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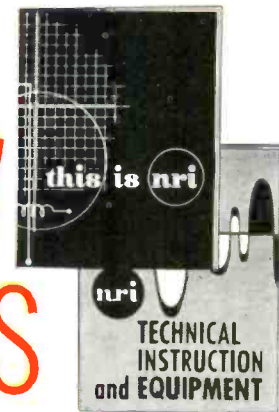
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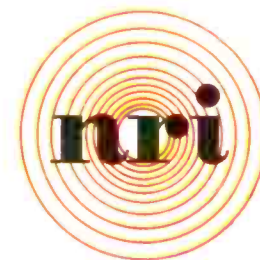


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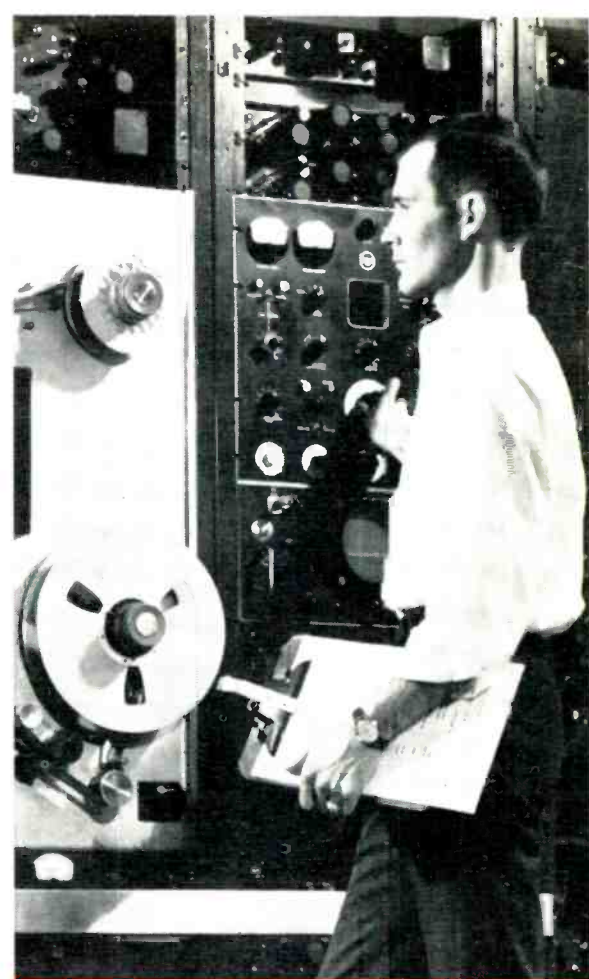
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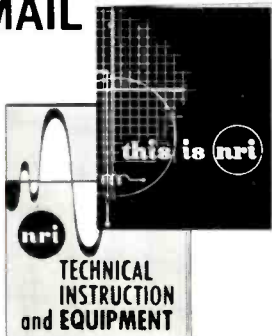
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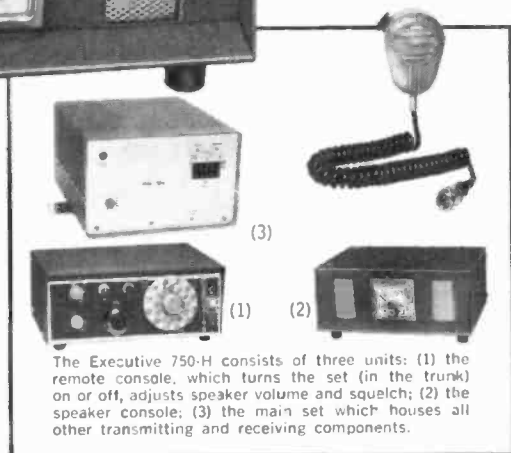
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VOLUME 21

JULY, 1964

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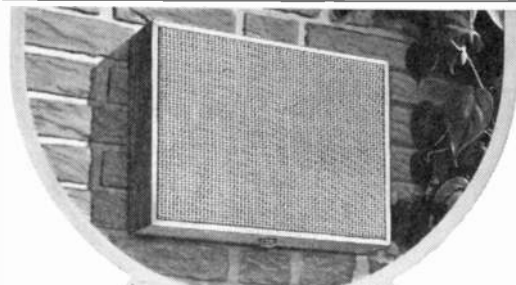
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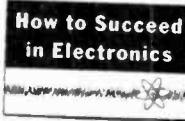
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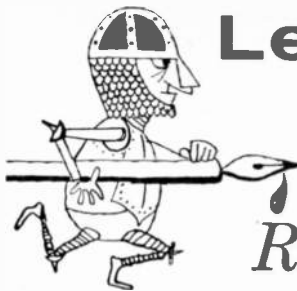
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Letters from our Readers

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Real-Life Components Wanted

■ How about a series of electronic theory articles in which each component would function as intended, but would take on human characteristics? The action could take place in "Schematicsville," and the characters might be "Coil," a shapely chick; "Ann Tenna," a skinny little gal with waving arms; "Mic Ro Farad," who runs the "Capacitor Motels"; etc. The police department would be made up of the Ohmsquad, its members often decorated with colored stripes on their uniforms.

CHARLIE FIELDS
Indianapolis, Ind.

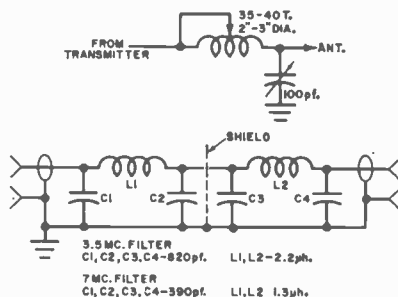
And then there could be "Solder Lug," an out-and-out crook; "R. F. Choke," a roughneck friend of his who is foiled by "Henry"; and "Chassis," a beautiful gun moll. We like the idea, Charlie, and will consider it for future use.

Novice Harmonics

■ Ever since I received my Novice ticket and put my rig on the air, I've had trouble with strong harmonic radiation on 80 and 40 meters. I wonder if you could publish some information on reducing harmonics—I bet there are a lot of hams in the same situation. Would an antenna tuner help solve the problem? How about filters, traps, etc.?

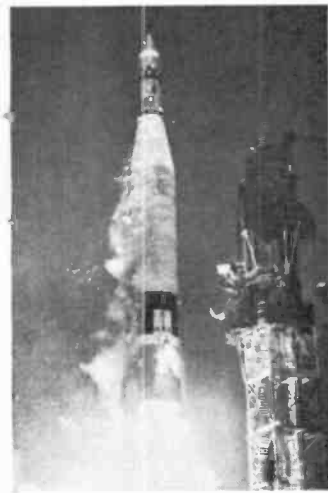
JOHN STENSBY, JR., WN4RES
Huntsville, Ala.

Well, first off, John, you should definitely try an antenna tuner. Aside from the advantages it will offer in impedance matching, it will add considerable selectivity to your antenna system, and greatly reduce harmonic radiation. One of our favorites is the simple

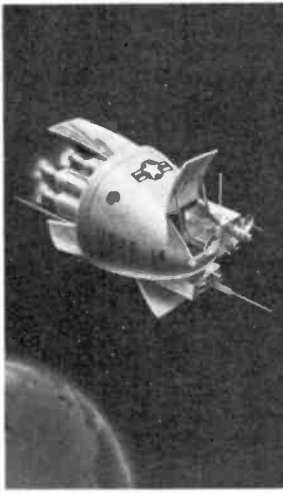


"L" tuner shown here; it will match a wide variety of antennas. If your harmonics can still be heard more than a mile away, you can say goodbye to them forever with a harmonic filter built into a tin can; you'll

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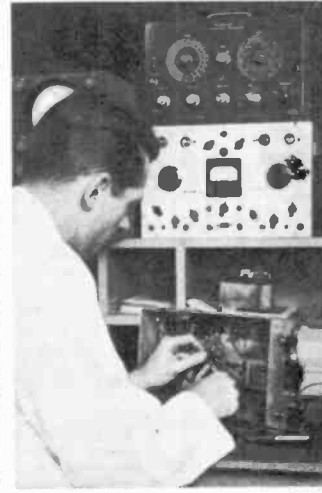
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Letters

(Continued from page 6)

need one for each band you work. See the ARRL Handbook and Antenna Book for more information.

Labels Lambasted

POPULAR ELECTRONICS has always had a very attractive cover except for one thing—the mailing label. At the moment, I'm looking at the cover of the April (1964) issue which reads: "...d circuit." "... talkie." and "...t kit (p. 65)." Is there any way to remove



the label without ruining the cover? Better yet, how about putting it on the back cover?

RICK VOGT, WN9JRY
Chicago, Ill.

There's no handy way to remove mailing labels that we know of, Rick, unless it's steaming them off, and, unfortunately, we'd get in trouble with the post office if we put them on the back cover. Most months we do try to put the printing where the label won't be, however.

"Secret Tube" Claims Disputed

Concerning "The Secret Tube That Changed the War" (March, 1964) which is credited to Major Harold Zahl by author Orr, your readers may be interested to know that the basic patent on such a tube, which included the tuned circuits as well as the electrodes in a glass envelope, was filed by the writer in England during 1925 and issued under International Convention in the United States during 1930. The Zahl tube in fact was so similar to the writer's 1925 model 150-mc. tube described in his patent that a settlement in favor of the writer was obtained by action in the United States Court of Claims, Washington, D. C.

W. J. BROWN
Registered Professional Engineer
Stamford, Conn.

Intrigued by Mr. Brown's letter, we asked both Dr. Harold A. Zahl and author Orr to comment on it. Both were kind enough to do so, and their letters (in part) appear below.

U. S. Patent No. 2,522,557 covering the VT-158 as mentioned in Mr. Orr's story was filed by the undersigned on Jan. 25, 1943, and issued Sept. 19, 1950. Twenty-six claims covering the features of my tube were granted. Eighteen earlier patents, including Mr. Brown's, were cited during the prosecution of my patent application. The issuance of my patent by the U. S.

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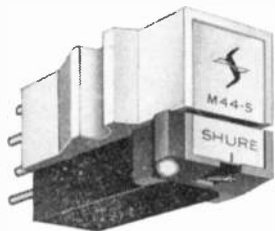
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CIRCLE NO. 26 ON READER SERVICE PAGE

Letters

(Continued from page 8)

Patent Office indicates that my tube was patentably different from all of these earlier patents, including the patent to Mr. Brown. I, of course, do not wish to take any credit for what Mr. Brown did. My patent covers my contribution to an art in which many others made successive contributions.

The VT-158 was made in production lots of tens of thousands and the radar sets using these tubes saw service in both major theaters of WW II and later in Korea. I enjoyed Mr. Orr's article very much and his accolades made particularly pleasant reading for me.

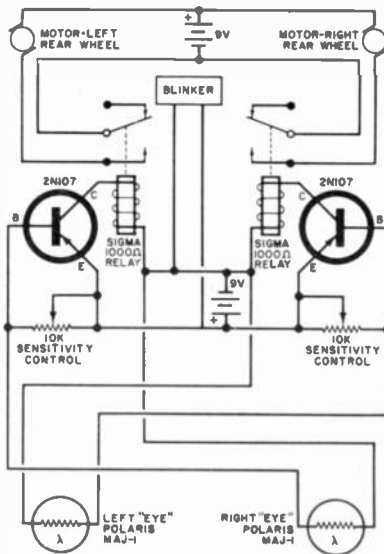
HAROLD A. ZAHL
Fort Monmouth, N.J.

■ Many interlocking and overlapping patents exist in the field of electronics and several patents exist in the area of electron tubes which contain internal circuitry. The Coaxitron is one such example, and other patents in this field are traceable to de Forest and Edison. In any event, Dr. Zahl created a device that was sorely needed and was not otherwise available, and that served his country in a time of dire need.

WILLIAM I. ORR
San Carlos, Calif.

He Builds "The Lightning Bug"

■ The statement you made recently that "The Lightning Bug" (Carl and Jerry, Nov., 1963) exists only in the story is false. Needing a new stunt for a Halloween party, I built a prototype. The schematic shows



the design used—the exterior is a matter of taste. Currently I'm working on "The Girl Detector" (Carl and Jerry, Jan., 1964).

RALPH M. REESE, JR., WN4QAA
Niceville, Fla.

We hope you make out well with your second project, Ralph!

The "Forgotten" Citizens Band

■ A holder of Class B, C, and D Citizens Radio permits (in addition to an amateur ticket), I have never once read about operations in the 460-470 mc.

POPULAR ELECTRONICS

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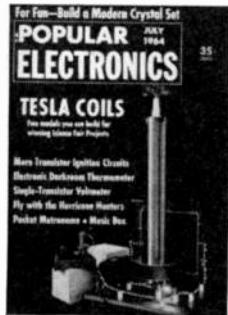
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Letters

(Continued from page 10)

Class B Citizens Band. A number of years ago, one company put out a relatively inexpensive transceiver for this region, but to date all the equipment I have seen for 460 consists of high-priced business rigs. Who manufactures this equipment? Are there many individuals with a "B" ticket or am I the only one?

DAVE P. WEIK, KA10619/KAG3247
Livingston, N. J.

You are not alone, Dave. Theoretically at least, the 460-470 mc. Class B service is intended for exactly the same purposes as the 26.96-27.255 mc. Class D service, and anyone can get a Class B ticket if he has a need for one; many have. Equipment is another story, however. Gear—which must conform to FCC Regs—is expensive to produce for 460, is relatively difficult to install and service, and has a limited range in some locales. Practically speaking, therefore, the band is used mostly by small businesses and others with communications needs more pressing than those of most CB'ers. Some manufacturers of Class B equipment are Link, RCA, Motorola, and GE.

Pico Equals Micromicro

■ POPULAR ELECTRONICS recently published the schematic of a wireless microphone ("Transistor Topics," March, 1964), giving the values of two capacitors as 100 pf. and 250 pf. What does "pf." mean?

CHARLES F. LESTER, M. D.
Miami, Fla.

The abbreviation "pf." is for "picofarad," which replaces the older term, "micromicrofarad" ($\mu\mu\text{f.}$). "Pico" was one of the recommended unit prefixes recently adopted by the International Committee on Weights and Measures, and means (as does "micromicro") 10^{-12} .

Found: Genuine Bargain

■ With reference to "Bargains by the Bagful" (February, 1964), you may be interested in a good buy I made recently—the amplifier section of a stereo tape recorder manufactured by a firm which went out of business. The unit—selling for 95 cents—included 37 half-watt resistors, 8 one- and two-watt units, 33 capacitors, 7 tube sockets, 2 dual controls with switches—over 80 parts, ALL of which checked good!

DENNIS C. SMITH
Detroit, Mich.

Any more where those came from, Dennis?

Out of Tune



C Bridge (November, 1963, page 66). The value of C1, specified in the Parts List as 100 $\mu\mu\text{f.}$, should be .001 $\mu\text{f.}$ as shown in the schematic diagram.

The **WXCVR** (January, 1964, page 65). The value of C2, specified in the Parts List as 470 $\mu\text{f.}$, should be 470 $\mu\text{f.}$ (or pf.) as shown in the schematic diagram.

-30-

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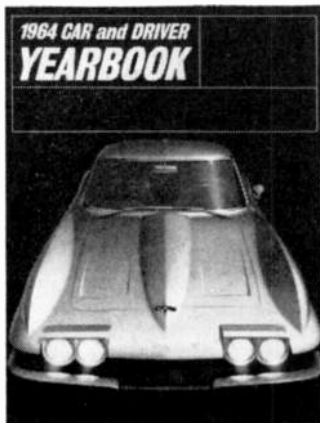
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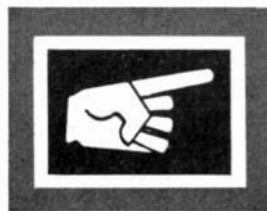
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Tips and Techniques

DEGAUSS YOUR TAPE RECORDER HEADS

When your tape recorder begins to sound "muddy," it's a good indication that the heads are in need of degaussing (or demagnetizing). There are commercial degaussers available, but it's easy to make one. Saw a $\frac{1}{8}$ " slot in a

$\frac{1}{2}$ " flat iron washer and wind six or eight turns of #14 or #16 insulated wire on the washer. Connect the wire ends to your soldering gun (after you remove the soldering element), and you'll be able to degauss both the heads and guides. The tool can also be used to erase small sections of recorded tapes, such as unwanted switch pops, or words.



—R. K. Dye

A "BELT" FOR YOUR SIGNAL

Planning to take your transistor radio on a camping or hiking trip? For better reception, make a belt out of TV twin-lead and a buckle from an old belt. Cut the twin-lead to a length slightly longer than one of your regular belts, and punch the appropriate holes in it. Fold over the



buckle end and fasten it securely. Now connect the leads together at the other end, and solder one of the leads at the buckle end to the buckle. A clip-lead from the

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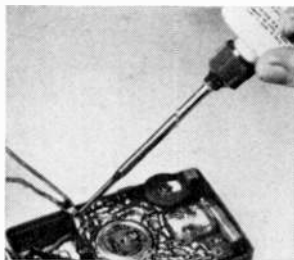
(Continued from page 14)

transistor radio antenna jack to the buckle will improve reception, especially in remote areas far from a radio station.

—John A. Comstock

REMOVE EXCESS SOLDER WITH A "SOLDER SUCKER"

Softening solder with heat is just part of the de-soldering problem. Using a wire brush to remove the soft solder causes it to splatter around where it isn't wanted. You can solve this problem with an empty squeeze bottle and an empty ball-point pen cartridge. Just remove the feed tube from



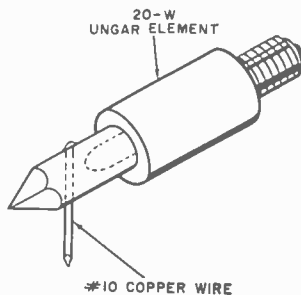
inside the squeeze bottle, and enlarge the opening in the nozzle to accept the cartridge from which the ball-point tip has been removed.

To use the "solder sucker," squeeze the bottle and plunge the end of the tube into the pool of melted solder, then release the pressure on the bottle. The solder will be sucked up into the bottle. Should the tip become clogged, it can be cleaned with heat and a piece of wire.

—Jerome Cunningham

DOUBLE-DUTY SOLDERING TIP

Need a small low-heat soldering tip? Carefully drill a hole through the end of an Ungar 20- or 50-watt soldering tip element,



drilling a hole close to the end as possible to avoid damage to the heating element. Mash one end of a short length of #10 solid copper wire and insert the other end through the hole. Force the

mashed end tightly into the hole to keep the wire in place. Dress the other end of the wire with a file to a chisel or pyramid tip, and tin it. The original larger tip can still be used whenever you wish.

—James F. Glennon

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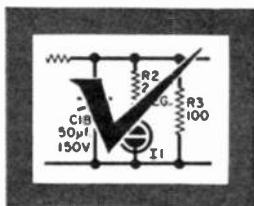
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Operation Assist



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Schematic Diagrams

Motorola FM receiver, chassis P 8116A1 H-C. Highway Patrol surplus. (James Wyma, 4230 N. 31 Ave., Phoenix, Ariz. 85017)

General Electric Model J76 receiver, ser. 862, mid-30's. (Gerald Widlake, Didsbury, Alberta, Canada)

MD-23/ARA-3 surplus modulator made by Ballantine Labs. (Howard Butler, Jr., 3315 W. Louisiana St., Midland, Texas 79702)

Superior Instrument Model TV-11 tube tester. (Thomas M. Sutton, 820 Chestnut St., Burkburnett, Texas 76354)

Sparton Model 4970 AM-FM receiver, chassis 8810. (Steve Citrin, 6220 W. Tenth Ave., Hialeah, Fla.)

Western Auto Supply "Air Patrol" Model 276 receiver, about 1935. Covers 540 kc. to 18.5 mc. in three bands. (John D. Mutch, Route 2, Box 97, Paul, Idaho)

Zenith Model 118474 three-band receiver, ser. S617231, chassis 1103. (Allen L. Andersen, 7945 S.W. 83 Ave., Portland, Ore. 97223)

RCA Model ACR175 ham receiver, about 1936. Tunes 550 kc. to 60 mc. (T. Cecire, 73 Mawal Dr., Cedar Grove, N.J.)

Capehart (div. of Farnsworth Corp.) Model 13LH2 three-band receiver plus phono, pre-war. 13 tubes. (Ken Grant, Box 36, Hubbard, Ore. 97032)

Supreme Model 542 multimeter, ser. 29321. (S. H. Wood, 29120 Lund, Warren, Mich. 48090)

Hallcrafters Model 5R42 "Continental." a.c.-d.c., s.w. and BC. (James E. Bradbury, 4225 Beauty Lane, St. Louis, Mo. 63134)

Hartman Model 3059 30-watt marine radiotelephone. (Sanford C. Olshansky, 20100 Tracey Ave., Detroit 35, Mich.)

RCA Victor disc recorder, Model MI-12701, circa 1940. (Steven Zeigler, 1415 Beaver Rd., Sewickley, Pa. 15143)

(Continued on page 20)

Coming up in August

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CIRCLE NO. 20 ON READER SERVICE PAGE

Operation Assist

(Continued from page 18)

Hallicrafters S-36A UHF receiver. Tunes 28-143 mc. (Fred L. Schultz, Box 182, Hasbrouck Heights, N.J.)

CRR-52253 surplus transmitter made by Bendix Corp. about 1940. (Davis Straub, 809 Podva Rd., Danville, Calif.)

Solar "Exam-ster," Model CF, ser. 91674. (C. B. Sutherland, 7272 Walling Lane, Dallas 31, Texas)

Apollo 16-mm. sound projector made by Excel Movie Products. Has two-tube amplifier that broadcasts audio to radio receiver. Uses infrared scanning system. (R. H. Reiter, Route 2, Box 97, Chesterton, Ind.)

U. S. Marine crystal-controlled receiver made by Fisher Research Labs., Type RS25-3. (John R. Sandefur, 536 Elizabeth St., Natchitoches, La. 71457)

Atwater Kent Model 649 BC-s.w. receiver, about 1930. (R. W. Masse, 166 Boston St., Salem, Mass. 01970)

Dictascriber wire recorder made by Magnetic Corp. of America. (James Heath, Triangle Trailer Court, Lafayette, Ind.)

BC-455-B surplus receiver, 6-9.1 mc. (Curt Cochran, 13 Kingston Heights, Kingston, Tenn. 37763)

Fada TV Model TV-125, before 1949. (Ernesto Alvarado, Box 969, San Jose, Costa Rica, C.A.)

Firestone (model unknown) three-band receiver/phono combo. 11 tubes. Circa 1945. Has push-button tuning on BC. (Bob Cooley, 418 East 5 St., Port Clinton, Ohio)

Mercury "Mark I" CB set imported by International Communications Corp of Santa Monica. (R. Hammond, Killian Co., 933 Linden Ave., Winnetka, Ill.)

Triumph Model 830 oscilloscope. (Barry Abrams, 7 Stuyvesant Oval, New York, N.Y. 10009)

Majestic Model G-25-A BC receiver, ser. 25723. Uses 84, 58, G89, 57AS tubes. (R. L. Young, Woodmont, Conn.)

Western Auto Supply Model 1139 10-tuber, 5 bands. Tunes 530 kc. to 18 mc. (Paul Cloud, 6567 Eldridge St., San Diego 20, Calif.)

United American Bosch Corp. Model 850 (or 810) receiver, ser. 129750. Three bands. (Hans G. Albrecht, RFD 3, Route 6, Newtown, Conn. 06470)

Bendix BC receiver, Model 687A, a.c.-d.c. or battery-operated. Circa W.W.II. (Bernard Kubiak, 1306 Ash St., Olean, N.Y. 14760)

AGA Model 1777 7-band, 7-tube s.w. receiver. Made in Sweden. Circa 1928. (Augustin Ortiz M., M. Calzas #535 Lomas, Mexico 10, D.F., Mexico)

Aurex 4-tube high-gain p.a. amplifier with built-in dynamic mike. (Ed Weidner, 678 Columbus, Benton Harbor, Mich.)

Lafayette Model HE-37 walkie-talkie. (S. E. Hollich, 12712 S. Memorial Parkway, Huntsville, Ala.)

Special Data or Parts

Bendix Model ATD (type CRR52253) Navy transmitter, about 1940, with 814 in final. Schematic, parts list, and operating manual needed. (John E. Shea, 15-B Carr St., Watsonville, Calif. 95076)

Wireless Set No. 19, Supply Unit No. 1 MK1, Army surplus, circa early 1940's, Z.A.12392, M.W. ser. 46735. Schematic and source for parts needed. (Eric C. Karanja, Box 18040, Nairobi, Kenya, E. Africa)

Case Model 610 receiver, made in Marion, Ind., about 1925; has "Tell Time Tuning." Alignment info and a schematic needed. (John Whybrew, Upland, Ind. 46989)

National Union Radio Corp. radarscope. 5FPTA CRT base diagram needed. (Bill Gilmour, 19 Edgewood Ave., Hamilton, Ontario, Canada)

Westinghouse Model H-212 AM-FM receiver, chassis V-2137, about 1950. Selector switch, part V6140, and dial face needed. (Lewis E. Beich, Box 183, Colerain, N.C.)

Zenith Model R615Y table-model radio, chassis 6J05; tunes AM 550-1600 kc. Loop antenna needed. (Ray Smith, 337 W. 6th Ave., Escondido, Calif. 92025)

BC-1335 Signal Corps receiver. Maintenance and operating manuals wanted, also info for conversion to CB or 10 meters. (Thomas Toms, Route 2, Bostic, N.C.)

(Continued on page 22)



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Operation Assist

(Continued from page 20)

RT-111/TRC-20 surplus unit. Power requirements and schematic wanted. (Joe Cross, 5676 N. E. 22 St., Des Moines, Iowa 50313)

Brand and Millen Model 1003 amplifier. Schematic and tubes needed. (E. L. Rowe, 427 Ave. F South, Saskatoon, Sask., Canada)

Westinghouse Navy surplus dynamotor, style 1171412-A; numbers on case CAY-211483, P-719697-1. Operating data needed. (Andrew L. McCaskey, Route 1, Weyers Cave, Va. 24486)

Sparton Model 10 three-band superhet. Calibrated glass dial or contact negative of dial needed. (Wesley W. Harris, Route 5, Box 2325, Bremerton, Wash. 98312)

Zenith Model 6-B-107 six-tube receiver. Source for No. 15 tubes needed. (J.O. Sanborn, 2312 N.E. 92 St., Seattle, Wash. 98115)

Silvertone radio/phone combo., Model 64-65. Third FM-AM i.f. transformer, No. R67804, needed. (F. H. Chapman, 9 Pilgrim Rd., Concord, Mass.)

Service Instruments Inc. Model 20-A electronic d.c. voltmeter, ser. 473. Schematic, parts list, and info to convert to a.c.-d.c. needed. (Robert D. Greene, 373 Newton St., Waltham, Mass. 02154)

Zenith receiver, ser. S489078, circa 1937-1940; has eight tubes including 1232 octal. Schematic and alignment info needed. (John J. Bucholtz, Jordan, Minn.)

Mobilite (of Beverly, Mass.) Model TR-148 eight-tube transceiver for two meters, series 150, ser. 394. Manual, schematic, technical data needed. (Pete Barth, 13648 Louvre St., Pacoima, Calif.)

General Electric Model F70 BC-s.w. receiver, about 1940. Schematic, parts list, and alignment info needed. (R. Barclay, 419 State St., Madison, W. Va.)

Earl Webber Co. Model 200 tube tester, ser. 8800. Replacement chart wanted. (Carl Geselchen, 617 Front Ave., Bismarck, N.D.)

BC-1271-A 12-tube receiver, ref. 10EU/17901, crystal-controlled on 126.18 mc., reconditioned by Canadian Aviation Electronics. Schematic and operating manual needed. (Reed Park, 260 Weldrick Rd., Richmond Hill, Ont., Canada)

Barker & Williamson surplus receiver, Model OA-65A/MRC-2. Technical manual needed and conversion info for ham use. (Neil Dresback, 1022½ Haskell St., Reno, Nevada)

Raytheon color TV, Model C-21C1-M. Horizontal output transformer needed, part 12-E-26639. (Wayne S. Clymer, Route 3, Box 186D, Medford, Ore.)

Philharmonic transmitter/receiver, military surplus RT-285A/URC-11. Info wanted to convert to CB use. (Gary Burke, NAS Noris Faetupac ASW, San Diego 35, Calif.)

Electronic Specialty Co. "Ranger" aircraft receiver, Model 108, 4 tubes, tunes 195-410 kc. Schematic and technical data needed. (B. J. Funk, 3299 W. 41 St., Cleveland 9, Ohio)

Silvertone wire recorder. Wire needed. (S. K. Pawloski, 546 Pine St., Ambridge, Pa.)

Crosley receiver, circa 1923-1925. Book-type capacitor needed. (Howard Donaghay, 222 Giles Rd., Bridgeton, N. J.)

Kolster Type "K" BC receiver. Special parts and schematic needed. (Ken Rubin, 1246 E. 22 St., Brooklyn, N.Y. 11210)

Murdock "Neutrodyne" receiver, about 1923. Schematic, instructions, source for tubes needed. (William Thompson, Box 445, Bingham, Maine)

Swingmaster radio/phone by General Television & Radio Corp., Model 635, circa 1940. Manual and schematic needed. (Mike Gunja, 7625 Fisher, Warren, Mich. 48091)

Robin Radio Co. Model 105 or 107 2-meter converter. Schematic and parts wanted. (Berkley R. Ramgorpt, Suite 212B, 136-04 Northern Blvd., Flushing 54, N.Y.)

Readrite tube tester, Model 430, ser. 6513. Tube charts, schematic, and operating info needed. (Gary W. Roth, Box 122, Harrington, Wash.)





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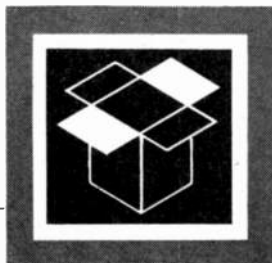
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New Products



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 11.

CAR RADIO CONVERTER

When the "Miniverter" is inserted in the antenna lead of an auto BCB receiver, it converts it to a short-wave receiver which covers any 1-mc. band from 1 mc. to 160 mc., depending on the "Miniverter" model selected. Manufactured by *Scientific Associates Corporation* primarily for use in mobile applications, the unit is available in 19 standard models, each of which includes a tuned r.f. stage and crystal-controlled oscillator.



Circle No. 75 on Reader Service Page 11

A simple on-off switch selects either regular broadcast reception or short-wave reception. The "Miniverter" is intended for amateur, marine, CB, aviation, and some fire and police department uses. Models for frequencies not covered by the standard models are available on special order. Prices start at \$14.95.

VHF WHIP ANTENNA

Designed by *Regency Electronics, Inc.*, primarily to work with its "Flight Monitoradio" aircraft band receiver, the new Type AA-1 coaxial whip antenna is for use in the 108-136 mc. VHF band. It has a nominal impedance of 72 ohms and weighs 4 ounces. The AA-1 comes in two easily assembled sections, each 23½" long (47" when fully extended). Price, \$5.95.

Circle No. 76 on Reader Service Page 11

SPECTRUM MONITOR KIT

The first low-cost spectrum monitor available in easy-to-build kit form, the *Heath Company's* "Ham-Scan" can be operated with virtually any receiver in use today. It permits visual observation of band activity up to 50 kc. above and below the frequency to which the receiver is tuned. Among other things, the Heath kit "Ham-Scan"



Circle No. 77 on Reader Service Page 11

will identify SSB, AM, and c.w. signals, spot band openings, identify splattering signals, and facilitate checking of carrier and sideband suppression of SSB transmitters. As the receiver is tuned, the display moves horizontally across the base line, the signal being monitored appearing in the center.

CITIZENS BAND TRANSCEIVER

Available in both wired and kit form from *Eico Electronic Instrument Co., Inc.*, the Model 777 CB transceiver features continuous receiver tuning, plus six crystal positions on both transmit and receive. The receiver is a double-conversion unit offering 6 db selectivity at 5 kc., and 20 db at 8 kc. It incorporates an automatic noise limiter, adjustable squelch, spotting switch, and S-meter. Sensitivity is rated at better than 1 μv. for a 10 db signal-to-noise ratio. A dummy load and ceramic mike are provided



Circle No. 78 on Reader Service Page 11

for use with the 5-watt-input transmitter. The power supply is a three-way type (6 or 12 volts d.c., 117 volts a.c.), permitting mobile or base station operation. Prices: \$189.95 wired; \$119.95 as a kit.

