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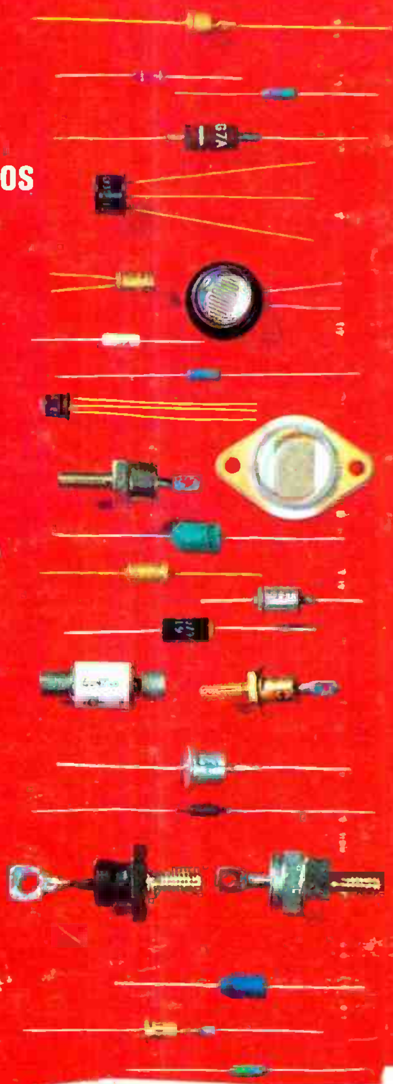

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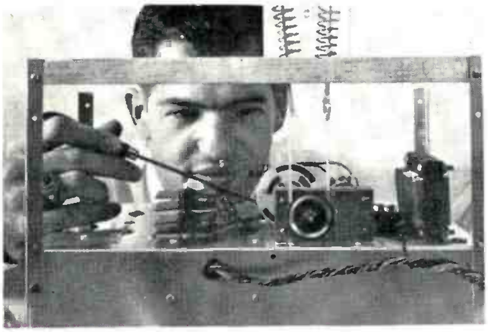

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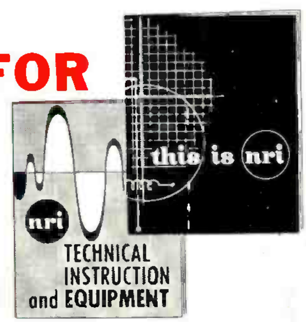

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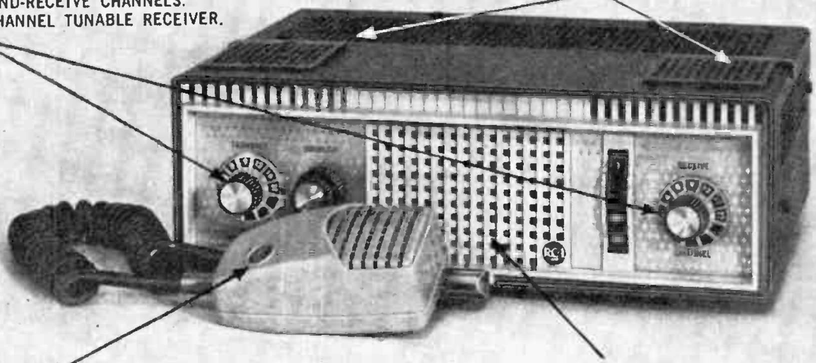

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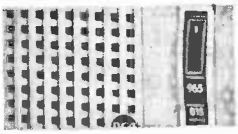

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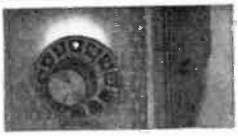
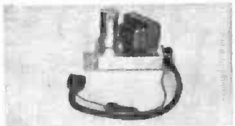


Illuminated working channel. Pilot lamps behind the fixed-channel dials show the channels being worked.



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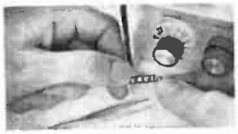

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POPULAR ELECTRONICS

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This month's cover photo by Bruce Pendleton

VOLUME 20 MAY, 1964 NUMBER 5

Special Bonus Section

Construction Projects

Amateur, CB, and SWL

Electronic Features and New Developments

Departments

POPULAR ELECTRONICS

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POPULAR ELECTRONICS is published monthly by Ziff-Davis Publishing Company at 434 South Wabash Avenue, Chicago, Illinois, 60605. May, 1964, Volume 20, Number 5. (Ziff-Davis also publishes Popular Photography, Electronics World, HiFi/Stereo Review, Popular Boating, Car and Driver, Flying, Modern Bride, Amazing, and Fantastic.) Subscription Rates: One year United States and possessions, $4.00; Canada and Pan American Union Countries, $4.50; all other foreign countries, $5.00. Second Class postage paid at Chicago, Illinois, and at additional mailing offices. Authorized as second class mail by the Post Office Department, Ottawa, Canada, and for payment of postage in cash.

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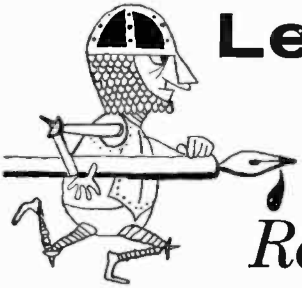


Letters *from our Readers*

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

Electronic Bargains: A Penny Saved . . . ?

■ I very much enjoyed "Bargains By the Bagful" (February, 1964). There is something more useless than the four unmarked "precision" resistors mentioned in the story—I have it. A recently purchased assortment yielded four 1-μf. units rated at 200-250 w.v.d.c., and one 25-μf., 25-w.v.d.c. unit. On checking, the breakdown voltages of the four 1-μf. capacitors proved to be somewhere below 50, and the only one in decent condition was the 25-μf., 25-volt job. How about that?

Ronald J. Koller
Chicago, Ill.

■ There is a more worthless item than an unmarked "precision" resistor—a miniature vacuum tube that is fine in all respects except that it lacks its identification number. At least those resistors can be tested with a VOM and then used with a little assurance as to their values.

Robert A. Gladstone
Newton Centre, Mass.

Reader Koller's assortment certainly appears to take a prize for being a "non-bargain." As for tubes, we agree that missing numbers can be a problem. Incidentally, some numbers can be made legible again by gently rubbing the tube with a soft lead pencil.

