scale. This does not affect accuracy or ease of reading.

Testing the SIMPLEX. The transistor in this circuit is easily damaged by excessive current. Before turning on the system, make sure the ballast resistor has not been omitted. If it has, there will be a 48-amp current surge when the breaker points close—and goodbye, transistor.

Your SIMPLEX ignition system should give as long and trouble-free service as any currently available transistor ignition equipment. If you want to check on its operation, measure the current flow with the engine running at fast idling speed Insert a 15 or 20-amp d.c. ammeter in series with the ballast resistor before starting the engine, and note the operating current, which should be 10 amperes, ± 1 ampere.

If the current is greater than 11 amperes, a slightly higher value of ballast resistor is required. If the current reading is under 9 amperes, first make sure that there are no loose or corroded connections in the ignition wiring. If the low current is not due to poor connections, connect a 2-ohm, 100-watt adjustable resistor in parallel with the ballast resistor, adjust it to bring the operating current up to 10 amperes, and your SIMPLEX ignition system is ready to go. —30—

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CIRCLE NO. 14 ON READER SERVICE PAGE

Transistor Topics

(*Continued from page* 82)

flashlight cells (*B1* and *B2*), a few clip leads, and, if desired, a transistor socket. The circuit arrangement shown is used for checking *pnp* transistors, but *npn* types can be checked just as easily by reversing all meter and battery polarities.

The suggested test technique is a simple step-by-step procedure:

1. First check the transistor for "shorts" or "opens." See "*Transistor Tester Round-up,*" P.E. January, 1963, for a simple method of doing this. If the unit is "good," proceed to step 2.
2. Connect the circuit shown in Fig. 4, setting *R1* to its maximum resistance value. Battery *B1* is a single flashlight cell. *B2* two cells in series. The VOM is used as an 0-1 milliammeter.
3. Adjust *R1* until *Q1*'s collector current (*Ic*), indicated by *M1*, reads 500 microamperes.
4. Disconnect the batteries and check *R1*'s value, using *M1* as an ohmmeter. Now determine the base current (for *Ic*=500 microamps) by dividing this value into *B1*'s voltage (1.5 volts). Record this as Ib_1.
5. Reconnect the circuit and check *Ic* again to make sure *R1*'s setting has not shifted accidentally, then adjust *R1* until *Ic* is 1.0 ma.
6. Again, disconnect the batteries and check *R1*'s new value. Use this to determine the base current (for *Ic*=1.0 ma.), as in step 4. Record this as Ib_2.
7. Subtract Ib_1 from Ib_2 to determine the *difference* in base current required to cause a collector current change of 500 ma. Record this as *dIb*.
8. Calculate transistor gain by dividing *dIb* into the difference in *Ic* (500), making sure that *dIb* is expressed in microamperes.

An example may prove helpful. Suppose the resistance measured in step 4 is 300,000 ohms and in step 6 is 60,000 ohms; then

$$Ib_1 = \frac{1.5}{300{,}000} = 5\ \mu\text{a., and}$$

$$Ib_2 = \frac{1.5}{60{,}000} = 25\mu\text{a.}$$

From this,

$$dIb = Ib_2 - Ib_1 = 25 - 5 = 20\ \mu\text{a.}$$

Finally,

$$Q1\text{'s gain} = \frac{500}{dIb} = \frac{500}{20} = 25.$$

If desired, the technique outlined may be used to check a transistor's gain for *any* given difference in collector current, provided the base currents (Ib_1 and Ib_2) can be measured or calculated. Although the values suggested apply specifically to small signal transistors, a similar method might be used to check high-power transistors. Here, a higher current range would be needed for checking *Ic* (*500* ma. to 1 ampere, for example), and *R1* would be replaced with, say, a 1000-ohm potentiometer. In addition, since the base currents would be much greater, they could be measured directly in steps 4 and 6, rather than calculated by using *R1*'s value.

Product News. RCA (Somerville, N. J.) has announced two new transistor types. The 2N2857 is a UHF silicon epitaxial planar transistor useful to 1200 mc.; it is designed for low-noise amplifier, oscillator, and converter applications. The other one, Type 2N2953, is a *pnp* germanium unit with a minimum gain of 200 and a cutoff frequency of 10 mc.; it is especially designed for the driver stages of audio amplifiers.

A series of five solar batteries called "Solarpacks" has been introduced by the International Rectifier Corporation (233 Kansas St., El Segundo, Calif.). Made up from a number of cells mounted in an anodized aluminum casting and protected by a weather- and heat-resistant epoxy, these units can supply from 3.5 to 16 volts at current ratings from 30 to 120 ma., depending on type.

A new 25-ampere transistor claimed to be industry's highest frequency germanium power transistor has been introduced by Motorola Semiconductor Products, Inc. (5005 East McDowell Rd., Phoenix 8, Ariz.). An epitaxial base type, features a gain-bandwidth product of 30 mc. Identified as Type 2N2912, the device is specially designed to operate efficiently in power converters powered by low-voltage sources such as solar cells, thermoelectric generators, sea cells, fuel cells, and rechargeable 1.5-volt batteries.

Also from Motorola comes news of a new series of high-frequency, small-signal transistors for communications and TV applications requiring high-gain, low-noise devices. The line features "mesa-type" transistors and includes both *npn* silicon and *pnp* germanium units. Basic characteristics are a 2000-mc. maximum f_{osc}, a power gain of 17 db at 200 mc., and low noise ratings.

That closes the semiconductor story for now. We'll be back next month with more circuits, tips and news.

—Lou

Across the Ham Bands

(Continued from page 75)

Multiband Beams and Verticals. Exactly the same principle is applied in designing multiband beam antennas, tuned traps being inserted in the parasitic (director and reflector) elements as well as the radiator. In a multiband vertical, in which the ground (or an artificial ground plane) serves as one half of the whole antenna, only one tuned trap need be inserted in the vertical element for each band.

In comparing the efficiency of a multiband antenna to that of a simple half-wave dipole cut to the same frequency, actual figures are rather hard to get, but some experiments by the author indicate a difference of no more than a db or so in favor of the one-band dipole. Most hams regard this as a small price to pay for the convenience of a single antenna giving good performance on several bands without switching or adjustments.

As mentioned before, Chet, W3DZZ, first brought this type of antenna to the attention of amateurs in his articles "Duo-Band Ham Antenna," in *Radio and Television News* for December, 1950, and "Multi-Match Antenna System" in *QST* for March, 1955. Incidentally, many of the original W3DZZ tri-bander beams are still radiating potent signals on the 10-, 15-, and 20-meter bands.

News and Views

Ralph David Miller, III, WP4BPH, 17 Onix St., Bucare, Rio Piedras, Puerto Rico, has a sad, sad story to tell. Many weeks ago, he ordered a new receiver to go with his new Novice license. Alas! he still has no receiver, but by visiting other Puerto Rico hams, Ralph has managed to work 12 states, Canada, and the Canal Zone. Ralph reports that he is giving away a couple hundred pounds of spare parts and tubes. All you have to do is to ask and pay parcel post from Zone 8. . . . **WPR-N.** Did you know that you can earn an attractive certificate by working ten Novice (WP4) stations on the island of Puerto Rico? Send your list of stations worked and QSO information certified by two other amateurs, plus $1, to Awards Manager, Puerto Rico Amateur Radio Club, P.O. Box 476, Roosevelt Station, San Juan, Puerto Rico. . . . **Louis Toth, Jr., WN2JJK,** 132 Lowell St., Cartaret, N.J., 07008, keeps 15 meters hot with a Johnson Ranger transmitter exciting a 40-meter dipole antenna, and he receives on a Hallicrafters S-108. Thirty-two states worked (28 confirmed) and nine countries worked would indicate that the combination does what it is supposed to. Louis divides his time unevenly between 15 and 40 meters; he has his Rag Chewers' Club certificate, and is a member of the Cartaret Civil Defense organization.