FM STEREO TUNER/AMPLIFIER

Incorporated in *H. H. Scott's* 345 64-watt FM stereo tuner/amplifier are three new circuits which are said to make for better

performance. The low-impedance symmetrical drive circuit in the amplifier section provides more power down to the low frequencies, lower distortion, cooler operation, and stability with any speaker load. Ultimate stereo separation and presence is claimed for the FM tuner series-gate time-switching multiplex circuit. Finally, the pulse-suppression-limiting circuit effectively suppresses interference from automobile ignitions, refrigerators, and the like. In addition,

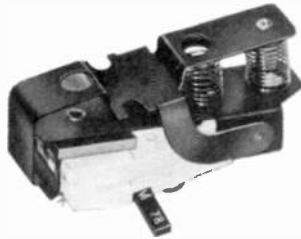


Circle No. 79 on Reader Service Page 11

tion, the 345 features new panel styling, slide-rule tuning with ball-bearing flywheel drive, and a convenient front-panel earphone receptacle. Price, under \$350.

CERAMIC STEREO CARTRIDGE

Positive scratch protection is claimed for the new "Featheride" ceramic stereo cartridge announced by *Electro-Voice, Inc.* A spring - suspension mechanism permits the cartridge to pivot when sudden force is applied, bringing the front end (and therefore the stylus) up off the record surface, and bringing a soft "sole" to bear on the delicate record surface. The "Featheride" is offered in two types, usable in phono units tracking at any force between 2 and 6 grams. It can be mounted in any modern tone arm having standard $\frac{1}{2}$ " or $\frac{7}{16}$ " mounting centers.



Circle No. 80 on Reader Service Page 11

SQUARE CUSHION HEADPHONES

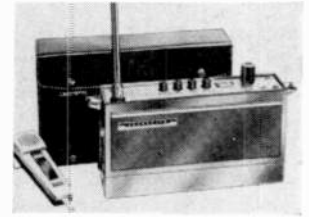
Piezoelectric Division/Clevite Corporation has announced a new square cushion design for its ED-300 Clevite/Brush hi-fi stereo headphones. Said to provide the wearer with more comfort over long periods of time while maintaining a tighter seal, the new headset carries an 18-month warranty against material or workmanship defects.

Circle No. 81 on Reader Service Page 11

July, 1964

ONE-WATT WALKIE-TALKIE

The HA-150 is a transistorized two-way CB unit with a 1-watt r.f. input. Announced by *Lafayette Radio Electronics Corporation*, it features a quick-release battery compartment which contains eight standard C cells for heavy-duty service. Push buttons select one of two channels for operation and switch in the squelch circuit and noise limiter.



Circle No. 82 on Reader Service Page 11

The receiver has 1- μ v. sensitivity, a push-pull audio circuit, and a 3" speaker. In addition to a 59" collapsible whip antenna, the HA-150 comes complete with a pair of crystals, batteries, push-to-talk dynamic microphone, and leather carrying case. Prices: \$79.95 each; two for \$154.95.

MATCHED DYNAMIC MICROPHONES

To insure uniformly good results for audiophiles who record live stereo programs, the *Turner Microphone Company* has made available two perfectly matched Model 500 cardioid dynamic microphones packaged together. Called the "Stereo Twins," the microphones come complete with plugs to match most stereo recorder inputs. Price, \$99.50.

Circle No. 83 on Reader Service Page 11

PORTABLE TAPE RECORDER

The Norelco Continental "101" (Model EL 3586) transistorized tape recorder announced by *North American Philips Company, Inc.*, weighs only seven pounds and uses inexpensive "D" type flashlight batteries. Frequency response is 80-8000 cycles. Features include a treble-base tone control, erase head, narrow-gap two-track record / playback head, sensitive dynamic microphone, input jack for recording from a radio, phonograph, or TV set, plus a second input jack for head-



Circle No. 84 on Reader Service Page 11

New Products

(Continued from page 25)

phones, remote microphone switch, or a.c. adapter. Operating at 1 1/2 ips, the Continental "101" will provide up to two hours playing time on a single 4" reel. Signal-to-noise ratio is better than -45 db.

TAPE RECORDER MAINTENANCE KIT

Do you have all the items needed to keep your tape recorder in good condition? *Freeman Electronics Corporation* is now marketing a tape recorder maintenance kit, the MK-100. Conveniently packaged in a compartmentalized grey leatherette box is a tape splicer, head demagnetizer, head cleaner, head lubricant, mechanism lubricant, splicing tape, and special Q-tips for reaching hard-to-get-at parts. Price of the MK-100, \$14.95.

Circle No. 85 on Reader Service Page 11

STEREO HEADSET REMOTE CONTROL

An individual volume control for each stereo channel has been incorporated into each ear piece of a new stereo headset—the ST-20—now being marketed by *Telex/*

Acoustic Products. Stereo balance and volume are remotely controlled from the listener's easy chair by adjustment of control knobs on each ear cup. The ST-20 plugs into the headphone jack of the stereo system. Response: 16 to 15,000 cycles, 4-16 ohms. Price, \$29.15, with 8' strain-resisting cord and plug.

Circle No. 86 on Reader Service Page 11

HIGH-OUTPUT MICROPHONE

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Circle No. 87 on Reader Service Page 11

-50-

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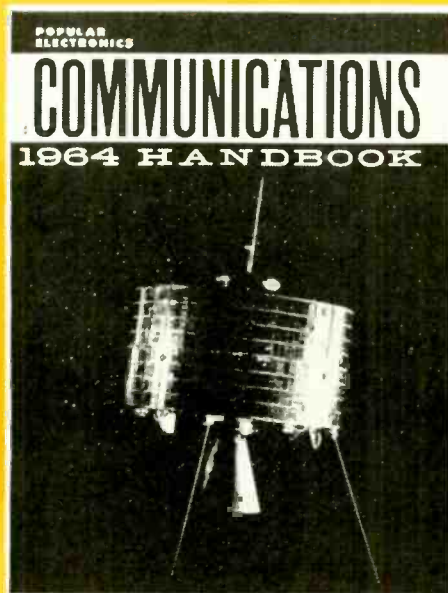
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BIG TC

A quarter of a million volts? All it takes is a transformer, a capacitor, a spark gap, and Tesla's famous coil

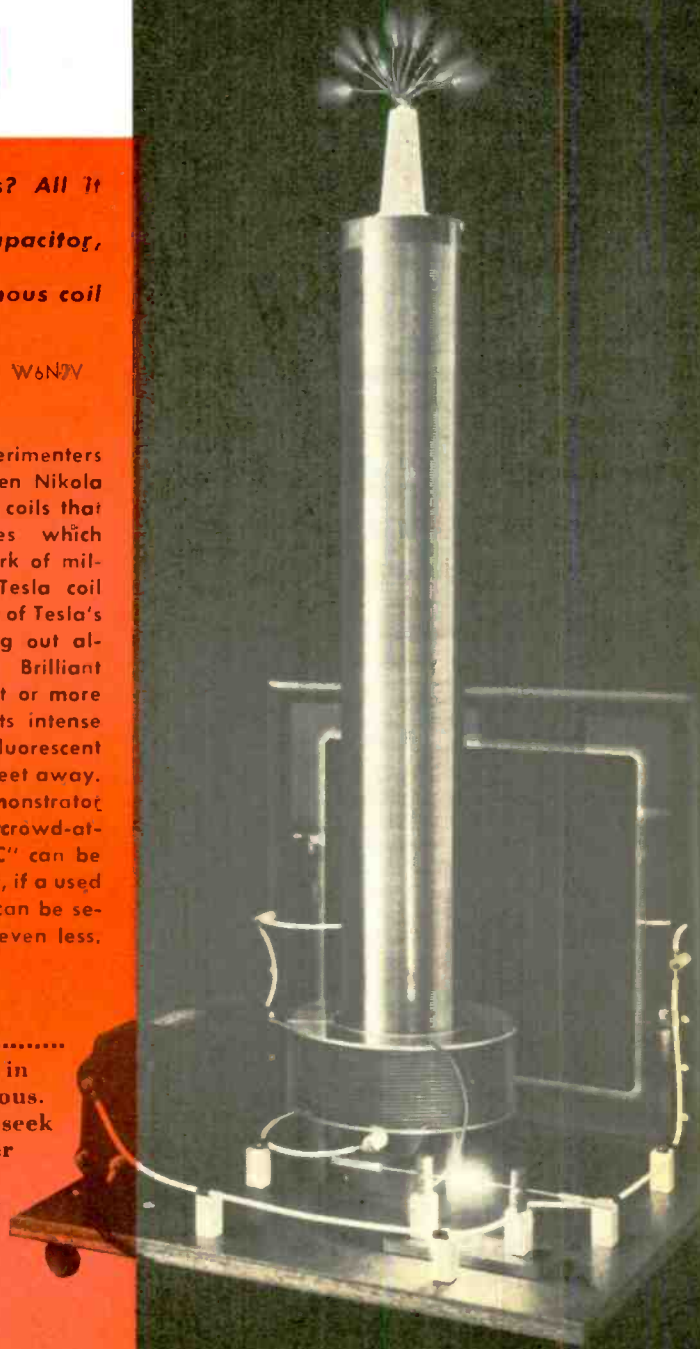
By CHARLES CARINGELLA, W6NJV

TESLA COILS have fascinated experimenters ever since the early 1900's when Nikola Tesla first experimented with giant coils that produced lightning-like discharges which would span his laboratory—the work of millions of volts of electricity. The Tesla coil described here is smaller than some of Tesla's designs, but it's capable of putting out almost a quarter of a million volts! Brilliant corona discharges as long as a foot or more provide a spectacular display of its intense electrical field, and neon and fluorescent lamps can be excited as far as five feet away.

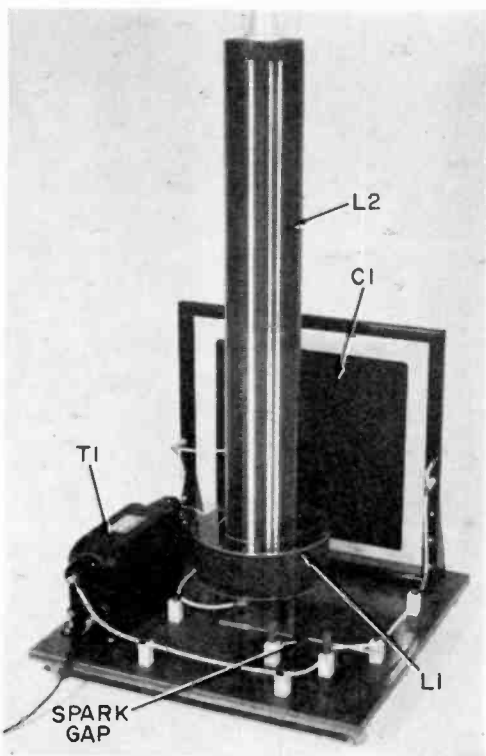
Intended both as a dynamic demonstrator of electrical principles and as a crowd-attracting science fair project, "Big TC" can be put together for about \$30. However, if a used transformer from a neon sign shop can be secured reasonably, the cost will be even less.

.....
WARNING: The voltages used in this project are highly dangerous. Inexperienced persons should seek aid from an instructor or other expert before building it.
.....

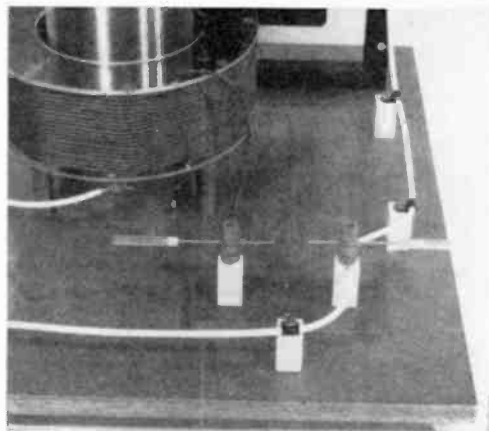
COVER STORY



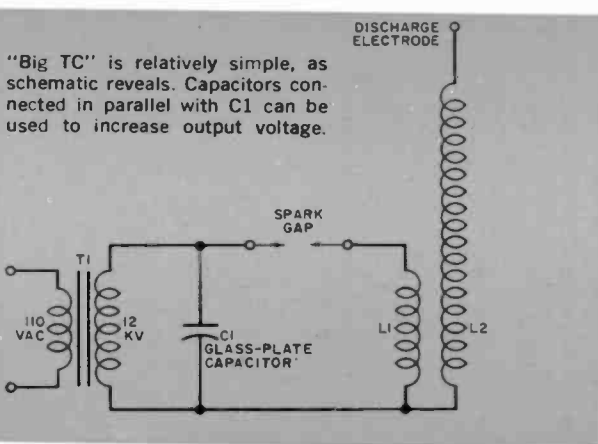
BIG TC



Mount L1-L2 in center of base, T1 and C1 at edges. A bigger base and greater component spacing will permit greater voltage output with less arcing.



Spark gap generates r.f. energy to excite coil. It consists of two copper rods mounted on standoffs.



"Big TC" is relatively simple, as schematic reveals. Capacitors connected in parallel with C1 can be used to increase output voltage.

As shown in the schematic diagram above, *T1* steps the household line voltage up to 12,000 volts. The transformer is the type commonly used to operate neon signs. A high-voltage glass-plate capacitor, *C1*, is connected directly across the high-voltage secondary winding of *T1*. The capacitor serves as an energy storage device, charging up to *T1*'s secondary voltage and then discharging in response to the 60-cycle a.c. voltage.

Discharging of *C1* is through the spark gap into coil *L1*. Each time the spark gap "fires," a high current flows through *L1*. The larger capacitor *C1* is made, the larger will be the current through *L1*. Discharges across the spark gap produce extremely jagged pulses of power which are very rich in r.f. harmonics. The energy—due to the values

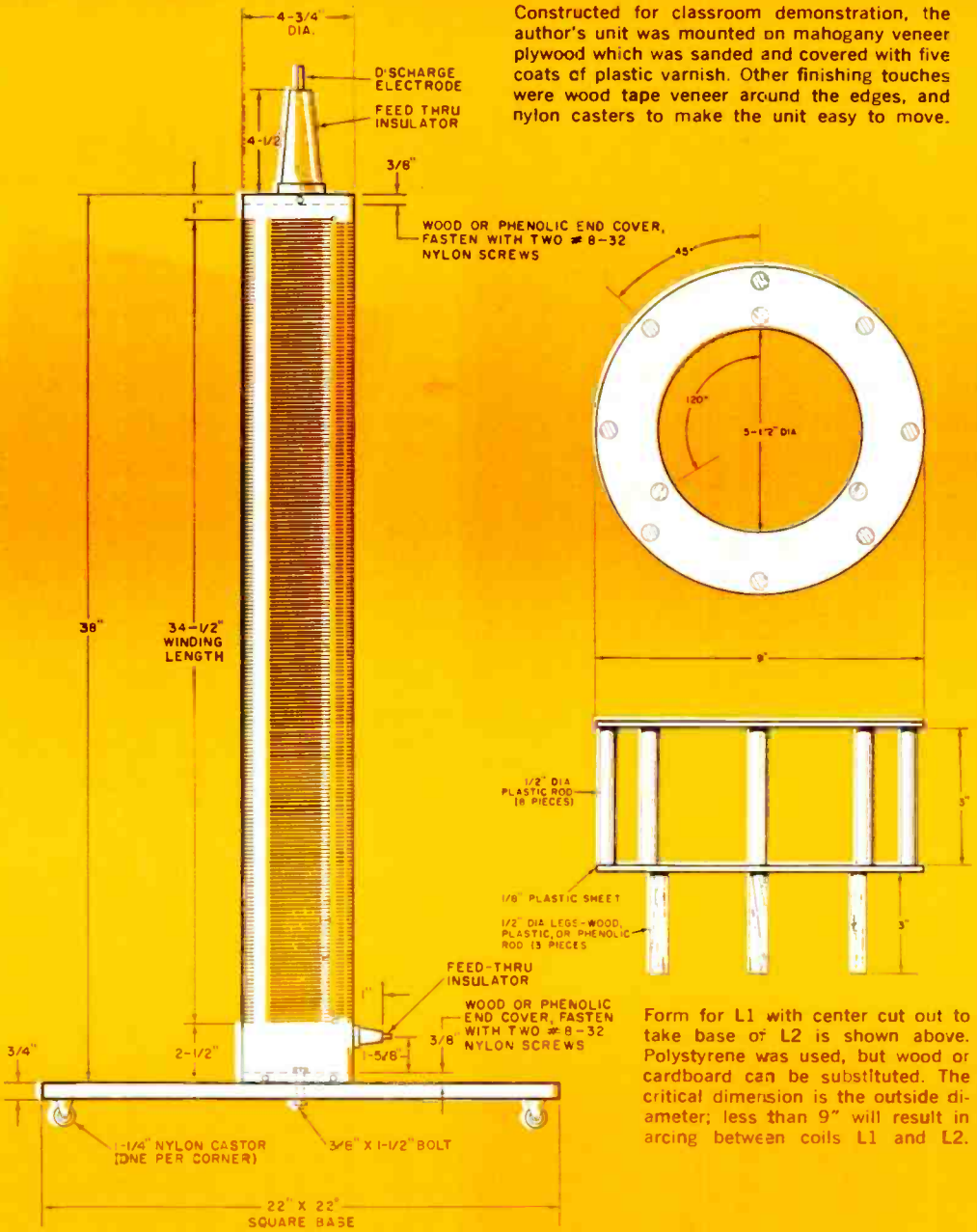
of the components used—is greatest in roughly the 100-kc. region.

Windings *L1* and *L2* form an air-core step-up transformer, with *L1* the primary and *L2* the high-voltage secondary. The voltage at *L2* will be 75,000 to 250,000 volts depending on the size of *C1*.

Design and Layout. The prototype of "Big TC" was built on a plywood base measuring $\frac{3}{4}$ " x 22" x 22", although a larger base would be desirable for high-voltage units to prevent arcing between *L2* and *T1* and *C1*. Mount *L2* in the center of the base and *T1* and *C1* as close to the edges as possible; if you plan to operate the unit at voltages exceeding 100,000 volts, make the base 3' x 3' for even greater separation between components.

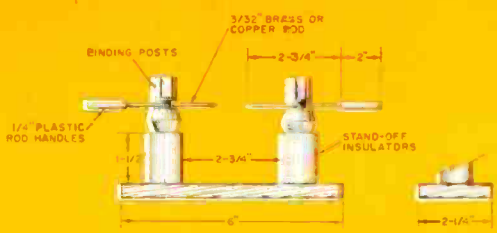
Power transformer *T1* is the only

Constructed for classroom demonstration, the author's unit was mounted on mahogany veneer plywood which was sanded and covered with five coats of plastic varnish. Other finishing touches were wood tape veneer around the edges, and nylon casters to make the unit easy to move.

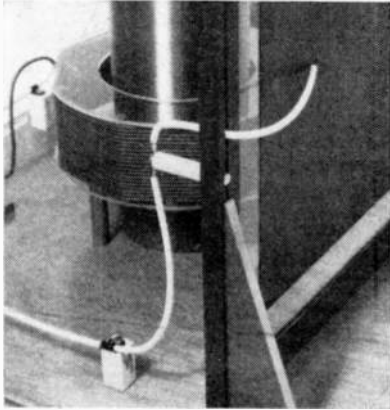


Form for L1 with center cut out to take base of L2 is shown above. Polystyrene was used, but wood or cardboard can be substituted. The critical dimension is the outside diameter; less than 9" will result in arcing between coils L1 and L2.

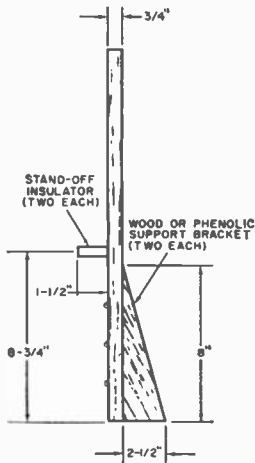
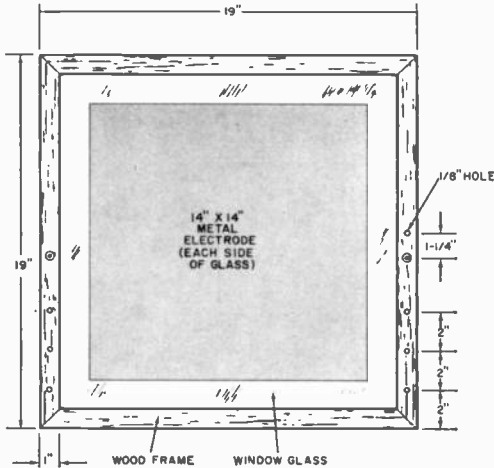
The various dimensions of the prototype coil are indicated in the drawing; none is particularly critical. Note that space has been left at each end of coil, and that stand-off insulators are used to bring out the ends. Nylon screws or glue must be used to fasten top end cover to avoid arcing. After winding coil, cover with many coats of acrylic plastic spray. Spray form first if cardboard is used. Details on spark gap are shown at right.



BIG TC



Leads are soldered directly to capacitor plates. Note use of stand-off insulators.



Glue metal plates to glass, leaving a generous margin of glass on all sides (see text). Epoxy glue, contact cement, or any other glue which will form a tight bond can be used. The wood frame protects the glass and makes mounting it possible.

high-cost component. A neon-sign unit rated at 12,000 volts a.c. at 30 ma., it sells for about \$40 new, but used transformers are constantly being salvaged by sign shops, and can be picked up for \$10 to \$20. It is also possible to find neon signs in junk yards, in which case you can probably buy the transformer for practically nothing. The author used a GE unit, No. 51G473, known technically as a "luminous tube transformer." Measuring $9\frac{1}{2}'' \times 6'' \times 4''$, it has 2" feedthrough insulators at either end connecting to the high-voltage winding.

Primary coil *L1* and all connecting leads must be made with high-voltage wire, preferably supported away from the base on 1" ceramic standoff insulators. Test prod wire such as Belden Type 8898 is ideal—it has flexible rubber insulation with a puncture voltage rating of 29,000 volts.

Winding the Coil. For the big coil (*L2*) a phenolic coil form* measuring $4\frac{3}{4}''$ in outside diameter and 38" in length was used. Alternately, cardboard, wood or other insulating materials can be substituted. You can improve these latter types of coil forms by spraying on at least six coats of acrylic plastic spray before winding the wire on them.

The winding itself is done with No. 26 Formvar-insulated wire—two 1-lb. spools (splice them together and keep the solder joint as small as possible) will give you a 2000-turn, tightly spaced coil covering $34\frac{1}{2}''$ of the coil form. There should be extra space between the ends of the winding and the ends of the form—see the drawing on page 31.

The lower end of the coil is terminated at a 1" feedthrough insulator installed in the side of the form, the top end of the coil at a $4\frac{1}{2}''$ feedthrough mounted to the top end of the form. Make the end covers of wood or phenolic discs cut to the inside diameter of the coil form, and mount them in place with
(Continued on page 76)

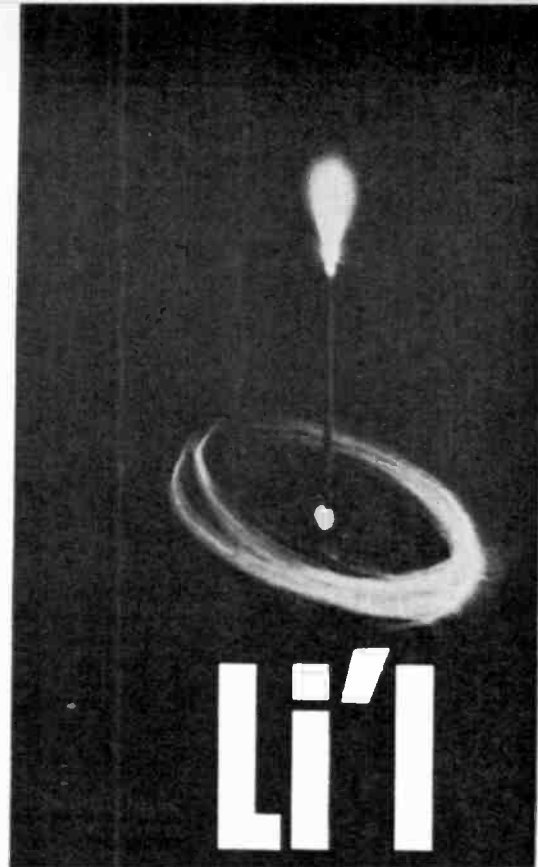
*Tubing can be found in metropolitan areas at surplus houses and establishments which sell plastics (sheets, rods, etc.). Clear acrylic tubing (48" long, $4\frac{1}{2}''$ O.D.) can be ordered from Industrial Plastics Supply Co., 324 Canal St., New York, N. Y. 10013, for \$13.85 including shipping charges and postage; address your order to the attention of Mr. Charles Roth.

A potent "little brother" to "Big TC," this Tesla coil version is inexpensive, easy to build, and it can put out 30,000 volts!

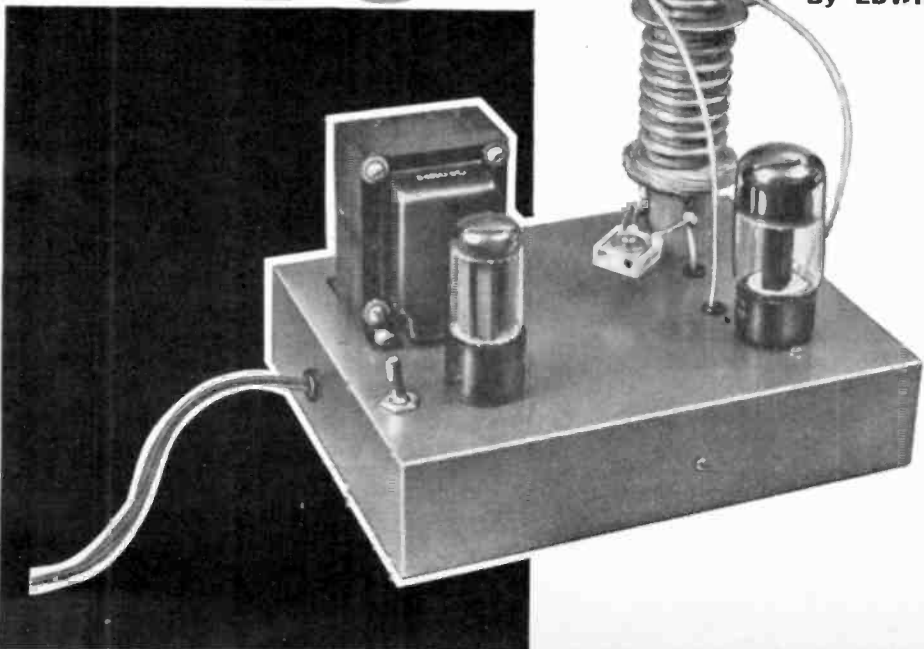
IF you have read the preceding article on "Big TC," you will have learned that a Tesla coil is simply a radio-frequency step-up transformer carried to extreme limits. While a coil that can generate 150,000-200,000 volts is exciting and very dramatic, many of the same visual effects can be demonstrated on a smaller scale with "Li'l TC." In fact, "Li'l TC" is much safer, easier to build, and less expensive—your junk box probably contains many of the necessary parts.

The only item many experimenters will have to buy in order to build "Li'l TC" is the r.f. coil. This coil is manufactured by the J. W. Miller Co. for use in generating the high voltages required in large-screen TV receivers. It is an item that is not stocked by many parts stores, although most of them can obtain it for you within 48 hours. If you have trouble finding the coil, it can be ordered from Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill., as their stock number 61G102 at a price of \$8.82 plus postage. An experienced project builder may not find it necessary to buy one of these coils, but may be able to

By **EDWIN N. KAUFMAN**

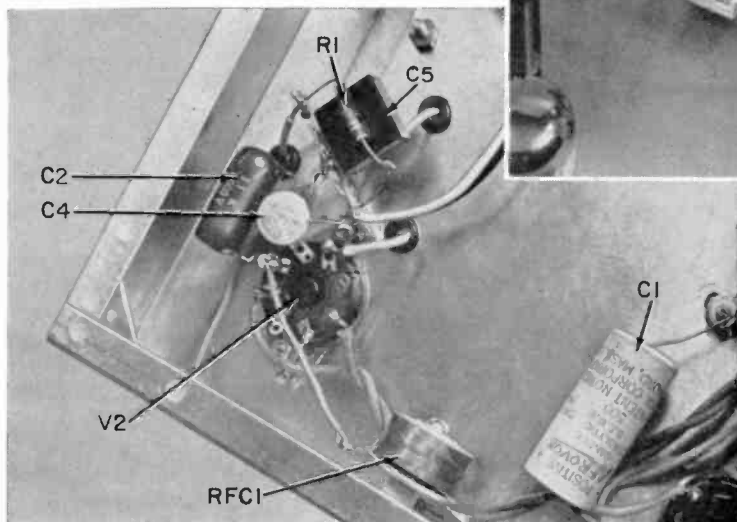
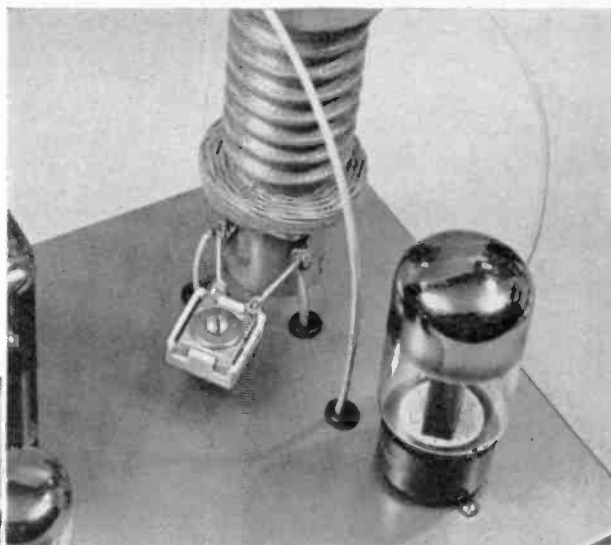


Li'l TC



Li'l TC

Tuning capacitor C3 is attached to the h.v. coil with two bus-bar leads so that it will be suspended in mid-air away from the coil and metal chassis. Use an insulated alignment tool to rotate the setscrew adjustment.



Most of the parts are grouped around the base of tube V2. Leads to the h.v. coil pass through grommets holes to the terminal Miller connections on the Miller coil form.

construct "Li'l TC" using a high-voltage transformer from a large-screen old-style TV receiver.

Construction. The mechanical layout is not critical, and the design shown in the photographs need not be followed exactly. It is convenient to place the r.f. coil off in one corner of the chassis and to drop the connecting leads to V2 through grommets holes in the chassis deck. The high-voltage output lead of the coil is shortened and a sewing needle soldered to the end to show "point discharge" effects.

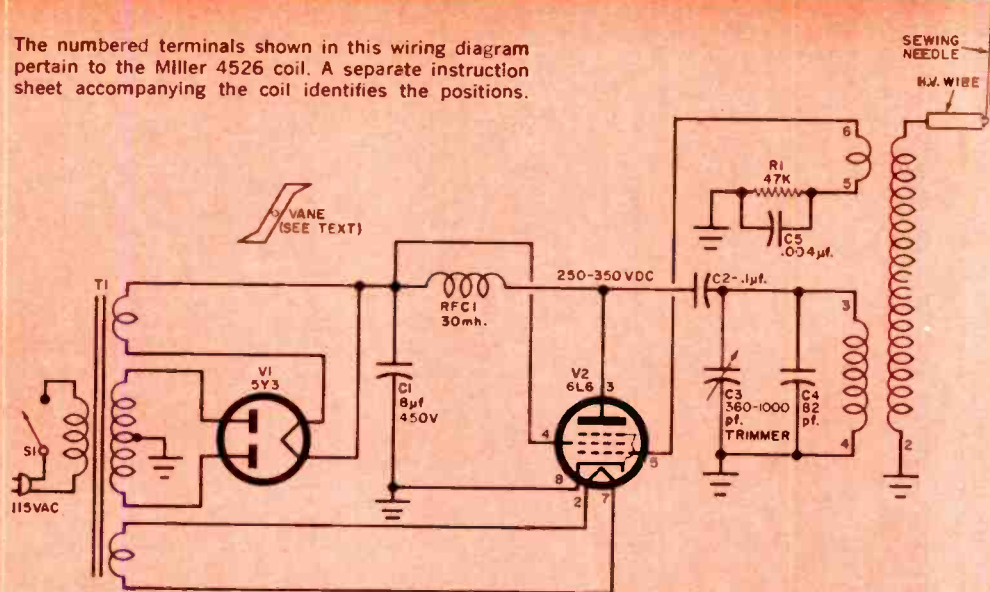
The power supply is of conventional design and the B-plus applied to the plate of V2 can range from 250 to 500 volts. However, 250 - 350 volts is more than ample for an output of between 12,000 and 15,000 volts. The output will also vary according to the type of tube used at V2. When you open the coil box, you will see that a 6Y6 is recommended

by the manufacturer. However, noticeably improved effects were obtained by the author by substituting a 6L6. A 6V6 or another equivalent power pentode would do in a pinch.