Electronic Auto Voltage Regulator

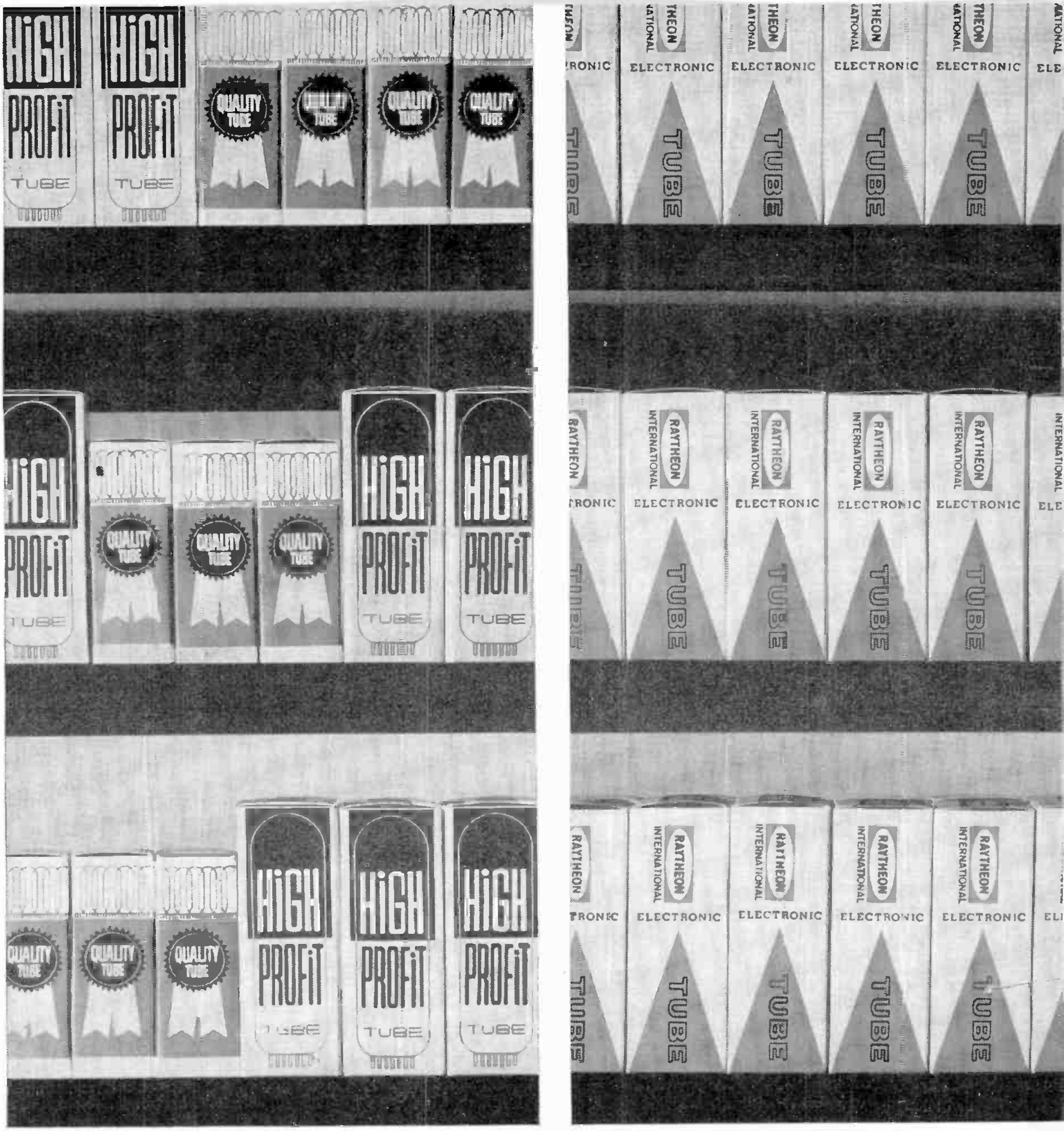
■ Of special interest to me have been the articles on transistor ignition ("Operation PICKUP," June and October, 1963; "Build Simplex Transistorized Ignition," February, 1964), and the "X-Line Tachometer" (January, 1964). How about an electronic voltage regulator for automobiles? Such a device might make a good construction project.

Glenn W. Noe, W8JNJ
Ada, Ohio

An electronic voltage regulator is definitely in the works, Glenn; look for it in the near future.

Improving "Reflectoflex" Enclosure

■ Those interested in constructing the "Reflectoflex" ("Build the Reflectoflex Speaker Enclosure," December, 1963) may want to incorporate two modifications which have been tested by the author. Filling the enclosure with pieces of fiberglass resulted in extended bass response with speakers having a low (45 cycles or less) resonance; no port was used, of course. The bass was tighter and better defined, at least with the speak-



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CIRCLE NO. 20 ON READER SERVICE PAGE

Letters

(*Continued from page* 6)

ers tested. Brighter, more sparkling highs were achieved by attaching sheets of thin aluminum to the undersides of the enclosure lids with epoxy resin glue. Allowing a slight bulge or droop in the metal actually improved dispersion.

James D. Reid
San Diego, Calif.

Code Tests: "Bug" or Hand Key

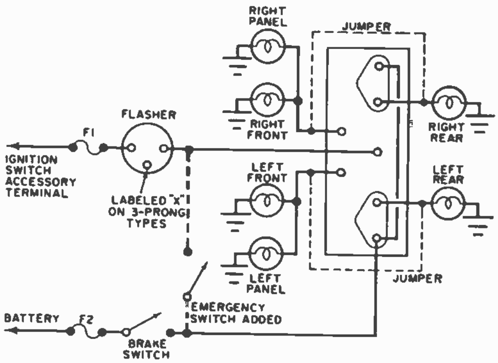
■ Is it permissible to use a "bug" when taking an amateur code test, or is it necessary to use a hand key? I'm currently studying for the Novice exam.

John Moriasty
Andover, Mass.

A call to the local offices of the FCC reveals that a "bug" is perfectly acceptable, John. This includes all classes, from Novice to Amateur Extra.

Simple Front and Back Flasher

■ In reference to "For Greater Safety—Flash Those Lights" (March, 1964), it is possible to construct an emergency four-light front and back flasher circuit as shown in the diagram below. The arrangement is somewhat simpler than the one shown in Fig. 2 in the article, and uses a s.p.s.t. switch instead of a 3-p.s.t. unit. With this circuit, the front turn signals and panel lights come



on when the brake pedal is pressed—an additional safety measure and one that is required by some new state laws. When the emergency switch is closed, all four front and back lights flash. In most cars, the jumpers simply tie together the two sets of wires at the distribution panel.

L. Shaefer
Beaumont, Texas

Thanks for the circuit, reader Shaefer. While it appears quite practical, we would suggest that those who wish to try it first inquire at their local motor vehicle bureau or police deparment to determine what the laws are in their states.

NAA Verifications

■ I read with interest and profit "How We're Using 'Rock-Bottom' Radio" (December, 1963), and am pleased to report that I am the proud possessor of a beautiful blue, white, and gold QSL from NAA. Other readers might be interested in verifying this station, which broadcasts on high frequencies—as well as at VLF—with a marker consisting of a series of V's followed by "de NAA." Correspondence should be ad-

Letters

(Continued from page 8)

dressed to U.S. Naval Radio Station NAA, Communications Officer, Cutler, East Machias, Maine.

JOE GLATH, JR., WPE3FBM
Natrono, Pa.

Ham QSL's Rare, Says SWL

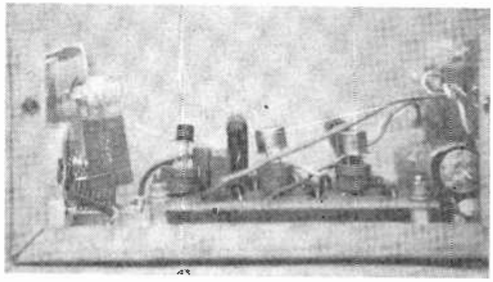
■ I have a complaint directed to hams in general. As an SWL, I monitor stations in various services including amateur stations. Unfortunately, the percentage of hams that QSL in answer to SWL reports is astoundingly low, even though the reports are in the form recommended by the ARRL. After all, a signal report from an SWL means a station's signals did get there, and our reports are just as valid as those of other hams.

BLACKWELL B. EVANS, JR.
Gretna, La.

There are two ways of looking at it, Blackwell. An amateur may have to invest quite a bit of money in QSL cards and postage, and hams are, like yourself, unsubsidized hobbyists. On the other hand, reports to North American stations that can truly be considered "DX," taking into account frequency and band conditions, will often draw a reply. Lastly, you can always include a blank verification form and a return envelope for a 99 per cent certain reply.