Ann Richards, WN5EDN, 10018 Hawthorne Blvd., Inglewood, Calif., really has the 40-meter band doing just what she wants it to do. In her first six weeks on the air, Ann has worked 36 states and four countries. In just one evening, she worked New Zealand, Midway Island, and Mexico. A home-brew vertical antenna excited by a home-brew 60-watt transmitter, and a Hallicrafters S-40B receiver are Ann's tools of accomplishment. She and her hubsand, **Jim, WA6VAE,** attribute the excellent results obtained to the fact that they took great pains to make certain that the antenna was properly tuned, as indicated by a 1.2:1 reading on the SWR bridge. By the way, while Ann is knocking them off on 40, Jim (WA6VAE) works 2 meters with a home-brew 15-watter, although he admits that he does get his time in on the 40-meter rig, too. . . . **Larry Schimelpfenis, WNØGQI,** 441 South 21 St., Fargo, N.D., got off to a fast start with his Eico 723 transmitter, National NC-98 receiver, and a two-crop antenna farm—a 40-meter dipole and a 15-meter ground-plane vertical. A new state a day for the first two weeks was entered in Larry's log.

Richard Livingston, WN5GJC, 4304 Zion St., Little Rock, Ark., 72204, really isn't using that crying towel, even though after starting out with a bang—three states worked the first day—his ham career has been mostly spent in debugging his transmitter. When it's working, the transmitter feeds an 80-meter dipole or a 100′ long wire. His receiver is a Knight-Kit. . . . **Norman B. Weingrow, WB2DLP,** Director of Stissing Lake Camps, Pine Plains, N.Y., invites those interested in learning ham radio to contact him at his classroom in the Electric Shop at the Russell Sage Junior High School 190, Forest Hills 75, N.Y. . . . **Jordan Kaplan, W9QKE,** 318 West Adams St., Chicago 6, Ill., who could work "mobile" on three ham bands simultaneously (if he had three heads) suggests that hams who have been experiencing erratic results from transistorized mobile power supplies check the ground connection between the power supply and the car body, and from the car battery to the car body.

We're out of space again. Before we go, remember that this is your column. Keep your news and views and pictures coming. By the way, we welcome contributions from all classes of hams—from Novice to Extra Class! Address your mail to Herb S. Brier, W9EGQ, Amateur Radio Editor, Popular Electronics, P.O. Box 678, Gary, Indiana, 4601. 73,

Herb, W9EGQ

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Rx for the Amateur/SWL

(Continued from page 68)

ond i.f., third mixer, and the first 60-kc. i.f. Delayed a.v.c. derived from the first audio stage is applied to the r.f. stage only when the signal reaches a predetermined level—a definite aid in receiving weak signals. A front panel control switches the a.v.c. between "off," "slow," "medium," and "fast" positions. "Slow" or "medium" a.v.c. allows the receiver to automatically adjust itself to bursts of r.f. energy—as opposed to a relatively constant carrier—such as those that make up a SSB signal.

Other features of the HQ-180AX worthy of mention include a fixed-tune BFO arrangement that is switched into play for SSB reception, making BFO adjustment unnecessary. New with the "AX" version is a 6CW4 crystal oscillator and 11 crystal sockets mounted as a subassembly on the upper left of the front panel. The crystal oscillator is designed to give very accurate fixed-tune reception on CB, amateur net or MARS frequencies, etc.

Standard receiver features are calibrated bandspread on the amateur bands, plus an arbitrary scale, 100-kc. crystal calibrator, continuously adjustable noise limiter, send-receive circuitry, and accessory and control sockets.

Ideal SWL Receiver. The HQ-180AX is the SWL's answer—whether he prowls the heterodyne-filled 31- and 49-meter bands, or prefers the BCB—to a prayer for a receiver that will do everything. Speaking of the BCB, fans of this part of the radio spectrum will find the main tuning spread so great that the band is divided into two segments (including, incidentally, 160 meters)—540 to 1050 kc., and 1050 to 2050 kc.

The receiver provides great versatility without compromise, not only in the range of frequencies it covers, but in the modes—AM, SSB, and c.w.—in which it can be operated. Needless to say, the Hammarlund HQ-180AX is a piece of gear for the radio man who enjoys operating his equipment. —30—

Reader Service No. 85—see page 15

The Amazing "Bug" Battery

(*Continued from page* 44)

more than half the fuel fed them, in the mid-1940's we turned belatedly again to the century-old idea of the fuel cell. Progress has been considerable, and today we have fuel cells powering everything from golf carts to the Apollo space vehicle.

In a typical fuel cell, hydrogen is fed to one electrode and oxygen to the other. Separated by an "ion exchange" membrane rather than the liquid or paste electrolyte of the storage battery, the fuel cell produces electricity—and water. This by-product is important on space missions, obviously. In theory, a fuel cell can be 100 per cent efficient. However, some energy is required to excite the molecules to an energy level necessary for the reaction producing current flow, and there is some resistance in the cell. Practically, 75 per cent is a good figure of merit.

With this kind of performance it might be wondered who needs batteries made from bugs. But the conventional fuel cell still has drawbacks. Hydrogen and oxygen are expensive, and power densities of fuel cells are rather low even though they are more attractive than regular batteries. A fuel cell that operates on cheap fuel oil is needed, and work is going on in this direction. Catalysts to speed up the reaction and cut down the internal loss of power are important. Such things as platinum, and more recently, nickel boride, are being used. Unfortunately, fuel cells using inexpensive hydrocarbon fuels such as natural gas, octane, etc., seem to require expensive catalytic electrodes such as spongy platinum.

The stage was now set for the entry of the bacteria battery, the biochemical fuel cell. As Dr. Welsh and others had noted, bacteria and their derivatives provide catalysts *par excellence*. And they are not nearly so fussy as more conventional catalysts. Experiments suggest that bacteria may make hydrocarbon fuel cells practical. More important, biocells have already shown they can turn even waste material into power.

The Electron Molecule Research biobattery in action on the cover represents the simplest type of bio-power. With its aluminum and copper electrodes it might appear to be a galvanic battery, using the rice husk "carrier" as an electrolyte. However, if a weak acid solution is added instead of the bacteria nutrient, current flow lasts only a short time. Thus the bacteria seem able to prevent polarization, or coating of the electrodes, that halts the reaction. EMR demonstration cells have been operated for more than a year with no decrease in output.

In more sophisticated biocells the anode and cathode sections are separated by an ion-exchange "bridge" through which ions diffuse to sustain current flow. Bacteria are placed at one or both electrodes and promote the process of stripping electrons from the "fuel" provided them.