Capacitor C3 is used to tune the primary of the h.v. coil. For convenience, two bus-bar leads about 1" in length were soldered to the capacitor and used to support it in mid-air. The remaining components are scattered around below the chassis deck.

Firing Up Li'l TC. When used in a TV receiver, the high voltage generated by this coil/oscillator arrangement is rectified and filtered. It is then considerably more dangerous than the unfiltered r.f. generated by Li'l TC. Nevertheless, Li'l TC should be treated with respect, for the voltage can puncture the skin of a finger, although high-frequency voltages usually tend to flow relatively harmlessly along the skin's surface.

The numbered terminals shown in this wiring diagram pertain to the Miller 4526 coil. A separate instruction sheet accompanying the coil identifies the positions.



PARTS LIST

C1—8.0- μ f., 450-volt electrolytic capacitor
 C2—0.1- μ f., 600-volt molded capacitor
 C3—360-1000 pf. trimmer capacitor
 C4—82-pf., 1.6-kv. ceramic capacitor—see text
 C5—0.004- μ f., 600-volt mica capacitor
 R1—47,000-ohm, $\frac{1}{2}$ -watt resistor
 RFC1—30-mh., 100-ma. r.f. choke (J. W. Miller 692 or equivalent)
 S1—S.p.s.t. toggle switch
 T1—Power transformer: primary, 117 volts a.c.;

secondaries, 500 volts, CT, 5 volts at 2 amperes, and 6.3 volts at 2.5 amperes (Thordarson 24R09U or equivalent)
 V1—5Y3 tube
 V2—6L6 tube—see text
 1—High-voltage coil 'J. W. Miller 4526—see text)
 1—Metal chassis (Premier ACH-404 or equivalent)
 Misc.—Tube sockets, wire, solder, etc.

After double-checking your wiring, turn on the a.c. power and permit the two tubes to warm up. Take an insulated screwdriver—something like a long alignment tool—and adjust C3 for a brush discharge from the needle point. If you do not have enough range in C3 to tune through the maximum discharge, change the value of C4—add more capacitance at C4 if the plates of C3 are tightly meshed; use less if C3's are too loose. You can set C3 for maximum discharge by listening to the sound of the brush effect—tune for a clean high-pitched hiss and not a sputtering sound.

The brush discharge from Li'l TC will be about 1" in height and can be seen best in a dimly lighted room. Actually, a brush corona will appear at any sharp edge on the output lead, so be careful to round out the soldered connections between the eye of the needle and the shortened h.v. lead.

Ionic Propulsion Vane. Probably the most impressive demonstration of a Tesla coil is the ionic propulsion vane. You can make one for Li'l TC by cutting out the general pattern shown in the diagram above.

Make the over-all length of the vane about 1" to 1½". Cut the vane from aluminum foil and puncture the center so that the vane is balanced. Use one of your wife's extra beads as a bearing by slipping it on the upright needle. Then drop the vane over the needle so that it rests on the bead and can rotate freely. Put a piece of cork or rubber on the tip of the needle to stop the vane from picking up so much speed that it spins right off the needle.

The photograph on the first page of this article is a two-second time exposure (slightly enlarged) showing what the brush corona discharge and rotating vane should look like.



Wind, Weather and Waldorf Salad

THE crewmen are clad in bright orange flight suits. The plane is a \$7-million Lockheed Constellation flown by Airborne Early Warning Squadron Four, the "Hurricane Hunters." Normally, the squadron is based at Roosevelt Roads Naval Air Station, near San Juan, P.R., but each summer a detachment is assigned to the Jacksonville, Fla., station to scout hurricanes moving up the coast for Miami Weather Central.

Equipment. Each weather plane is a nightmare (or dream) of electronic equipment. Power for the flying weather lab is drawn from six 28-volt d.c. generators and two 117-volt a.c. generators

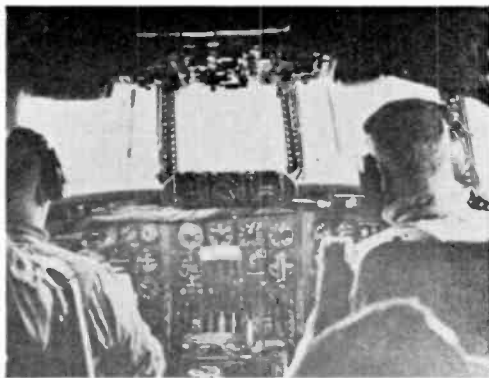
Steak, salad and high winds. This is the Hurricane Hunters' usual menu!

By AL ERXLEBEN

Crew members consist of aerographers, navigators, radio men and radar men. All are trained in the



"Connie" (at left) is airborne weather lab. Note big radome.



Pilot and co-pilot scan the instruments and leaden skies.

Photos by Ray Price

providing three-phase, 400- and 1000-cycle a.c.

Weather data is secured with a pair of radar systems. One, a long-range APS-20E, operates at two megawatts. The other, an APS-45, is used for height-finding. There are more than a half-dozen repeating scopes. While the plane is primarily designed for scientific use, IFF (Identification, Friend or Foe) equipment is included. A separate *video* radar transmitter can be brought into play to provide ships with a 200-mile radar "range."

Radio-Sonde equipment and communications gear complete the electronic complement of the plane. There are 17 AM and c.w. transmitters, and 20 receivers—low-, high-, very-high-, and ultra-high-frequency units. Eight UHF

transceivers are used for voice communications, limited to line of sight. The antennas are arranged on the fuselage so that banking will switch a different antenna into play, avoiding blind spots caused by the body of the plane. And there are two HF-SSB transceivers that share time with the LORAN DF equipment.

The Mission. A trip can last for more than 12 hours, and the crew can consist of 22 to 24 men, depending on the length of the mission. On short trips, food is carried aboard, and on long flights, the meals are cooked during the trip. Despite hundreds of penetrations to various hurricanes' eyes during 21 years of operation, the "Hurricane Hunters" have lost only one plane and crew. These boys are on their toes... they have to be! —30—

science of plotting the path a hurricane has followed, is following, and will follow in the future.



Not Cricket, Caroline!

Englishmen are hearing their first

radio commercials, thanks to

offshore radio ships



THERE'S a new blight in blighty, and it's curdling the Post Master General's morning porridge! There are three government-controlled BBC networks operating in Great Britain, none of which carries commercial messages; the operating cost is defrayed by a tax levied on the listeners. Recently, a ship, fully equipped for quality radio transmission, anchored out in the territorial waters of England, and began transmitting to the shore on 1508 kc. or thereabouts. The ship station called itself "Radio Caroline," and in addition to pop programming, it offered Britons their first taste of commercials . . . paid for by advertisers at the rate of from 70 to 110 pounds per minute.

The idea seems to have caught hold, and there are indications that *Radio Caroline* will be joined by several sister ships. Although different firms are involved in the ventures, they all seem to

be the brainchildren of Ronan O'Rahilly, a 23-year-old Irishman.

Her Royal Majesty's Post Master General hasn't taken this "pirate radio" situation very lightly, and has instituted proceedings against the "pirates," filing complaints with the International Telecommunications Union. The "Caroline" sails under a Panamanian flag as of this writing, but even if its operators lose this right, they are still safe—as long as they stay in international waters. So far, the P.M.G. has cut off radiotelephone service to the ship but food supplies haven't been tampered with, and two major oil companies are bidding for the contracts to supply fuel. Communication with shore is being handled by two charter tugboats.

So the battle rages. How will it come out? As one wit put it, the question seems to be whether or not "Britannia really rules the (radio) waves." —~~50~~

Tap Tap Temperature Taker

*No darkroom should be without
this accurate electronic thermometer
which signals the temperature*

By **HARTLAND B. SMITH**, W8VVD

EXPERIENCED darkroom workers know that consistently good photographic negatives and prints can be achieved only if developing solution temperatures are carefully controlled. This can prove rather difficult, however, especially if you're working in the dark or under a dim safe-light, and it's easy to forget to make periodic temperature checks when you're involved in a complicated process.

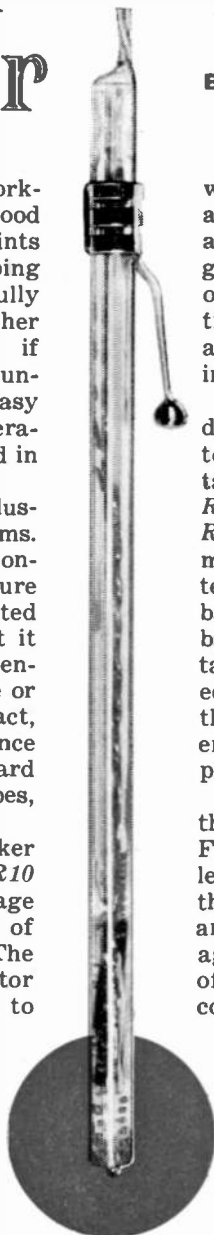
The "Temperature Taker" illustrated here solves these problems. It not only provides a close, continuous check on the temperature of any liquid (its use is not limited to photography, of course), but it also emits an audible alarm whenever the temperature goes above or below a preset figure. It's compact, battery-powered for convenience and to eliminate the shock hazard of a.c. power used near water pipes, and very accurate.

Heart of the Temperature Taker is a probe-shaped thermistor ($R10$ in the schematic diagram on page 41) having a nominal resistance of 4000 ohms at 77° Fahrenheit. The actual resistance of the thermistor depends upon the temperature to

which it is subjected. For example, at 100° F its resistance drops to around 2500 ohms, while at 50° it goes up to approximately 7500 ohms. It is this temperature-sensitive resistance variation which actuates the audible temperature indicator incorporated in the unit.

Referring again to the schematic diagram, voltage from $B1$ is applied to the top and bottom of a resistance bridge formed by $R1$, $R2$, $R3$, $R4$, and $R10$. The junction between $R4$ and $R10$ is grounded, while the movable arm of $R2$, a potentiometer, is connected, via $R5$, to the base of $Q1$. When the bridge is balanced, that is, when the resistance ratio between $R4$ and $R10$ equals the ratio between $R1$ plus the top end of $R2$ and the bottom end of $R2$ plus $R3$, the voltage applied to the base of $Q1$ will be zero.

With its base at zero potential, the transistor lacks forward bias. For all practical purposes, the collector will draw no current from the voltage divider formed by $R6$ and $R7$. Thus, forward biasing voltage will be able to reach the base of $Q2$ via $R6$. Current flows in $Q2$'s collector circuit and, consequently,



through the coil of relay *K1*, pulling the movable relay contact against fixed contact *B*.

If we now slowly move the arm of *R2* toward *R3*, an increasingly negative voltage will appear at the base of *Q1*. As this forward bias rises, *Q1*'s collector begins to draw current through *R6*, creating a voltage drop in the resistor that lowers the bias on *Q2*. If we continue turning the shaft of *R2*, *Q1* will finally draw so much current through *R6* that the bias of *Q2* will drop low enough to cut off its collector current. Relay *K1* will open. The specific setting of *R2* which results in the opening of *K1* is dependent upon the resistance ratio between *R4* and *R10*. Since *R10* is a thermistor, this ratio varies with temperature. Consequently, the dial of *R2* may be calibrated in degrees Fahrenheit as shown in the photos on pages 42 and 43.

Suppose we immerse *R10* in a liquid with a temperature of 68° F. When *R2* is set at the 68° mark, *K1* will open. If the temperature now rises, the resistance of *R10* will drop, thereby balancing the normally unbalanced bridge and reducing the negative bias on *Q1*. At a sufficiently high temperature, *Q1* will draw so little current through *R6* that the bias of *Q2* will increase and *K1* will close, applying voltage from *B2* to the coils of *K2* and *K3* via *R11* and *R12*.

As soon as *C2* charges to the closing voltage of *K3*, the relay's armature will flip, interrupting the current flowing through the coil from *B2*. After the energy stored in *C2* has been dissipated by the coil, the armature will flip back to once more provide a return path for the battery current. Capacitor *C2* recharges and the cycle repeats itself approximately once each second. The clicking sound produced by the flipping armature serves as an effective warning to the darkroom worker of a temperature rise in the liquid surrounding *R10*.

Relay *K3* will continue to click until the temperature goes down sufficiently to open *K1*. Since less current is needed to hold in *K1* than is required to close it, a drop of at least 1° must normally occur to reduce *Q2*'s collector current far enough to open *K1*. In order to reduce this on-off temperature differential, *K2* ungrounds the arm of *R9* whenever *K1*

closes. This operation adds resistance in *Q2*'s emitter circuit, effectively lowering the transistor's bias so that its collector current falls to a level barely sufficient to hold in *K1*. As a result, only a small fraction of a degree drop in temperature is now required to deactivate *K1*.

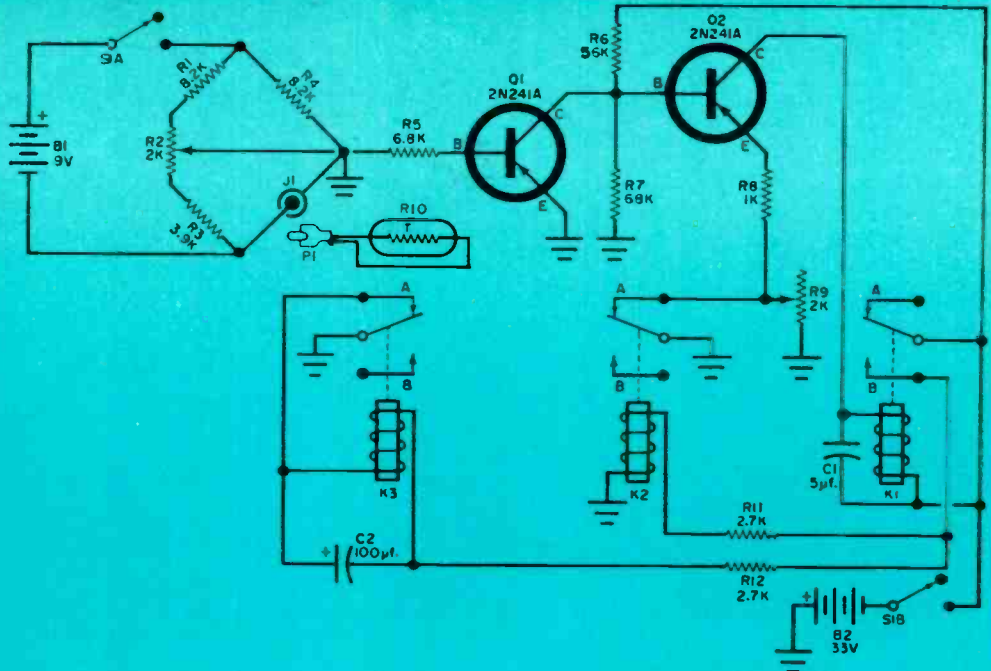
Other Circuit Arrangements. If temperature control within a degree or so is satisfactory for your purposes, you can construct a simpler version of the Temperature Taker with some savings in cost. Simply ground the bottom end of *R8* and omit *R9*, *R11*, and *K2*. Without these components, a temperature change of approximately 1° will be needed to activate *K1*.

While the unit shown here was wired to indicate a temperature *increase*—since photographic developers have a tendency to warm up above the desired temperature while in use—it can be easily converted to indicate a temperature *drop*. This feature may be especially useful if you employ elevated processing temperatures for color film. To make it work this way, just move the wire on terminal *B* of *K1* to terminal *A*, and the wire on terminal *A* of *K2* to terminal *B*.

The values of resistors *R1* and *R3* given in the schematic diagram provide a temperature range of 59° to 85° F. To monitor a lower temperature range, you simply alter the values of *R1*-*R3*, making *R1* smaller and *R3* greater. Increase *R1* and decrease *R3* for higher temperatures. A *wider* range of temperatures can be covered by using more resistance at *R2*, and less at *R1* and *R3*. In all cases, however, the sum of the three resistances should equal approximately 14,000 ohms.

In applications where a ticking relay isn't loud enough, ground the bottom end of *K3*'s coil and remove *C2*. The relay contacts can then be used to control an external bell, buzzer, or other noisemaker.

Construction. Although not especially critical, the layout shown in the photos makes for a neat, easily wired instrument. Mount *R2*, *K3*, *J1*, and *S1* on the front cover of a 3" x 4" x 5" Mini-box as shown in the photo on page 41. Most of the other components are mounted on a 3¹/₁₆" x 4¹/₁₆" piece of perforated circuit board which is supported by four 1" spacers slipped over 1¹/₄" 6-32

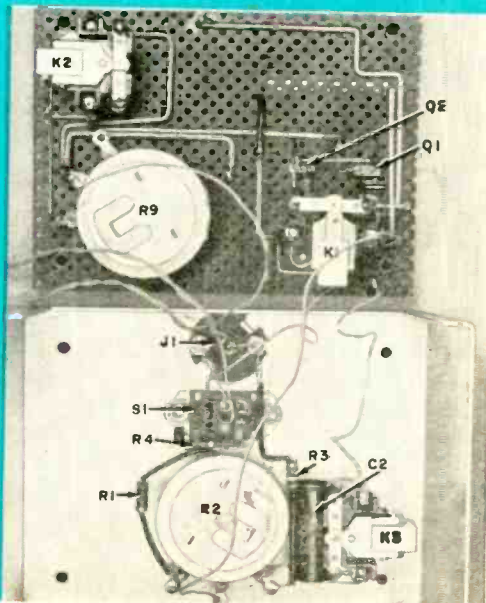


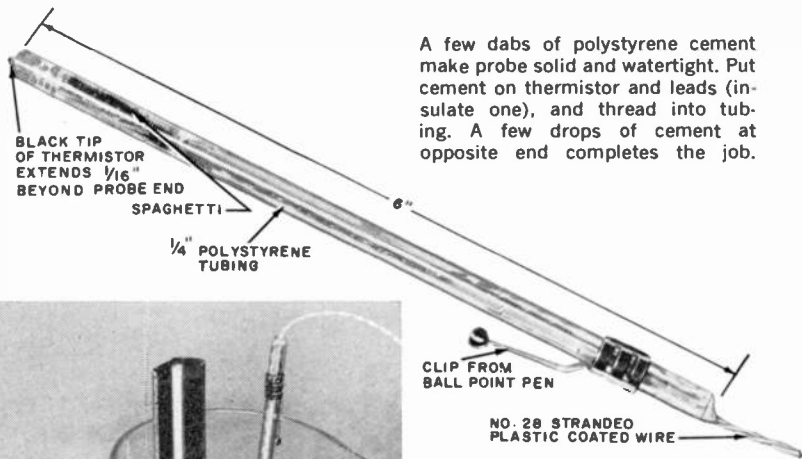
PARTS LIST

- B1—9-volt transistor battery
- B2—33-volt battery (Burgess XX22 or equivalent)
- C1—5-µf., 25-volt electrolytic capacitor
- C2—100-µf., 25-volt electrolytic capacitor
- J1—Phono pin jack
- K1, K2, K3—Miniature s.p.d.t. relay (Sigma 11F-9000-G/SIL.)
- P1—Phono pin plug
- Q1, Q2—2N241A transistor
- R1, R4—2200-ohm resistor
- R2, R9—2000-ohm potentiometer (Mullory M2MPK or equivalent)
- R3—3900-ohm resistor
- R5—6800-ohm resistor
- R6—56,000-ohm resistor
- R7—68,000-ohm resistor
- R8—1000-ohm resistor
- R10—4000-ohm probe-style thermistor (Fenwall GB34P2—Allied Radio Stock No. 8E629, \$2)
- R11, R12—2700-ohm resistor
- S1—D.p.s.t. slide switch
- 1—3" x 4" x 5" Minibox
- 1—Transistor battery connector (Cinch 5D or equivalent)
- 1—3-prong battery plug (Cinch 5B1A or equivalent)
- 4—1 1/4" C-32 machine screws and nuts
- 4—1" metal spacers for 6-32 screws
- 1—3 1/4" x 4 1/4" piece of perforated circuit board
- 1—6" length of 1/4" polystyrene tubing
- 1—Control knob
- 1—Roll of No. 28 stranded plastic covered hookup wire
- 1—Roll of No. 20 solid plastic covered hookup wire
- 2—Transistor sockets (Cinch 2H3 or equivalent)
- Misc.—Polystyrene cement, solder, spaghetti, electrical tape

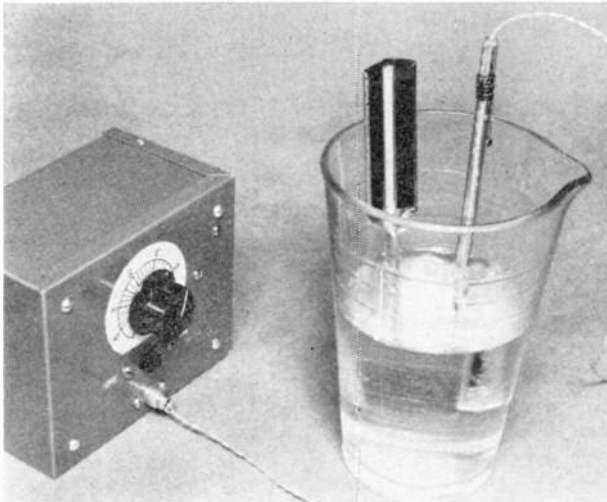
Principle behind device is fact that R10 varies in resistance as temperature changes. As it does so, it balances resistance bridge, cutting off Q1 which, in turn, activates Q2, K1, K2, and K3.

Removal of perforated board from cabinet shows parts placement. The board is wired with No. 20 solid wire; use stranded wire for probe leads and for connections between board and front panel.





A few dabs of polystyrene cement make probe solid and watertight. Put cement on thermistor and leads (insulate one), and thread into tubing. A few drops of cement at opposite end completes the job.



Calibrate the Temperature Taker with warm water and ice as described in the text, using an accurate thermometer for reference. Unit may be made to cover various temperature ranges depending on the values selected for R1-R3.

screws passing through holes in the front cover.

The only precautions to be taken in wiring the unit are to insulate *K1* from the chassis—its armature and frame are attached to each other—and to observe the correct polarities of *C1* and *C2*.

As stated on its shipping container, *R10* is a "delicate electronic instrument." Therefore, it should be handled with care and given adequate physical protection. The thermistor specified in the Parts List is a tiny black dot at one end of a thin glass rod about $\frac{1}{8}$ " long. Two bare wire leads emerging from the rod serve as terminals.

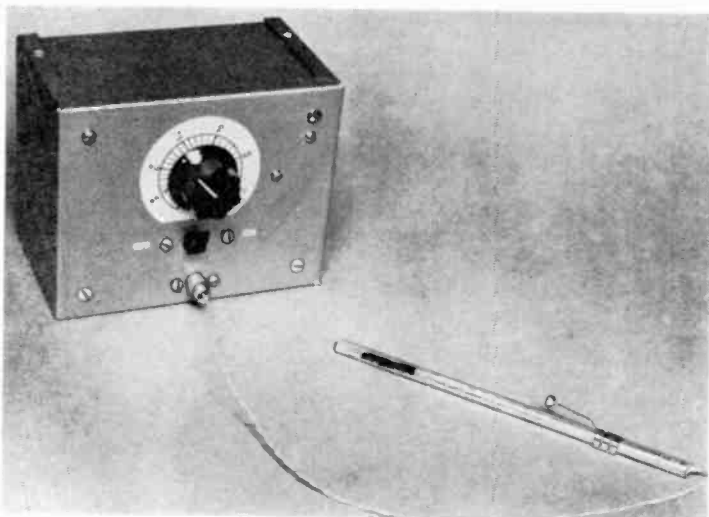
Construct a probe from a 6" length of $\frac{1}{4}$ " polystyrene tubing to serve as a housing for the thermistor. Any convenient length of wire may be run between the probe and the Temperature Taker. In the original, two 2½-foot lengths of plastic-covered No. 28 stranded hookup wire were twisted together for the purpose. Connect one end of the twisted pair to *P1* and thread the other end through the hole in the center of the

probe. Before soldering the wires at this end to the thermistor, insulate one of the bare leads on *R10* with spaghetti. There won't be room inside the probe for spaghetti on both leads.

Apply a liberal amount of polystyrene cement to the thermistor and spaghetti, and pull them into the probe by gently tugging on the wires until only the very tip of the thermistor extends beyond the end of the probe. Wipe all cement from the tiny bit of *R10* which remains exposed. A few drops of cement placed on the cable where it emerges from the probe will keep out unwanted moisture. Push the clip from a discarded ball-point pen over the probe to act as a means for clamping it to the side of a developing tray.

Adjustment and Calibration. After all wiring has been completed and checked for errors, reduce the resistance of *R9* to zero. Plug in the batteries and *R10*. Then turn the knob of *R2* fully counterclockwise. Throw on *S1* and slowly advance *R2*. At some setting of the potentiometer, if the room temperature

Completed Temperature Taker with thermistor probe is at right. Although prototype was designed to indicate rising temperatures over a specific range, the range can be tailored to suit the user; falling temperatures can also be made to sound an audible alarm.



is between 70° and 75° . $K1$ and $K2$ should close and $K3$ should begin clicking. After giving the knob of $R2$ a barely perceptible counterclockwise twist, advance $R9$ until the clicking stops. Too much resistance at $R9$ will cause erratic operation of $K1$ and irregular clicking of $K3$. Too little resistance at $R9$ will result in a significant difference between the on and off settings of $R2$.

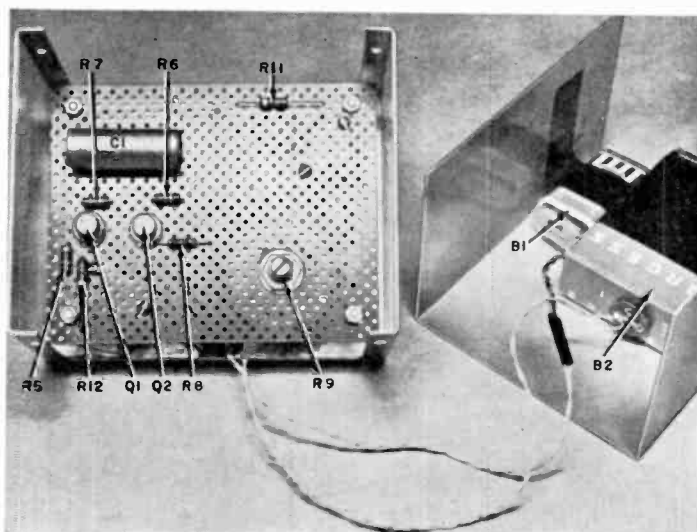
An accurate photographic thermometer, a glass graduate or other suitable container, a stirring rod, some ice cubes and a supply of warm water are required to calibrate the instrument. Temporarily

tape the heavy paper on which you plan to draw a dial scale underneath the knob of $R2$. Clip both the probe and the thermometer to the side of the graduate, as illustrated on page 42, and partially fill it with 70° water. Set $R2$ fully counterclockwise.

While stirring the contents of the graduate, slowly add warm water until $K3$ starts to click. Now, dunk an ice cube in the water just long enough to cool it to the point where $K3$ stops. Stir vigorously and then pause for a minute to allow the water to cease moving. Turn

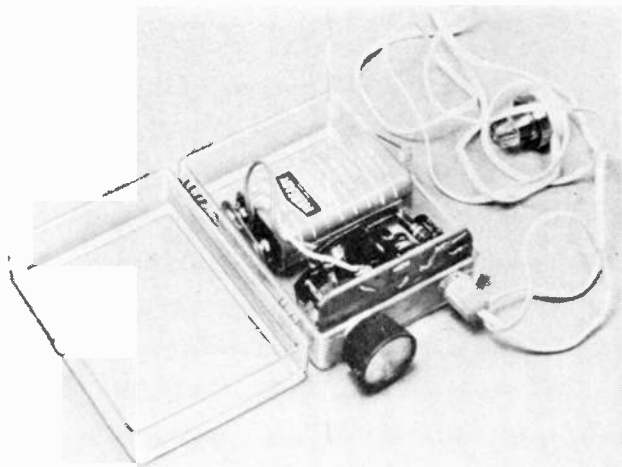
(Continued on page 82)

Four major components— $J1$, $K3$, $R2$, and $S1$ —are mounted on front panel of the unit, the remainder on perforated board positioned directly behind it with spacers and bolts. Control $R9$ is inside, since only initial adjustment is needed.



POCKETABLE METRONOME

A variable-speed pacer will be a boon for any tyro instrumentalists



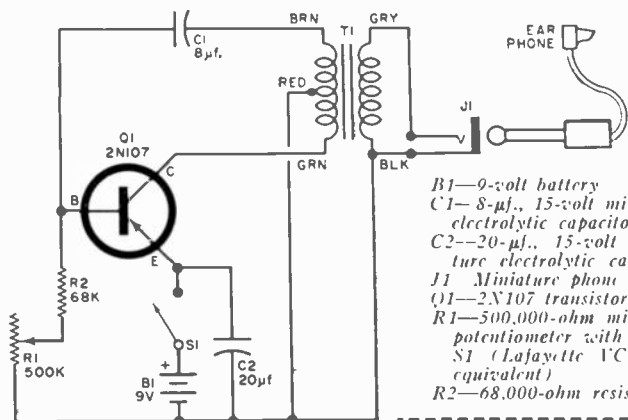
PEOPL**E** are rhythm-conscious, and if you are learning to type, play an instrument, dance, exercise, or any of countless other rhythmical functions, this metronome will mark the beat for you at a rate of from 80 to 300 clicks per minute. It is small enough to fit in a pocket, and the earphone stores nicely in the roomy case.

The metronome circuit is a simple relaxation oscillator with a 20- μ f. emitter bypass capacitor (*C2*) to stabilize the circuit. Two holes in the circuit board are enlarged to accept jack *J1* and potentiometer *R1*. As these components also hold the circuit board to the plastic case, the jack hole should be enlarged sufficiently to pass the collar of the jack.

Before permanently wiring the circuit, check the range of clicks. If they are too slow, decrease the resistance of *R2*; if they are too fast, increase *R2*'s value. Potentiometer *R1* has a tapered resistance, and both outer terminals should be tried to see which gives the greater spread of click range.

Metronomes are usually bulky affairs, never thought of as portable. This one is a departure from the norm, with more applications than a normal metronome could shake its pendulum at!

—Sal Stella



Switch *S1*, on back of *R1*, closes when knob is turned; *R1* varies click speed.

PARTS LIST.

B1—9-volt battery
C1—8- μ f., 15-volt miniature electrolytic capacitor
C2—20- μ f., 15-volt miniature electrolytic capacitor
J1—Miniature phone jack
Q1—2N107 transistor
R1—500,000-ohm miniature potentiometer with switch *S1* (Lafayette VC-39 or equivalent)
R2—68,000-ohm resistor

S1—S.p.s.t. switch (part of *R1*)
T1—Transistor miniature output transformer (Lafayette TR-99 or equivalent)
 1—6-ohm earphone
 1—Battery connector
 1— $\frac{7}{8}$ " x $1\frac{1}{8}$ " circuit board
 1—Plastic hinged box or other housing approx. 1" x 2" x $2\frac{3}{8}$ "

ADVANCED EXPERIMENTER'S CORNER



FIELD-EFFECT TRANSISTOR VOLTMETER

*Extraordinarily high
input impedance,
portability and accuracy,
with a single transistor*

By **JEFF H. TAYLOR**, Texas Instruments, Inc.

THE field-effect transistor is a relatively unexploited member of the semiconductor family. Until last February it was also one of the more expensive transistors, but a "price break" now places this unusual component in an attractive position as a possible experimenter's tool.* The voltmeter described in this

article is similar in many respects to a VTVM, but uses, instead of a vacuum tube, a single unipolar field-effect transistor—the 2N2498.