Crystal Super Calibrator

■ I recently constructed the "Crystal Super Calibrator" (November, 1963), and am well pleased with the results. In building the unit, I made two modifications



that might be of interest to your other readers: I used transistor sockets (see photo), and wired a 50-pf. silver mica capacitor in series with the variable capacitor for easier calibration.

DAVID F. ROBERTS
Jacksonville, Fla.

Adjustable "Nonsense Box"

■ My version of the "Nonsense Box" (July, 1963) is adjustable. By replacing *R9*, the random fire resistor, with a potentiometer, you can vary the speed at which the lights flash, and create a new sideline and big decisions about how fast the Nonsense Box should operate.

WALT STINSON, WAØGJZ
Glendale 22, Mo.

Good tip, Walt. The only trouble is that this takes some of the "nonsense" out of it.

Missing P.E. Pages?

■ After recently resubscribing to P.E., I was pleased to find the same good features and projects in step with modern times as were the articles in issues of previous

Letters

(*Continued from page* 10)

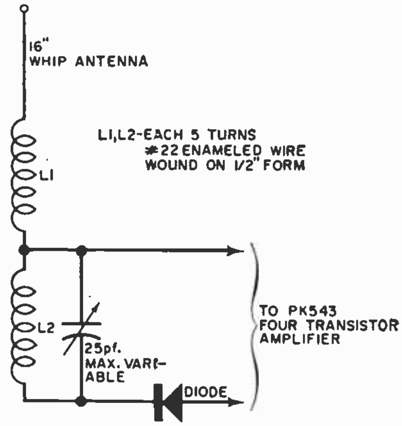
years. It was good to find the "Carl and Jerry" adventures still going strong. Just one complaint—my January, 1964, issue is minus pages 17 and 18. I'm not grumbling; it's just that I hate to miss a good project or feature.

BILL RUSSELL
Summit, Ark.

Many thanks for the nice comments, Bill. As a matter of convenience for the printers, the RCA Institutes insert card was counted as pages 17 and 18. Speaking of pages, you'll undoubtedly note that we're running a large extra section this month—the first of many that we believe will be of great interest to P.E. readers.

Modified "Airline Eavesdropper"

■ I was very much interested in the "Airline Eavesdropper" (April, 1963) as I live near Dowal International Airport in Montreal. The original circuit worked well, but I believe it can be improved as shown in the diagram. With the modified version, I can now



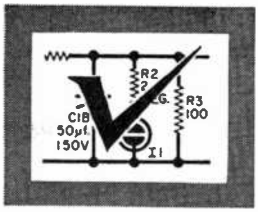
listen to the airport control tower from my house using a 16" whip antenna. The circuit is inexpensive, and gives good loudspeaker volume from any point around the airport.

MURRAY FORTUNE
Pointe Claire, Que.

Out of Tune

VHF Listener (*March,* 1964, *page* 55). A few extra "picofarads" appear in the Parts List, although the diagram is correct. The Parts List should read: *C2, C4, C8—0.001-µf., 100-volt disc ceramic; C3—0.0033-µf., 100-volt disc ceramic.* In the diagram, the decimal point before .47 µf. at *C13* is almost invisible; the Parts List is correct. Finally, coil *L1* should be wound with #14 wire, not #18. —30—

Operation Assist



THROUGH THIS COLUMN we try to make it possible for readers needing information on outdated, obscure, and unusual radio-electronics gear to get help from *other* readers. Here's how it works: Check over the list below. If you can help anyone with a schematic or other information, *write him directly*—he'll appreciate it. If *you* need help, send a post card direct to OPERATION ASSIST, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Give the maker's name, the model number, year of manufacture, bands covered, tubes used, etc. Be sure to print or type everything legibly, including your name and address, and be sure to state specifically what you want, i.e., schematic, source for parts, etc. Remember, *use a post card*; we can handle them much faster than letters. And don't send a return envelope; your response will come from fellow readers. Because we get so many inquiries, none can be acknowledged, and POPULAR ELECTRONICS reserves the right to publish only those requests that normal sources of technical information have failed to satisfy.

Schematic Diagrams

Air King 2-band, BC and s.w., 5-tube radio, no date. (John Draut, 210 W. 251 St., New York, N.Y. 10471)

Philco Model 16, code 125-126, 4 bands, BC and s.w., 11 tubes, about 1937. (George Nagelschmidt, 10 West 4 St., Oswego, N.Y.)

Atwater Kent radio, No. 4445-L5158, about 1924. (G. J. Astole, 2504 Limestone Rd., Wilmington 8, Del.)

Philco Model 38-4 8-tube, BC and s.w. radio, about 1947. (Scott Daniels, 1749 Popham Ave., New York, N.Y. 10453)

United American Bosch Model 640, ser. 503940, 6 tubes. BC, s.w. and police bands. Date unknown. (Larry Bowman, R.D. #3, Shippensburg, Pa.)

Air Champ Model AC-202, 2-tube superregen. Uses 90-volt "B" battery, 1.5-volt "A." (Bob Reddy, 140 Russell Ave., Rochester, N.Y. 14622)

Superior Instrument Co. Model TV-10 tube tester. (Roy L. Morrison, P.O. Box 164, Bone Gap, Ill. 62815)

NATCO 16-mm. movie projector, Model 3030-1. (Tomas V. Calisterio, Baptist Student Center, Luna St., La Paz. Iloilo City, Philippines)

R 1155 British aircraft receiver. Ref. 10D/98, ser. 14831. 5 bands. (SA 127688 GDSM Gerencser Frank, BNHQ 1 Canadian Guards, Picton, Ontario, Canada)

Philco Model PT30, approx. 1940. Five tubes, broadcast band. (D.J. Lowry, 26850 Fort Meigs Rd., Perrysburg, Ohio 43551)

Doolittle Radio Co. 9-tube crystal-controlled transmitter. Has 807 final. (J. T. Marshall, 3430 N.W. 2nd Terrace, Miami, Fla. 33125)

E. H. Scott receiver Model T-585. Power pack T-559. 4 bands, all chrome, 23 tubes. (John Mac Jannet, 3611 Colfax St., Gary, Ind.)

(*Continued on page* 16)

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VOID AFTER MAY 31, 1964 5

Operation Assist

(Continued from page 14)

GE console, Model E-126, date unknown. 12 tubes, 4 bands. (R. Easton, 947 Armstrong Ave., St. Paul, Minn. 55102)

Grebe "Synchrophase AC six," circa 1929, broadcast band only. **Rees Mace** "Gnome," British portable, for broadcast and low frequencies. (Douglas Ready, 142 Brook Ave., Staten Island 6, N.Y.)

Cunningham Model 1121, series II. (Glenn F. Sweeney, 225 Twin Hills Dr., Syracuse, N.Y. 13207)

Jewel radio set analyzer Model 409, made about 1935. (Louis S. Young, Rte. 1, Box 22, McNab, Ark. 71849)

Atwater-Kent breadboard BC receiver, circa 1923, Model AK-4910. Uses six 01A tubes. (Lester C. Harlow, 29 E. Rosevear Ave., Orlando, Fla. 32804)

Atwater-Kent Model 46, about 1925. Has eight tubes. (James A. Trzynka, 811 Milton St., Fort Wayne, Ind. 46806)

Peirce wire recorder Model Z60. Uses four tubes, date unknown. (Thomas B. Quinn, P.E., Box 76, Leoti, Kan. 67861)

Europhon Model ES-59. Four-band, six-tube receiver, made in Italy. (Walter Pastuszka, 6107 Hartwell, Dearborn 1, Mich.)