In addition to more effective catalytic action and the use of cheaper fuels, the biocell operates at room temperature rather than the high temperatures required in some fuel cells. It is also characterized by the mild, "natural" conditions at which life processes take place, with a *p*H factor in the neutral range and a dilute water solution as an electrolyte.

Fuel for the biocell varies from sugar to organic sea material, yeast, mushrooms, or urea. The U. S. Bureau of Mines has demonstrated a biocell operating on the inorganic material, pyrite, or fool's gold. Suggested are such things as grass, dry leaves, sewage, and other waste materials. One of the most interesting biocells was made by Magna researchers, using bacteria at one electrode and algae at the other, with sunshine as fuel! In effect this represented a biological solar battery and offers the intriguing possibility of converting sunlight to electricity more efficiently than the photovoltaic cell.

The biocell, like the conventional fuel cell, is not without its drawbacks, of course. Compactness is not among its merits, as witness the bulk of the EMR do-it-yourself battery. Densities of only several amperes per square foot of electrode surface have been reported and this is not sufficient for many applications.

The potential difference exhibited by living materials leads to mild reactions, and the voltage of typical cells is only about half a volt. Cell resistance is a problem, as is the proper shape and size of the cell itself. And obviously the bacterial "workers" must be fed and thus gobble up half the available energy!

Success already achieved with biocells, despite little real knowledge of the phenomenon of bioelectrochemistry, seems to indicate that the biocell's problems are not insurmountable. Compared with those of harnessing the power of nuclear fusion they seem small by contrast, though, of course, nobody suggests that the payoff will be as great. Right now researchers know that the biocell works; they want to know how to make it work better and the chances are good that they will succeed.

Biocells—Today and Tomorrow. Space planning is helping to boom biocell development. When NASA asked for bids on a project there were 33 responding firms. Contracts have gone to four of them, and working systems may be part of manned space vehicles within several years. This is the "Space Oasis" concept, referred to before, with biocells working in conjunction with an algae solar converter in the spaceship's closed cycle. Magna Corporation, Marquardt Inc., General Electric, and Ford's Aeronutronic Division are doing such research work for NASA.

In operation, such a closed-cycle plant will process waste material to provide water, food, and electricity to operate radio and other auxiliary equipment. As an example of the potential power supply, tentative specifications describe a 20-watt urea-fueled battery with 100 ampere-hour daily output from the waste of one crew member.

Much farther along are U. S. Navy projects. Magna has produced multiwatt units of a marine bio-battery. These are presently being used only to power transmitters in buoys, but there are heady suggestions of bio-powered boats for the future. General Scientific Corporation has also produced prototype units for the Navy.

A submarine to be powered by conventional fuel cells is being studied, and there is a possibility that the biocell may be advantageous in such applications. If the model boat already demonstrated, and the hints of using the Black Sea as a power source can be taken seriously, the term "ocean current" takes on an entirely new meaning!

In addition to these programs and other government-funded work, there are privately sponsored projects in the biocell field, with some aimed at commercial use of the new power source. On land the biocell may be put to work first in powering remote electrical and electronic installations, aircraft landing lights, fence chargers for ranches and farms, and similar tasks. Army portable radars have already operated successfully on conventional fuel cells and such military gear using bio-power seems possible.

Later on may come projects like harnessing the energy in sewage, paper mill effluent, and so on. While conventional generating plants are obviously safe for many years to come, developments in biochemistry may eventually lead to low-cost industrial electricity competing in some areas with that produced by fossil fuels.

More easily foreseeable are processes in which the biocell does a dual job. It has been pointed out that a brewery is a potential power plant if the heat of fermentation can be converted to electricity. The same might apply to a bakery and to other industries dependent on biochemical action.

The biocell may also prove of great value as a chemical process rather than a power producer. Since the fuel cell can work both ways, electricity might be supplied *to* the cell and the bacteria furnish useful by-products rather than electricity. Another interesting suggestion is use of the biocell as a detector of germs during possible germ warfare, since a foreign strain of bacteria would adversely affect the electrical output.

The conventional fuel cell has a history of more than 20 years of accelerated development. Even though it is still a long way from perfected, it is considered worthy of spending additional millions toward improvement. Application of the biocell, on the other hand, came just three years ago and it has made amazing progress in that short time.

Many scientists feel that attempts to exploit bio-power this early are putting the cart before the horse and that many more years of basic study are indicated first. However, Ernest Cohn, head of NASA's Electrochemical Technology Projects, points out an interesting parallel in the chemical industry. While papers and theses are still being written describing original research on production of ammonia, we nevertheless have an excess of manufacturing capacity for the compound.

Not sure just how the biocell really works, scientists and engineers are nevertheless putting it to use. Given 20 years, it too may do some marvelous things. Meanwhile, you can put together a simple bio-battery of your own and watch, or listen to, bug-power go into action! -30-

Light-Controlled Power Supply

(Continued from page 55)

mounting ring was then attached to the fiber wafer provided with capacitor *C1* for off-ground mounting, and the wafer was mounted over the photocell by means of two machine screws which fasten it to the heat sink.

A slot in one edge of the back plate provides an opening for the line cord. This opening must be close-fitting enough to prevent the entry of ambient light, which would reduce the range of control provided by the photocell.

IQ Exercise. This prototype model does operate fairly well, but it has some shortcomings, and does not in our opinion make optimum use of the parts and the basic idea. Nor does it exploit all the possibilities for control the LDR-25 characteristics suggest. To set your mind juggling ideas, here are some of the points on which the prototype falls short.

For one thing, enough light from the lamp appears to leak around the vane and under the wafer to seriously restrict the range of adjustment. Also, despite the use of a vernier-type knob, the range of control covers only a small portion of the dial, due to the shape of the vane and the position in which it is mounted.

The heat sink is small, and due to the spacers is not thermally in good contact with the box. These facts, and use of a 6-watt lamp totally enclosed within the box, combine to limit the power the photocell can safely pass to a level far below its 25-watt maximum dissipation rating, despite two screened ventilation holes in the box ends.

Then there's the feasibility of using the LDR-25 in some sort of feedback arrangement to regulate output voltage or current, and many other possibilities that sharp-minded readers will doubtless perceive. The idea is to give your imagination free rein, limited only by the stipulations that the device is to be a low-voltage power supply in which light has a control or regulatory function. All in all, the prototype unit, made for us by Harold Reed, should be a fine basis to start from in demonstrating your Ingenuity Quotient. —30—

On the Citizens Band

(*Continued from page* 79)

decision to join forces with the Civil Air Patrol late last year. Art relates that the basic purpose of the B.C.R.C. is to help members further their interest in electronics and to be of civic value. The club feels that the latter purpose is being accomplished through their sponsorship of a C.A.P. squadron.

To the Broward Citizens Radio Club's knowledge, they are the first CB club in the country to have organized a C.A.P.-CB Squadron. Art promises they'll take a back seat if another club can prove otherwise, but to date they're pretty certain their C.A.P. action is a first!

Club Chatter. The Teen Keystone Radio League, Philadelphia, Pa., claims a first among the younger CB set. The club has been in operation for one year as of November '63 with membership ages ranging from 12 to 20 years. Group claims 100 per cent participation in all activities—without one citation ever received for misuse of the band. The T.K.R.L.'s first club paper, *The Keystoner,* issued Nov. 1, is clean-cut, well-written. Its pages feature a "Price Watch" listing everything from coins (Philadelphia-style) to increases and decreases in CB equipment prices. Paper also features rule warnings, "Space For Sale" (they need ads), and "Help Wanted" (they need typists, artists, proofreaders and others for the paper). If you're in the area and would like to help out this young group, drop a line to *The Keystoner,* 7807 Thouron Ave., Philadelphia, Pa.