The 2N2498 transistor—unlike its bipolar brothers—exhibits extremely high input impedance and some of the other characteristics that might be attributed to a vacuum tube, specifically a pentode. Because of these characteristics, a voltmeter can be designed with a single

*As this is written, the 2N2498 field-effect transistor is being offered at \$12.75. Both the 2N2497 and 2N2499 are somewhat more expensive, \$14.25 and \$16.35 respectively.

transistor and a bare minimum of parts. As the specifications on the next page show, the field-effect transistor voltmeter is small, lightweight, and has a battery life equal to the shelf life of the mercury cells used to power it.

Technically, the voltmeter uses a field-effect transistor in a source-follower configuration (similar in many respects to the familiar cathode-follower arrangement used with vacuum tubes). The voltage gain of the final circuit is less than unity, and varies with changes of the small-signal common-source forward transfer admittance and other circuit impedances.

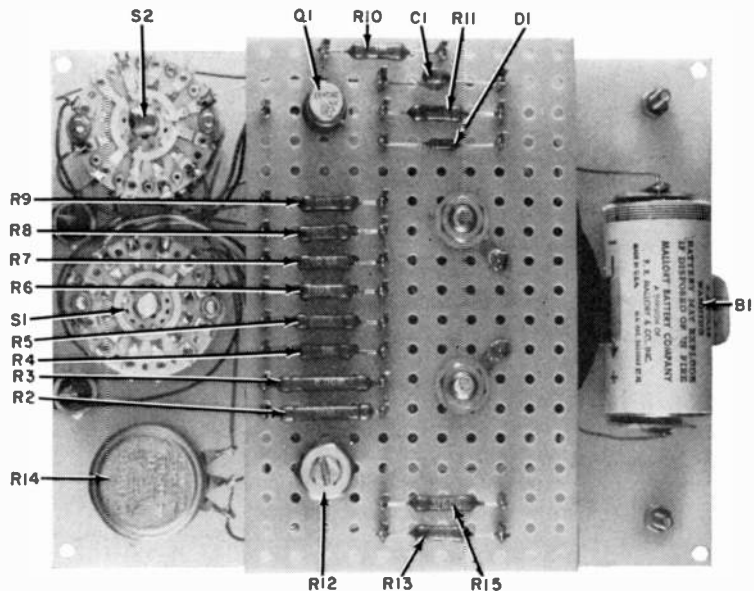
Circuit Theory. The basic voltmeter circuit is shown in the small diagram in the upper right-hand corner of the next page. To analyze it, assume that a zero potential is established between points *A* and *B* and that current will flow through the transistor and resistor R_s . This places point *C* negative with respect to point *B*. Combination resistors R_a and R_b can be adjusted to provide a potential at point *D* equal to the potential at point *C*. The meter will now indicate zero. If a negative potential is applied to the input (*A-B*), the current through the transistor and resistor R_s will increase and point *C* will become more negative—causing a meter reading proportional to the potential difference between points *A* and *B*.

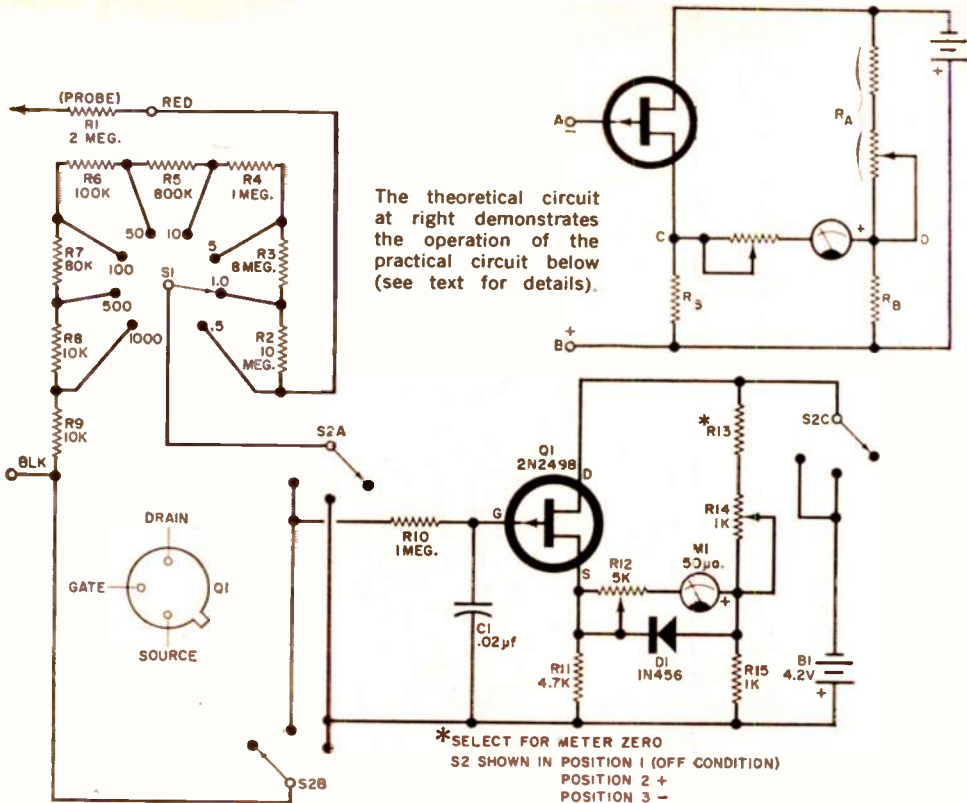
The input resistance of this circuit can be extraordinarily high since it is determined by the *gate-to-channel* leakage of the field-effect transistor. ("Channel" refers to the conducting path between the "source" and the "drain.") Obviously, this circuit will not work in actual practice since the open gate would permit static potentials at point *A* to cause the meter needle to wander. A practical version of this basic circuit is shown in the large schematic diagram and construction photograph.

A Practical Circuit. Through a rather modest arrangement of switches and resistors, a single field-effect transistor voltmeter can be built possessing the detailed specifications outlined at the bottom of page 47. The input impedance of this voltmeter is determined by the series combination of resistors $R1$ through $R9$. To provide protection from transient overload or stray a.c. voltage injection, the filter consisting of $C1$ and $R10$ has been introduced. Diode $D1$ has been wired across the meter so that the movement current can be limited to about $1\frac{1}{2}$ times the full-scale deflection value. Although this circuit was designed using the 2N2498 field-effect transistor, most (but not all) of the 2N2497's and 2N2499's will work as well.

Since the over-all accuracy of the voltmeter is largely determined by the input resistor string, resistors $R2$ through

The voltmeter is mounted in a black Bakelite meter box available at most radio supply houses. The circuit components are mounted on a piece of perforated phenolic board which is attached to the back of meter $M1$ with nuts on the meter input terminals. Although layout is not critical, care should be taken to insure that leakage paths do not develop in input circuit.





The theoretical circuit at right demonstrates the operation of the practical circuit below (see text for details).

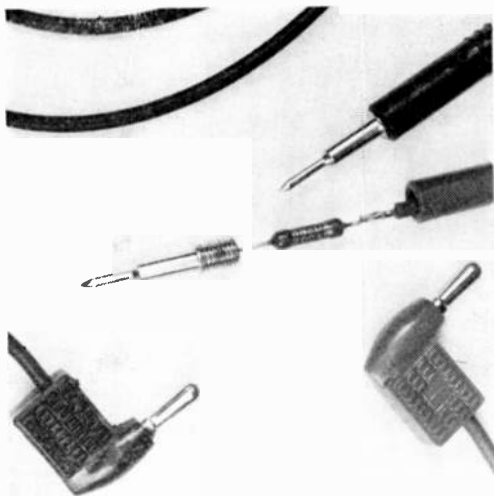
*SELECT FOR METER ZERO
S2 SHOWN IN POSITION 1 (OFF CONDITION)
POSITION 2 +
POSITION 3 -

PARTS LIST

- B1—4.2-volt mercury battery (Mallory TR233 or equivalent)
- C1—0.02- μ f., 200-volt capacitor
- D1—1N456 silicon diode
- M1—0-50 microampere meter (Simpson Model 29 or equivalent)
- Q1—2N2498 field-effect transistor (Texas Instruments)
- R1—2-megohm (or 1.8- or 2.2-megohm), $\frac{1}{2}$ -watt resistor, 10%
- R2—10 megohms (1-watt resistors, 1%)
- R3—3.0 megohms (Aerovox CPX-1 or equiv.)
- R4—1.0 megohm
- R5—800,000 ohms
- R6—100,000 ohms
- R7—80,000 ohms
- R8, R9—10,000 ohms
- R10—1.0-megohm, $\frac{1}{2}$ -watt resistor, 10%
- R11—4700-ohm, $\frac{1}{2}$ -watt resistor, 10%
- R12—5000-ohm potentiometer with lock
- R13—1000- to 5000-ohm resistor—see text
- R14—1000-ohm potentiometer
- R15—1000-ohm, $\frac{1}{2}$ -watt resistor, 10%
- S1—1-pole, 8-position rotary switch (Centralab P.A-1001 or equivalent)
- S2—3-pole, 3-position rotary switch (Centralab P.A-1007 or equivalent)
- 1—Battery holder (Krystone \approx 17.3 or equivalent)
- 2—Banana jacks, one red, one black
- 1—Black plastic multimeter case (approx. 6 1/8" x 5 9/32" x 2 5/16") or similar
- Misc.—Set of test leads with banana plugs, knob for zero control, perforated phenolic board

SPECIFICATIONS

- Accuracy** Determined by meter movement used. Accuracy of instrument shown is within $\pm 2\%$ of full scale.
- Battery Life** Essentially shelf life.
- Input Impedance** 22 megohms on any range (including 2-megohm probe).
- Power Consumption** Approximately 5 mw.
- Power Supply** 4.3-volt mercury battery.
- Voltage Range** 0.5 volt to 1000 volts. Eight ranges selected with front panel switch.
- Full-scale readings of:** 0.5, 1.0, 5.0, 10, 50, 100, 500, and 1000 volts.
- Warm-Up Time** Zero.
- Weight** Approximately 2 1/4 lb. with battery.



Solder resistor *R1* to the pin of the probe and slip it inside the red handle. The probes need not be reversed to reverse polarity, since this is accomplished through front panel switch *S2*.

Construction and Calibration. The voltmeter can be built on a single piece of phenolic board and attached to the back of meter *M1* through the meter input terminals. Except for the resistor in the probe, all of the resistors can be mounted to the board with Vector terminals and soldered in place. The layout should approximate that in the photo to eliminate the possibility of leakage paths in the input part of the circuit.

R9 should be stable and preferably have an accuracy of $\pm 1.0\%$. Of course, if you have access to a bridge, standard $\pm 5\%$ resistors can be measured and very close values selected on this basis.

Resistor *R13* must be selected so that potentiometer *R14* will adjust near its center position to set meter *M1* to a zero deflection. The value of *R13* may vary from 1000 to 5000 ohms, but once set it will need no further adjustment.

The final accuracy of the voltmeter depends on the values of resistors *R2* through *R9* as well as a calibrating voltage source. Ideally, a digital voltmeter of known accuracy and a variable d.c. voltage source should be used. However, initial calibration with several 1.34-volt mercury batteries may be used to set the 0-5 volt scale. Linearity of the scale is adjusted by varying potentiometer *R12* and locking it into position once satisfactory linearity has been established. -30-

BASS REFLEX ENCLOSURE DATA

If you plan to build your own bass reflex speaker enclosure, you'll find the Electro-Voice Technical Bulletin #10 on the design and construction of bass reflex enclosures a real help. And before

ordering the lumber, you might read the E-V "Guide to Compact Loudspeaker Systems," a colorful "idea book." Both are available free from Electro-Voice, Inc., Buchanan, Mich.

TEMPUS FUGIT

"Wal sonny," said the OT to the youthful ham one day,
 "It wasn't always easy to construct your rig, and say—
 you had to build 'em big, in an ugly-looking rack;

the parts were really very scarce, they'd set your budget back!

"You'd breadboard all the circuits, testing each in turn, you see
 with Fahnestock clips, resistive pencils, lots of wire and gee—
 those tickler coils were fancy, you tuned for the least smoke.

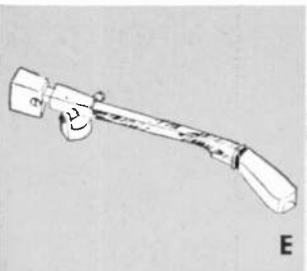
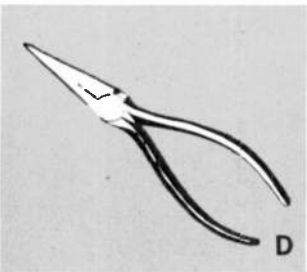
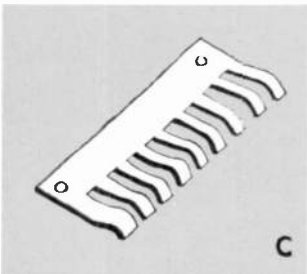
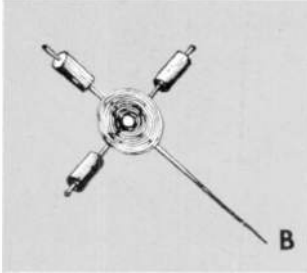
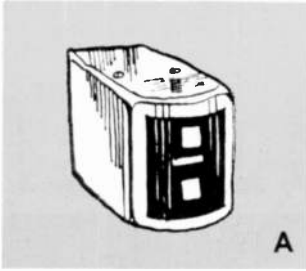
The little sets you build today, they really are a joke!

"When we old hams would really go, why we'd talk far and wide
 I once talked right to Pittsburgh and it filled my heart with pride."
 The young ham flipped his little switch and gave the key a whack.
 The OT sat there goggle-eyed! An AC4 came back!

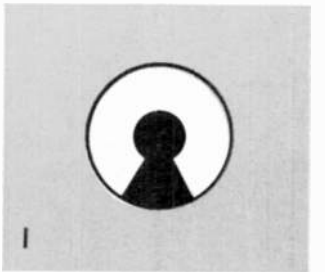
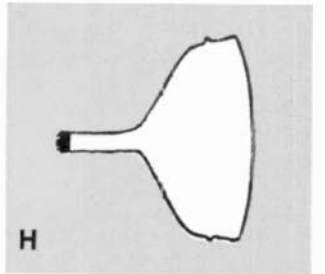
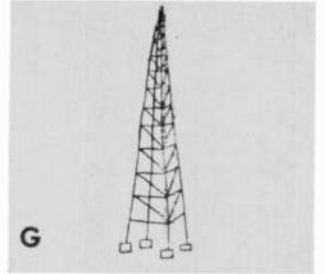
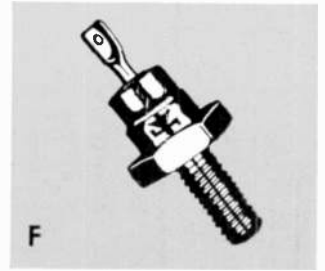
—Byron G. Wels, K2AVB

BIO-ELECTRONIC QUIZ

By ROBERT P. BALIN



The body of knowledge a technician should learn contains many terms that are derived from their resemblance to parts of the human anatomy. See if you can match the common electronic terms listed below (1-10) with the sketches (A-J) of the devices to which they most likely pertain.



(Answers on page 90)

- | | | |
|----|--------|---------|
| 1 | Arm | _____ |
| 2 | Eye | _____ I |
| 3 | Finger | _____ |
| 4 | Hair | _____ |
| 5 | Hand | _____ |
| 6 | Head | _____ H |
| 7 | Legs | _____ |
| 8 | Knee | _____ |
| 9 | Neck | _____ H |
| 10 | Nose | _____ |

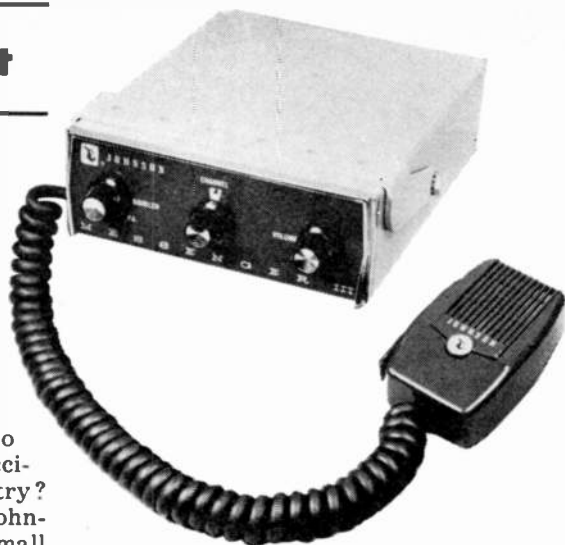
Equipment Report

MESSENGER III

ARE YOU in the market for a CB transceiver that doesn't drain your car battery? Or a transceiver that is so small you begin to wonder if the manufacturer hasn't accidentally left out half of the circuitry? Completely transistorized, the E. F. Johnson "Messenger III" is absurdly small and on receive draws only 50 ma. from a 12-volt car battery. On transmit, the power drain is still only around 600 ma.—compared to the 4 to 6 amperes drawn by conventional tube-type transceivers.

And despite the size of the Messenger III, E. F. Johnson has not skimped on circuitry. The tested power output (at 5 watts input) is right up there at a good solid 100% modulated 3.4 watts. The receiver is double-conversion with superior selectivity characteristics, plus more sensitivity than is needed.

The Messenger III can also be used as a field portable, or as a mobile public address system with only modest switch-

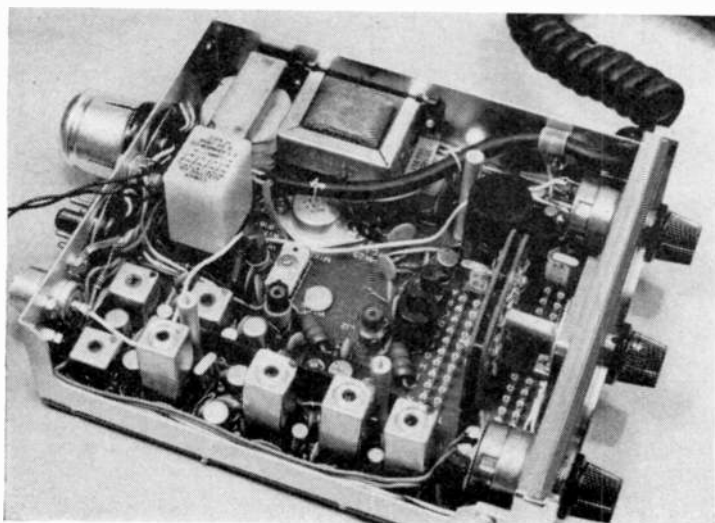


ing changes. Selling at \$189.95 (net), plus \$29.95 (net) for the base station 117-volt a.c. power supply, it is as modern in every sense of the word as any CB transceiver could be.

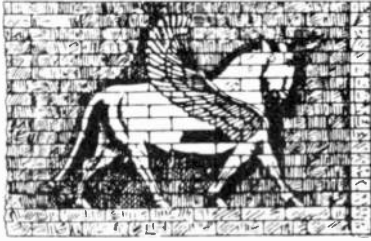
—30—

BOX SCORE				
	Excellent	Good	Fair	Poor
Talk Power	✓			
Selectivity	✓			
Sensitivity	✓			
Squelch	✓			
Noise Limiting	✓			
Stability	✓			
Operating Ease		✓		

Circle No. 88 on
Reader Service Page 11



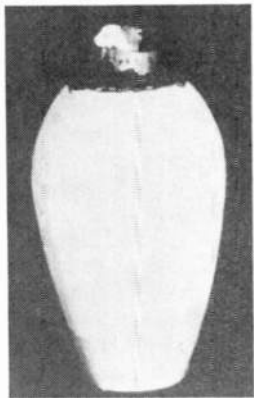
The Messenger III, designed along "space-age" lines, is a rugged unit. In this photo, the crystal bank for 11 transmit and receive channels is visible just behind the front panel. The white box near the rear skirt is a special transmit/receive antenna switching relay such as might be found in a guided missile. Manufacturer also has transistorized selective calling systems available for use with the Messenger III.



By WALTER G. SALM

Babylon Battery

*The electric battery existed
2000 years ago! Did ancients
possess other science facts?*



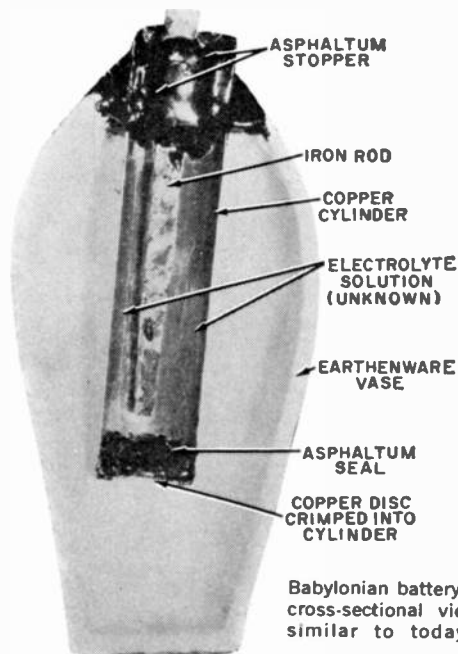
Batteries were built into earthenware jars such as this one. Asphaltum was used to seal battery element in place.

ELECTRIC BATTERIES over 2000 years ago? Not really impossible, if you stop to ponder the considerable amount of knowledge the ancients possessed. Unfortunately, most of this knowledge was lost during various conquests and library burnings.

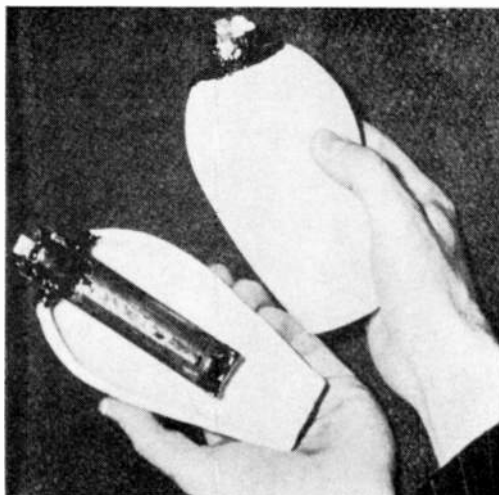
These early electrochemical batteries were first brought to light by a German archaeologist, Wilhelm Konig, working for the Iraq Museum. They were discovered in the ruins of an ancient Parthian town on Khujut Rabu'a, a hill not far from Baghdad. The cells were apparently used for electroplating gold, and as there were no patent laws, the processing details were passed from father to son, and kept closely guarded.

Cell Construction. The ancient cells were reported to the American scientific press in 1939 by Willy Ley, a science historian. He described the central cell elements: a copper cylinder containing an iron rod that had been corroded as if by chemical action. The cylinder was soldered with a 60/40 lead-tin alloy, the same solder alloy we use today. The electrolyte was another matter. As this was thoroughly dried by time, it's anybody's guess. However, there were a number of usable chemicals around in those days that could have done the job.

Willard F. M. Gray, an engineer at GE's Pittsfield, Mass., plant constructed



Babylonian battery, shown in the cross-sectional view at left, is similar to today's dry cell.



Cutaway model exposes interior of ancient cell. Vase was not for looks, but to support elements.

replicas of these cells, and used copper sulphate as an electrolyte. Mr. Gray's models, shown in the photographs, are now in the Berkshire Museum in Pittsfield. The earthenware jars used to house the original cells kept the cells upright, and the tops were sealed with asphaltum, a caulking compound that cannot be duplicated today. Mr. Gray used black sealing wax instead.

Iron and copper rods found with the ancient cells may have been used to series-connect them for higher voltages.

Applications. Gold wasn't the only thing these pre-A.D. smiths used the cells for. They were also able to plate silver and antimony. This, of course, speaks well for their knowledge of chemistry, too. Some of the plating solutions they had to compound included ferrocyanides, lye solutions and orate baths (gold dissolved in hydroxide). These chemicals were available to the ancients, and they could have used any of them. The asphaltum that sealed the batteries was the same material that Noah used to caulk the ark. The Bible calls this material "bitumen" and it must have been an all-around sealing compound, with numerous applications.

Other Finds. While the Parthians had only a limited knowledge of the electro-

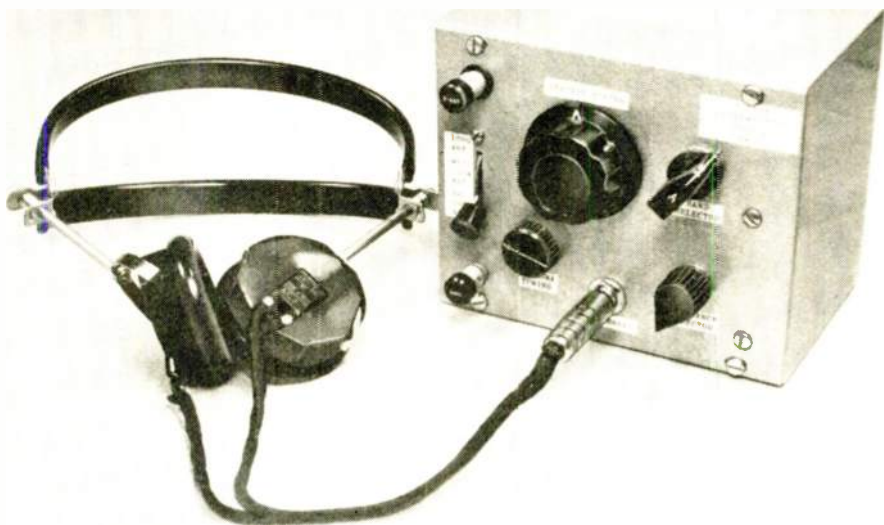
chemical batteries, archaeologists have found the remains of four more in a magician's hut in the excavation of Seleucia, a town not far from Khujut Rabu'a. The Berlin Museum had pieces of ten more such batteries, possibly without realizing what they were.

Although Cleopatra didn't actually have electric lights in her palace, it is entirely possible that Mark Antony presented her with gifts that he had picked up in his travels, and that these gifts were electroplated. Surely, some of these electroplated jewelry items must have found their way out of the Mesopotamian region and into neighboring kingdoms.

While we are all doubtless impressed by our own technological achievements, it gives one pause to think that one of our commonplace "modern" discoveries is not a discovery at all, but a re-discovery of an ancient artifact! Who can surmise what other secrets the ancients hold in shrouded mystery?

It is unfortunate that the knowledge and technology of the ancients was destroyed before it could be recorded and saved, but each year more wonders of the old sciences come to light. Who knows? Perhaps some day our own technology will catch up to theirs. ~~—70—~~

Build a MODERN CRYSTAL SET



No tubes, transistors, or power! A few parts and lots of ingenuity result in this amazing little receiver

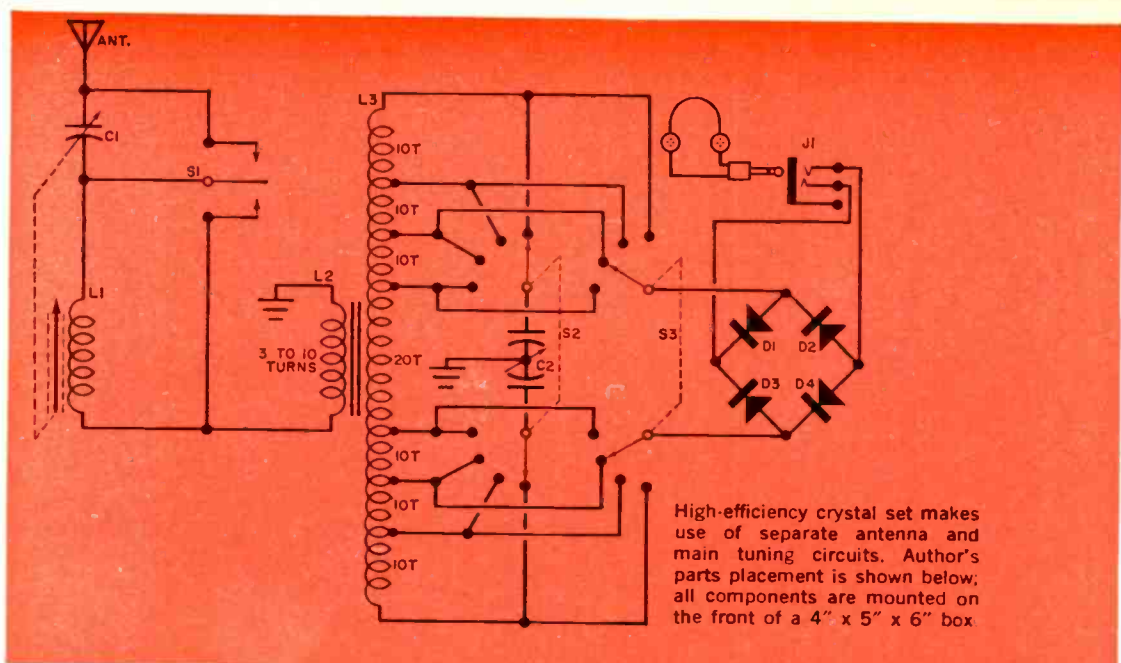
By WALDO T. BOYD, K6DZY

FIFTY YEARS, during which the audi-on valve, the multipurpose tube, and the transistor have come into being, have neither outmoded the fascination of building a crystal set nor the thrill of listening to it for the first time. Basically, a crystal set is limited to the use of only the power supplied by the station heard. Transistors, which fall in the category of amplifiers, must also be ruled out if the experimenter wants to stay within the classic meaning of the term "crystal set."

Unfortunately, "cat whisker sets" have long been known for their lack of sensitivity and selectivity, usually receiving two or three local stations at once. The

author's goal was to improve on the traditional crystal set by using good materials, high- Q resonant circuits, new techniques, and innovation. Proof of the success of the "Modern Crystal Set" is that its measured output is ten times as great as a "standard" coil-capacitor-diode kit used as a comparison this with an acceptable degree of selectivity!

Antenna Circuit. In contrast to the usual crystal set which ignores a number of known facts about antenna length and tuned circuits, this set uses series tuning in the antenna circuit. Switch *S1* selects either a capacitance (*CI*), or inductance (*LI*), or both. The result is that either a bedspring or 500 feet of

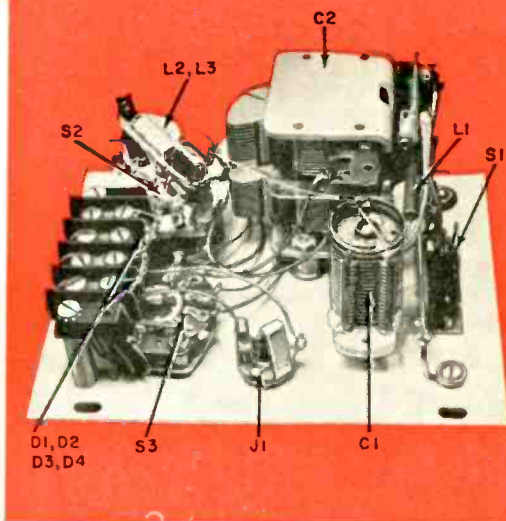


outdoor wire will work as an antenna, since $L1$ tends to "lengthen" a sky wire, while $C1$ "shortens" it.

By ganging $C1$ and $L1$ (although ganging is not absolutely necessary), one control does the work of two. As shown in the photos and drawing, a small dial cord drum is soldered to $C1$'s last rotor plate, and revolves when $C1$'s shaft is turned. One-half the circumference of the drum should be approximately equal to the total length of the ferrite slug used in $L1$; a bottle cap can be adapted if a dial cord drum is not available. Metal hooks are glued into the ends of the ferrite slug, which is then coupled to the drum with dial cord. A small pulley from an old BCB receiver (or a pulley made with a battery nut on a piece of wire) and a rubber band complete the job. The ferrite slug should enter the coil as $C1$'s rotor plates begin to mesh.

Good selectivity is achieved by transformer ($L2$ - $L3$) coupling the antenna circuit to the main tuning circuit ($L3$, $C2$). Start with 10 turns for $L2$, and reduce this if even greater selectivity is desired.