E. H. Scott Model RBO, 1943 vintage. Broadcast and s.w. 11 tubes and magic eye. (Karl W. Seitz, 34 Manitou Ave., Poughkeepsie, N.Y. 12603)

Freed-Eisemann Neutrodyne radio, about 1925. Model 800. (Richard Long, 1190 Bonds Rd., Salem, Oregon 97301)

Raytronic Laboratories (Detroit) "Cathode Beamer." (E. Nowak, Jr., 524 S. 13th St., Saginaw, Mich. 48601)

Metz Babyphone Model 100. Made in Germany about 1956-57. Ser. 72892. (John M. Jediny, 315 Fulton Ave., Jersey City 5, N.J.)

Earl Webber Co. (Chicago) tube tester, "Neon Glo" Model 30. (Kieth Witney, 47 Peony Ave., Winnipeg 17, Manitoba)

Atwater-Kent Model 70, type Q. Uses two 112-A's, two 171-A's, and a 222. (Ole H. Tollefsrud, Gardner, N.D. 58036)

Truetone Model D-702. ser. A40658. Five-tube BC receiver. (Al Krol, 56 Main St., Whitesboro, N.Y. 13492)

Breting-12 1937 communications receiver. 12 tubes, 10-200 meters. (Marvin Wilkin, 1208 Broadway, Council Bluffs, Iowa)

Solar "Exam-meter" capacitor analyzer. Model CF, ser. 95870. (Timothy Murphy, 282 West 2nd St., Oswego, N.Y.)

Mill Novelty Co. amplifier, Model MCP-5900B, about 1940. (L. E. Shelvik, 2209 E. Washington Ave., Madison 4, Wis.)

Sparton Model 7-36 BC-s.w. receiver. (Bob Eslinger, 319 S. Elm St., Wallington, Conn.)

RCA power pack for Victrola, Model AP-736-B. Uses following tubes: 50, CX-26, UX-281, T-81. (Jerome Kolpa, 4844 Douglas Rd., Downers Grove, Ill. 60515)

Atwater-Kent receiver Model 55C, about 1924. (Michael D'Amico, Tanners Marsh Rd., Guilford, Conn. 06437)

Special Data or Parts

Fada Model 6A. BC and s.w. Uses six tubes. Data and schematic required. (Alan P. McGuiness, 4744 Cape May Ave., San Diego, Calif. 92107)

Berlant series 30 stereo tape recorder. Instruction manual needed. (Richard Memory, Audio-Visual Coordinator, Castro Valley H.S., 19400 Santa Maria Ave., Castro Valley, Calif.)

National O.S.R. oscillator coil. Has four leads. (Geo. P. Logan, 76 Oxford Cres., Chateaugary Ctr., Chateaugary, Quebec)

Abbot Instrument two-meter transceiver. Model TR4B. Any data, and schematic diagram. (Tom Dehlinger, 336 E. Elgin Ave., Forest Park, Ill. 60130)

Seeburg Selecto-Matic 100 Model 100-B, ser. 17616. Service manual needed. (H. E. Jones, Skating Rink, Moab, Utah)

(Continued on page 18)

Operation Assist

(*Continued from page* 16)

Philco Model 41-255 9-tube, 3-band receiver, circa early 40's. Manual needed, and cabinet to fit. (Mike Pruitt, 141 Fuller St., Danville, Va.)

Superior Instrument Co. tube tester Model TD-55. Tube chart needed. (Herbert Ulmer, 43 W. 47 St., New York 36, N.Y.)

Atwater-Kent Model 510. Ten tubes, BC and s.w. Date unknown. Data and schematic needed. (J. A. Laakso, Box 371, RFD#1, Brooklyn, Conn. 06234)

WD-11 tubes in good working order wanted. (A. P. Ciardi, 1119 Luzerne St., Scranton, 4, Pa.)

E. H. Scott Model RCK high-frequency receiver. Power transformer needed. (C. D. Ray, 417 Cedar Drive, Hampton, Va.)

National Model AGS-E22 receiver (1935). Coils, tube placement info. needed. (Nicholas Nicastro, 228 Park Ave., Hoboken, N.J.)

I-777 tube tester, surplus; 3000-ohm wire-wound logarithmic taper "R" potentiometer needed. **Supreme** Model 385 tube tester, made in 30's, using 01A tube; schematic and setup manual needed. **Old tubes:** 50z7G, HY115, HY123, HY125, XD, XSG, XW, XY, L55B wanted. (Richard Urciolo, 5911 Halpine Rd., Rockville, Md. 20851)

Fairchild Guided Missiles Div. transistor tester, Model 103. Diagram and handbook needed. (M. Aviv, 582 Broadway, New York 12, N.Y.)

Majestic Model 491 built by Grunow Corp. for farm lighting plant use. Manual needed, any other data. Unit operates on 32 volts. (Robert J. Hayes, 2008 Summitt Ave., Muscatine, Iowa)

Sutton Electric UHF converter, Model AC56. Instruction manual and schematic needed. (Eugene Patrick, 2633 N. 9th St., Philadelphia, Pa. 19133)

Freed-Eisemann Model NR-7, ser. 655M. Six tubes. Made about 1925. Info about battery needed, and a schematic. (Frank E. Prussa, Atkinson, Nebr. 68713)

Philco Model 7020 3" scope. Sources for replacement parts needed, especially power transformer, plus manual or schematic. (Rodger L. Casey, 107 Cottage Ave., Aurora, Ind.)

McMurdo Silver Model 900A Vomax VTVM, made about 1950. Instruction manual needed. (Dr. Michael Cefola, Chem. Dept., Fordham University, N.Y. 58, N.Y.)

Soundscriber 33⅓-rpm disc recorder. Schematic wanted, and instructions and source for proper cutting stylus and discs. (Kerry Horner, 16216 Via Sonora, San Lorenzo, Calif.)

Stromberg-Carlson Model 210-PG, ser. 101227, 11-tube AM-FM receiver, about 1947. Any data or info. (Peter Neenos, 399 Capen Blvd., Buffalo, N.Y.)

Supreme standard diagnometer, circa 1934. Operating instructions needed. (Jack Allgarei, Rte 4, Merrill, Wis. 54452)

BC-1206D Beacon receiver. Technical data and schematic needed. (Francis D. Donovan, 19 Winthrop St., Medway, Mass. 02053)

Solar Mfg. Co. Model CE capacitor, Exam-eter type 1-60, ser. E-5183, about 1946. Technical data needed, especially on power transformer secondaries. (D. B. MacGregor, Box 186, Valley City, Ohio)

Marconi Inst. Ltd. Model TF-888 portable receiver tester, made in England. Manual or schematic needed. (Billy F. Thomas, 5337-C Brett Dr., Fort Knox, Ky.)

Espey Model 104 tube tester. About 1942, military surplus. Info on rectifiers needed and schematic. (Ronald E. Carr, 1130 S. Birch St., Santa Ana, Calif.)

IP-243/ALA-6 azimuth indicator. Manual wanted, schematic, and info. to convert to bench scope. (Dave Kaymark, 524-177 St., Hammond, Ind.)