The Citizens Radio Association of Lake County, Waukegan, Ill., participated in what was termed an S.O.S. program last October. A shipment of oral polio vaccine was found frozen on the day it was to have been used to inoculate county residents. The club's emergency patrol set up communication facilities in 29 clinic sites throughout Lake County to assist in delivering vaccine and other needed items to those clinics that experienced shortages. The group handled emergency runs for eight hours, was highly commended by civic and medical authorities, and invited to lend a hand at the next inoculation.

The Otter Valley Citizens Radio Club paper, *QRM,* recently reported on the fall session of the Tri-State CB Conference held in Schenectady, N.Y. Conference was attended by over 60 member-representatives of 14 CB clubs from New York, Vermont, Massachusetts, and Connecticut. Items discussed included goals for improving CB, how to maintain membership, publicity and public relations, publications, finances, activities, meeting places, community services and communications.

The CB Broadcaster, printed voice of the Greater Dallas Citizens Band Club, Dallas, Texas, lists the following month's monitoring schedule two weeks in advance of the duty-dates. To eliminate confusion and to be sure everyone knows what's happening and when, the assigned day of the week is listed, as is the date, the monitor's name, his call-sign, and his phone number. In the event the scheduled monitor knows in advance he will be unable to cover his duty period, seven alternate monitors are listed.

The 1964 club roster is near completion. If you haven't forwarded this year's officers, changes of address and any and all information of interest to CB'ers across the country—do it now! Forward your material (and pictures!) to Matt P. Spinello, CB Editor, One Park Avenue, New York 16, N.Y.

I'll CB'ing you. *—Matt, KHC2060*

Short-Wave Report

(Continued from page 72)

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 Eastern Standard and the 24-hour system is used. Reports should be sent to P.O. Box 254, Haddonfield. N.J. 08033, in time to reach your Short-Wave Editor by the eighth of each month; be sure to include your WPE Monitor Registration and the make and model number of your receiver.

Afghanistan—A registered letter from Kabul brought this latest schedule: on 15,225 kc. at 0530-0600 in Eng. to the Far East; at 1330-1400 in German and at 1400-1430 in French to Europe; on 15,135 kc. at 0600-0630 in Eng. to S.E. Asia and Indonesia; on 11,955 kc. at 1300-1330 in Arabic; on 4775 kc. at 0830-0900 in Urdu, at 0900-0930 in Eng., and at 1230-1300 in Russian.

Bolivia—CP18. *R. El Condor*, Oruro, 6070 kc., is still operating here in Spanish only with closing at 2200 after which CE607, Santiago, Chile, is heard.

Brazil—ZYR232, *R. Universitaria Santos Dumont*, Sao Jose dos Campos, is noted on 17,725 kc. around 1900 with classical and semi-classical music and multilingual announcements and requests for reports. This station is operated by students of the *Technological Institute of Aeronautics*.

Ceylon—The Commercial Service of *R. Ceylon* now transmits on announced frequencies of 15,205 and 9667 kc. at 2030-2230 (Sundays to 2330) and on 9667 kc. at 0730-1145. Special requests are being made for reception reports of sponsored programs; be sure to indicate the name of the sponsor. Reports go to Radio Advertising Services, P.O. Bag 10013, Bombay 1, India.

Chile—Noted after several years is CE602, *R. Portales*, Talca, 6020 kc. A local news bulletin in Spanish is given at 0005; semiclassical music follows. In years past they verified with a photographic-type card.

Colombia—*R. El Sol de Cali* is now on 5040 kc. and usually good from early evening. A letter from the station states that 6115 kc. is no longer in service. Station HJBG, *La Voz del Norte*, is again active on 4875 kc., though only fair. Station HJEQ, *La Voz de Cauca*, 6145 kc., is noted at times at 2000-2030 but with severe QRM. Station HJAG, *Emissora Atlantico*, 4900 kc., is fair to good most evenings from 1900 on.

Congo (West)—Brazzaville has discontinued their xmsn to N.A. However, their 1400-1500 xmsn to Africa on 15,190 kc., can usually be heard well. There is a newscast at 1430.

Czechoslovakia—*R. Prague* has instituted a new xmsn to N.A. on Sundays at 1000 on 15,285 and 17,830 kc. Reception reports are requested. This is in addition to the regularly scheduled N.A. xmsns. Prague's Spanish xmsn on Mondays at 2100 on 6000 kc. is causing severe QRM to *R. Americas*.

Ecuador—Currently being heard: HC2VP, *R. Atalaya*, Guayaquil, 4600 kc., with Latin American music and ads to 2200, an ID, then a short news bulletin, all Spanish; HCBK2, *R. El Mundo*, Guayaquil, with Spanish news at 2345 on 4710 kc.; HCQR1, *R. Quito, La Voz de Capital*, Quito, 4923 kc., with Latin American music and ads from 2200, many ID's.

Egypt—Cairo is noted on 9675 kc. at 1638-1700 with a newscast from 1645. A musical mailbag program is aired at 1701-1715.

Ethiopia—Station ETLF, *Radio Voice of the Gospel*, Addis Ababa, 15,435 kc., has Eng. news at 1515-1525 daily to W. Africa. The 9760-kc. outlet is heard from 1300 s/on in Eng., then into language.

Ghana—*R. Ghana*, Accra, is heard well at 1600-1635 on 11,800 kc.; at 0945-1028 on 17,910 kc.; and from 0935 to Sudan and Ethiopia on 15,190 kc. These are all in English.

Honduras—Station HRQW, *R. Juventud*, Tela, is noted on 4995 kc. at 1945-2010 with ID's, music, and ads.

Iran—A station believed to be *R. Teheran* has been tuned on 9660 kc. with singing at 1045, an ID in Persian (?) at 1100, then more singing to 1128. An ID was given, anthem played, and s/off effected at 1130.

Japan—At press time, *R. Japan*'s xmsn to N.A. at 1830 was being aired on 11,705, 11,780, and 15,135 kc., replacing 15,190 and 15,305 kc.

Jordan—Reported by one of our top men, Amman was noted on the unusual frequency of 8938 kc. from 1703 to 1900 s/off with singing, some western music, and mostly Arabic language. Has anyone else heard this station?

Korea (South)—The newest schedule from the *Voice of Free Korea* reads: General Service in Eng. at 0030-0100 on 11,925 kc.; at 0230-0300 on 15,125 kc.; and at 0530-0600 on 9640 kc. There is a 10-minute newscast at each opening. English to S.E. Asia is broadcast at 0900-0930 on 15,125 kc. French to Europe is broadcast at 0200-0230 and to Asia at 0930-1000, both on 15,125 kc. Spanish to Latin America is aired at 2230-2250, and Korean to the same areas at 2250-2300, both on 9640 kc. Reception reports are encouraged.

Mexico—Station XEBH, Hermosillo, Sonora, was noted on 11,560 kc. for several days but it was probably only spurious radiation from XEBR, 11,820 kc., which relays XEBH, 920 kc. Station XEWW, Mexico City, has been noted at times testing around 7200 kc.; further details are lacking.