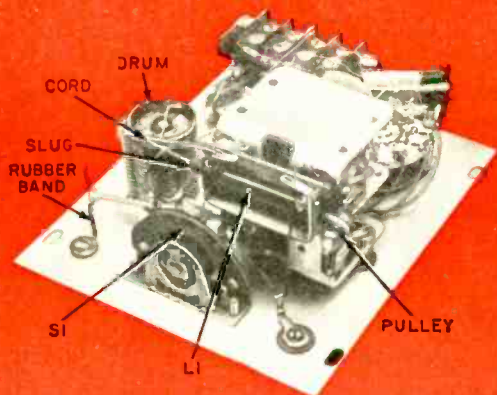
Main Tuning Circuit. The main tuning circuit has to perform two functions: provide both a parallel-resonant tuned circuit for station selection and enough



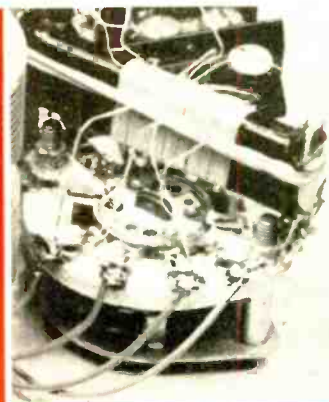
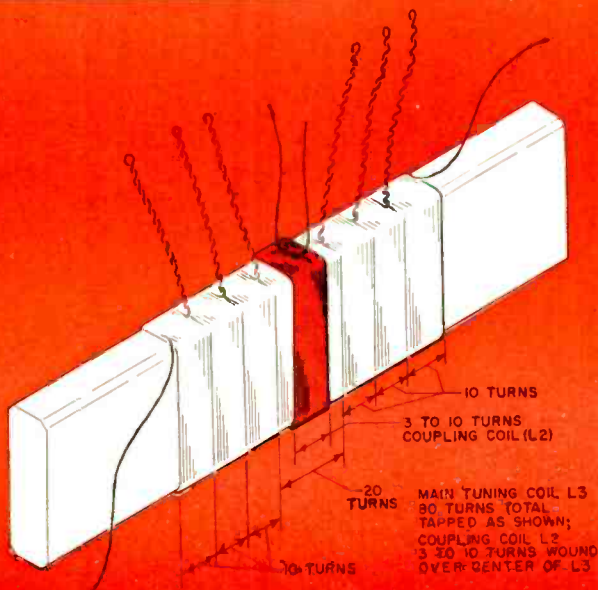
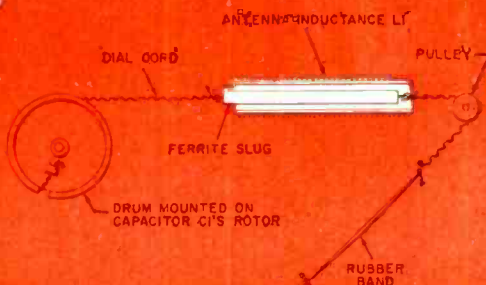
audio power to drive the headphones. The first function is best served by using a high- Q circuit—this is achieved by winding the coil on a ferrite rod with litz wire. Since there is an optimum inductive-capacitive combination for highest Q at any frequency, $L3$ is tapped.

The taps also help in another way. The headphones place a load on the tuned circuit and lower Q . By extending the taps to $S3$, the headphones can be matched to the coil at the point which

(Continued on page 83)



Shaft of C1 also tunes L1 with the components ganged as shown. Coil L1 is mounted in a cardboard holder which is glued to the back of C2. Components must be mounted so that end of L1 and drum are overh.



Wind L3 on bare ferrite rod, 80 turns total. After L3 winding is completed, wind L2 over center section. The ferrite rod used here is approximately 2" x 1/2" x 3/16".

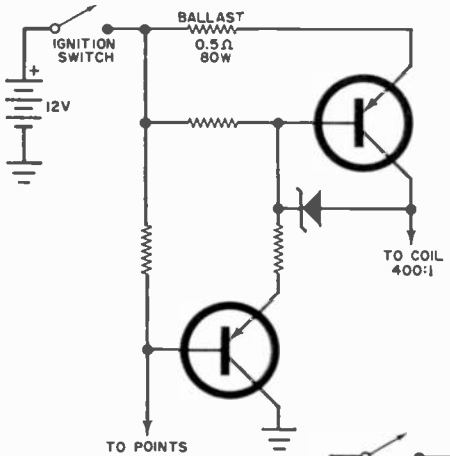
PARTS LIST

- C1—Miniature variable capacitor, approx. 250 pF maximum
 C2—Dual TRF-type broadcast receiver variable capacitor, approx. 365 pF, per section
 D1, D2, D3, D4—General-purpose germanium diode (Lafayette No. SP-148 or equiv.)
 J1—Three-conductor open-circuit phone jack
 L1—Slug-tuned broadcast tuning coil (may be salvaged from many auto radios of 1939-49 vintage, or use Burstein-Applebee No. 14C89 and remove threads); inductance not critical
 L2, L3—Wind directly on rod from new or used ferrite antenna, as per drawing, with 5 x 44 litz wire, enamel and fabric insulated
 S1—S.p.d.t. switch with center "off" position

- S2, S3—Two-pole, four-position wiper switch, non-shorting (Centralab PA-1090 Series, Type 1093, or equivalent)
 1—Set of headphones, high-impedance, crystal type (recommended (Burstein-Applebee No. 22A47 or similar)
 1—Three-circuit phone plug
 1—4" x 5" x 6" Minibox
 1—Roll of 5 x 44 litz wire (Belden Type 8817; Allied Stock No. 48T981 @ 29 cents)
 Misc.—Control knobs, binding posts (insulated feedthrough type for antenna), terminal strip, spacers, machine screws and nuts for mounting components, small dial cord drum (see text), epoxy cement, hookup wire, solder, etc.

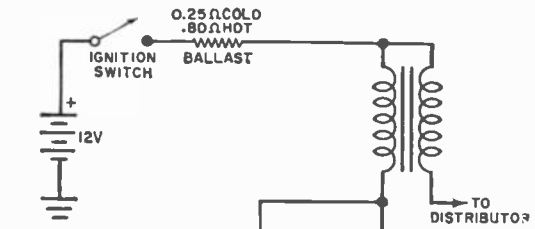
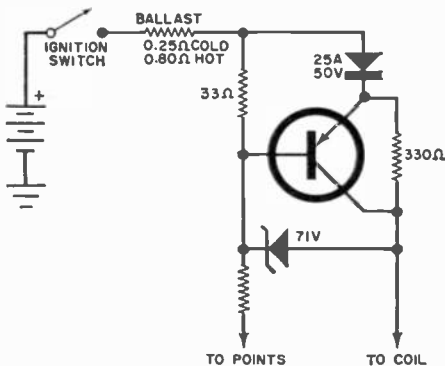
More Transistor Ignition Circuits

Following up our feature article in last month's issue, here are five more circuit diagrams of systems currently on the market

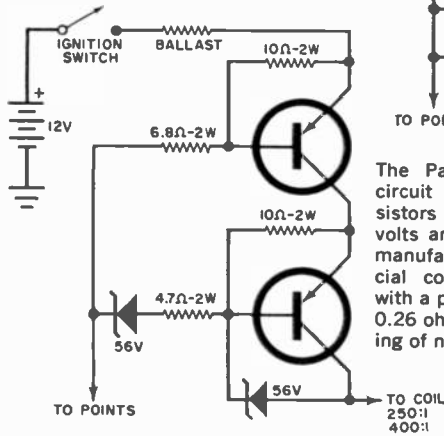


The Delta Products Transnitor Mk-5 uses the circuit arrangement above to keep current through the points at a very low value. This system with coil sells for \$39.95 with usual guarantee.

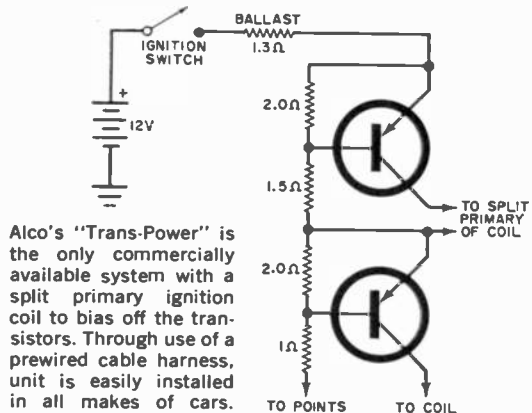
A Prestolite 250 system (below) is similar to this manufacturer's 201 system (see p. 86, June issue). The transistor has a current capacity of 15 amperes with an applicable breakdown rating of 90 volts. This system presently retails at \$63.00.



Micro-Kits sells the "Micro-Fury" system at right for \$29.95 wired or \$24.95 as a kit. The coil has a turns-ratio of 400:1.



The Palmer two-transistor circuit at left uses transistors with ratings of 60 volts and 15 amperes. The manufacturer supplies special coils for this circuit with a primary resistance of 0.26 ohm and a current rating of not over 10 amperes.

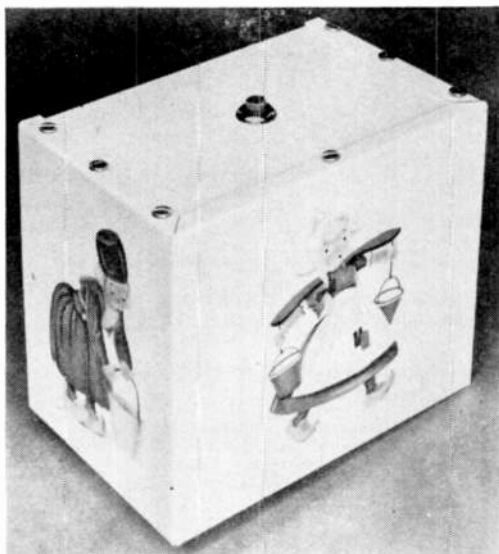


Alco's "Trans-Power" is the only commercially available system with a split primary ignition coil to bias off the transistors. Through use of a prewired cable harness, unit is easily installed in all makes of cars.

The Lullaby Box

By **HARTLAND B. SMITH**
W8VVD

After fifteen minutes of soothing music, the box turns off. So does the baby . . .



GENTLY press the button atop the "Lullaby Box" and it softly emits soothing, tinkling tones for a 15-minute period. Then it turns itself off, making it unnecessary for the busy housewife to interrupt her duties to do so. An excellent baby tranquilizer, the gadget makes an ideal gift at baby showers or for parents of young children.

Depressing normally-open switch *S1* lets current flow in the coil of *K1*, closing the relay; *K1* is locked in the closed position. At the same time, power is applied to the musical movement and the timing motor.

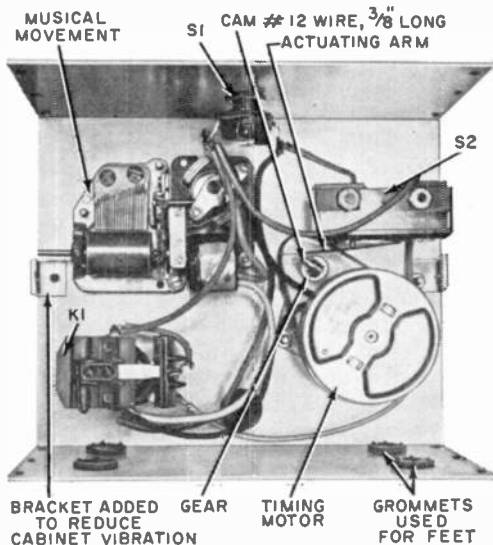
After about one minute of operation, the timing motor cam moves away from the spring of *S2* and this switch drops to the lower contact; current continues to flow to the motors and relay through this contact. Some 14 minutes later, the cam once again pushes the actuating arm of *S2*, forcing the arm back to the top contact. This time, current to *K1* is interrupted, and the action stops.

Construction. All components are mounted on the rear cover of a 4" x 5" x 6" Minibox. Start by soldering a piece of #12 copper wire about $\frac{3}{8}$ " long to the timing motor gear (see photo at right) so that it protrudes about $\frac{1}{8}$ " beyond the edge of the gear. Do not allow ex-

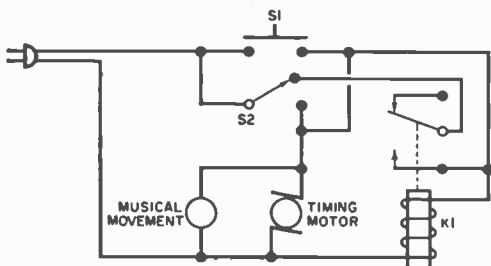
cess solder to drip into the gear teeth. Drill a $\frac{5}{16}$ " hole in the Minibox cover to provide clearance for the opposite end of the motor shaft.

Mount switch *S2* on $\frac{1}{2}$ " spacers which will place its contact spring in line with the motor cam. Be sure the distance to the cam is such that positive action takes place. Break or file off the locating stud under the relay, and mount the relay on a grommet, rather than directly to the box. This will eliminate a loud "boing" when the relay pulls in.

Since the entire box acts as a sound-



Wiring of "Lullaby Box" is not critical, but parts placement is since timing motor cam must act positively on switch *S2*.



Musical movement, timing motor, and relay K1 are all 115-volt units. See text for operation.

PARTS LIST

- K1—S.p.d.t. relay, 115-volt a.c. coil (Potter & Brumfield KA5AY-115AC or equivalent)
- S1—S.p.s.t. normally-open push-button switch
- S2—S.p.d.t. snap-action switch (Acro BRD2-5L or equivalent)
- 1—115-volt a.c. musical movement—"Brahms Lullaby" (Novelties of Distinction, 131 W. 42 St., New York, N.Y.)
- 1—4-rph timing motor (Allied Radio 78B497)
- 1—4" x 5" x 6" aluminum Minibox
- 6—Rubber grommets for $\frac{3}{8}$ " holes
- 2— $\frac{1}{2}$ " metal spacers
- 2—6-32 x $1\frac{1}{2}$ " machine screws
- Misc.—Screws, nuts, washers, wire, solder, paint, decorative decals, etc.

ing board, you don't have to drill holes to let the music out. You can prevent rattles and resonances by adding two small brackets to the box, and using additional sheet metal screws to make the box tighter. Use four rubber grommets as mounting feet, and another grommet for the line cord.

A coat of paint and some decals will enhance the overall appearance of the box. Should you decide to paint it, do so after the holes are all made but before the parts are installed. Decals should be applied after the wiring is finished, to keep them neat and clean.

Testing. When the "Lullaby Box" is completed, first give it a thorough visual inspection to be sure that none of the wiring is in contact with the metal box. Plug the unit in, and test it for correct operation. If all is satisfactory, apply a single drop of light machine oil to each bearing and gear tooth in the musical movement, but do not oil the drum or comb. Then fasten the two halves of the Minibox together. -30-

Scientific Short-Wave Listening

UNLESS you speak several languages, the chances are that you haven't been able to identify all the signals you hear as you tune across the short-wave bands. One good solution to this common SWL problem is the "Tentative High Frequency Broadcasting Schedule," which is published by the International Telecommunications Union in Geneva, Switzerland. This "tome" is available directly from the ITU, and it costs 17 Swiss francs. At present, the Swiss franc is worth about 20 cents, but this figure has been known to fluctuate from time to time. Its current value can be determined by consulting a financial news publication. When you order the book, send along an International Money Order for the full amount.

The THFBS contains over 100 large pages on which are listed the precise frequency, hours of operation, power and geographic coordinates of virtually every international short-wave station in the world. In addition, exact data is in-

cluded for each station on the type of antenna system used, gain in db, and bearing of directional antennas. The zones, or target areas of the world to which each international broadcast is beamed, are also given. The introductory text is printed in French and Spanish as well as in English.

With the THFBS and a good receiver, you will probably be able to pinpoint any foreign short-wave station you hear. In fact, the book so quickly removes the mystery surrounding the location of some of the lesser-known foreign stations that you may find yourself passing these up and spending your time looking for and listening to the few clandestine stations that are not on the international list!

Other helpful items that will enhance your short-wave listening pleasure are a clock set to GMT time, a map showing the world zones, and a frequency standard for accurate frequency measurement.

—Lauren A. Colby, K4RFC



Monthly Short-Wave Report

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

NOTES FROM YOUR SHORT-WAVE EDITOR'S DESK

THE FIRST commercial broadcasting station in the Arab world will go on the air shortly with a power of 500,000 watts. Located at Mansourah in the United Arab Republic, the station will broadcast a Pan-Arab non-political program of light music with short periods of advertising for 16 hours daily. It will be audible in Lebanon, Jordan, Syria, Iraq, Saudi Arabia, the Arabian Gulf, Libya, and Sudan, as well as in the United Arab Republic itself.

The new station may already be on the air as we go to press, but as this is being written we do not have any information as to the frequencies that will be used. In view of the territories to be covered, however, we assume that they will be in the medium-wave band. East Coast listeners should have a chance to log this super-powered station.

Radio Caroline. A commercial medium-wave station operating from a converted ferry boat nine miles off the English coast, *Radio Caroline* will soon be silenced if the

International Telecommunications Union has any say in the matter. The ITU asked the Government of Panama to assist in closing the station because the ship has been flying the Panamanian flag. (See "Not Cricket, Caroline!" on p. 38 of this issue.)

The ITU, an agency of the United Nations, allocates radio frequencies under a world-wide agreement. In previous actions, its intervention led to the lowering of the Panamanian flag on commercial broadcast ships which were located off the coasts of the Netherlands and Denmark; however, both are reportedly still in operation.

How NOT to Obtain QSL's. "Please send me your QSL." No thanks, no return postage, no explanation. This request was received from a WPE6 short-wave listener by W1UGH, a licensed amateur operator in Hudson, Mass. It was sent to his previous home in Rhode Island by someone who evidently was trying the hard way to collect a verification card from that state.

As W1UGH pointed out, and we whole-

The equipment of Ed Barkowski, WPE3GI, Arnold, Pa., includes two receivers—a Hallicrafters S-120 and a Lafayette HE-30—a Westinghouse four-track tape recorder, and an indoor "long-wire" antenna. Ed has 40 countries logged, with 20 verifications.



July, 1964

Albert J. Sauerbier, of Washington, N.J., is well known to many DX'ers: he is the treasurer of the Newark News Radio Club. A DX'er of long standing, Al is currently using a National NC-183-D receiver and a Hy-Gain trap antenna, 15 feet above ground.





The listening post of Eddie Peschke, WPE5CJD, in Houston, Texas, features a Hammarlund HQ-145X receiver, with a Zenith "Transoceanic" portable serving as a standby. The antenna used is a 50' single-wire "L" type, 40' high. Eddie is a member of the National Association of Armchair Adventurers.

heartedly agree, this is definitely *not* the way to collect QSL cards. Such actions may make licensed operators take a dim view of all SWL requests. Needless to say, the WPE6 did not receive his Rhode Island card.

Thank You, KL7's. While this is out of the realm of short-wave broadcasting as such, we would, nevertheless, like to extend a collective vote of thanks to the amateur radio operators who maintained communications with the outside world during the recent Alaskan earthquake. They certainly performed under extremely adverse conditions. Most, if not all, of the normal forms of communications, including many of the medium-wave broadcast stations, were knocked off the air.

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)
Argentina	Buenos Aires	11,780, 9690, 6090	2200, 0100 (Mon.-Fri.)
Australia	Melbourne	17,840, 15,220 9580	2030, 2130, 2230 0745
Bulgaria	Sofia	6070 (and/or 9700) 7290	1900, 2000, 2300 1630
Canada	Montreal	15,190, 11,760, 9585	1800 (Caribbean) 0215, 0300 (W. Coast)
East Congo	Leopoldville	11,755	1630, 2100, 2230
Czechoslovakia	Prague	11,905, 9795, 9550, 7345, 5930	2030, 2230
Denmark	Copenhagen	15,165 9520	0700 2100
Finland	Helsinki	15,185	1530 (Mon.-Fri.)
West Germany	Cologne	11,945, 11,795, 9735 9545, 6075 9735, 9575, 6145, 6075	1010 2035 0000
Hungary	Budapest	9833, 7215, 6234	1930, 2030, 2200, 2330
Italy	Rome	9575, 5960	1930, 2205
Japan	Tokyo	15,205, 15,175, 11,780	1830
Lebanon	Beirut	11,890	1630
Netherlands	Hilversum	17,810, 15,445 11,950, 9590 7125, 6085 6035, 5985	1030 (Tues., Fri.) 1415 (Tues., Fri.) 1630 (exc. Sun.) 2030 (exc. Sun.)
Portugal	Lisbon	6185, 6025	2105, 2245
Rumania	Bucharest	11,810, 9510, 7225, 7195, 6190, 5990	1730
Spain	Madrid	9360, 6130	2215, 2315, 0015
Sweden	Stockholm	15,240 9660 5990	0900 2215 2045
Switzerland	Berne	9665, 9535, 6165 15,315	2035 0950
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

First States Awards Presented!

To be eligible for one of the new series of DX awards designed for WPE Monitor Certificate holders, you must have verified stations (any frequency or service) in at least 20 different states. The following DX'ers, listed in the order in which their applications were received, are the first to qualify for these awards.

Fifty States Verified

Harold Schrock (WPE9AKF), Paxton, Ill.
Jack Lane (WPE9EVU), Lafayette, Ind.
Norman C. Elser (WPE8CSI), Evansport, Ohio
William R. Gardiner (WPE2CLX/4), Perry, Fla.
John W. Reasoner (WPE0CLU), Ames, Iowa
Nathan Rosen (WPE2CY), New York, N. Y.

Forty States Verified

Jerry McMahan (WPE0SS), Cedar Rapids, Iowa
Philip Berkeley (WPE1ENY), Swampscott, Mass.
David Johnson (WPE0DHJ), Denver, Colo.
William E. Chapman (WPE1DRZ), Middletown, Conn.
James Eudaily, Jr. (WPE4GLQ), Millers Creek, N. C.
Steve Weinstein (WPE3FNL), Pittsburgh, Pa.
Bill Lund (WPE6CJ), Manhattan Beach, Calif.
Rod Paulson (WPE0CZR), Fargo, N. D.
John T. Arthur (WPE2CLD/6), San Jose, Calif.
Ray Minter (WPE3CRB), Baltimore, Md.
John S. Rose (WPE9FXU), LaGrange Park, Ill.

Thirty States Verified

Donald R. Stark (WPE3FCB), McMurray, Pa.
Don Stitt (WPE0BCT), Hastings, Nebr.
Martin Lash (WPE9GIE), Skokie, Ill.
Robert Binau (WPE3DTP), Williamsport, Md.
Denis E. Frank (WPE8FBQ), Farmington, Mich.
James W. Phillips (WPE4EDV), Waverly, Va.
Chuck Edwards (WPE4BNK), Ft. Lauderdale, Fla.
Edward C. Bassett (WPE9EHF), Toledo, Ill.
Bruce McNair (WPE2LEP), Fords, N. J.
Michael J. Plihcik (WPE2JDF), Woodside, N. Y.
Jan M. Dyroff (WPE3DSU), Norristown, Pa.
Christopher Lucas (WPE1FNH), Fairfield, Conn.
Ron Uzdavinis (WPE2KLQ), Woodbury, N. J.
Thomas E. McNiff (WPE4FEW), Arlington, Va.
Roger C. Burket (WPE3EKS), Altoona, Pa.
Paul Turner (WPE2LHB), Albany, N. Y.
Mike Wolowich (VE3PE1TW), Fort William, Ontario, Canada

Twenty States Verified

David L. Rogers (WPE5DRJ), Buffalo, Okla.
Don Eggert (WPE9FMV), South Bend, Ind.
F. B. Goldsmith (WPE5BKV), Oklahoma City, Okla.
William Woodfield (WPE4HGT), Norfolk, Va.
John S. Walker (WPE0DVS), St. Louis, Mo.
Rick Kulp (WPE0CAU), Bettendorf, Iowa
Dick Winchell (WPE0CMH), Waverly, Iowa
Bill Kleronomos (WPE9GPI), Westchester, Ill.
David Lawrence Ballew (WPE4HGQ), Nashville, Tenn.
J. C. Landin Jr. (WPE4HHR), Portsmouth, Va.
Steven Teley (WPE2IAR), Brooklyn, N. Y.
Robert Mezzatesta (WPE2JQA), Lodi, N. J.
Ronald Everett (WPE8FCO), Maple Heights, Ohio
Edward Tompkins (VE3PE1ZJ), Toronto, Ontario, Canada
Blaine Baile, Jr. (WPE1FET), China, Maine
Wendell C. Putney (WPE2LWN), Troy, N. Y.
Robert Kunitsky (WPE2HUF), Linden, N. J.
John Sowers (WPE3DZP), Lebanon, Pa.
Ted Palmer (WPE6EXH), Sierra Madre, Calif.
Stephen E. Schmidt (WPE2IXG), Webster, N. Y.
Richard Clinard (WPE4GNV), Madison, Tenn.
Marc Arenstein (WPE4GSP), Richmond, Va.
Bruce D. Drewett (WPE4GXG), Miami, Fla.
Leo Krygowski (WPE1DZF), Lowell, Mass.
Dennis Reid (WPE6FFD), Morgan Hill, Calif.
Vincent De Meis (WPE3FEE), Philadelphia, Pa.
Larry Cotariu (WPE9GPJ), Park Forest, Ill.
Raymond Reynolds (WPE1EXT), Lowell, Mass.
Samuel Zaitlin (WPE1FCM), Biddeford, Maine
Edmund Brandt, Jr. (WPE9GHU), Chicago, Ill.
Bill Booth (VE3PE1PB), Woodbridge, Ontario, Canada
Eugene Bond, Jr. (WPE2JF-W), Moorestown, N. J.
Bill Wickboldt (WPE0DET), St. Paul, Minn.
Eugene Gayda (WPE9ENZ), Lansing, Ill.
Robert Siemion (WPE8FWQ), Detroit, Mich.
Bill Campbell (WPE2JHA), Canandaigua, N. Y.
Tim Vorel (WPE9FIB), Westchester, Ill.

While we do not have a record of those amateurs who participated in the Alaskan operation, we would like to emphasize the point that in times of great distress the amateur operator is more often than not the only source that civil authorities can go to for communications help. In the past, during fires, floods, and other disasters, amateurs have been on the spot and ready for action, usually within minutes. And we are pleased to be able to say that, in many instances, non-licensed short-wave listeners have been right there with them to assist in any way possible.

Card Swapper's Callbook. A compilation of active card swappers with names, addresses, calls, ZIP numbers, and other information has been proposed by Don Erickson, 24360 Myers St., Sunnymead, Calif. 92388. If you are an active card

swapper and would like your name to appear in such a callbook, write to him and find out more about it.

Club Notes. To date, the following clubs have indicated that they would like to join the Association of North American Radio Clubs currently being organized: Newark News Radio Club, Canadian DX Club, SWL-Certificate Hunters Club, North American Shortwave Association, American SWL Club, Worldwide Monitors Radio Club, National Radio Club, Inc. (Denver), Folcroft (Pa.) Radio Club, Canadian International DX Club, and the Kentucky DXers Association. There are still a few organizations from which no word has been received. A study of the proposed constitution is currently being made by the interested clubs.

(Continued on page 85)

The Bee's Knees



CARL AND JERRY were sitting on Carl's back stoop enjoying the dew-washed freshness of the summer morning. Carl had Bosco, his dog, clamped firmly between his knees and was wooling the dog's ears affectionately while the animal growled in mock protest at this thoroughly enjoyed rough treatment.

"Hey, there's Mr. Gruber heading this way," Jerry said. "Sure looks as though he has something on his mind."

Carl turned to see his elderly neighbor coming across the back yards at such a lively clip that his cane barely touched the grass. The little man was a favorite with both boys. They admired and respected the way Mr. Gruber refused to bow to his advancing years, maintaining a deep interest in everything, and especially scientific progress. Most of all they liked his enthusiasm, the way he became all worked up over a new idea or project.

"Good morning," he greeted them as he sat down on the bottom step and began to fan himself with his ancient bat-

tered derby. "I was hoping you two might be up already. You're invited to join me in performing a very interesting and rewarding experiment."

"Good!" Carl exclaimed. "We were just wondering what we could do on a fine day like this. What have you got in mind?"

"Getting the honey out of a bee tree I've spotted!" Mr. Gruber announced triumphantly. "Yesterday when I was up Eel River fishing for goggle-eye, I noticed lots of bees flying around. I did some investigating, and found them going in and out of a hole in the side of a big old sycamore growing right on the bank of the river. Since the tree is growing between the road and the river, we don't have to ask anyone's permission to chop into it."

"How about the bees' permission?" Jerry asked. "While it has been some time since I was stung, I can remember how it feels with no trouble."

"We'll take care of that," Mr. Gruber said confidently. His blue eyes sparkled

By
JOHN T. FRYE
W9EGV

happily behind his steel-rimmed glasses as he went on. "Boys, you haven't really lived until you've helped cut a bee tree. It has everything: danger, mounting suspense, and finally a sweet reward. Best of all, it will give us a chance to try a new electronic method of keeping the bees quiet while we scoop out the honey. Just last week I read an article about it, and now we can try it. It seems like fate."

"What is this 'new electronic method'?" Carl asked cautiously.

"It was discovered by the entomology department of the University of Wisconsin's School of Agriculture along with the U. S. Department of Agriculture's Bee Culture Laboratory in Madison. The work was done by Mr. R. E. Showers, a teacher at the East High School in Green Bay, while holding a National Science Foundation fellowship and working under the supervision of Dr. F. E. Moeller. In fact, Mr. Showers and some of his high school students are still carrying on experiments.

"Anyway, it was discovered that certain audio frequencies have a very profound effect on bees. Frequencies between two hundred and twelve hundred cycles seemed to produce a strong tranquilizing effect, with nine hundred and sixty cycles being the optimum frequency. Going either way from this frequency reduced the effect. When a scout bee—you know, the one that comes back to the hive and does an interpretive dance to tell the others where the goodies are—was exposed to nine hundred and sixty cycle audio, *he danced out completely erroneous information* as long as the sound was on! Investigators were able to work colonies of bees without being stung and without the protection of veils or smoke, using only the soporific effect of a small code-practice buzzer tuned to nine hundred and sixty cycles and fastened to the side of the hive. Even when the bees had been quieted for as long as a half hour with the audio, they returned to normal almost instantly when the sound was cut off."

"Very interesting!" Jerry commented. "But how do we go about using this information?"

"There's nothing to it!" Mr. Gruber said, getting to his feet. "You fellows have a little transistorized audio amplifier and a transistorized code-practice oscillator already built up. You set the oscillator on nine hundred and sixty cycles and feed it into the amplifier. The amplifier can feed out into a small speaker with which we can direct sound toward the hole in the tree. While the sound puts the bees to sleep, we can chop into the tree and take out the honey. A half-watt of audio should be plenty—the buzzer the entomologists used couldn't have put out more than that."

"What do you think, Carl," Jerry asked, sounding more and more intrigued by the moment.

"I say let's do it," Carl answered, already way ahead of him.

"Time's a wastin'," Mr. Gruber broke in. "You two put the electronic gear we need into your car and drive around back in the alley. I'll get my axe and some dishpans and a dipper from Martha for collecting the honey. Boy oh boy! I can almost taste that fresh honey on hot biscuits right now!"

He departed in a shuffling trot, and Carl and Jerry, grinning affectionately at his retreating figure, started obediently for their basement laboratory. Truth to tell, they also felt tugs of growing excitement. There was something infectious about the enthusiasm of the little man.

MR. GRUBER was waiting for them when they stopped the car behind his garage, and they quickly loaded the pans and the axe into the trunk. Bosco, sensing that something was afoot, had followed them, and now he stood at the corner of the garage with drooping head and tail, looking the very picture of dejection as he saw they were preparing to leave without him.

"Hold on!" Mr. Gruber called as Carl
(Continued on page 80)



Transistor Topics

By LOU GARNER, Semiconductor Editor

THE earliest low-cost transistors—the now-famous CK721 and CK722—were encapsulated in plastic. Although these transistors were widely used, the plastic cases were not entirely satisfactory. Often, internal defects would develop after the transistors had been in use for extended periods. In other cases, new transistors would become “leaky” or change their characteristics while still in storage. Many of these troubles could be traced to the properties of the plastic cases. As a result, manufacturers switched to the now almost universal metal cases.

Unfortunately, metal housings are relatively expensive as compared to plastic cases. The cost of the housing represents, in many cases, a fair percentage of the manufacturing cost of the transistor itself. The use of metal also involves a secondary operation, that of mounting the transistor in its case. Since special techniques are required, such as cold-welding or soldering, this adds to the cost of the finished component.