Wasp (or Super-Wasp) s.w. receiver, about 1933. Schematic and tech. data wanted. (William H. Schaeffer, c/o Lucien J. Pronovost, 227 Walnut St., Waterbury, Conn. 06704)

Recordio Model 6A20 turntable and recorder. Operating data and service manual required. (D. De Palma, 1001 Fourth St., N.W., Albuquerque, New Mexico) —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	136.139 mc.
Relay 2	136.140 mc.
Echo 2	136.170 mc.
Tiros 7	136.233 mc.
Tiros 8	136.233 mc.
GGSE	136.319 mc.
Ariel	136.405 mc.
Explorer 14	136.440 mc.
Syncom 2**	136.468 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	136.886 mc.
Tiros 7	136.922 mc.
Tiros 8	136.923 mc.
Alouette	136.978 mc.
Syncom 2**	136.980 mc.
Saturn 5	136.995 mc.

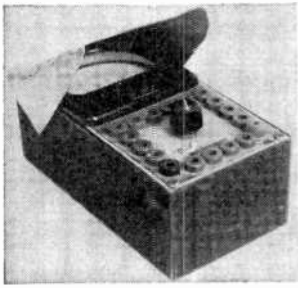
*Transmits while satellite is in sunlight
**Transmits only upon ground command

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, Cosmos 23, Elektron 1 and Elektron 2.

Tips and Techniques

MULTIMETER GLASS-SAVER

The other tools in your tool box may not respect the glass face of your multimeter. As a result, carrying the meter unprotected in this way can make for a messy repair job. You can protect the meter face with an aluminum cover as shown. Bend sheet aluminum to the proper shape with the ends toed slightly inward to exert a pressure on the meter sides. —*Charles Green*



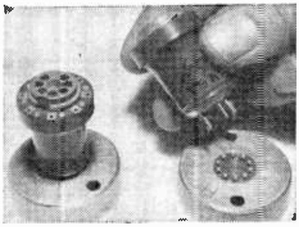
CAMERA TRIPOD PINCH-HITS AS MIKE STAND

A floor stand for a microphone is not often listed as standard equipment for a home tape recordist. For easy recording of noise-free tapes, however, it is almost a necessity. If you own a camera tripod, you can attach your microphone to the tripod's swivel head with a simple clamp or bracket, and derive all the benefits of a good mike stand. —*Glen F. Stillwell*

DIME STORE EYEGLASS MAGNIFIERS

With miniature circuits becoming more miniature every day, some sort of optical assistance can be a big help in troubleshooting them. Dime store magnifying spectacles do an admirable job in this respect, providing "binocular" vision at low cost. They are available in varying degrees of magnification and can easily be slipped over regular eyeglasses. It will probably pay you to get two pairs, one for medium distances and the other for extreme close-ups. Bring along a transistor radio chassis to check the glasses before you buy them. —*Hartland B. Smith*

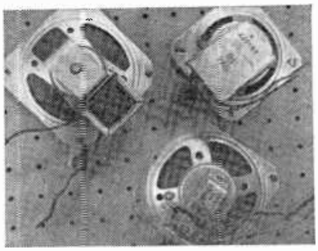
STORING ADAPTER SOCKETS



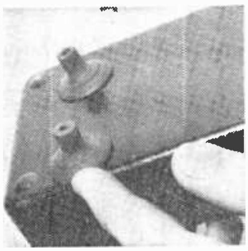
To keep your adapter sockets handy and safe, there's no better place to put them than in your tube pin straighteners. The adapter socket pins will be protected, and the sockets themselves will be ready for use at all times. —*Clyde C. Cook*

LOUDSPEAKER CONE PROTECTION

Don't toss your loudspeaker cones haphazardly into a junk box. A piece of perforated hardboard will serve as a mount to protect them from possible damage; a single nut and bolt will securely hold each speaker to the board. For additional protection, you can place each cone in a plastic food-wrapping bag before mounting it. Your speakers will then be ready for use when you want them—instead of ready for the trash can. —*Margie V. Erickson*



RUBBER FEET FROM SUCTION CUPS



You can make some dandy rubber feet for your instruments from simple suction cups. Rubber cement will hold them in place, or, if you like, a small hole can be drilled in each suction cup and a bolt used to attach it to the cabinet. The suction cups are resilient, and provide good shock protection. —*John A. Comstock*

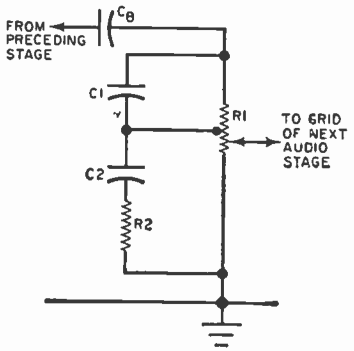
(*Continued on page* 22)

Tips

(*Continued from page* 21)

SIMPLE ADD-ON TONE COMPENSATION CIRCUIT

When the volume is turned low on an amplifier providing music for background listening, the bass and treble seem to fall away faster than the midrange, due to the way human hearing functions. Perfect com-

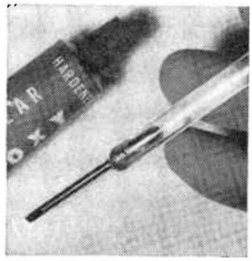


pensation for this effect requires relatively costly precision circuitry, but a fair approximation can be had with the circuit shown. Reconnect the lead from C_B, the original coupling capacitor, to the off-ground end of *R1*, and you are ready for improved low-level sound. Potentiometer *R1* is a 2-megohm unit tapped at ½ megohm from the ground end (IRC-CTS Q13-139X), *R2* is a 47,000-ohm, ½-watt, 10-percent carbon resistor, *C1* is a 33-picofarad, 200-volt ceramic, and *C2* is a .02-microfarad, 200-volt paper or Mylar unit.

—*Jesse J. Richmond, Jr.*

BIG LITTLE SCREWDRIVERS

Occasionally you need a screwdriver with an extra-long reach. You can make your own with very little trouble. Obtain a length of plastic rod, and drill a hole in one end, first chucking the rod tightly in a vise. Use a slow-speed drill to avoid binding—an "egg-beater" hand drill will do the job best—then cement the screwdriver blade into the hole with epoxy cement and allow it to harden overnight.



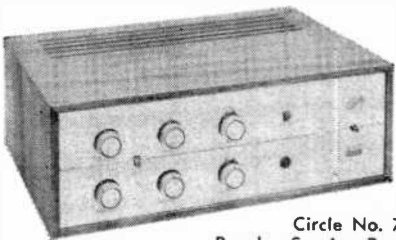
—*Clyde C. Cook*

New Products

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

36-WATT STEREO AMPLIFIER

Available both as a kit and factory-wired, the Model 2036 Classic Series 36-watt stereo amplifier announced by *Eico Electronic Instrument Co., Inc.,* is rated at 36 watts IHFM music power and 28 watts continuous power. Harmonic distortion at 10 watts per channel, 40 cycles, is 0.5%, while IM distortion at the 1 watt per channel level is down to 0.25%. The 2036 incorporates a speaker system switch that permits selection between two pairs of speaker systems in different locations, and a headphone jack. The shielded control panel eliminates interference and exposed voltage points when unit is operated without cover. Prices: $74.95 (kit); $114.95 (wired).