Morocco—Rabat, 15,070 kc., has French at 1515-1530, Eng. from 1530 to past 1600 with

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	QRM—Station interference
Eng.—English	QSL—Verification
ID—Identification	R.—Radio
kc.—Kilocycles	s/off—Sign-off
mc.—Megacycles	s/on—Sign-on
N.A.—North America	xmsn—Transmission
	xmtr—Transmitter

DX Awards Presented

The following DX'ers have qualified for awards this month (100, 75, 50, and 25 countries verified). Congratulations, and welcome to the Awards List!

One Hundred Countries Verified

John W. Reasoner (WPEØCLU), Ames, Iowa
Bill Wambach (WPE9AT), Evansville, Ind.
Joseph L. Hueter (WPE3EP), Philadelphia, Pa.

Seventy-Five Countries Verified

Richard E. Lawrenson (WPE1QY), Camp Lejeune, N.C.

Fifty Countries Verified

David C. Eastman (WPE1AW), Ashton, R.I.
Frank Gregory (VE3PE1VQ), Brampton, Ontario, Canada
Will White III (WPE4FWR), Lexington, Ky.
Norman W. Styer Jr. (WPE3AA), Elverson, Pa.
Jerry H. Drott (WPE4ECG), Charleston, Miss.

Twenty-Five Countries Verified

Steve D. Carver (WPE2FVK), East Aurora, N.Y.
B. L. Manohar (VU2PE1D), Hubli, India
Joe Kasser (G2PE5S), London, England
Robert H. French (WPE8FGH), Bellaire, Ohio
Michael Fusick (WPE9EZX), Chicago, Ill.
Asher Fried (WPE2JNR), Paterson, N.J.
Mario Calleri (WPE1FFP), Lincoln, R.I.
Martin Thrope (WPE1ETP), Lowell, Mass.
D. M. Elliott (VE5PE1G), Moose Jaw, Sask., Canada
Robert F. Seiloff, (WPE8BAI), Battle Creek, Mich.
Charles Kaminski (WPE1DYZ), Norwich, Conn.
Walter Poppinga (WPE9CBC), Lafayette, Ind.
Daniel Dravet (VE2PE1EB), Montreal, Quebec, Canada
Al Burzynski (WPE6DJB), Glendale, Calif.
Robin Martin (WPE2GEH), Glen Head, N.Y.
Richard Thomas (WPE9JS), Minooka, Ill.
Lewis Strassberg (WPE2GWH), Brooklyn, N.Y.
Bruce Antonoff (WPE2KUG), New York, N.Y.
Mike Pilon (VE2PE1FW), Dorval, Quebec, Canada
Francis E. Duck (VE3PE5W), Grassie, Ontario, Canada
Robert Reinhard (WPE3EXG), Middletown, Pa.
Richard Mills (WPE2HOZ), New York, N.Y.
Jessee Ring (WPE4GLK), Narrows, Va.
Patricio McGrath (6YAPEIA), Kingston, Jamaica
Gale B. Francis (WPE6ERD), Sacramento, Calif.
Edward C. Bassett (WPE9EHF), Toledo, Ill.
David Decsman (WPE2FWL), Buffalo, N.Y.
John O'Donnell (WPE9GCK), Edwardsville, Ill.
Terry A. Radtke (WPE9FEL), Zachow, Wisc.

news from 1600 on. This is the African beam.

Netherlands—At deadline time, *R. Nederland* was airing its "Dutch By Radio" courses as follows: at 0230-0250 to Australia and New Zealand on 11,730, 9715, and 9630 kc., to India and W. Australia on 15,445 kc., and to Europe on 6020 kc.; at 1030-1050 to Middle and Far East on 15,445 and 11,710 kc., to Africa on 15,425 kc., and to Europe on 6020 and 5980 kc.; at 1740-1750 to N.A. and Europe on 9715 and 6085 kc.; and at 2030-2050 to N.A. on 6035 and 5950 kc. The lessons are repeated on Wednesdays at 1000-1020 to Middle and Far East on 15,445 and 11,710 kc., to Africa on 15,425 kc., and to Europe on 6020 and 5980 kc.; at 1530-1550 to N.A. and Europe on 9715 and 6035 kc.; and at 1730-1750 to N.A. and Europe on 9715, 6085, and 6020 kc. A new course is planned for 1964; details will be given as soon as they are received. Meanwhile, the "Happy Station Program" is being aired on Sundays as follows: at 0100-0225 to Australia, New Zealand, and Pacific areas on 9715 and 9630 kc.; at 0530-0800 to Europe, Far East, and Pacific areas on 21,480, 15,425, 6020, and 5980 kc.; at 1100-1225 to Africa, Middle East, and Europe on 17,775, 15,425, and 6020 kc.; at 1600-1730 to Latin America, Spain, and Portugal on 11,730, 6085, and 6020 kc.; and at 2100-2230 to N.A. on 9590 and 5984 kc.

Peru—Station OAX10, *R. Chiclayo*, Apartado Postal 229, Chiclayo, has moved from 5680 kc. to 5521 kc. and features many time checks and ads. They close at 0000. Station OAX3E, *R. Huaras*, Huaras, 5699 kc., also closes at 0000 after a lengthy listeners' request program; reports of this being on 5710 kc. are in error and probably refer to *R. Ayaviri*, another Peruvian on 5714 kc. Station OAX8Q, *R. Pucallpa*, Jiron Ucayali, Pucallpa, 9580 kc. has been heard but with great difficulty around 1839-1850 in Spanish with ads and local news. Station OAX8F, *R. Loreto*, Casilla 174, Iquitos. 9504 kc., is often confused with HI4U, Santo Domingo, D.R., on 9505 kc. and/or the Chilean station on 9502 kc. Station OAX8F operates in dual, at times, with 4456 kc.

Reunion—St. Denis was tentatively logged on 3380 kc. with African-type music at 1815-1830; French news at 1830-1845; music to 1900; unreadable after 1915.

South Africa—A new schedule shows operations at 2200-2300 on 6150 and 7275 kc., at 0500-0945 on 21,690 kc., at 0945-1300 on 9525 kc., at 1300-1615 on 7275 kc., at 0500-1210 on 15,080 kc., at 1210-1500 on 11,900 kc., and at 1500-1615 on 6150 kc. This is the African Service.

Station ZUD, a telephone station in Olifantsfontain, operates daily around 2215 on 9180 kc. with a test xmsn. They will verify.

Switzerland—Berne's N.A. East Coast xmsn is now beamed on 9665 kc. (replacing 11,865 kc.), 9535 and 6165 kc. at 2030-2145. The West Coast xmsn at 2330 has been deleted and incorporated into the India and Pakistan xmsn at 0945-1100 on 11,865 and 9665 kc. (to India and Pakistan) and 15,315 kc. (to N.A.).

Turkey—Ankara's latest schedule shows Eng. at 0845-0915 to S. and S.E. Asia on 17,820 kc. and at 1600-1700 (no target area listed but presumably to Europe and United Kingdom) on 15,160 kc.

Erzurum, 7647 kc., is noted with Arabic chanting from 2302; some modern European music around 2327; all announcements in Turkish. This is a regional station.