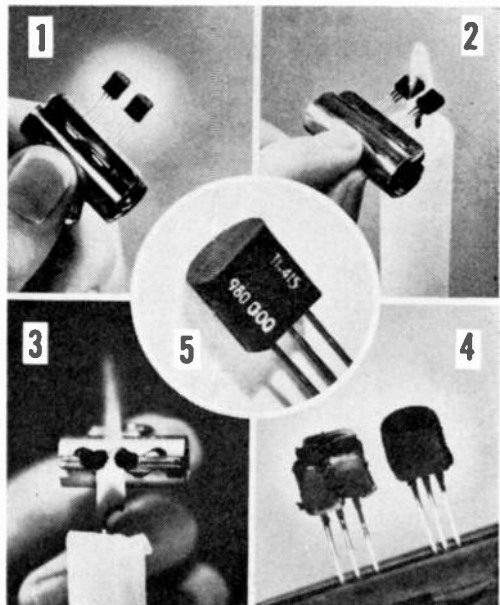
During the past few years, however, great forward strides have been made in the manufacture of plastic materials. Most of the problems encountered with the early plastics have been overcome by the development of new formulations. A little over a year ago, General Electric introduced a line of low-cost silicon transistors encased in an epoxy-plastic. They were developed to supply a potential consumer entertainment market for silicon types which, up to that time, had been prohibitively expensive and had been used almost exclusively in costly military equipment. Many of the new GE units (Types 2N2711 through 2N2716) were priced below comparative germanium types, their lower leakage and better high temperature characteristics notwithstanding.

More recently, Texas Instruments developed a line of silicone-plastic encapsu-

lated transistors. Identified as “Silect” transistors, the first units in the new series (Types TI 415 through TI 419) are low-level, low-noise amplifiers suitable for operation from d.c. to 30 mc., or as oscillators to 80 mc. They can be used in radios, intercoms, toys, cameras, TV sets, hi-fi equipment, electronic organs, portable receivers, car radios, and CB gear.

The new TI types are exceptionally resistant to heat, as shown in the composite photo on this page. The transistor package at right in ① is made of silicone-plastic, while the unit on the left, made in the same molds, is conventional plastic. After being heated over a candle flame, ② and ③, the conventional plastic deformed and split, while the silicone remained undamaged. The irregular outline of the silicone package in ④ is due to carbon deposited by the candle flame, which can easily be wiped off. A close-up view of one of the new transistors is shown in ⑤.

Technical specifications of the GE units



Silicone-plastic encapsulated transistors developed by Texas Instruments are much more resistant to heat than conventional plastic-cased units. Photo shows what happens to each type of case when held over a candle flame. See text for details.

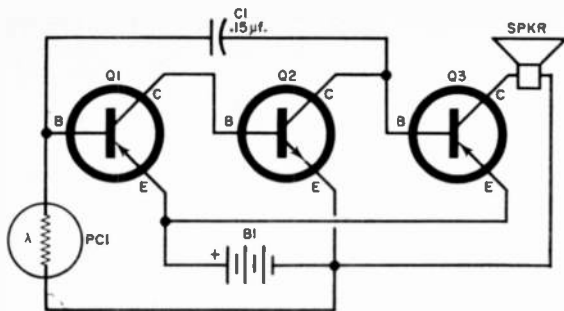


Fig. 1. Light-sensitive audio oscillator circuit submitted by reader Jim Thorn. If too much light falls on PC1, a small ½-watt resistor can be connected in series with one of the photocell's leads.

can be obtained by writing to the General Electric Company, Electronics Park, Syracuse, N.Y., while data sheets on the "Silect" types are available from Texas Instruments, Inc., Semiconductor-Components Division, 13500 North Central Expressway, Dallas, Texas.

Readers' Circuits. Jim Thorn (Box 87, Dayton, Wash. 99328) submitted the schematic diagram in Fig. 1). Jim adapted the circuit from one featured in our January, 1963, column. A light-sensitive audio oscillator, it can be used as the basis for a CPO, a simple musical instrument, or an audible light meter.

Referring to the diagram, transistors Q1, Q2, and Q3 are wired as a three-stage, complementary, direct-coupled amplifier/oscillator. Capacitor C1 provides feedback between the second and first stages to start and maintain oscillation, while Q3 serves as a power amplifier to drive the small speaker used as an output device. Photocell PC1 provides a variable base bias to Q1. In operation, Q1 and Q2 function as a type of relaxation oscillator, with its frequency determined by C1 and PC1's resistance. Since the latter value changes with the amount of light falling on PC1's sensitive surface, the unit's output tone varies with light intensity. Operating power is supplied by B1.

Readily available components are used in the design. Transistor Q1 is a 2N107 *pn*p transistor, Q2 a 2N170 *np*n unit, and Q3 a 2N301A *pn*p power transistor. The photocell, PC1, is an International Rectifier CS-120-M6 cadmium sulphide photoconductor. Capacitor C1 is nominally a 0.15- μ f. paper or ceramic unit, but other values will serve the same purpose. A small (4" to 6") speaker with a 4- to 8-ohm voice coil is employed. The 6-volt power pack (B1) can be made up of four flashlight cells in series or may be a single battery, such as a Burgess Z4. If desired, an s.p.s.t. power

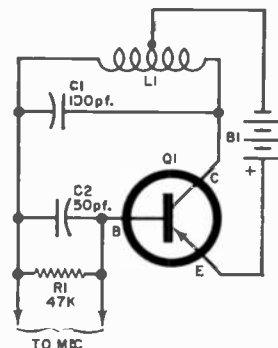


Fig. 2. John Franke's simple wireless microphone circuit. Although John hand-wound coil L1, a standard tapped antenna coil could be used.

switch (or hand key) may be connected in series with either of the battery leads.

Since the circuit is relatively simple, neither layout nor wiring is critical. The unit can be assembled in a metal, plastic or wooden case (such as a small cigar box), depending on individual preferences. Either point-to-point wiring or an etched circuit board can be used.

As with most direct-coupled circuits, individual transistor characteristics may be critical and it may be necessary to try different units to obtain optimum performance. Jim writes, also, that the circuit may not work if too much light falls on the photocell. In the latter case, he suggests connecting a small half-watt resistor in series with one of PC1's leads, determining the proper value by experiment.

The simple wireless microphone circuit in Fig. 2 was submitted by John Franke (8208 Brinson Arch, Virginia Beach, Va.). Designed for short-range applications, the unit transmits in the AM broadcast band.

In operation, *pn*p transistor Q1 is used as a modified Hartley oscillator. The unit's frequency of operation is determined by tuned circuit L1-C1. The transistor's base bias is furnished through part of coil L1 and through current limiting resistor R1, bypassed by capacitor C2. The modulating audio signal, obtained from a crystal microphone cartridge, is introduced in Q1's base circuit, while operating power is supplied by B1.

As in the previous circuit, readily available components are used. Transistor Q1 is a 2N393, C1 and C2 are small mica or ceramic capacitors, and R1 is a half-watt resistor. The 3-volt battery (B1) is made up by connecting two penlight cells in series. John used a hand-wound coil for L1 in his model, winding 150 turns, center-tapped, of

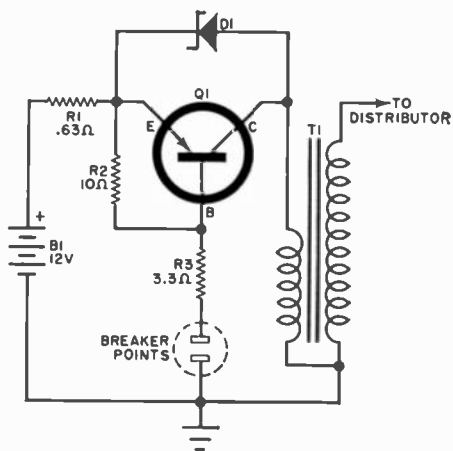


Fig. 3. Transistorized ignition circuit suggested by the Bendix Corporation is designed for operation with a 12-volt, negative-ground electrical system.

#30 enameled wire on a small form. However, a standard tapped antenna coil could be used here, if preferred, and *C1* might be replaced with a small trimmer capacitor for adjusting frequency. An s.p.s.t. push-button switch could be connected in series with either battery lead as a "push-to-talk" switch if desired.

Any of several construction techniques can be used. John writes that he assembled his model on an etched circuit board and mounted it in an empty cigarette package. Although no antenna is shown, a short one could be connected to *Q1*'s collector.

Transistorized Ignition. The transistorized ignition circuits featured in past issues of *POPULAR ELECTRONICS* have been extremely popular, and a number of readers have requested that we feature additional circuits

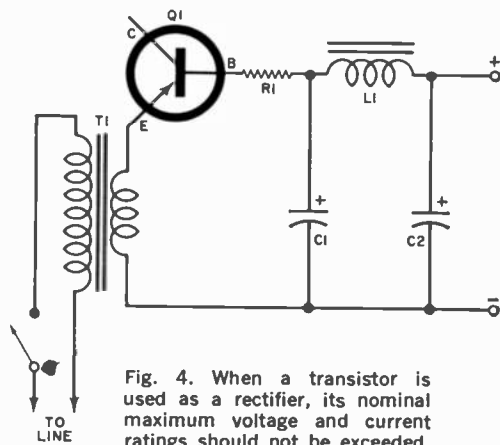


Fig. 4. When a transistor is used as a rectifier, its nominal maximum voltage and current ratings should not be exceeded.

from time to time. Suggested by the Bendix Corporation (Semiconductor Division, Holmdel, N.J.), the circuit in Fig. 3 is quite simple and requires a minimum number of components. It is designed for operation with a 12-volt, negative-ground electrical system.

Referring to the diagram, *Q1* is a Bendix B1867 *pnp* power transistor and *DI* is a 1N3004, 91-volt, 10-watt zener diode. Resistor *R1* is a temperature-compensating unit; rated at 50 watts, it should have a nominal value of 0.63 ohm and a temperature coefficient of 0.005 ohm/°C/ohm. Resistor *R2* is rated at 10 ohms, 2 watts; *R3* at 3.3 ohms, 5 watts. The inductance coil, *T1*, should have a 300:1 turns-ratio, with a primary inductance of 0.8 mh. and a secondary inductance of 65 h.

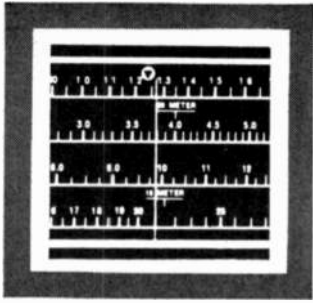
Leads should be kept short and direct and relatively heavy wiring should be used in the emitter and collector circuits. Wire the basic circuit in a closed case to prevent accumulations of dust and grease on the wiring, and mount *Q1* on an insulated heat sink. The completed unit should be mounted in the automobile in a position where it is exposed to minimum heat from the engine.

Circuit Contest. Do you delight in developing new circuit applications? If so, you may be able to win a rich reward, for Motorola Semiconductor Products, Inc. has announced a four-months-long, nation-wide circuit design contest. Under the rules, contest entries must be based upon designs which use Motorola *pnp* and *npn* silicon annular transistors to improve efficiency and performance, reduce size and weight, and reduce component requirements in a given circuit.

First prize is a \$2500 two-week paid vacation for two to attend the 1964 Olympic Games in Tokyo, Japan. Complete information about the contest, including a formal entry blank, is available from the sponsor. Write to Motorola Semiconductor Products, Inc., Technical Information Center, Box 955, Phoenix, Ariz. 85001.

Transitips. The average experimenter or hobbyist will—over a period of time—acquire a fair-sized collection of "defective" transistors. Some of these may be leaky, others partially open, and still others shorted. In many cases, fortunately, these units may still be useful for some projects.

A transistor with an open collector or emitter lead, for example, can be used either as a rectifier or as a diode detector. A typical rectifier application is illustrated in Fig. 4. Here, *pnp* power transistor *Q1* is used as a half-wave rectifier in a low-voltage power supply, *T1* is a step-down
(Continued on page 78)



Across the Ham Bands

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

VERTICAL ANTENNAS: STRAIGHT AND SIMPLE

THE long sunny days of summer are obviously the ideal time to refurbish your old antenna, put up a new one, or to experiment with a different type. If you've been using a horizontal antenna, for example, you might like to try a vertical. At the very least, your results will be different.

Basically, whether they're vertical, horizontal, slanting, or bent, there are two kinds of simple antennas. One type requires a connection to an actual or artificial ground system for its operation; the other needs no ground connection. In the grounded type, the ground acts like an electrical mirror and doubles the antenna's effective length.

Even when operated "against ground," a full-size vertical antenna for 80 or 160 meters is quite a tall stick—60 or 125 feet high. But many amateur locations can easily accommodate the 33-foot length of a 40-meter vertical, or one of the commercially available 40-through-10-meter verticals which are approximately 27 feet long. These antennas will radiate most of their power at the low angles above the horizon most desirable for working DX.

For best results, it is very important to install any vertical antenna well away from

utility wires, buildings and trees; otherwise, such obstructions will absorb much of the power radiated by the antenna and distort its theoretical circular radiation pattern. In addition, unless a grid of wires is buried just under the surface of the earth around the base to reduce ground losses, a large percentage of the r.f. power fed into the antenna will be wasted in ground having average conductivity.

This is where an artificial ground system becomes helpful. It is often possible to mount a vertical antenna on the roof of a building to get it above many power-absorbing objects. Then, four $\frac{1}{4}$ -wave wires ("radials") can be connected together under the base of the antenna and extended away from it like the spokes of a wheel to form an efficient "ground plane" for the antenna. The end of each "radial" is supported and insulated with a standard antenna insulator, and the antenna is fed with 50-ohm coaxial cable.

Compared to a horizontal antenna 30 to 40 feet high, the vertical antenna will usually perform better over the longer distances—say beyond about 700 miles—but the horizontal will usually do better over the shorter

Novice Station of the Month

You don't need elaborate equipment to pile up contacts. Gordon Walford, WN8JXF, New Carlisle, Pa., worked 29 states with an AMECO AC-1 one-tube, 15-watt transmitter; a three-tube home-built receiver; and a 16'-high 40-meter dipole. Gordon will receive a one-year subscription to POPULAR ELECTRONICS for submitting this winning photo in our Novice Station of the Month contest. 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. All contest entries should go to Herb S. Brier, Amateur Radio Editor, POPULAR ELECTRONICS, Box 678, Gary, Indiana 46401.





Although Jo Kondas, WB2EKV, of Brooklyn, N.Y., has a General Class license, she still prefers to spend most of her air time on six meters. Her off-the-air time is divided between her OM, whose ham call-sign is WA2JKY, and her two-year-old son.

distances. The ideal arrangement, of course, is to have both types, and use the one that best matches the propagation conditions of the moment.

Detailed construction details for home-brew vertical antennas are available in the various amateur handbooks; and, of course, manufacturers include complete assembly instructions with their antennas.

CLASSIC HAM CIRCUITS

Unless you experienced them, it is difficult now to imagine the problems that the rapid growth of TV after World War II caused radio amateurs. As rapidly as television reached a new area, television interference (TVI) complaints flooded in on all hams in the area.

Overlooking the many TVI cases gener-

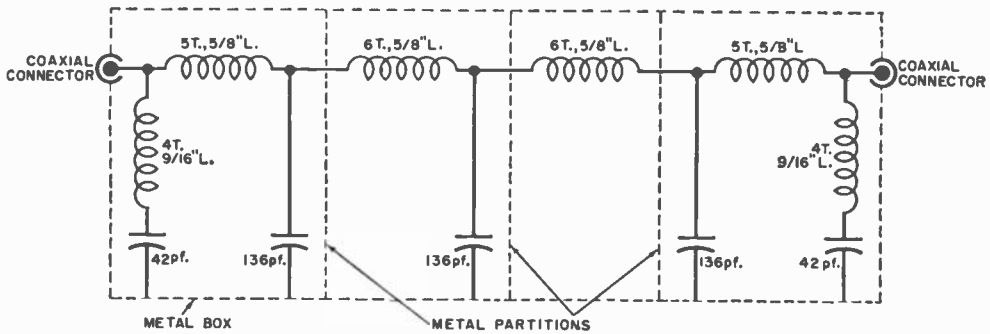
ated by sources of interference other than amateur, a major cause of the trouble was harmonic signals from nearby transmitters in and near the television channels. All short-wave transmitters—amateur and commercial—emitted these signals; but, until the advent of television, they rarely troubled anyone. When a harmonic happened to be in or near a local TV channel, however, it would ruin reception on that channel for all nearby viewers, even when it was very weak.

The problem quickly became a first-class crisis that had to be solved speedily or amateur radio would be fighting for its life. Some pessimists claimed that it could not be solved in transmitters operating above the 40-meter amateur band. They based this belief on the fact that all transmitters unavoidably generated harmonics, and it would be impossible to reduce their strength sufficiently to prevent interference to nearby TV receivers tuned to the lower channels.

For a time, this pessimistic outlook seemed to have some validity, because many amateurs managed to reduce the harmonics

Each summer 60 would-be radio amateurs with an interest in outdoor life enroll in the Camp Albert Butler Radio Session which is sponsored by the Gilvin Roth YMCA in Elkin, N.C. For more information on this unusual camp, write to C. L. Peters, General Secretary, Gilvin Roth YMCA, Elkin, N.C.





In this typical low-pass filter, all coils are wound to $\frac{1}{2}$ " I.D. using #12 wire. When inserted in 52-ohm coaxial transmission line between a well-shielded transmitter and an antenna, the filter attenuates all spurious signals a minimum of 75 db.

from their transmitters to the point where they could no longer be measured with a sensitive field strength meter, only to discover that the remaining harmonics were still strong enough to produce TVI!

Low-Pass Filter. Other amateurs tried another approach to the problem. Instead of trying to eliminate the harmonics, they reasoned that if they connected a low-pass filter with a cutoff frequency somewhat below 54 mc. (the low-frequency limit of TV channel 2) between the transmitter output terminal and the antenna, the filter would pass the desired signals to the antenna and reject the undesired harmonics.

One slight drawback to this idea was that no one had ever built a low-pass filter for such high frequencies. But design data for audio-frequency, low-pass filters were available in electronic engineering handbooks, and amateurs were quick to seize on what skimpy information there was as a basis for r.f. low-pass filters.

In spite of predictions of excessive losses and poor attenuation characteristics, the finished filters had negligible insertion losses, and their attenuation curves were even better than had been hoped for. Therefore it was a double shock when it was found that installing the low-pass filter between the transmitter and the antenna system reduced TVI much less than had been hoped for. In fact, sometimes, instead of reducing it, the low-pass filter actually increased local TVI!

Shielding the Transmitter. At this point, dedicated amateurs like Phil Rand, W1DBM, Mack Seybold, W2RYI, and others, who had been spending countless hours on the TVI problem, realized that another ingredient was necessary before they could hope for success. Since a low-pass filter in the antenna feedline kept harmonics from reaching the antenna, it was apparent

"CQ BSA"

The ham bands will be loaded with Boy Scouts during the week of July 17-23. The Valley Forge Jamboree and American Heritage Camporee will find thousands of Boy Scout hams looking for contacts with each other in field and home stations. Special QSL cards will be issued to verify all contacts and SWL reports directed to the Jamboree-Camporee, and the following certificates will be awarded: WAS-BSA for working Boy Scout hams in 50 states; WER-BSA for submitting QSL's from scout hams in the 12 scouting regions. Send cards to Boy's Life Radio Club, New Brunswick, N.J., 08903. All QSL cards will be returned with the certificates.

that the TVI-producing radiation must be escaping from the transmitter via other routes. They reasoned that if the entire r.f. section were enclosed in an r.f.-leakproof, tight metal box, and if all leads into the enclosure were effectively grounded for r.f. (except for the antenna lead), the harmonics would be kept bottled up inside the enclosure where they could do no damage.

And they were right! A properly shielded and filtered high-powered amateur transmitter equipped with a good low-pass filter can be operated on any amateur frequency between 1.8 mc. and 29.7 mc. or 51 mc. (depending upon the cutoff frequency of the filter) without a trace of harmonic-type TVI on a TV receiver in the same room. Without the filter and adequate shielding, however, the same transmitter blots out the picture on one or more channels, at least when it is operated in the 14-mc. or higher frequency bands.

The diagram above shows the relative simplicity of a typical low-pass filter. Needless to say, this device has been a boon to amateur radio.

(Continued on page 77)



At El Doral Open, golf pro/sports-caster Jim Warga gives the fans the news as it happens. Base station transmits to rented walkie-talkies.



Jack Nicklaus lines up a 20-foot putt on the 18th green. Behind him, Thomas Burke relays the fact to Jim Warga back at the base station.



Sports fan slings a walkie-talkie over his shoulder, plugs earphone in his ear, and hears what's happening.

Golf Goes Walkie-Talkie

By ALBERT COYA

WHEN the golfers teed off in the \$50,000 El Doral Open in Miami this year, over 300 loyal fans not only saw the action but heard a competent "play-by-play" description via the CB walkie-talkies (Lafayette HE-29's) they rented from Golfcaster, Inc.

Sports-caster Jim Warga operated the base station transmitter. Aids, scattered over the course, employed other CB units to keep Jim informed of progress along the way, so that up-to-the-minute information could be passed on to the listeners. The channel used was not revealed for an obvious reason—people who owned walkie-talkies could take advantage of the system without paying the two-dollar fee!

The firm, founded by sportsman Thomas J. Burke, plans to use this system in the future to cover other sports events across the country. Before too long, you may pay admission to see an event, and a small additional fee to get the inside scoop. —30—



Over 300 people rented CB units for \$2 apiece so that they could follow the tournament play around the course.



On the Citizens Band

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

REPORTS received from readers of this column make it possible for us to keep thousands of CB'ers abreast of new and unusual applications for Citizens Band equipment. Many of these uses are for emergency purposes. Some are out of the ordinary realm of personal and business communications, brought about by a particular need at a definite time.

UNUSUAL USES OF CB

For example, Irene Griffith, KKD-0768, secretary of the Somerset County Citizens Band Association of Middlesex, N. J., has told us about the part that CB equipment played in the county-wide "Victory Over Polio Campaign" held last March. Fourteen of the SCCBA club members participated in this operation under the supervision of the county civil defense director. Twelve mobile units were placed at distribution centers to coordinate necessary communications regarding quantities and condition of the Salk vaccine, and other details involved in its distribution. The CB "net control" was handled by Bill Noe, 2Q0649, and Rawley Nelson, 2W4584; they manned a 2-meter/11-meter station combination and successfully coordinated the efforts of the CB'ers with CD headquarters.

A very unusual application was brought to our attention by Grady J. Bell, Jr., KCF2548. The wife of a friend of his was killed while their son was serving with the U. S. Navy in the Pacific. Getting the son home in time for the funeral services entailed several telephone calls, both incoming and outgoing. So Grady established a temporary CB station at his friend's home, utilizing a 5-watt unit with a 48" fiberglass whip. This enabled the friend to keep his phone line open for all incoming calls. Outgoing calls were made on Grady's phone at his base after the friend had relayed the information needed via CB radio.

Then there's the CB'er who made a trip to New York, glider capital of the world (that's what he said) to watch the videotaping of a nationally known TV show. While there, he chatted with several glider pilots and learned that CB had become very popular with this group. Since gliders have been known to sit down in unusual places, CB seems to have become the answer when they need help. The pilots can count on getting a call through almost any-



Members of the Somerset County CB Association assist civil defense authorities during recent "Victory Over Polio Campaign" in New Jersey. Bill Noe (seated above) and Rawley Nelson manned the CB/CD net control on 11 and 2 meters, while Ed Wahler (at left) was one of 12 mobile operators.

1964 OTCB JAMBOREE CALENDAR

Planning a jamboree, get-together, banquet or picnic? Send the details to: 1964 OTCB Jamboree Calendar, POPULAR ELECTRONICS, One Park Avenue, New York, N. Y. 10016. For more information on the jamborees below, contact the clubs or club representatives listed.

Griffin, Ga. July 2-5
Location: National Guard Armory. Sponsors: Griffin area CB'ers.

Martinsville, Ind. July 4-5
Location: Morgan County 4H Fairgrounds. Sponsor: Morgan County CB Radio Club, Box 533.

Rushville, Ind. July 12
Location: Fairgrounds. Sponsor: Rush County CB Radio Club, Inc. Contact: Wm. Bailey, RR #1.

Bridgeport, W. Va. July 12
Event: Picnic and Roundup. Location: Stuart Park. Sponsor: Tri-County Citizen "D" Banders, Inc., Box 173, Bridgeport.

Alliance, Ohio July 12
Event: Picnic. Sponsor: Carnation City CB Club.

Middlefield, Mass. July 19
Event: Annual Western Massachusetts CB'ers Jamboree. Location: Fairgrounds. Contact: Dick Lennon, South Rd., Peru, Mass.

Youngstown, Ohio July 19
Event: Picnic. Sponsor: Mahoning Valley CB Club.

Decatur, Ga. August 1-2
Event: Georgia CB Radio Council Jamboree. Location: Atop Stone Mountain. Contact: Dixie Communications Club, Box 136, Decatur.

Reno, Nevada August 8-9
Sponsor: Silver State CB Association (Reno-Sparks), 1549 Prospect Ave., Sparks, Nevada.

Plaistow, N. H. August 8-9
Event: Interstate (Mass. & N. H.) Jamboree. Location: American Legion Farm, Haverhill, Mass. Sponsor: CB Socialities, Box 336, Plaistow.

New Waterford, Ohio August 9
Event: Picnic. Sponsor: Penova CB Club of East Liverpool, Ohio.

Washington, Mich. August 15-16
Location: Green Acres Recreation Area. Sponsor: Oakland Social CB's, Inc., of Pontiac, Mich.

Lebanon, Ohio August 16
Event: Second Annual SWOCBA Nationwide Jamboree. Location: Warren County Fairgrounds. Sponsor: Southwestern Ohio Citizens Band Assn., Box 231, Mason, Ohio.

Norwalk, Ohio August 22-23
Event: Second Annual Week-End for CB'ers. Location: Huron County Fairgrounds. Sponsor: Sheriff's Huron County Emergency Net, Box 201, Norwalk.

Norfolk, Va. August 22-23
Event: Convention and Trade Show. Location: Monticello Hotel. Sponsor: Virginia State Citizens Band Radio Assn., Inc., Ruckersville, Va.

Enon Valley, Pa. August 30
Event: Picnic. Location: Brady's Run Park. Sponsor: Sociable 5 Watts CB Club. Contact: Roy Shetler, Enon Valley.

Dalton, Ga. September 4-7
Location: Abertson Midget Lakes. Sponsor: North Georgia CB Radio Club, Inc.

Pittsburgh, Pa. September 13
Event: Picnic. Location: White Swan Park. Sponsor: Five-Eleven CB Radio Club, 868 Glass Run Rd.

Fort Wayne, Ind. September 20
Event: 1964 Roundup. Location: Memorial Coliseum. Sponsor: Maumee Valley CB Radio Club, 4816 Reed St., Fort Wayne.

Albany, N. Y. September 27
Event: Tri-Club Chicken Barbeque Jamboree. Location: Halfmoon Beach, Crescent, N. Y. Sponsors: Troy Area CB Club, Schenectady Electric City CB'ers, Saratoga Spa Ten-Fourers. Contact: Stephen Stracher, Box 299, Lans. Station, Troy.

Bristol, Conn. October 11
Location: Lake Compounce. Sponsor: Bell City Citizens Band Radio Club. Contact: John P. Dempsey, 163 High St., Bristol.

where in the U.S.A., and someone at the other end will always come to the rescue. The visiting CB'er informed the flying CB'ers that they had a definite advantage over earthly CB groups: "no ignition interference!"

While Weldon W. Shows, KCJ7810, the "Henderson Hummer" (in Henderson, N. C.), didn't report a new application, he reminded us that those who use the old faithful No. 47 pilot lamp for tuning up, either as a dummy load or within the line, should leave the final judgment to a photo exposure meter. It seems that our eyes don't quite pinpoint the glow as well as a meter does. This trick works—we've tried it.

Expressway Patrol. Atlanta (Georgia) Contac Radio Association members have seen to it that drivers in distress on Atlanta's expressways no longer need hit the panic button. A new CB-equipped "expressway patrol" cruises along the main traffic arteries leading into the city every night and brings aid to stranded motorists. The patrol is a public service project of the club, working under the direction of the Atlanta Traffic and Safety Council.

About 50 ACRA members volunteer their time to patrol the expressways each night. They are in constant contact with an ACRA monitor who can place emergency calls for wreckers, ambulances, and the police and fire departments. In case of minor motor-ing difficulties patrol members will bring gasoline, help change tires, provide highway information, and aid in starting automobiles.

Club Chatter. Members of the Allegheny Valley Citizens Radio Club, Pittsburgh, Pa., are not an association to let grass grow under their objectives! They made three assists in just one week! An auto accident requiring police aid found Ethel Shagi, KID2541, relaying the plea to Evelyn Marsico, KIC7331, who in turn contacted police. Another auto accident prompted Al Marsico, 20Q2095, to contact the Johnstown Control on Channel 9 for police and an ambulance. And AVCR members John Scherzer, 20W5325, and John King, 20W4008, aided local police in recovering a stolen auto which had been on the missing list for several days.

Members of the Blair Cambria Citizens Radio Association, Duncansville, Pa., are again publishing the *Five Watt Gazette*. This monthly paper was off the scene for almost two years, and the new staff is making a stellar effort to revive it. The first issue to appear after the lengthy hiatus is filled with several editorials definitely worth reading.

(Continued on page 79)

New 1964 Heathkit® All-Channel Color TV



GR-53A
\$399⁰⁰

(Includes chassis, all tubes, VHF & UHF tuners, mask, mounting kit, & special speaker) cabinet optional \$49.00

Everyone Agrees It Outperforms Any Other, Is Easy To Build, & Saves Up To \$400!

Here's What The Experts Say! Popular Electronics, May issue: "The GR-53A is not a skimpy receiver in which corners have been cut to keep costs down and still provide color TV. Instead, the GR-53A (on a comparison shopping basis) has the same color and sound fidelity, flexibility, and ease of handling as those manufactured receivers which sell for over \$600."

Radio-TV Experimenter, June issue: "The repair cost savings during the Heath Color TV set's life compared to commercial units may be more than \$200."

Popular Mechanics, February issue: "Mounted, pre-aligned critical circuits enable beginners to assemble. Picture quality is topnotch."

Science & Mechanics, April issue: "Built-in servicing circuits such as a dot generator are valuable aids in getting the set operating for the first time & eliminating expensive service calls & bills when realignment or part replacement is needed later on." **Anyone Can Build It!** No special skills or knowledge required . . . all critical assemblies are factory-built & tested . . . simple check-by-step instructions take you from parts to picture in just 25 hours!

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CIRCLE NO. 6 ON READER SERVICE PAGE



POP'tronics Bookshelf

TRANSISTORIZED MINIATURE AMPLIFIER AND TUNER APPLICATIONS

by Rufus P. Turner

Several years ago Lafayette Radio began importing a small number of preassembled transistorized amplifiers and tuners. Attractive in price (\$3.75 to \$14.95), these units need only input, output, and battery power connections. Many projects have been published in POPULAR ELECTRONICS using both the amplifiers and tuners. However, a quick look at the 60-plus projects in this book is convincing proof that the surface has just been scratched. While exact construction details are not included, the volume is packed with ideas on scores of devices that can be activated by these low-cost component packages.

Published by Lafayette Radio Electronics Corp., 111 Jericho Turnpike, Syosset, L.I., N.Y. 11791. 96 pages. Soft cover. \$1.50.



UNDERSTANDING DIGITAL COMPUTERS

by Ronald M. Benray

This book offers an interesting compromise between arithmetic and electronics aimed at the audience that wants to know how a digital computer operates. It is definitely not a book that you can sit down and expect to finish in two or three evenings. It is instead a text that could have been part of a series of practical do-it-yourself experiments—such as those provided by correspondence schools. Your reviewer has no argument with the thoroughness with which the author attacks this difficult subject, only that he gives the reader far greater credit for memory and attentiveness than would seem justified. Nevertheless, the book is an excellent reference volume.

Published by John F. Rider Publisher, Inc., 850 Third Ave., New York 22, N.Y. 166 pages. With soft cover, \$3.75; with cloth binding, \$5.45.