Circle No. 75 on Reader Service Page 15

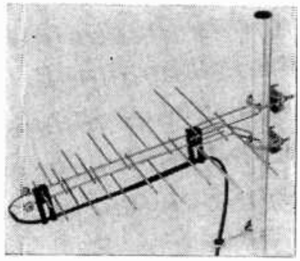
COMPONENT MOUNTING SYSTEM

"Versaframe" is a new type of breadboard mounting system announced by *Design Products Corporation* which consists of parallel conductor bars mounted in an open frame. The frame is made of strong molded thermoplastic; the conductor bars are plated copper alloy. The conductor bars are provided with punched mounting holes and the bars are spaced to fit standard printed-circuit receptacles. The conductor bars act as a heat sink as components are soldered in place. Since the "Versaframe" can be wired and rewired any number of times, it's practical for breadboarding and for experimental circuits.

Circle No. 76 on Reader Service Page 15

UHF TV ANTENNA

Blonder-Tongue Laboratories, Inc., has introduced the "Golden Dart"—a UHF television antenna based on the "periodic" principle—which is said to provide more uniform gain than conventional antennas. Sturdy polypropylene insulators are used to maintain the proper distance between the lead-in wire and the antenna. The Golden Dart is weather-resistant and comes preassembled with all welded joints. Thumb-tightened stripless screws for twin-lead connection and D-bolt mast mounting simplify installation. Price, $5.95.



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SINGLE-SIDEBAND CB TRANSCEIVER

A true single-sideband transceiver, the Mark "Sidewinder" Model SSB-27 doubles the effective number of channels available from 23 to 46 by featuring selectable upper or lower sideband operation. Since all legal power (10 watts PEP) is concentrated in one sideband, there is no carrier to waste power or cause interference, and there is no duplicated sideband. Developed by *Mark Products*, Division of Dynascan Corporation, the SSB-27 features a four-section crystal lattice filter, "voice lock" vernier adjustment for best voice reception, crystal oven, and product detector. Each crystal does quadruple duty, since the

Circle No. 78 on Reader Service Page 15

same crystal is used for both transmit and receive on both upper and lower sideband. Said to provide a gain of about 10 in a CB system, the SSB-27 is priced at $299.50.

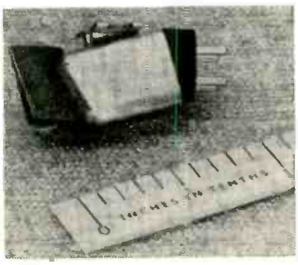
6- AND 2-METER VFO

Designed to operate with modern transmitters using crystal oscillators in the 8 - 9 mc. region, *Lafayette Radio Electronics'* Model HE-89 is an imported self-powered variable frequency oscillator. High electrical stability is achieved by a series - tuned 6BA6 Clapp oscillator; an 0B2 voltage regulator tube protects the unit from line voltage variations. The illuminated plexiglass dial is calibrated from 50 to 54 mc. (6 meters) and 144 to 148 mc. (2 meters). Output voltage: 10-20 volts r.m.s. Price, $29.95.

Circle No. 79 on Reader Service Page 15

SUBMINIATURE STEREO PICKUP

The size of a thumbnail, and with a total weight of less than 5 grams, the new 500AT Micro Fluxvalve announced by *Stanton Magnetics, Inc.*, retains the high output and high performance standards of the Stanton Stereo Fluxvalve, and has a new magnetic circuit for improved sound. The 500AT, designed for automatic turntables utilizing low-mass tone arm systems, incorporates the recommended RIAA 15° playback angle (proposed EIA standard).



Circle No. 80 on Reader Service Page 15

REED SWITCH COILS

Two types of reed switch coils are now available for use with *General Electric's* X-7 reed switch in the "Experimenter Line" of blister-card packed components. (The X-7 switch is recommended for use in making night light controls, light flashers, burglar alarms, etc.) Coil C-1 consists of 7000 turns of #38 magnet wire having a d.c. resistance of 440 ohms, while coil C-2 is 10,000 turns of #39 magnet wire with a d.c. resistance of 825 ohms. Price, $1.60 per coil.

Circle No. 81 on Reader Service Page 15

TRANSISTORIZED TAPE RECORDERS

Concord Electronics Corporation has added three new transistorized tape recorders to its existing line. The stereo Model 884 (shown) features four separate transistorized preamps, tape - source monitoring switch, three separate heads, three speeds on selector switch, illuminated vu meters, built-in sound-on-sound switch, plus push-button operation. A less expensive stereo unit, the Model 440, has transistorized preamps, push-button operation, three speeds, two dynamic microphones and separate mike and auxiliary inputs. The third unit, Model 330, automatically records voice or music; among its automatic features are: start and stop, slide advance, and movie sync.

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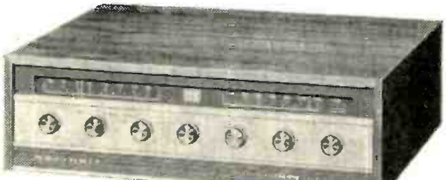
STEREO RECEIVER KIT

New from the *Heath Company* is an all-transistor receiver which houses two 20-watt power amplifiers, two separate preamplifiers, and a wideband AM, FM and FM-stereo tuner. Features of the AR-13 Heathkit include: automatic switching to stereo plus a stereo broadcast indicator light; two filtered tape recorder outputs for direct "beat-free" stereo recording; magnetic phono and two auxiliary inputs; dual-tandem controls; high-gain r.f. stage and high-Q rod antenna; a.f.c.; and flywheel tuning. The walnut cabinet has an ex-



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New Products

(*Continued from page 25*)

truded gold-anodized aluminum front panel. Price, $195.

HI-FI TV ADAPTER

The Stradford Model 480 will pick up your TV receiver audio and feed it to a hi-fi amplifier or receiver, providing hi-fi TV sound reproduction through your speaker system. The adapter, available from *Trutone Electronics, Inc.*, is supplied with a coupler

Circle No. 84 on Reader Service Page 15

which is placed around the glass of the sound detector tube in the TV receiver. No tools (except a screwdriver) or soldering are required; no connections or modifications are made to the internal wiring of the TV set or hi-fi system. By connecting the output of the adapter to the music or phono input of your tape recorder, you can record TV sound at full fidelity. Price, $35.75.

METER DIAL MARKING SET

A "Meter and Dial Set" using the "Instant Lettering" dry transfer marking system is now available from *The Datak Corporation*. Included are arcs, lines, arrows, and assorted rotary tap switch patterns. Each set of twelve 5" x 7" sheets contains a complete assortment of patterns in black, white, and red, arranged according to frequency of use. Price, $4.95 per set.

Circle No. 85 on Reader Service Page 15

LABEL MAKER

The *Kohner* "Name-O-Matic" No. 580 provides a way to identify your antenna and power cables, fuse box circuits, switches, home-brew chassis, tools, etc. The label maker embosses letters on plastic self-adhesive colored tape, narrow or wide, on one or two lines. To use it, you turn a dial to the letter you want, then press the embossing lever. Price, $5.95, including 23 feet of gold tape. Additional 23' tape packets, $1 each.

Circle No. 86 on Reader Service Page 15

POP'tronics Bookshelf

HOW TO BUILD TINY ELECTRONIC CIRCUITS

by Morris Moses

The art of building complex electronic circuits in less and less physical space has advanced rapidly in the past ten years, driven by the need for ever smaller and lighter electronic packages for aircraft and missiles. Most of the books published to date have dealt mainly with methods suited to factory or industrial laboratory use. It is a pleasure to report that Mr. Moses' book describes many techniques and methods that can be used by the home constructor in miniaturizing his own electronic circuits for portable radios, amplifiers, and the like. The book is profusely illustrated, and most of the circuits and methods described are practical and well within the capabilities of the hobbyist. The lack of an index is the only regrettable feature in an otherwise excellent book.