U.S.S.R.—*R. Kiev* has Eng. to N.A. on Mondays, Thursdays, and Saturdays at 2100-2120 on 7210, 9610, 9670, and 9710 kc., and at 2300-2320 on 7190, 7210, and 9710 kc.

Vietnam (North)—Hanoi was noted on 9760 kc. at 0550 with native music, at 0600 a gong and native language ID, then a talk, at 0615 music and another talk. A report to the station was returned from San Francisco with the notation that mail service to this country had been suspended.

Clandestine—The mailing address for *R. Libertad* is P. O. Box 1624, Miami 1, Florida, not Box 2624 as previously listed in this column. A self-prepared QSL, written in Spanish, was returned with the signature of Humberto Lopez Perez, Engineer. (One reader asked if this station were located aboard the S. S. *Rex*. While your Short-Wave Editor has also noted that the *Rex* has been in the news recently and while we believe that *R. Libertad* is on shipboard, we still have no information as to exactly what ship, if any, is used as headquarters for this station.)

Medium-Wave Stations

The standard broadcast band continues to command a considerable amount of attention during the current cycle of minimum sunspots. The following is a listing of stations heard within the past month by DX'ers in many of the Eastern states, plus a few items from Californians. Try for them; you'll log a number of countries that you won't normally catch on the short waves. The listing is by frequency.

550 Montego Bay, Jamaica—nights
560 YVLX, *R. Rumbos*, Caracas, Venez.—nights; Kingston, Jamaica
580 WKAQ, San Juan, P.R.—nights
584 Madrid, Spain—around 1840-1900
620 HIST, *R. Santo Domingo*, D.R.—nights
625 TIRICA, *La Voz de la Victor*, San Jose, C.R.—around 2100
640 Point-a-Pitre, Guadeloupe—sunset
642 Paramaribo, Surinam—best on Mondays at 0345
644 St. Johns, Antigua—around sunset
650 YVQO, *Ondas Portenas*, Venez.—1830-1930
660 TGLM, *R. Seis Sesenta*, Guatemala—2300-0000
670 HRN, *La Voz de Honduras*, Tegucigalpa—2300-2330
675 Union Radio, Nicaragua—fair 0000-0100
690 R. Pregresso, Havana, Cuba—around 2230
700 Montego Bay, Jamaica—around sunset
720 YVQR, *R. Cumana*, Cumana, Venez.—nights
HJAN, *Emissora Unidas*, Colombia—1930-2030
725 TILX, *R. Colombia*, San Jose, C.R.—0000-0200
730 CMCA, Havana, Cuba—evenings; Eng. at 1800-1830
XEX, Mexico City—around 2215
HJCU, *R. Tricolor*, Colombia—1900-2000
740 HRYN, *La Voz Del Merendon*, Honduras—2300-0000
750 Port Maria, Jamaica—around sunset
755 CSA3, Lisbon, Portugal—evenings around 1820 with English "Voice of the West" program
775 TIW, *Radio City*, San Jose, C.R.—nights
782 CSB9, Miramar, Portugal—evenings
820 HJED, Cali, Colombia—evenings; some Eng. ID's
828 YNOL, *Ondas Del Luz*, Managua, Nicaragua—English religious programs during the evenings
833 Belize, British Honduras—very strong

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evenings; Eng. from 1900; s/off 2235; they announce as *British Caribe* in Spanish

840 Castries, St. Lucia—French but with some Eng. ads

HJBI, *Ondas Del Caribe*, Colombia; evenings; best at 0000-0100

KOST, location unknown, definite ID (KOST listed as an FM station in Houston, Texas, on 100.3 mc.—Ed.)

845 Rome, Italy—early evenings; French news at 1930

855 PJC2, *R. Curom*, Willemstad, Curacao—nights

870 WHOA, San Juan, P. R.—sunset

900 CMJV, Ciego de Avila, Cuba—evenings

XEW, Mexico City, Mexico—2030-2100.

925 TIR, *Radion*, Costa Rica—after 0000

935 Agadir, Morocco—around 1845

950 LR3, Buenos Aires, Argentina—0415-0445

965 YNLU, *R. Managua*, Nicaragua—nights

970 WIVI, Christanstad, Virgin Islands—sunset

1000 WBNB, Charlotte Amalie, Virgin Islands—sunset

1033 HJGE, *R. Bucaramanga*, Colombia—Eng. ID at 2230

1035 4VE, Cap Haitien, Haiti—evenings in Eng. and French

1043 Dresden, East Germany—strong around 2230

1050 XEG, Monterrey, Mexico—Eng. around 0130

1075 TIFC, San Jose, C.R.—Spanish and Eng. religious programs

1090 CX28, *R. Imparcial*, Montevideo, Uruguay—around 0245

SHORT-WAVE MONITOR CERTIFICATE APPLICATION

ALL radio listeners interested in furthering the hobby of SWL'ing—regardless of whether you DX on the BCB, VHF, TV, SW, or FM bands—are eligible to apply for a POPULAR ELECTRONICS "Certificate of Registration." You must have verified (have QSL cards from) a minimum of five radio stations, of which one was outside the borders of the United States. There is no age limit, or special equipment qualification; the only requirement is that the applicant have a sincere interest in radio communications.

A new certificate processing procedure has just been introduced. All certificates are filled in and lettered before mailing. All certificates are now mailed flat and unfolded. If you want to register and receive your WPE identification sign, fill in the new application blank below before March 15, 1964. Mail with 25 cents in coin to: Monitor, POPULAR ELECTRONICS, One Park Avenue, New York, N. Y., 10016. Canadians should use their own currency. All other applicants not in the U. S. A. should use five International Postal Reply Coupons. Allow 2-4 weeks for processing.

(Do not fill out)

(Please Print)

Name ....

Street, City and Zone ....

State and Zip ....

Receivers in use Make .... Model ....

Make .... Model ....

Age Occupation ....

Ham/CB call-letter assignment(s) ....

I listen mostly to SW Broadcast Hams CB BCB VHF VLF ....

I use the following antennas ....

I have QSL cards and countries verified. Check if subscriber to P.E. ....

Signature Date ....

(Good only until March 15, 1964)