TRANSISTOR TRANSMITTERS FOR THE AMATEUR

by Donald L. Stoner, W6TNS

Transistor experimentation and circuit development have always fascinated Don Stoner. POPULAR ELECTRONICS readers will recall that some of his circuits were published in these pages and in other electronics journals. This book is an extension of Don's articles on low-power transistorized transmitters. Written for the ham operator, it includes a variety of proven circuits for modulators, crystal checkers, tunnel diodes, and small transmitters.

Published by Howard W. Sams & Co., 4300 West 62 St., Indianapolis 6, Ind. Soft cover. 128 pages. Price, \$2.95.



ELECTRONICS IN EVERYDAY THINGS

by William C. Vergara

It's always interesting to find a book that is *not* a run-of-the-mill publication. This second edition of William Vergara's book is an extraordinary "fact sheet" on electronics aimed at the curious, but not knowledgeable (electronically speaking), everyday citizen. The book asks 113 questions about electronics ranging from music power ratings in hi-fi to whether or not you can defeat a radar speed trap. The answers are concise but thorough, and obviously written with a great deal of care. About the only complaint a reader might have is that there is insufficient organization of the material into categories.

Published by Barnes & Noble, Inc., 105 Fifth Ave., New York 3, N.Y. Soft cover. 235 pages. Price, \$1.75.

Free Literature

Allied Radio's 144-page "Carnival of Values" mid-season sales book includes many new products, selected items from the general catalog with substantial price reductions, and manufacturers' close-out values on leading national makes with discounts of up to 33 $\frac{1}{3}$ %. The emphasis is on transistorized equipment, but all categories of products sold by Allied are represented. Write to Allied Radio Corp., 100 N. Western Ave., Chicago, Ill. 60680 for a copy of Sales Book No. 235 . . . The Datak Corporation, 63 Seventy-first St., Guttenburg, N. J., has published a new 48-page catalog on "Letraset Instant Lettering." Their electronic line has been expanded to include a new meter and dial set, as well as a "Datacoat Coating" which protects the rub-on lettering on metal, plastic, and painted surfaces.

-30-



Satellites On The Air

The following satellites were in orbit and transmitting as this issue closed. The satellites are listed by frequency and by code name. Some satellites are mentioned several times since different frequencies are used for tracking and telemetry.

Vanguard 1* 108.012 mc.

Echo 2 136.020 mc.

Telstar 2 136.050 mc.

Alouette** 136.077 mc.

Explorer 18 136.110 mc.

Relay 1 136.140 mc.

Relay 2 136.141 mc.

Echo 2 136.170 mc.

Tiros 8 136.233 mc.

Tiros 7 136.234 mc.

Ariel 1 136.405 mc.

Syncom 2** 136.468 mc.

Ariel 2 136.558 mc.

Alouette** 136.590 mc.

Relay 1** 136.620 mc.

Relay 2** 136.621 mc.

1963 38C (USA) 136.651 mc.

EGRS 136.804 mc.

Solar Radiation 136.887 mc.

Tiros 7 136.922 mc.

Tiros 8 136.924 mc.

Alouette 136.978 mc.

Syncom 2** 136.980 mc.

Saturn 5 136.995 mc.

*Transmits while satellite is in sunlight

**Transmits only upon ground command

This listing does not include all of the satellites in orbit—many of which no longer transmit, or transmit weak or sporadic signals. Satellites of the Soviet Union use tracking and telemetry frequencies in the band between 19.990 and 20.010 mc. Whenever news reports indicate that a new Soviet satellite is in orbit, check the news broadcasts from Radio Moscow for the exact frequency. At press time a number of Soviet satellites are in orbit, but do not appear to be transmitting on their regular channels. These satellites include: Polyot 1 and 2, Cosmos 25, 26, and 29, Elektron 1 and 2.

July, 1964

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CIRCLE NO. 18 ON READER SERVICE PAGE

Big TC

(Continued from page 32)

nylon screws (metal screws at the top end would produce corona discharges which could burn the coil form). Alternatively, the top coil cover can be cemented in place with epoxy cement if a sturdy coil form is used. The coil is attached to the base with a $\frac{3}{8}$ " bolt.

Winding the coil is not nearly as difficult as it appears—the author completed the task in about two hours. Spray the entire winding with acrylic plastic for added insulation, moisture protection, and to keep the windings in place. You can't overdo this step—the author used the contents of an entire aerosol spray can on the prototype, applying one thin layer at a time and letting it dry before adding another.

Building the Primary. As shown on page 31, the form for *L1* was made with polystyrene rods and sheeting. While the plastic has excellent insulating qualities and looks attractive, wood or even cardboard can be substituted. If plastic is used, it can be strongly "welded" together with acetone. Regardless of the material used, the form should have an outside diameter of at least 9" to avoid arc-over between *L1* and *L2*. The coil itself (*L1*) consists of 20 turns of heavy test prod wire.

Spark Gap. The spark gap is simply two ordinary binding posts mounted on stand-off insulators. In turn, these are mounted on a phenolic base measuring $\frac{3}{8}$ " x $2\frac{1}{4}$ " x 6". The electrodes are brass and copper rods with a gap on the order of 1" between them. This distance will vary slightly, depending on the size of capacitor *C1*.

Fabricating the Capacitor. The capacitor consists of two 14" x 14" sheets of tin cemented to a $18\frac{1}{2}$ "-square piece of window glass. Although aluminum foil can be used for the capacitor plates, tin was obtained from a sheet metal shop for this purpose so that connecting leads could be soldered directly to it. If you use aluminum foil, a fairly good connection can be had by making leads of $\frac{1}{2}$ "-wide aluminum foil strips and taping them down to the electrodes.

Glass is an excellent dielectric material for this application since it has an extremely high puncture voltage and a high dielectric constant. As you will note in the drawing on page 32, a border of glass is left around the capacitor plates—this should be at least $1\frac{1}{2}$ " wide. The calculated capacity of *C1* is approximately 0.0027 μ f.

Testing and Operation. Caution! Adjustments to the Tesla coil, and specifically to the spark gap, should be made *only* when the unit is *off*. Although the output voltage of the Tesla coil may be on the order of 150,000 volts, the current capacity is only hundreds of microamps. This current can inflict a nasty shock and r.f. burns, however.

Use EXTREME CAUTION around the neon sign transformer. It delivers 12,000 volts at 30 ma., and this voltage could be lethal under certain conditions. Again, be sure the plug is out when you make adjustments.

To adjust the spark gap, first open it to about $1\frac{1}{2}$ "; it will not fire at this point. Gradually move the electrodes together—unplugging the unit each time you adjust the gap—until the point is reached where the gap "fires."

The author's version of "Big TC" produced an output voltage of 100,000 volts with the 0.0027- μ f. capacitor described. To increase the output voltage, simply construct one or two more capacitors and parallel them across *C1*. With two capacitors in parallel, the prototype Tesla coil produced 150,000 volts; with three capacitors, 200,000 volts. However, it began to break down between coil *L2* and capacitor *C1* above the 200,000-volt region. As mentioned earlier, greater output voltage can be obtained by making the base larger and increasing the spacing between components to eliminate arcing.

The output of your Tesla coil can be estimated by drawing an arc to a metallic object attached to a long wooden handle. Slowly increase the distance between the object and the discharge terminal until the arcing stops: a 6" arc represents 100,000 volts, a 14" arc about 200,000 volts, and a 21" arc some 300,000 volts. More amazing than figures, however, are the brilliant, spectacular phenomena exhibited by high-voltage, high-frequency electricity. —30—

Across the Ham Bands

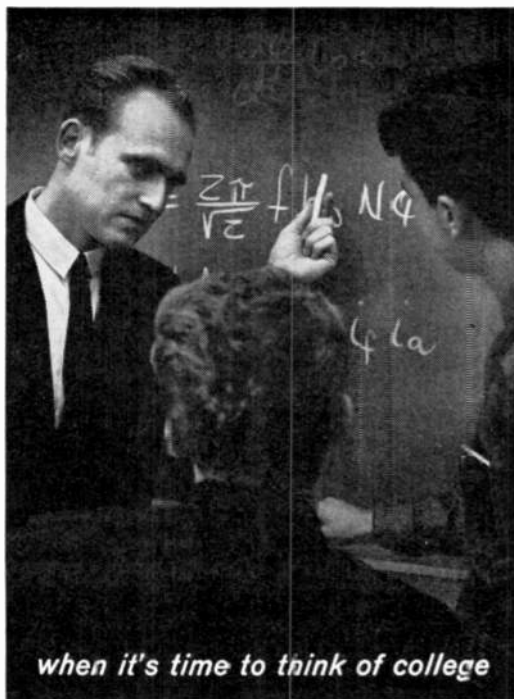
(Continued from page 69)

News and Views

Steve Blaisdell, K7SVB, Box 336, Grand Canyon, Ariz., is looking for skeds in Vermont, Rhode Island, and Maine to complete his WAS. If you can help him, look for him on any of the lower frequency ham bands . . . **Dennis Daupert, WA9HDL**, 6218 Zionsville Rd., Indianapolis, Ind., who won the Novice Station of the Month contest for January, now has his General ticket and 25 states worked on 80 meters. Equally important, his dad Richard is now WN9ITR . . . **John Stensby, WN4RES**, 5105 Holmes Ave., Huntsville, Ala., shares his equipment with his brother, James, WN4RER; and when their father's ticket comes through, he has his claim staked out for equal air time. John has 25 states confirmed on 80 meters. The Stensby station includes a home-constructed transmitter, an RME-4300 receiver, and a multiband doublet antenna.

John J. Kellog, WB2AWY, 31 Lincoln Court, Keansburg, N. J., spent part of a 15-day leave from the Navy on 80 meters. Fifteen states and two Canadian provinces were the result, giving John renewed faith in his Heathkit DX-20 transmitter and ARC-5 receiver . . . Still another John, this one **John Wood, VE5DX**, Box 493, Oxbow, Sask., Canada, operates on 40, 20, and 6 meters with his Knight-Kit T-60 transmitter and Lafayette HE-80 receiver. Although he has a "jumble of antennas," the favorite is a 40-meter vertical. He's looking for contacts in the southern U.S. in particular, but will be glad to schedule anyone needing a Saskatchewan contact . . . **Paul Sussman, WB2AXW**, 310 West 72 St., New York, N. Y., has been operating portable from Philadelphia on 54 mc. Using a Heathkit "Sixer" feeding a dipole only seven feet off the ground, he worked four states and Canada. Paul now has a Johnson Viking "Challenger" transmitter and a BC-312 receiver plus a 6-meter converter. WB2AXW/3 will be active on 6 meters into the fall at 6003 Chester Ave., Philadelphia, Pa.

David O. Box, WA5BMC, Mantachie, Miss., is net manager of the new Mississippi Novice Traffic and Training Net. The net meets daily at 1730 (5:30 p.m.) CST on 3745 kc.; the call-up signal is "CQ MISS NTT." You are invited to join; write to WA5BMC if you'd like more information . . . Since March 17, 1964, the FCC has been collecting its newly scheduled license fees and holding them pending final decision as to their legality. If the fees are finally ruled illegal, they will be returned . . . **Chuck Lang, WN6HHZ**, 10009 Stonehurst Ave., Sun Valley, Calif., is a great believer in surplus gear. He has a BC-669 transmitter, a BC-779 "Super-Pro" receiver, and a BC-604 transmitter/receiver. A Heathkit "Twoer" completes Chuck's ham equipment . . . **Phil Kampe, WASEAM**, 4937 S. Tonti



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CIRCLE NO. 13 ON READER SERVICE PAGE

St., New Orleans, La., uses a Johnson Viking "Ranger" transmitter, a Hammarlund HQ-110 receiver, and a vertical antenna. As a Novice, Phil worked 49 states and 12 different countries; his record now is all states and 41 countries, which is darn good for a 13-year-old OM.

Randy Riskin, WN9JTP, 896 Webster Lane, Des Plaines, Ill., keeps the 80-, 40-, and 15-meter Novice bands working for him. A Heathkit DX-40 transmitter and a Hammarlund HQ-100C receiver take turns pushing and pulling on a dipole 45 feet high. Randy's record is 36 states and 10 countries worked . . .

Matt Harris, WNSIBV, 422 Petama, Harlingen, Texas, sticks to 7176 kc. His favorite operating time is after 2:00 a.m., although his parents don't share his enthusiasm for that time. His Heathkit DX-60 transmitter feeds an inverted-V antenna, and he receives on a Hammarlund HQ-110. Matt worked 18 states in his first month on the air . . . **Ken Lindt, WN6EQV**, 8928 Chimineas, Northridge, Calif., works the 80-, 40-, and 15-meter Novice bands, but 40 meters is his favorite. Ken's EICO 720 transmitter, Hy-Gain 14-AVS vertical antenna, and Knight-Kit R-100A receiver have worked 22 states and Canada. He will be glad to add California to *your* states-worked list.

Don't you think your "News and Views" or a photo of you and your ham station would look good on these pages? We do; you send the material, and we'll do our best to use it. Write to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, Box 678, Gary, Indiana 46401. 73,

Herb, W9EGQ

Transistor Topics

(Continued from page 66)

(filament) transformer, $L1$ a filter choke, $C1$ and $C2$ electrolytic capacitors, and $R1$ a small current limiting resistor (typically, 33 ohms at 1 watt). With *pn*p types, the emitter or collector serves as an anode, the base as a cathode. With *np*n types, the emitter or collector becomes the cathode, the base the anode.

When a transistor is used as a rectifier, care must be taken not to exceed its nominal maximum voltage or current ratings. Two transistors may be employed for full-wave rectification and four in a bridge circuit.

Small signal transistors make excellent diode detectors. In the simple "crystal" receiver circuit illustrated in Fig 5, a transistor with an open emitter ($Q1$) is used in place of a conventional diode.

Frequently a "leaky" transistor can serve as a temperature-compensating element.

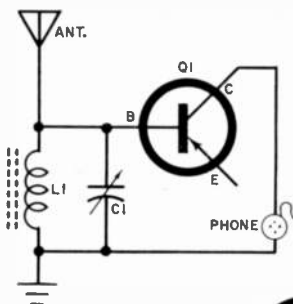


Fig. 5.

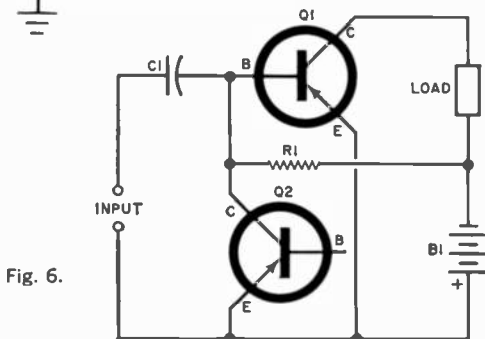


Fig. 6.

One arrangement is shown in Fig. 6. Here, a compensated base bias is supplied to amplifier $Q1$ by a voltage-divider made up of $R1$ and $Q2$. In operation, an increase in temperature lowers $Q2$'s internal resistance, reducing the bias furnished to $Q1$.

Even shorted or "burned-out" transistors are useful. When polished or plated with gold (or silver), they can serve as the main element in a variety of interesting jewelry items. Your Semiconductor Editor has a lapel button made from a gold-plated transistor as well as a pair of cuff links assembled from defective units. They can also be used for tie-tacks and tie-bars, watch fobs, earrings, necklaces, pins, bolo ties, pendants, necklaces and bracelets.

New Books. If you're an advanced student or an experimenter who wants to learn more about engineering design methods, you'll be interested in two books recently published by Sine-Ser-Co., P.O. Box 3, Arlington, Mass. 02174. Both are college-level texts and are written by an eminent authority, Dr. Harry E. Stockman, Professor of Electrical Engineering at Lowell Technological Institute.

The first book, *Transistor and Diode Experiments*, is an 85-page, spiral-bound volume featuring 11 experiments covering such topics as transistor characteristics and parameters, amplifiers, phase splitters, output stages, multivibrators, triggering, a.f. and r.f. oscillators, synchronization and modulation. Reproduced by a "ditto" process, it sells for \$2.

Selling for \$2.75, the second book, *Tran-*

sistor Network Calculations, is a 125-page, spiral-bound text. It includes a review of symbolic and LaPlace-Transform solution methods, a treatment of function sources, and thorough discussions of basic design theorems and matrix techniques.

Once again it's time to close. Until next month, have fun!

-Lou

On the Citizens Band
(Continued from page 72)

The group below are the officers of the Arfax CB Club of Falls Church, Va. Hard work, planning, and participation by all concerned have boosted a handful of members with a small, compact newspaper to an organization of 100 with a huge monthly paper (usually 20 pages or more) called the *Arfax Facts*. Shown in the back row (left to right) are: Ken Brewster, KCG1160, sergeant at arms; Warren Harrison, 4Q0791,



trustee; and Ralph Keys, KCF2462, trustee. Bottom row: Ann Gillenwater, KCG0258, secretary; Van Gillenwater, KCG0258, vice president; Don Bates, KCG0708, president; and Jim Lang, KCG2725, treasurer. There are seven members on the staff of *Arfax Facts*; "Cactus Bob" Howison, KCF0952,

stands at the helm as editor. The club is a member of the Virginia State CB Association.

CB Club Roster. The following new clubs have been added to the 1964 OTCB Club Roster this month:

- Sioux Empire Citizens Communication Association, Sioux Falls, S.D. This group is the first South Dakota club to check in.

- Citizens Band Radio League, Lebanon, Pa. Their compact two-page newspaper manages to include a new members column, pet peeves in CB, items for sale, last-meeting information, next-meeting information, and a monthly message from the club's president.

- Bedford County Five Watts, Bedford, Pa. Recently elected officers are Reid Hackney, KID6862, president; Loren Cooper, KID6559, vice president; Gene Kiessling, KID7759, secretary; James Kilcoin, Jr., KID5757, treasurer; and Earl Effranc, 20Q2956, communications officer.

- Capital District Citizens Band Radio Club, Inc., Albany, N.Y. This group's excellent newspaper, *The Carrier*, is jam-packed with interesting reading, upcoming club activities, and *paid advertising!*

- Citizens Emergency Radio Club, Rome, N.Y. According to club president Tom Little, 20Q4550/WB2AZU, this is the largest CB organization in Rome. A special emergency committee trains members as to procedures during 10-33's.

- Terre Haute CB Club, Terre Haute, Ind. If you're interested in joining, contact Lester L. Morton in care of the club at the Terre Haute Police Department.

See you next month! In the meantime, don't forget to write. Fill us in on the latest functions or planned activities in your area, and include pictures of club activities if you can. The address is: Matt P. Spinnello, CB Editor, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.

-Matt, KHC2060



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The Bee's Knees

(Continued from page 63)

started the motor. "Look at that poor dog standing there sorrowing because he's being left out of the fun. Can't we take him?"

"O. K.," Carl agreed. "An act such as that canine ham is putting on deserves an Oscar and should be rewarded. Come on, Bosco!"

The animal's head and tail came up in a flash, and he leaped clear over the closed rear door of the car and landed in the seat with Mr. Gruber, shivering with delight at being permitted to go along.

They soon reached the spot where Mr. Gruber had been fishing. The little-traveled road paralleled the river at this point, with only a narrow strip of sloping river bank separating the two. While Bosco frolicked about, sniffing at all sorts of exciting scents, Carl and Jerry, carrying the equipment, followed Mr. Gruber along a path through the low bushes until he reached the base of a big sycamore tree. There was a three-inch hole in the scaly trunk about a dozen feet from the ground, and bees were flying busily in and out.

Jerry connected up the oscillator, speaker, and amplifier while Mr. Gruber stalked about the tree eyeing it with the intent concentration of a diamond cutter preparing to split the Great Kohinoor. Finally he extended his cane and touched a spot on the trunk about shoulder high and directly beneath the bees' entrance.

"We'll chop here," he said to Carl, who was leaning on the axe handle. "Are you ready with the 'bee-pacifier,' Jerry?"

For an answer, Jerry threw a switch. A pure, surprisingly loud tone came from the little speaker he held in his hand.

"Point the speaker directly at the hole and stand out of the way of Carl's axe," Mr. Gruber directed. "Okay, Paul Bunyan, lay on the wood!"

Carl spat on his hands in imitation of a professional lumberjack, swung the double-bitted axe back over his shoulder,

and sank the blade deep into the green tree-trunk. He never had a chance to chop a second time. A tornado of angry insects boiled from the hole in the trunk and descended like a blanket, sparing no one.

While Carl and Jerry were feeling the stabbing pain of multiple stings, they saw Mr. Gruber snatch off his derby and start flailing wildly with it, and yelps from Bosco revealed that he, too, was being stung. Suddenly Mr. Gruber turned and ran for the river with the speed and nimbleness of a sixteen-year-old, and the boys and the dog were right behind the galvanized little man as he gave a great leap out into the stream and disappeared beneath the surface.

Fortunately, the water was only about three feet deep, and it was fairly easy to keep submerged simply by squatting down and coming up briefly now and then for air. After a few minutes the bees gave up the attack, and the three men cautiously surfaced and waded on out to a sand bar in the middle of the stream. Bosco was already there, whimpering and pawing at his muzzle which had received the most stings.

THAT didn't work very well, did it?"

Mr. Gruber said sheepishly, glancing out of the corner of his eye at the lumpy, swelling faces of his young friends.

"That's the understatement of the year," Carl agreed, grinning crookedly as he started plucking stings from the back of his hand.

"Don't do that!" Mr. Gruber said. "You're just squeezing venom from the little poison sacks down into the skin

punctures. Scrape the stings off with a knife blade as I'm doing. That way they won't amount to much."

"Mr. Gruber," Jerry asked, "are you *sure* you didn't overlook something in that article about the bee-tranquilizing?"

"See for yourself," Mr. Gruber invited as he removed his derby, shook some water from it, and fished a soggy newspaper clipping from inside the sweat-band.

Jerry read the story and then carefully examined the clipping. Suddenly he used his fingernails to separate two layers of paper and peeled them apart until the clipping was twice its former length. He read the continuation of the story, and a smile creased his swollen face.

"Mr. Gruber," he said gently, "I'm afraid you were in such a hurry to try out this bee-quieting business that you forgot one important point. The story goes on to say that the threshold limit for the reaction was 125 db of audio measured *at the level of the bee*. The figure is confusing since it gives the airborne energy which just serves to disturb the substrate. The actual sound energy we put into the substrate is much less, and it is substrate vibration that causes the reaction. In other words, there was enough energy from that little buzzer the researchers screwed to the side of the hive to quiet the bees perched on the hive or the comb, but to transmit the same amount of vibration to the hive by conduction through the air from a speaker, we would have to exceed the limit of human pain. The experimenters were never able to put out enough audio

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energy to quiet a bee while in flight." "If that doesn't beat everything!" Mr. Gruber exclaimed with a crestfallen air. "Now I remember I was interrupted by Martha's wanting me to go to the store while I was reading that article. I folded it and put it into my hat where it stuck together. I never finished reading it and even forgot that there was more to it. Does the story say anything else?"

"There's one other thing. By amputating pairs of legs, the entomologists have found that the fore pair is about eighty-five per cent responsible for carrying the sound stimulus. The remaining fifteen per cent of conduction is about equally divided between the middle and hind pairs. Why are you grinning, Carl?"

"I was just thinking about that business of the sound energy having to be conducted to the bee's body through his legs," Carl said. "We failed because our sound energy didn't pass through the bee's knees. Get it? 'The bee's knees—'"

He was interrupted by handfuls of sand scooped in his direction by both Mr. Gruber and Jerry. Even Bosco barked and tried to nip his ankles as he ran away laughing. -30-

Tap Tap Temperature Taker

(Continued from page 43)

R2 only far enough to start the unit ticking. Note the reading on the thermometer and place a light pencil mark on the paper scale opposite the knob's pointer.

Put the ice cube back in the water until *K3* stops and the temperature drops one degree. Then advance *R2* to the point where the ticking starts again, and mark this new knob setting. Continue cooling the water and marking the scale until you can turn *R2* no further. You will now have calibration points at one-degree intervals from approximately 85° to 59° F. The dial scale may be drawn and lettered with India ink. Before cementing it in place, moistureproof it with two coats of Krylon or clear lacquer.

During the calibration process, keep in mind that *R10* reacts much more rapidly than the thermometer does. Thus, you

should wait at least one minute after each application of ice before comparing the setting of *R2* with the thermometer's reading. And remember to do plenty of stirring to insure an even temperature throughout the water.

Performance. To demonstrate the Temperature Taker's ability to detect minute temperature differentials, the probe was held a foot above the floor in a heated room. Control *R2* was set just below cutoff. Raising the probe only six inches was sufficient to cause *K3* to begin clicking. Dropping the probe back to its original position almost immediately silenced the relay.

Since the transistors, relays, and other components in the device are, themselves, temperature-sensitive, you may wonder about the stability of the instrument, as a whole, under varying external temperature conditions. To check this problem, the unit was placed atop a hot air register. At the end of an hour, the case and contents were very warm to the touch, but the dial error was only 2°. When used at the relatively even temperatures encountered in the average home darkroom, errors resulting from ambient thermal changes should be insignificant.

Battery aging is of little consequence, since a 20 per cent voltage drop in either *B1* or *B2* has only a minor effect on accuracy. Battery cost runs in the neighborhood of two cents per hour. -50-

Modern Crystal Set

(Continued from page 55)

permits the greatest transfer of energy with the least effect on tuning.

Wind *L2* directly on a bare ferrite antenna rod without added insulation (see drawing, page 55). The leads should be long enough to reach *S2*'s terminals; do not cut the tap loops when winding. Most litz wire can be soldered without scraping if it is held for a few moments in a puddle of solder and flux. Add a touch of glue at the base of each tap and at the ends of the windings.

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Set" is the use of fixed diodes—four of them in a bridge circuit—instead of a cat whisker and galena crystal. The author mounted them on a screw-type terminal strip to avoid heat damage; an ordinary tie strip can be substituted if you use a heat sink when wiring. Be sure to observe diode polarities.

By far the best headphones for this purpose are crystal types. Putting the two phones in series rather than in parallel may prove beneficial in some cases. If you must use magnetic phones, the addition of an output transformer may improve results.

Assembly and Testing. As shown in the photos, all components are mounted on the front of the aluminum case. While it is not necessary or especially desirable to follow the author's layout, some experimentation will be necessary to gang *L1* (mounted to the back of *C2* in the prototype with epoxy cement and a cardboard holder) and *C1*. The author used a lever switch for *S1*. Spacers were used to mount the terminal strip and *C1* and *C2*. Small metal brackets can be made to mount *L2-L3* to the supporting screws holding *S2* if desired. The ferrite rod is simply glued between the two small brackets.

The first step in testing the set is to provide a good ground such as a cold water pipe and an antenna, preferably a long wire. Tune with the main dial and the antenna control, trying *S1*'s three positions for best results. When maximum volume has been achieved, try the three remaining switch positions on the "band switch" (*S2*), varying the other controls with each setting. Finally, try the four positions of the "impedance selector" (*S3*). As you will note, all controls unavoidably interact to some degree.

With all controls adjusted, you will find that changing stations involves a coordinated change of both antenna and main tuning knobs, with an occasional change in band and impedance switch settings. For those who have experimented with the "garden variety" crystal set, tuning will seem sharp and volume astounding. Not the least of the rewards you'll receive when you build a "Modern Crystal Set" are the police and aircraft calls you may hear at one of the tap settings!

Short-Wave Report

(Continued from page 59)

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. We regret that we are unable to use all of the reports received each month, due to space limitations, but we are grateful to everyone who contributes to this column.

Albania—According to a recent verification letter, *R. Tirana* is operating in Eng. at 2000-2030 and 2130-2200 on 9390 and 7090 kc. The 9390-kc. outlet is also noted in Eng. at 1630-1700 and from 1700 in Italian.

Argentina—*Radiodifusion Argentina al Exterior*, Buenos Aires, now operates Mondays to Fridays on the following schedule: to Europe on 11,710, 11,780, and 6090 kc. at 1400-1500 in Spanish, to 1600 in German, to 1700 in Italian, to 1800 in French, and to 1900 in English; to East Coast N.A. at 1900-2000 in Portuguese and 2000-2200 in Spanish on 9690 kc., at 2100-2200 on 11,780 kc. in Spanish, and at 2200-2300 on 11,780, 9690, and 6090 kc. in English; to West Coast N.A. at 2300-0100 in Spanish and to 0200 in Eng. on 11,780, 9690, and 6090 kc. Reports go to Sarmiento 151, Buenos Aires.

On weekends, *Radio Nacional* operates on 15,345 kc. to 1700 and on 9690 kc. from 1715. The 11,710-kc. channel is no longer used for this xmsn.

Azores—*Emissora Regional dos Acores*, CSA97, Ponta Delgada, is audible on 4865 kc. around 1730 with Portuguese music and anmts. The IS consists of chimes.

Barbados—*Radio Barbados*, Black Rock, is one of the most widely reported medium-wave

stations. On 795 kc., it is being heard from 0500 to 0530 and evenings to 2115 s/off. It is rated at 10 kw. The station is government-owned and operated by a statutory board. Located four miles north of Bridgetown and 100 yards from the West Coast of Barbados island, it is beamed north-northwest.

Bolivia—Station CP81, *R. Pio XII*, Llallagua, 5965 kc., is noted at 0515-0545 with news, music, and ID's. Station CP70, *R. Grigota*, Santa Cruz de la Sierra, 4828 kc., has been off the air for some time and is now heard irregularly around 2215 with Latin American music and talks and a very weak signal.

Brazil—According to *R. Timbira's* QSL card, this station broadcasts a listeners' correspondence program on Sundays at 1800 on 4975 kc. in Eng., Spanish, and Portuguese.

British Honduras—A recent verification letter states in part, "Our short-wave service is temporarily suspended; but we hope to resume transmission in June." Meanwhile, the 834-kc. outlet continues to be heard well in many areas.

Brunei—*R. Brunei*, 4865 kc., has been noted at 0900-0930 with modern and old-time music and anmts in English.

Canada—Station CBNX, St. John's, Newfoundland, relays CBN on 6160 kc. and is noted at 0740 with a religious program, at 0800 with news from *R. Canada*, and from 1730 but with heavy QRM from a station with Arabic music.

Ceylon—During the past years, many DX'ers have reported difficulties in obtaining QSL's from the Commercial Service of *R. Ceylon*. However, reports addressed to Radio Advertising Service, Cecil Court, Lansdowne Rd., Bombay 1, India, have brought in verification letters. This probably is a company that produces some (or all) of the commercial programs broadcast from Colombo.

Dominican Republic—Station HICB, Santiago, is heard on 6120 kc. at good level but with heavy QRM to 0100 s/off.

Ecuador—Station HCJE, Quito, has a "DX Party Line" to N.A. on the first and third Monday of the month at 2130-2200 on 9745, 11,915, and 15,115 kc. and to the Pacific areas on the first and third Wednesday of the month at 0430-0500 on 6050 and 9745 kc. Station HCGB4, *R. Nacional Espejo*, Esmeraldas, has been tuned at 2330-2345 on 3844 kc. R.

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CIRCLE NO. 23 ON READER SERVICE PAGE

Quito, *La Voz de la Capital*, Quito, 4923 kc., was noted at 2300 with a news bulletin in Spanish and to 0000 s/off with pop music, ID's, and commercials; they verified with a QSL card and pennant. *Emissora Gran Colombia*, Quito, 4910 kc., was also noted at 2320-0030 with pop music and five ads for each record, all Spanish.

France—Paris has been noted on 9485 kc. with s/off at 2115 after a program in Spanish, although the latest schedule indicates that this program is aired only on 9755, 11,845, and 11,920 kc. to Latin America. An Arabic program to the Middle East has also been heard on 11,920 kc. at 1100-1300.

Germany (West)—*Deutsche Welle*, Cologne, has been carrying a special program to N.A. at 1710-1720 on 6120, 6185, and 9735 kc. The program generally consists of music only.

Greenland—If tests are satisfactory, there will be a short-wave xmtr in Greenland in

1965 that will cover the entire island. The Armed Forces Radio & Television Service, Thule, has been noted on 1425 kc. in the medium-wave band from 2130, weak but clear.

Iceland—Reykjavik has moved from the 25-meter band to 9720 kc. and operates Sundays only at 0800-1000 in Icelandic.