Published by Gernsback Library, Inc., 154 W. 14th St., New York 11, N.Y. Soft cover. 192 pages. $4.15.

TRANSISTOR IGNITION SYSTEMS HANDBOOK

by Brice Ward

This is the first paperback on what will probably be a popular topic for authors of soft-cover books. Brice Ward—called "Mr. Transistor Ignition" around his neighborhood in southern California—has written an interesting summary of our present knowledge of automotive ignition systems. Having developed, as well as analyzed, various ignition systems, Mr. Ward was well qualified to write this practical handbook. Included is an explanation of how a conventional ignition system works, and a discussion of the limitations that brought on transistor "switches." Design parameters of such switches are singled out and carefully isolated. This type of information has never before appeared in print, and is invaluable in attempting to judge the ultimate worth of any transistorized ignition system. The book also includes installation data for a few systems that the author has found of particular merit. Trouble-shooting notes and an appendix with a comprehensive listing of manufactured systems round off this handy volume. Just in case you're wondering, POPULAR ELECTRONICS' "Operation PICKUP" is not mentioned since it was developed just as this book was going on the printing presses.

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

BASIC ELECTRONIC TEST INSTRUMENTS (Revised Edition)

by Rufus Turner

Unlike many writers of textbooks in electronics, Rufus Turner writes upward from practical experience gained through years of teaching and thousands of lab bench workouts, rather than downward from a lofty engineering viewpoint toward the technician level. The result is a fact-filled book, with no involved math, that successfully carries out the author's appointed task. Turner's revised *Test Instruments* (first published in 1953) is a good example of a book on a practical subject competently handled by a practical writer. The entire gamut of test instruments used in labs, schools, and home workshops are described. Circuit diagrams (commercial as well as home-built) predominate, accompanied by working instructions on calibration and operation. This book is a good refresher and reference guide for those who have occasional contact with test instruments.

Published by Holt, Rinehart and Winston, Inc., 383 Madison Ave., New York 17, N.Y. Hard cover. 299 pages. $5.95.

DIODES AND TRANSISTORS

by G. Fontaine

This book is not a basic text, nor is it meant to be. However, as a ready reference, it belongs on every semiconductor engineer's bookshelf. It will indeed be used often. Fontaine starts with the properties of semiconductors and covers everything you need to know about them and their application. The volume was originally written in French and was translated into English in England. As a result, American

Bookshelf

(*Continued from page 27*)

readers may trip over an occasional word-spelling problem. The diagrams are copious, many in two "colour." Unfortunately, the European symbols for components are used throughout, and decimal points have been replaced by the commas used in Europe. It may "tyre" you at first, but once you get on to the system, the book will prove its worth.

Published by Hayden Book Co., Inc., 850 Third Ave., New York, 22, N.Y. 480 pages. Hard cover. $9.50.

TRANSISTOR SPECIFICATIONS AND SUBSTITUTION HANDBOOK

To the experimenter, the fact that there appear to be literally hundreds of transistors with very similar characteristics seems never to have been satisfactorily explained. This book doesn't pretend to render even a remote guess as to why this condition exists, but does the next best thing—it provides a tabular listing of about 4700 transistors with detailed *maximum operating values*. The first 16 pages of the book discuss the correct ways to make substitutions and the pitfalls to be avoided.

Published by TechPress Publications, 4554 S. Kedzie Ave., Chicago 32, Ill. Soft cover. 96 pages. $1.95.

Free Literature

Two new brochures on CB equipment may now be had for the asking. The RAY-TEL line of transceivers is described and illustrated in an 8-page pamphlet which also covers antennas and accessories; it's available from Raytheon Co., 213 East Grand Ave., South San Francisco, Calif. . . . And in a 16-page catalog announced by Hy-Gain Antenna Products Corp., N.E. Highway 6 at Stevens Creek, Lincoln, Nebr., are pictures and complete descriptions—including electrical and mechanical specifications—of all Hy-Gain's CB base station and mobile antennas and accessories. . . . Covering many fields—from stereo/hi-fi to amateur radio to test equipment—is a 32-page booklet on Eico kits and factory-wired units. The new Classic Series Kit Pack is featured in this publication, which is chock full of all kinds of equipment. Write to Eico Electronic Instrument Co., Inc., 131-01 39th Ave., Flushing, N.Y., for your copy. —30—


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RESTORETH THY RELIC RADIO

"Classic" radios? There were many, all distinctive for the rugged, beautiful craftsmanship that went into them

By THEODORE M. HANNAH

A RECENT TV PROGRAM featured an old radio that, when dusted off and turned on, mysteriously began to receive programs of a bygone day 30 years in the past. While it is highly unlikely that *your* treasured antique will bring in such old-time favorites as the *A & P Gypsies, Fibber McGee and Molly*, or *Amos and Andy*, it *is* likely to do a better job on today's programs than it did on those of its own day thanks to the improved recording and transmitting equipment now in use. And don't be surprised if you find it out-performing some of its modern counterparts—many of the radios of yesteryear demonstrate standards of excellence that have rarely been equaled.

RESTORETH THY RELIC RADIO

Why the sudden interest in finding and restoring broadcast receivers made 30 or 40 years ago, the Atwater Kents, Freshman Masterpieces, or Fada Flash-O-Graphs? Psychologists would probably say that it is a symptom of a subconscious desire to return to the simpler days of the past, and this may be partly true. Compared to the miniaturized, modularized circuits of today, the huge parts and wide-open spaces of the old sets are inviting. Battery sets were built breadboard-style with or without wooden cabinets; they were beautifully simple and almost completely trouble-free. The a.c. sets were big, heavy, conservatively designed, and generally of good quality. Because not every town had a radio station, the sets had to be built for DX, and even today, many of the antiques are superb in this respect.

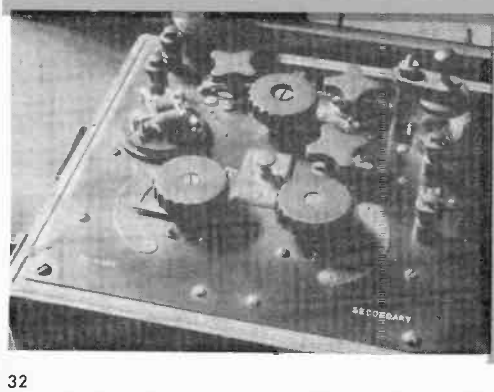
Dating Your Antique. The earliest commercially-built tube sets were regenerative models using from one to three triode tubes. The few tube types available in the early 1920's included the UV200 and UV201, WD11 and WD12, and UV199. Introduced in 1923, the famous 01A quickly became *the* standard tube for about the next five years. From an original cost of $9, prices steadily came down until the tube was selling for $2.50 or less in 1929. During this period, receivers were generally five- or six-tube TRF models.

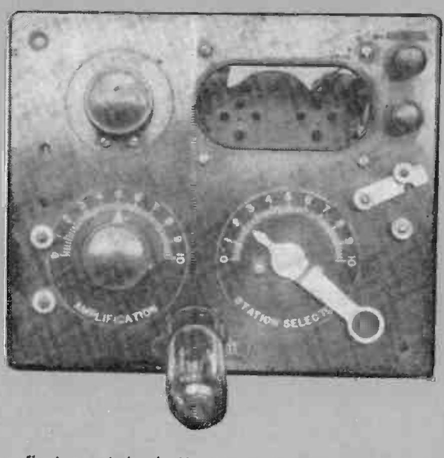
In the early 20's, a receiver often sold for $250 or more, including tubes, batteries, and antenna. Even at these high prices, 100,000 sets were sold in 1922. Incidentally, radio kits are not as new as you might think. As early as 1923-24, "do-it-yourself" neutrodyne sets were being sold in nicely packaged kits. Costs ranged from $65 to $80.