SHORT-WAVE CONTRIBUTORS

Andrew Kasparson (*WPE1DFW*), Auburn, Mass.
Michael Bugaj (*WPE1EZB*), Middletown, Conn.
Riley Sundstrom (*WPE2AJ*), Stockton, N. J.
Irwin Belofsky (*WPE2BYZ*), Brooklyn, N. Y.
Gerry Klinck (*WPE2FAH*), Buffalo, N. Y.
Harley Rutstein (*WPE2HKR*), Englewood, N. J.
Les Shattuck, (*WPE2HZU*), Locke, N. Y.
Bruce Felzer (*WPE2JKR*), Long Beach, N. Y.
Emil Vandevelde (*WPE2KHS*), Oakland, N. J.
Al Quaglieri (*WPE2KMH*), Albany, N. Y.
Dean Steiner (*WPE2KVX*), New York, N. Y.
John Feldman (*WPE3EHU*), Feasterville, Pa.
John McKillop (*WPE3EMA*), Washington, D. C.
Joseph Hueter, Sr. (*WPE3EP*), Philadelphia, Pa.
R. M. Daniel, Jr. (*WPE3EXU*), Swarthmore, Pa.
Grady Ferguson (*WPE4BC*), Charlotte, N. C.
Chuck Edwards (*WPE4BNK*), Fort Lauderdale, Fla.
John Brunst (*WPE4BQ*), Neptune Beach, Fla.
David Pope (*WPE4DMX*), Crescent Beach, S. C.
Roy Moore (*WPE4FWH*), Hazard, Ky.
Steve Kercel (*WPE4FZZ*), Chester, Va.
Jack Keene (*WPE5BMP*), Houston, Texas
John Hopkins (*WPE5DPN*), New Orleans, La.
Bill Lund (*WPE6CI*), Manhattan Beach, Calif.
Charles Matterer (*WPE6DGI*), San Leandro, Calif.
W. E. Lipis (*WPE6DRU*), El Cajon, Calif.
Bob Bilkiss (*WPE6EI*), Los Angeles, Calif.
John Miller (*WPE8FOC*), Parkersburg, W. Va.
Dan Schonberg (*WPE8FWH*), Shaker Heights, Ohio
Jerry Heien (*WPE9BOD*), Berkeley, Ill.
Phil Cutler (*WPE9EFL*), Barrington, Ill.
Pat Zuller (*WPE9FSU*), Lombard, Ill.
Arthur Backstrom (*WPE9GAK*), Chicago, Ill.
John Beaver, Sr. (*WPE0AE*), Pueblo, Colo.
Jack Perolo (*PY2PE1C*), Sao Paulo, Brazil
Gary Cooper (*VE3PE1MX*), St. Catharines, Ont., Canada
Doug Renwick (*VE6PE4X*), Stettler, Alberta, Canada
Ashok Shanku (*VU2PE1E*), Bombay, India
Argon Akomer, M.D., Hollywood, Fla.
Joe Piechuta, Meriden, Conn
Clifford Stott, W. Springfield, Mass.

1155 HIAS, Santo Domingo, D.R.—nights
1196 *Voice of America*, Munich, Germany—sunset; Eng. news at 0000
1205 Bordeaux, France—around 2230 but as early as 1630 in Conn.
1235 ZBM1, Hamilton, Bermuda—nights
1376 Bordeaux, France (same as on 1205 kc.)
1385 4VS, Port-au-Prince, Haiti—nights
1395 HCVE4, Esmeraldas, Ecuador—nights
1466 3AM2, Monte Carlo, Monaco—sunset; also around 0030
1500 Fort-de-France, Martinique—1800-2100
1538 Dakar, Senegal—1815-1830 or around local sunset
1540 ZNS, Nassau, Bahamas—excellent all day in southeastern states; good evenings in many areas
1565 *R. Libertad*—s/off 0037.
1570 XERL (formerly XERF) Ciudad Acuna, Mexico—Eng. around 0200; reports go to XERL, Del Rio, Texas

The above stations represent only a small fraction of what can be heard in the frequency range of 540-1600 kc. The times given for these stations are not their only operating times; they are the times when you stand a reasonably good chance of hearing them provided that you tune carefully and that conditions are better than average.

We would welcome reports of medium-wave stations other than those listed here, as well as more reports from our West Coast readers. No doubt some of the DX'ers in western states can hear some of the trans-Pacific stations. Give us an indication of the best times to listen. —30—

ELECTRONICS MARKET PLACE

RATE 60¢ per word. Minimum 10 words prepaid. April issue closes February 5th. Send order and remittance to Martin Lincoln. POPULAR ELECTRONICS, 1 Park Ave., New York 16, N. Y.

FOR SALE

GOVERNMENT Surplus Receivers, Transmitters, Snooperscoopes, Parabolic Reflectors, Picture Catalog 10¢. Meshna, Nahant, Mass.

WPE-CB-QSL cards—Brownie-W3CJI—3111A Lehigh, Allentown, Pa. 18103. Catalogue with samples 25¢.

CB WPE QSL Cards, Samples Free. Radio Press, Box 24, Pittstown, New Jersey.

"SPECIAL! WPE-SWL-CB-QSL cards, 3 colors, $2.50 per 100—Free Samples, Garth, Jutland, New Jersey."

TRANSISTORIZED Products Importers catalog, $1.00, Intercontinental, CPO 1717, Tokyo, Japan.

INVESTIGATORS, free brochure, latest subminiature electronic listening devices. Ace Electronics, 11500-L NW 7th Ave., Miami 50, Fla.

CANADIANS—GIANT Surplus Bargain Packed Catalogs. Electronics, Hi-Fi, Shortwave, Amateur, Citizens Radio. Rush $1.00 (Refunded). ETCO, Dept. Z., Box 741, Montreal, CANADA.

TELEPHONE Voice Switch (LS-500). Actuates automatically and unattended any tape or wire recorder. Pictorial installation instructions included. $23.75. Post Paid US. WJS Electronics, 1525 No. Hudson, Hollywood 28, Calif.

14 Weather instrument Plans $1.00. Saco, Box 2513B, South Bend, Indiana.

TRANS-NITION electronic ignition parts kit. Negative ground $20.00. Coil, Manual special $8.50. Manual $2.00. Anderson Engineering, Wrentham, Massachusetts.

INVESTIGATORS! Do your own sound work. Send $1.00 for brochure of latest electronic equipment. WJS Electronics, 1525 No. Hudson, Hollywood 28, California.

SUPERSENSITIVE Listening-In-Device picks up any telephone conversation in vicinity. No connection to telephone necessary. Easily concealed. $2.98 complete. Consolidated Acoustics, F1302 Washington Street, Hoboken, New Jersey.

DIAGRAMS for repairing Radios $1.00. Television $2.50. Give make model. Diagram Service, Box 1151 PE, Manchester, Connecticut 06042.

SAVE Money—Free catalog: Photography, Tape Recorders, Hi Fidelity, Electronics, Tools. Wholesale Radio & Camera Co., Box 3085, Phila. 50, Pennsylvania.

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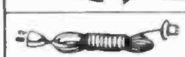

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___1U5	.65	___6BF6	.44	___6T8	.85	___12DT8	.79
___1X2B	.82	___6BG6	1.70	___6U8	.83	___12DW8	.89
___2AF4	.96	___6BH8	.98	___6V6GT	.54	___12DZ6	.62
___3AL5	.46	___6BJ6	.65	___6W4	.61	___12ED5	.62
___3AU6	.54	___6BJ7	.79	___6W6	.71	___12EG6	.62
___3AV6	.42	___6BK7	.85	___6X4	.41	___12EK6	.62
___3BC5	.63	___6BL7	1.09	___6X8	.80	___12EL6	.50
___3BN6	.75	___6BN6	.74	___7A8	.68	___12EZ6	.57
___3BU8	.78	___6BQ6	1.12	___7AU7	.65	___12F8	.66
___3BY6	.58	___6BQ7	1.00	___7EY6	.75	___12FA6	.79
___3BZ6	.56	___6BU8	.70	___7Y4	.69	___12FM6	.50
___3CB6	.56	___6BX7	1.11	___8AU8	.90	___12FR8	.97
___3CS6	.58	___6BZ6	.55	___8AW8	.93	___12FX8	.90
___3DG4	.85	___6BZ7	1.03	___8BQ5	.60	___12GC6	1.06
___3DK6	.60	___6C4	.45	___8CG7	.63	___12J8	.84
___3DT6	.54	___6CB6	.55	___8CM7	.70	___12K5	.75
___3GK5	.99	___6CD6	1.51	___8CN7	.97	___12L6	.73
___3Q4	.63	___6CG7	.61	___8CS7	.74	___12SF7	.69
___3S4	.75	___6CG8	.80	___8EB8	.94	___12SK7GT	.95
___3V4	.63	___6CL8	.79	___8FQ7	.56	___12SL7	.80
___4BQ7	1.01	___6CM7	.69	___9CL8	.79	___12SN7	.67
___4CS6	.61	___6CN7	.70	___11CY7	.75	___12SQ7GT	.91
___4DT6	.55	___6CQ8	.92	___12A4	.60	___12U7	.62
___4GM6	.60	___6CR6	.60	___12AB5	.60	___12V6	.63
___5AM8	.79	___6CS6	.57	___12AC6	.55	___12W6	.71
___5AN8	.90	___6CS7	.69	___12AD6	.57	___12X4	.47