India—*All India Radio*, New Delhi, has this schedule: 0500-0600 to N.E. Asia on 17,850, 15,105, and 9520 kc., and to Australia and New Zealand on 15,290, 11,710, and 9740 kc.; 0830-1000 to S. E. Asia on 15,225 and 11,810 kc.; 1340-1430 to E. Africa on 11,815, 11,790, 9680, and 7125 kc.; 1445-1545 to Europe on 9915, 7235, and 5995 kc. and to W. Africa on 11,825, 9690, and 7105 kc. The 15,225-kc. channel is one of the best heard at present, at 0830-1000.

Indonesia—*R. Republik Indonesia*, Djakarta, broadcasts in Eng. at 0600-0700 and 0900-1030 on 9710 and 9585 kc., and can also be heard on 11,795 and 11,710 kc.; they supply a decora-

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(3) A fee of 50 cents (U. S. coin) must accompany the application to cover the costs of printing, handling, and mailing. This fee will be returned in the event an applicant is found to be ineligible. Applicants in countries other than the U.S. may send the equivalent of 60 cents (U.S.) in coins of their own country if they wish.

(4) Apply for the highest DX award for which you are eligible. If, at a later date, you are eligible for a higher award, then apply for that award.

(5) Send your application, verification list, and fee to: Hank Bennett, Short-Wave Editor, P. O. Box 254, Haddonfield, N. J. 08033. Do not include an application for a Short-Wave Monitor Certificate (you are not eligible for any of the awards until you have a Short-Wave Monitor Certificate in your possession). Reports, news items, or questions should be mailed in a separate envelope.

tive program schedule. Station YDR2, a 300-watt outlet in Ambon, has been noted on 7140 kc. in native language at 0430-0503.

Iran—The latest schedule from Teheran shows these operations: Home Service at 0255-0715 and 0726-1430 on 3780 and 7125 kc., at 1430-2030 on 4840 and 7125 kc., and at 2030, 0133 on 7085 and 3780 kc.; the Foreign Service is broadcast on 7031 kc. at 1430 in Persian, at 1500 in Russian, at 1515 in Turkish, at 1530 in French, and at 1545 in English. Other Iranian stations are: *R. Tabriz*, on 6155 kc., at 2125-0000, 0254-0700, and 0824-1330; *R. Rezaieh*, on 6940 kc., at 0645-1130. Despite the fact that this schedule was copied directly from the official station schedule, we believe there are some errors in the Home Service portion. Further checks will be made. Test xmsns have been noted from 100-kw. xmtrs at 2130-0030 and 0730-1030 on 7135 and 9659 kc., and at 0030-0730 on 15,135 and 11,730 kc.

Iraq—*R. Baghdad* has French at 1530-1600, Eng. to 1640, and German to 1710, on 6030 and 6095 kc. Another outlet on 6155 kc. is heard in Arabic at 2313-0003.

Israel—*Kol Zion*, Jerusalem, has moved from 9625 kc. to 9615 kc. where it operates, dual to 9009 kc., at 1100-1530. There is an Eng. newscast and talk at 1510.

Japan—Tokyo has been heard on 9530 kc. at 0400 with Eng. news, at 0415 in Japanese, and

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SHORT-WAVE ABBREVIATIONS

anmt—Announcement	N.A.—North America
B/C—Broadcasting	ORM—Station interference
Eng.—English	OSL—Verification
ID—Identification	R.—Radio
IS—Interval signal	s/off—Sign-off
kc.—Kilocycles	xmsn—Transmission
kw.—Kilowatts	xmtr—Transmitter

at 0430 with music; and on 7195 kc. at 0615-0645 with native-language talks and music. There is an Eng. ID at 0645 s/off. The Far East Network, APO 67, is scheduled as follows: on 3910 kc. at 0245-1910 (10 kw.) and 1925-0235 (1 kw.); on 6155 kc. (10 kw.) and 15,360 kc. (1 kw.) 24 hours daily; on 11,750 kc. at 1925-0235 (10 kw.) and 0245-1910 (1 kw.). Maintenance is performed at 1005-1458 on Mondays (3910 kc.), Thursdays (6155 kc.), Tuesdays (11,750 kc.), and Wednesdays (15,260 kc.).

Netherlands Antilles—Bonaire, 800 kc., has *R. Nederland* programs scheduled as follows: (weekdays) Spanish from 1830 to 1920, a Dutch news bulletin to 1940, and English to 2030; (Sundays) the "Happy Station Program" in Spanish at 1830-1920 and in English at 1940-2030. The Dutch newscast is also aired at 1920-1940 on Sundays.

Willemstad's assigned frequencies are 6085 kc. (2 kw.) and 9655 kc. (1 kw.). Does anyone have any information as to whether there are any broadcasts on these frequencies? Any information should be sent to *World Radio TV Handbook*, Lindorffsalle 1, Hellerup, Denmark.

New Zealand—Wellington's latest schedule reads: to the Pacific Islands at 1200-1445 and 0100-0345 on 11,780 and 9540 kc., and at 1500-0045 on 15,280 kc.; to Australia at 1500-1730 on 11,780 kc., at 1745-0045 on 15,110 kc., and at 0400-0645 on 6080 and 9540 kc.; to Antarctica (Sundays only) at 0315-0345 on 6080 kc. The station states: "All reports are acknowledged by letter or QSL card. Listeners' reports should include the wavelength or frequency of the transmission, date, time, and if possible, some program detail and comments on any interference."

Nigeria—Lagos has been found on 15,255 kc. at 1845 with "high-life" music announced in Eng. and at 1900 with a French newscast.

Norway—*R. Norway* was noted on 15,775 kc. at 1500 with news and at 1530 with s/off, and on Saturday at 0930-1000 with a listeners' request program. The 9610-kc. outlet was heard closing in Eng. to N.A. at 0000.

Peru—A newly reported station, *R. Andina, La Voz de Los Agricultores Andinas*, 6255 kc., was heard at 0555-0630 with music and frequent ID's. Station OAX3E, *R. Huarez*, Huarez, is another new one; operating on 5700 kc., it was noted from 2240 to 2307 s/off with music and a few anmts in Spanish.

Philippines—Far East Broadcasting Corp., Manila, was noted on 15,230 kc. at 0719-0800 with hymns and a children's program, and on 9730 kc. at 1030-1045 with Eng. news and at 1550-1559 with an Eng. religious program to India.

Portugal—Lisbon broadcasts daily to East Coast N.A. at 2100 and to the West Coast at 2245 on 6025 and 6185 kc. Another *Voice of the*

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 Gary Robertson, Hanford, Calif.
 Charles Scott, Petrolia, Ontario, Canada
 Steve Smay, Springfield, Mo.
Deutsche Welle DX Bulletin, Cologne, Germany
 Far East Network, Tokyo, Japan
Radiodiffusion Television Francaise, Paris, France
R. Malaysia, Sarawak
R. Nederland, Hilversum, Netherlands
Sweden Calling DX'ers Bulletin, Stockholm, Sweden
Trans World Radio, Chatham, N. J.
World Radio TV Handbook, Hellerup, Denmark



Hans Koster, WPE8GXT, Kalamazoo, Mich., works with a National NC-60 and a Lafayette "Explor-Air." His antenna system consists of two 100' long-wires 40 feet high. There is also a homemade antenna tuner and an r.f. amplifier in the Koster shack.

West program is aired on 15.380 kc. with an Eng. news bulletin at 1305. Medium-wave DX'ers might try for the Eng. program on 755 and 1061 kc. starting at 1745 (at 1800 on Sundays).

Sarawak—The latest schedule from *R. Malaysia*, Sarawak, for Eng. xmsns reads: Sundays, Mondays, Wednesdays, Fridays, and Saturdays at 1800-1915 on 4950 and 7160 kc.; Sunday to Thursday (during school term only) at 2000-2245 on 7160, 7270, and 9565 kc.; daily newscast at 0000-0015 on 7270 kc.; daily except Wednesdays and Sundays at 0000-0030, Tuesdays at 2300-0030, Saturdays at 0030-0130 and 2200-0130, all on 7160 kc.; Saturdays at 0900-1000 on 4835 kc.; and daily at 0600-0700 and 0800-0930 (Saturdays to 1000) on 4950 kc.

Senegal—Dakar has started using a 200-kw. xmtr on 764 kc. that is reportedly scheduled from 0100 to 1900. Several East Coast medium-wave DX'ers claim that this is the strongest transatlantic station logged in many years. One report from the West Coast claims it is the loudest transatlantic station ever heard, with best reception at 1720-1900. Those DX'ers with smaller receivers might try for it on Mondays from 0200 when WABC, New York, 770 kc., is off the air.

Switzerland—Berne has been heard on 15-190 kc. with opening at 0944 to India and Pakistan.

United Nations—Reports for United Nations broadcasts should be sent to Radio and Visual Services Division, United Nations, New York, N. Y. Correct reports are confirmed by card and new listeners are sent general information about the U. N. upon request.

Uruguay—A new station on 11,710 kc. is *R. Oriental*, Montevideo, noted around 1900.

U.S.S.R.—*Govorit Kamchatski*, Petropavlovsk, 4485 kc., was noted at 0445 with talks in Russian. Frunze, Kirgis, 4009 kc., has been heard at 2030-2100 with musical exercises, classical music, and some talks in Russian; a newscast is given at 2100. The Tyumen Asiatic S.S.R. closes at 1500 on 5045 kc. with the call *Govorit Tyumen* and 12 clock chimes.

Venezuela—According to a verification letter, *R. Tovar*, Tovar, 3365 kc., 1000 watts, op-

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WPE2BJV	WPE2DEY	WPE2ICG
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WPE2CBP	WPE2EC	WPE2IVU
WPE2CFP	WPE2EGX	WPE2JKP
WPE2CRL	WPE2EMG	WPE2KK

erates daily from 0525 to 2130 (Sundays from 0825). Reports should go to Carrera 4 No. 5-46, Tovar, Estado Merida, Venezuela.

Yemen—There is to be a short-wave xmtr operating "soon" in Eng. and French in the 41-meter band. No other details are currently known except the power rating, which will be 5000 watts.

Zambia—Northern Rhodesia B/C Corp. now has this schedule: National Program on 3270 kc. at 2300-0130 and 1230-1600, on 4911 kc. at 1000-1230, on 4965 kc. at 2300-0300, and on 6165 kc. at 0130-0700; the "A" Program in vernaculars on 3346 kc. at 2300-0110 and 1100-1500, on 4828 kc. at 2300-0110, on 4965 kc. at 0945-1500, on 6060 kc. at 0500-1045, and on 7220 kc. at 0500-0930; the "B" Program in vernaculars on 4828 kc. at 0900-1500. Reports should go to Broadcasting House, Box RW 15, Ridgeway, Lusaka.

Clandestine—The elusive "Kiss Me Honey" station has been reported on 11,950, 11,696, 9537, and 6095 kc. around 0830 and 1245. Its location is not known but one source believes that this station is *Radio Liberation*, Formosa. This has NOT been confirmed.

R. Espana Independiente is now being noted on 6296 kc. at 1605-1627, dual to 6950 kc., with anti-Franco broadcasts.

Jammers have been noted on 710 and 1140 kc., presumably from Havana, and supposedly to override the Spanish broadcasts from Miami's WGBS and WMIE.

-50-

Bio-Electronic Quiz Answers

(Quiz on page 49)

1 — E Pickup ARM	6 — A Tape HEAD
2 — I Magic-EYE Tube	7 — G Tower LEGS
3 — C Contact FINGER Stock	8 — F Zener Diode KNEE
4 — B HAIRspring	9 — H Picture Tube NECK
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TRANSISTORIZED Products Importers catalog, \$1.00, Intercontinental, CPO 1717, Tokyo, Japan.

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

SENSITIVE, Reliable Switches for Alarms, Remote Control, Temperature, etc. DODSON'S, 206 E. Main, Post, Texas.

WPE-CB-QSL cards—Brownie-W3CJ1—3111A Lehigh, Allentown, Pa. 18103. Catalogue with samples 25¢.

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

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RECEIVE telephone calls in your car. 30 mile range. No FCC approval necessary. Easily built for few dollars. Attaches to car radio antenna. Plans \$2.00. Deeco, Box 7263-AD, Houston 8, Texas.

\$100.00 WEEKLY Spare Time Selling Banshee TS-30 Transistor ignition systems and coils. Big demand. Free money making brochure. Slep Electronics, Drawer 1782D, Ellenton, Florida 33532.

TRANSISTOR ignition described June and October Popular Electronics, "Operation Pickup." Complete kit finest components quickly assembled. Guaranteed. Negative ground kits \$14.95 Postpaid. Positive ground \$19.95 Postpaid. Specify 6 or 12 volt when ordering. Electromart, 1616 S. 81st St., Milwaukee, Wis.

GENERAL INFORMATION: First word in all ads set in bold caps at no extra charge. Additional words may be set in bold caps at 10¢ extra per word. All copy subject to publisher's approval. Closing Date: 5th of the 2nd preceding month (for example, March issue closes January 5th). Send order and remittance to: Martin Lincoln, POPULAR ELECTRONICS, One Park Avenue, New York, New York 10016.

CONVERT any television to sensitive, big-screen oscilloscope. Only minor changes required. No electronic experience necessary. Illustrated plans, \$2.00. Relco Industries, Box 10563, Houston 18, Texas.

IGNITION! Transistor. Coil, ballast \$7.95. Free Parts Lists. Transfire, Carlisle 40, Mass.

COMPLETE KNIFE catalog 25¢. Hunting, Pocket, Utility. Heartstone, Dept. ZD, Seneca Falls, New York 13148.

TRANSISTORIZED Treasure detector finds buried gold, silver, coins. \$19.95 up. Kits available. Free catalog. Relco, Box 10563, Houston 18, Texas.

BUY From Factories! Appliances, cameras, watches, etc! Free details! Cam Company, 436PH Bloomfield Ave., Verona, N. J.

PRINTED CIRCUIT BOARDS. Hams, Experimenters. Catalog 10¢. P/M Electronics, Box 6288, Seattle, Wash. 98188.

MEN ONLY!—Surprise Package \$1.00. Enterprises, Box 266-Z, Spring Valley, New York 10977.

FREE Catalog, Electronic Paris Bargains. Franklin Electronics, Box 51a, Brentwood, N.Y. 11717.

POCKET Calculating Machine, \$1. Free catalog. Brown's, 6114 Wissahickon, Philadelphia 19144.

WHOLESALE prices on TV cameras, transmitters, converters, etc. direct from factory. Catalog 10¢. Vanguard, 190-48 99th Avenue, Hollis, N.Y. 11423.

RAY GUN—Want to build a Laser? Complete set of instructions tell you everything. Shoots a pencil-thin beam of light. Burns, instantly, anything in its path. Really a fabulous item! A must for every science fiction buff or science experimenter. \$9.95 ppd. Exacto Supply Co., 109½ W. 5th, Pittsburg, Kansas.

SIMPLEX Transistor Ignition described in February Popular Electronics. Complete parts kit available at low cost. Write for information. Electromart, 1616 S. 81st St., Milwaukee, Wis.

MAGNETIC engine novelty, 4000 rpm, 10 parts. Assemble one yourself from our guaranteed kit. Mail \$1.00 now! Pontin Products, 3234 S. Hudson, Seattle 8, Wash.

WORLD Trade Inquiries. Electronics contacts Worldwide. 25¢ stamp brings sample copy. World Traders, Box 6266, Spokane 28, Wash.

ELECTRONIC gear, transistorized & conventional. Send 25¢ for prices. Fisher Electronics, Box 665, Union, Oregon 97883.

C-B'ERS—Ground Plane Antennas. List \$9.95 and up. Dealers wanted. Write circular. Komet Electronics, P.O. 222PE, Tilton, N.H. 03276.

EYESTRAIN reduced while assembling components. Free Magnasighter brochure. Magnasighter, 14460 Dunbar, Sherman Oaks, Calif.

15 DISTANCE One-tube plans—25¢; One-tube Handbook—50¢. Includes Transistor experiments, catalog. Laboratoris, 1131-L Valota, Redwood City, Calif.

BUILD Simple Test Equipment! Dollar brings Guaranteed plans and instructions. Jones, Box 882, Hagerstown, Maryland 21741.

ELECTRONIC ORGANS tuned with record player, DIF-FROSTROBE disc and instructions \$1.00, Pulford Greaves, Box 33, Dearborn, Mich.

HEAR AIRCRAFT, TOWER EMERGENCIES, WEATHER! POCKET, TRANSISTORIZED VHF RECEIVER \$9.95 POST-PAID. FREE DETAILS. TRANSCO, BOX 13482 NORTH COUNTY STATION, ST. LOUIS 38, MO.

INVISIBLE beam transistorized burglar alarm. Complete Plans—\$2.00. Beck, 777 Ruth Drive, Newbury Park, Calif.

TV CAMERA under \$40.00—Completely transistorized space age flying spot scanner—Schematics, Photographs, Plans—\$3.00. Transistorized shocking cane—simple complete schematic—Plans—\$1.00. Beck, 777 Ruth Drive, Newbury Park, Calif.

CB QSL-WPE-SWL Cards—Attractive 2 colors, glossy white. Biggest selection of novelties. Call record books. Plastic card holders, Warning, Gag, Call letter signs, Decals, Identification badges, etc. NEW CATALOG No. 106 FREE! WOODY, 2611 Shenandoah, St. Louis, Mo. 63104.

TELEPHONE EXTENSION IN YOUR CAR. Answer your home telephone by radio from your car. Complete diagrams and instructions \$2.75. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

CONVERT Standard transistor Radio into Radio-Intercom. Plans 50¢. Bill Crane, 4826 Granite Reef, Scottsdale, Arizona, 85257.

POLICE RADAR DETECTOR plus legal Jammer. Stop before Radar Speed Traps. Build for less than \$10; used with Car Radio. Complete Construction Details \$3.75. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

POWER transistor: 2N155, 8.5 watts. Excellent for amplifiers. \$1.00 Free catalog. Western Components, Box 2581, El Cajon, Calif.

RECORD TV Programs at home. Easy to construct. Watch your favorite TV Shows whenever you wish. Complete Construction Details \$4.75. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

TRANSISTORS, SCR's diodes, Nickel Cadmium batteries, meters, crystals, Components. Quality Guaranteed. Send 10¢ for Catalog. Electronic Components Co., P. O. Box 2902A, Baton Rouge, La. 70821.

COLOR TV. Convert your black and white TV to color. Completely Electronic. No Mechanical Gadgets. Costs about \$35. Construction Details \$4.75. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

QUAD antenna information—3-4-5 elements. High gain. \$2.00. Methods, 509 Osage St., Neodesha, Kansas.

ANSAPHONE. Automatic Telephone Answering Machine delivers and takes messages. Build for under \$40. Plans \$4.75. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

TELEPHONE Voice Switch: (LS-500). Actuates automatically and unattended any tape or wire recorder. Pictorial installation instructions included. \$23.75. Post Paid USA, WJS Electronics, 1525 No. Hudson, Hollywood, Calif. 90028.

QSL'S \$2.50/100. New catalogue-samples 10¢. Longbrook, Box 393-Y, Quakertown, N.J.

400:1 Transistor Ignition Coils. \$6.97 each. Send for free list of other parts. Fightmaster Distributors, 3936A Northwest 10th, Oklahoma City, Okla. 73107.

TV CAMERA. Build for less than \$50. Construction details \$4.75. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

TRANSISTOR semikits CB, 6 meter, 2 meter, police and fire converters \$1.00 each. Sweep generator 100 kc to 100 mc \$2.00. Many other projects. Free catalog. Paulin Sales, Box 122A, Upland, Calif.

TAIL TRANSMITTER. TINY Transistorized Transmitter for the Private Eye. Signals its location for miles. Construction Details \$4.75. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

15W FLUORESCENT lamp operation from car or boat battery. Complete plans and special transformer \$12.00. Plans only: \$2.00. Specify 6 or 12 volts. O & H Co., 335 Hoe Ave., Scotch Plains, N.J.

ULTRASONIC DISHWASHER. Cleans in seconds. Build for \$40.00. Plans \$4.75. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

YOU have only one month left to send your dollar for the electronics buy of the century. Baker, R.R. 1, Greencastle, Indiana.

PHONE VISION. See the party to whom you are talking. Use your ordinary telephone with easy to build attachment. Uses your TV Receiver. Construction Plans \$4.75. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

TRANSISTOR Ignition Coils, heavy-duty 400:1. \$8.50. Guaranteed. Free literature. Electrospecialties, Box 548, Trion, Georgia 30753.

SPEAKERPHONE. Bell System Type. Amplifies in both directions. Will not squeal. Plans \$4.75. Don Britton Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

TRI-AMP transistorized audio amplifier, generator, tracer, CPO, mike tester, etc. Built-in speaker. Detailed plans with photos, \$2.00. ELECTRONI-KIT, 23958 Archwood, Canoga Park, Calif.

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PICK up hidden programs now on FM broadcast bands for continuous music without commercials. Build an SCA adapter. Detailed text with schematic \$3.00. Wired adapters \$75.00. We specialize in sub carrier activity equipment. Music Associated, 65 Glenwood Road, Upper Montclair, New Jersey.

USED amateur equipment, accessories, tubes, test equipment, for sale or trade. Send for list. Belvidere, 150 Sixth St., Bristol, Conn.

CONVERT any television to T.V. analyzer cost about \$4.00. Audio video signal tracers AGC oscilloscope horiz. vert. oscillator output, etc. Operates as T.V. plans \$2.00. Ripley T.V. Service, Box 2988, Ripley, Okla.

MICROWAVE Transmitter for X-band Radar speed trap, microwave relay station, intrusion and infiltration sensor. Build under \$40. Complete construction details, \$4.75. Somerset, Box 201, Edison, Pa. 18919.

TRANSISTORS—10PNP audio \$1.00—BC Engineering, 385 Ludlow, Stamford, Conn.

110VAC 60 cy from car generator. Powers lights, refrigerator, transmitter, receiver etc. Simple, easy to convert. Plans \$2.00. Tedco, Box 12098, Houston 17, Texas.

DOLLARS AHEAD, new CB transceivers, all makes. Write for quote. Pan, Box 016, Los Angeles 25.

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POWER Supply Three outputs 7, 14, 20 volts DC 0.1 amps each. Input 115 volts, 60 Cycles. Excellent for Transistor Hobbyists and Experimenters. \$9.95 prepaid. Centron Company, Box 311, Harrington Park, N.J. 07640.

CUSTOM Engineered 400:1 Transistor Ignition Coils. Vacuum Molded Epoxy, no High Voltage Leakage. Many dollars less than ordinary Coils. Satisfaction Guaranteed. Send now and save. Only \$8.95 Postage Paid. Hoffman Enterprises 2068 West Century Blvd., Los Angeles, Calif.

RIDER'S Trouble Shooters Manuals. Volumes 1 thru 23. Best source of diagrams for antique radios. 1919 thru 1954. \$100.00. Freight collect. E. Olmstead, 3121 St. Louis, Rapid City, South Dakota.

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STEREO Amplifier: Powerful two channel sixteen transistor circuit. Simple assembly. Precision etched circuit board eliminates 90% of the work. Kit contains circuit and complete plans. \$5.95. Stereo Designs, 901 Water St., Lumberton, N.C.

RUBY Laser Kit Including Ruby, 2 flash tubes and main components—\$215.00. Also Vacuum pump 10 microns Hg, 25 Liters—\$75.00 and 3000W, 115V DC Generator \$50.00. R. Wassmer, 10 Beech St., Butler, N.J.

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MOBILE transistorized power supply. A proven buy! Input: 12 to 14 volts dc. Output: 275 vdc at 100 milliamperes. Order direct from manufacturer! Wired and tested. Guaranteed! For negative ground only. Price \$18.88. Postpaid in USA! Technical Equipment Products Co., 106 Lynn St., Tullahoma, Tennessee.

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CBERS HAMS! Compact AAA-1 Clipper-Filter kit triples talk-power, fits any CB transceiver, improves selectivity; \$10.99. Double reception with SK-3 Preselector for GW-10, GW-11; SK-4 for GW-12. Kit, \$8.99; wired, \$11.99. SK-20 Preselector, tunable 3.5-30 megacycles, kit, \$18.98, (featured page 64, October Popular Electronics). Noisejector, NJ-7, \$4.49. Prices postpaid! (Free kit, antenna list.) Holstrom Associates, P.O. Box 8640-E, Sacramento, Calif. 95822.

BARGAINS! Used Ham, CB, Test equipment offered by fellow readers in "Equipment Exchange." Interesting sample copy 10¢. Brand, Sycamore, Ill.

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Hi-Fi Components, Tape Recorders, at guaranteed "We Will Not Be Undersold" prices. 15-day money-back guarantee. Two-year warranty. No Catalog. Quotations Free. Hi-Fidelity Center, 1797 (P) 1st Avenue, New York, N. Y. 10028.

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WANTED

CASH Paid! Unused tubes, electronic equipment. Barry, 512 Broadway, N.Y.C. 12.

QUICKSILVER, Platinum, Silver, Gold. Ores Analyzed. Free Circular. Mercury Terminal, Norwood, Mass.

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TUBE Headquarters of The World! Free Catalog (tubes, electronic equipment) write! Barry, 512 Broadway, N.Y.C. 12.

BRAND New Tubes. World's lowest prices on Radio, TV—industrial—special purpose tubes. Write for free parts catalog. United Radio., Newark, N.J.

7" TV test tube—\$6.99. Tubes—6146—\$2.95; 6211 (12AU7 equiv.) 39¢, 3 for \$1. Germanium diodes, tested, equiv. 1N34, 1N60 etc., 30 for \$1. Tophat silicon rectifiers, 750 MA—1000 piv 75¢. Transistors, tubes, resistors, condensers etc., bargain priced. Free catalog. Arcurus Electronics, Dept. ZD, 502-22nd St., Union City, N.J. 07087.

RADIO & T.V. Tubes—33¢ each. Send for free list. Cornell, 4213 University, San Diego, California 92105.

TUBES WANTED, all types, highest \$\$\$ paid, Lou-Tronics, 74 Willoughby Street, Brooklyn, N.Y. 11201, UL 5-2615.

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RAD-TEL TUBE CO. NOT AFFILIATED WITH ANY
OTHER MAIL ORDER TUBE COMPANY

Qty. Type	Price	Qty. Type	Price	Qty. Type	Price	Qty. Type	Price	Qty. Type	Price	Qty. Type	Price	Qty. Type	Price	Qty. Type	Price
024	.79	5AQ5	.54	6AX5	.74	6DA4	.68	6SQ7GT	.94	12AL8	.95	12DT5	.76	19AU4	.87
1AX2	.62	5AT8	.83	6BA6	.50	6DE6	.61	6T4	99	12AQ5	.60	12DT7	.79	19BG6	1.39
1B3	.79	5BK7	.86	6BC5	.61	6DG6	.62	6T8	.85	12AT6	.50	12DT8	.78	19EA8	.79
FON5	.55	5BQ7	1.01	6BC8	1.04	6DJ8	1.21	6U8	.83	12AT7	.76	12DWB8	.89	19T8	.85
1G3	.79	5BR8	.83	6BE6	.55	6DK6	.59	6V6GT	54	12AU6	.51	12DZ6	.62	21EX6	1.49
1J3	.79	5CG8	.81	6BF5	.90	6DN6	1.55	6W4	.64	12AU7	.61	12E05	.62	25AX4	.70
1K3	.79	5CL8	.76	6BF6	.44	6DQ6	1.10	6W6	.71	12AV6	.41	12EG6	.62	25C5	.53
1R5	.77	5CO8	.84	6BG6	1.70	6DT5	.81	6X4	.41	12AV7	.82	12EK6	.62	25CA5	.59
1S5	.75	5EA8	.80	6BH8	.98	6DT6	.53	6X8	.80	12AX4	.67	12EL6	.50	25CD6	1.52
1T4	.72	5EU8	.80	6BJ6	.65	6DT8	.94	7A8	.68	12AX7	.63	12EZ6	.57	25CU6	1.11
1U5	.65	5J6	.72	6BJ7	.79	6EA8	.79	7AU7	.65	12AY7	1.44	12F8	.66	25DN6	1.42
1X2B	.82	5T8	.86	6BK7	.85	6EB5	.73	7EY6	.75	12AZ7	.86	12FAG	.79	25EM5	.55
2AF4	.96	5U4	.60	6BL7	1.09	6EB8	.94	7Y4	.69	12B4	.68	12FM6	.50	25L6	.57
3AL5	.46	5U8	.84	6BM6	.74	6EM5	.77	8AU8	.90	12BD6	.50	12FR8	.97	25W4	.68
3AU6	.54	5V6	.56	6BQ5	1.12	6EM7	.82	8AW8	.93	12BE6	.53	12FX8	.90	32ET5	.55
3AV6	.42	5X8	.82	6BQ7	1.00	6E8U	.79	8BQ5	.60	12BF6	.60	12GC6	1.06	35C5	.51
3BC5	.63	5Y3	.46	6BZ6	.70	6EV5	.75	8CG7	.63	12BH7	.77	12J8	.84	35L6	.60
3BN6	.75	6AB4	.46	6BX7	1.11	6EW6	.57	8CM7	.70	12BK5	1.00	12K5	.75	35W4	.42
3BU8	.78	6AC7	.95	6BZ6	.55	6EY6	.75	8CN7	.97	12BL6	.56	12L6	.73	35Z5	.60
3BY6	.58	6AF4	1.01	6BZ7	1.03	6FG7	.69	8CS7	.74	12BQ6	1.16	12SF7	.69	36AM3	.36
3BZ6	.56	6AG5	.70	6C4	.45	6FV8	.79	8EB8	.94	12BR7	.74	12SF7	.69	50B5	.69
3CB6	.56	6AH4	.81	6CB6	.55	6GH8	.80	8FQ7	.56	12BV7	.76	12SK7GT	.95	50C5	.53
3CE6	.58	6AM6	1.10	6CD6	1.51	6GK5	.61	9CL8	.79	12BY7	.77	12SL7	.80	50EM5	.55
3DG4	.85	6AK5	.95	6CG7	.61	6GK6	.79	11CY7	.75	12BZ7	.86	12SQ7GT	.91	50L6	.61
3DK6	.60	6AL5	.47	6CG8	.80	6GN8	.94	12A4	.60	12CN5	.56	12U7	.62	70L7	.97
3DT6	.54	6AM8	.78	6CL8	.79	6H6	.58	12AB5	.60	12CR6	.67	12V6	.63	117Z3	.85
3GK5	.99	6AQ5	.53	6CM7	.69	6J5GT	.51	12AC6	.55	12CU5	.58	12W6	.71	807	.75
3Q4	.63	6AS5	.60	6CN7	.70	6J6	.71	12AD6	.57	12CV6	1.06	12X4	.47		
3S4	.75	6AT6	.49	6CQ8	.92	6K6	.63	12AE6	.50	12CX6	.54	17AX4	.67		
3V4	.63	6AT8	.86	6CR6	.60	6S4	.52	12AE7	.94	12D4	.69	17DQ6	1.06		
4BQ7	1.01	6AU4	.85	6CS6	.57	6SA7GT	.99	12AF3	.73	12D8	.83	18FW6	.49		
4C6	.61	6AU6	.52	6CS7	.69	6SH7	1.02	12AF6	.67	12DL8	.88	18FX6	.53		
4DT6	.55	6AU8	.87	6CU5	.58	6SJ7	.88	12AJ6	.62	12DQ6	1.04	18FY6	.50		
4GM6	.60	6AV6	.41	6CU6	1.08	6SK7GT	.95	12AL5	.47	12D57	.84				
5AM8	.79	6AW8	.90	6CY5	.70	6SL7GT	.84								
5AN8	.90	6AX4	.66	6CY7	.71	6SN7	.65								

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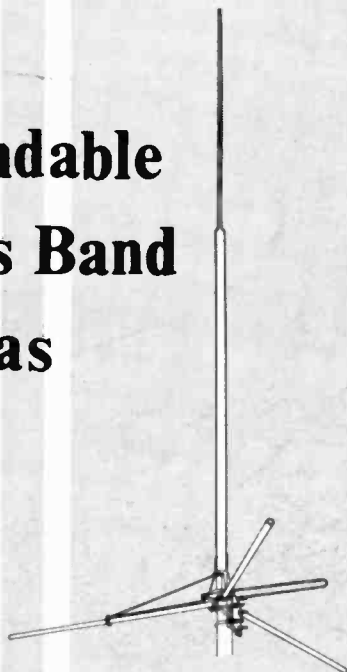
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