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Qty. Type	Price	Qty. Type	Price	Qty. Type	Price	Qty. Type	Price
___5AQ5	.54	___6CU5	.58	___12AE6	.50	___17AX4	.67
___5AT8	.83	___6CU6	1.08	___12AE7	.94	___17DQ6	1.06
___5BK7	.86	___6CY5	.70	___12AF3	.73	___18FW6	.49
___5BQ7	1.01	___6CY7	.71	___12AF6	.67	___18FX6	.53
___5BR8	.83	___6DA4	.68	___12AJ6	.62	___18FY6	.50
___5CG8	.81	___6DE6	.61	___12AL5	.47	___19AU4	.87
___5CL8	.76	___6DG6	.62	___12AL8	.95	___19BG6	1.39
___5CQ8	.84	___6DJ8	1.21	___12AQ5	.60	___19EA8	.79
___5EA8	.80	___6DK6	.59	___12AT6	.50	___19T8	.85
___5EU8	.80	___6DN6	1.55	___12AT7	.76	___21EX6	1.49
___5J6	.72	___6DQ6	1.10	___12AU6	.51	___25AX4	.70
___5T8	.86	___6DT5	.81	___12AU7	.61	___25C5	.53
___5U4	.60	___6DT6	.53	___12AV6	.41	___25CA5	.59
___5U8	.84	___6DT8	.94	___12AV7	.82	___25CD6	1.52
___5V6	.56	___6EA8	.79	___12AX4	.67	___25CU6	1.11
___5X8	.82	___6EB5	.73	___12AX7	.63	___25DN6	1.42
___5Y3	.46	___6EB8	.94	___12AY7	1.44	___25EH5	.55
___6AB4	.46	___6EM5	.77	___12AZ7	.86	___25L6	.57
___6AC7	.96	___6EM7	.82	___12B4	.68	___25W4	.68
___6AF4	1.01	___6EU8	.79	___12BD6	.50	___32ET5	.55
___6AG5	.70	___6EV5	.75	___12BE6	.53	___35C5	.51
___6AH4	.81	___6EW6	.57	___12BF6	.60	___35L6	.60
___6AH6	1.10	___6EY6	.75	___12BH7	.77	___35W4	.42
___6AK5	.95	___6FG7	.69	___12BK5	1.00	___35Z5	.60
___6AL5	.47	___6FV8	.79	___12BL6	.56	___36AM3	.36
___6AM8	.78	___6GH8	.80	___12BQ6	1.16	___50B5	.69
___6AQ5	.53	___6GK5	.61	___12BR7	.74	___50C5	.53
___6AS5	.60	___6GK6	.79	___12BV7	.76	___50EH5	.55
___6AT6	.49	___6GN8	.94	___12BY7	.77	___50L6	.61
___6AT8	.86	___6H6	.58	___12BZ7	.86	___70L7	.97
___6AU4	.85	___6J5GT	.51	___12CN5	.56	___117Z3	.85
___6AU6	.52	___6J6	.71	___12CR6	.67	___807	.75

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Protect your future through the New CREI Program in Space Electronics

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The Most Sweeping Change in Speaker System Design... Starts with the New E-V FOUR!

Until now, there have been just two ways to determine the absolute quality of a speaker system: the scientific method, and the artistic approach. But each, by itself, has not proved good enough.

The scientist, with the help of impersonal equipment, charts and graphs, has strived to obtain the finest possible measured results. If the figures were right, then it *had* to sound right, and anyone disagreeing was dismissed as "not objective". But often, two speakers measured substantially the same, yet sounded quite different.

On the other hand, the artistic school of loudspeaker design has depended on the judgement of a handful of experts whose "golden ears" were the final yardstick of perfection. If you didn't agree with the experts, your ear was "uneducated" and not discriminating. But too often the measured response of the expert's system fell woefully short of reasonable performance—proof that even trained listeners can delude themselves when listening to loudspeakers.

Now, with the introduction of the E-V FOUR, Electro-Voice has pioneered a blend of the best features of both measurement methods to lift compact speaker performance to a new level of quality. It wasn't easy. The use of both techniques required extensive facilities, something E-V enjoys in abundance.

For instance, E-V has one of the industry's largest, most completely-equipped laboratories for the study of acoustical performance. Actually, the E-V engineering staff alone is larger than the entire personnel complement of many other speaker firms. In the E-V lab, measurement of speaker performance can be made with uncommon precision. And the interpretation of this data is in the hands of skilled engineers whose full time is devoted to electro-acoustics.

But beyond the development of advanced scientific concepts, E-V embraces the idea that a thorough study of the subjective response to reproduced sound is essential. E-V speakers must fully meet both engineering and artistic criteria for sound quality. Where we differ from earlier efforts is in greatly increasing the sample of expert listeners who judge the engineering efforts.

To this end, experts in music and sound from coast to coast were invited to judge and criticize the E-V FOUR exhaustively before its design was frozen. Adjustments in response were made on the spot—in the field—to determine the exact characteristics that define superb performance. It was not enough to say that a unit needed "more bass". What kind of bass? How much? At what frequencies? These are some of the more obvious questions that were completely settled by immediate adjustment and direct comparison.

The new E-V FOUR is the final result of this intensive inquiry into the character of reproduced sound. According to wide-spread critical comment, the E-V FOUR sound is of unusually high calibre. And careful laboratory testing reveals that there are no illusions—the measurements confirm the critics' high opinion of this new system.

Of course, it is one thing to design an outstanding prototype—and something else to produce an acoustic suspension system in quantity at a fair price. It is here that extensive production facilities, combined with creative engineering approaches, guarantee the performance of each E-V FOUR. And these same facilities ensure reasonable value. For instance, the E-V FOUR sells for but $136.00 with oiled walnut or mahogany finish and just $122.00 in unfinished birch. Yet, in judging its sound qualities, it was successfully compared with speaker systems costing as much as $200.00.

We urge you to make your own analysis of E-V FOUR compact speaker performance. Visit your E-V high fidelity showroom and compare, carefully, this new system. We feel certain that you will agree with the engineers and the critics that the new E-V FOUR offers a truly full measure of high fidelity satisfaction.

E-V FOUR components include: 12" acoustic suspension woofer / Ring-diaphragm mid-range driver / 5" dynamic cone tweeter / Etched circuit crossover

ELECTRO-VOICE, INC.
Dept. 244P, Buchanan, Michigan

Electro-Voice
SETTING NEW STANDARDS IN SOUND

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