The following milestones in the development of broadcast receivers may help you establish the vintage of your antique radio:

1923—Neutrodyne circuit introduced
1924—First commercial superheterodyne (by RCA)
1927—First screen-grid tube (type 222); a.c.-powered receivers; first a.c. tubes (types 226 and 227); types 280 and 281 rectifier tubes
1928—A.c.-operated screen-grid tube (type 224)
1930-1—TRF receivers almost complete-

Although this set can't be considered a classic, it is a rare antique: a crystal receiver used by the U.S. Army during WW I. The buzzer (at left) was used as an r.f. generator for finding a sensitive spot on the crystal so that the cat whisker would be adjusted for best signal reception.





The first one-tube battery receivers used the WD11, a 1½-volt triode. This is RCA's Radiola which came shortly after Westinghouse's Aeriola receiver.

ly replaced by superhets; remote-cutoff tube (type 35/51); power pentode tube (type 247)

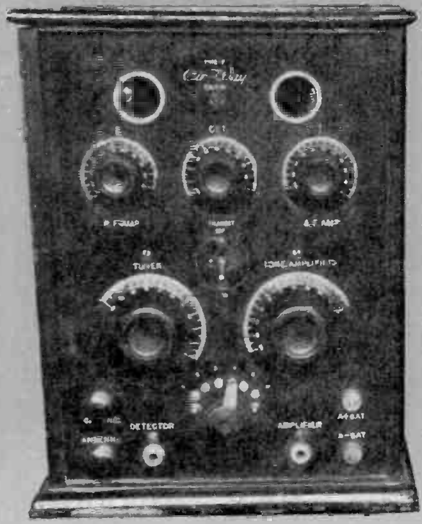
1931-2—Widespread introduction of low-cost "midget" sets

1935—First metal tubes

Antique Radio Hunting. Almost 15 million receivers were produced between 1923 and 1929—where are they now? Most of them have, of course, been scrapped, a few are still in use, and the rest are waiting to be found by antique radio collectors. Oddly enough, antique shops are usually not the place to find antique radios. Your best sources for relic receivers are used furniture stores and the thrift shops operated by Goodwill Industries, the Salvation Army, and similar organizations. And, if you let them know of your interest, you can often get old sets from friends and neighbors.

Next to the sets you get for nothing, the best bargains are usually found in thrift shops. Typically, radios, especially the older ones, are sold in "as is" condition at prices as low as a dollar or two. In most cases, you will not be able to try the set by plugging it in, so all you can do is look it over and judge its probable condition, taking the price tag into account.

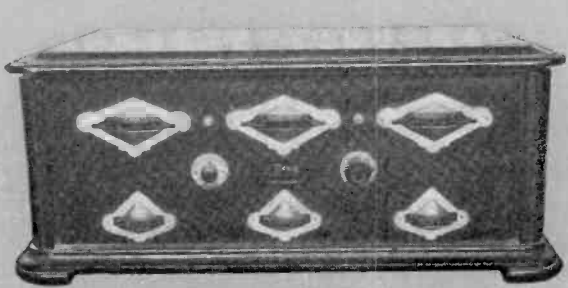
Prices at used furniture shops will be a bit higher—say $10 or $12—but a little



An early regenerative radio, a "blooper." Due to the large amount of r.f. they radiated, they could be heard in other receivers.

If you were under the impression that radio kits are a modern innovation, here's proof to the contrary. The 1924 Freshman Masterpiece kit above, a five-tube TRF model, was the pride and joy of the electronics hobbyist of that era. All three dials had to be adjusted to tune in a broadcast station.

Popular Grebe Synchrophase of the early 20's used a two-step r.f. amplifier, detector, and two-step audio amplifier. Protruding from the polished panel are the three tuning dials with vernier dials below. Tubes were UV200's and UV201's powered by a filament storage battery, and dry cell B batteries. All wiring was done with spaghetti-covered bus bar.

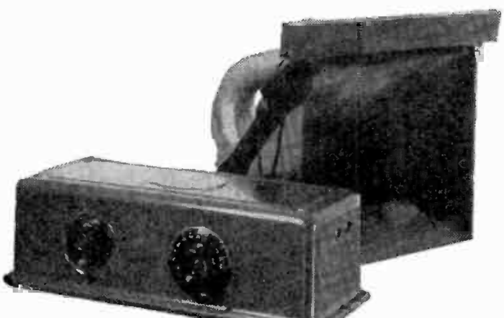


bargaining can usually be employed. Not being familiar with the different antique radios, the owners of these shops often base their prices on the size and condition of the cabinet. For this reason, you may find a small "classic" priced well below a larger run-of-the-mill model.

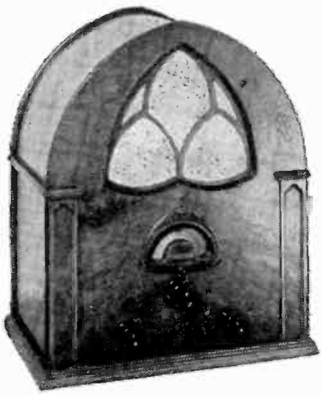
What sets can be considered "classics" is, to some extent, a matter of opinion, but among the most sought-after relics are the Grebe receivers and the early RCA Radiolas (the three-tube Model IV, for example, which cost $275 in 1923). Another collector's item is the Atwater Kent Model 10; this receiver is displayed in the Smithsonian Institute.

From a later era, the Scott receivers are often put in the classic category. Gleaming in chrome-plated splendor, a Scott receiver is truly a beautiful thing. A typical classic in this line is the 20-tube "Phantom Deluxe" of about 1940. You will occasionally see Scott receivers advertised—at fairly high prices—in

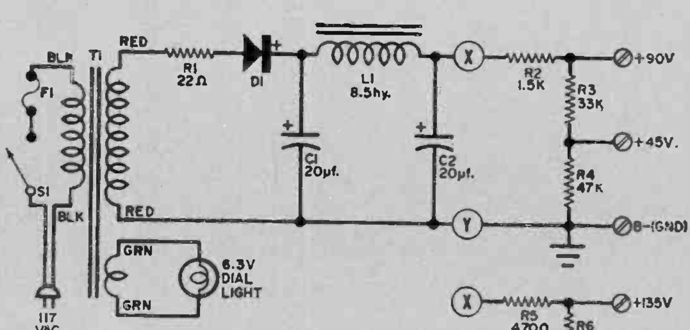
A six-tube battery set of about 1926, one of the first with single-dial tuning. It came with a desk the author paid $5 for at a used furniture store.

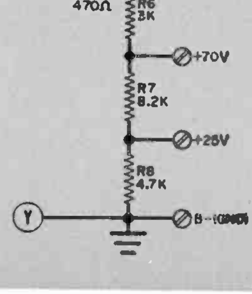


"Midget" sets were very popular in 1931. This one, an early superhet in the familiar Gothic design purchased for $1.50, is the Atwater Kent Model 84.



Build this power supply to power your battery-operated antique. The voltage divider shown with the schematic is for the typical set using five 01A's requiring two plate voltages; the alternate divider supplies the three B voltages needed for some sets.





PARTS LIST

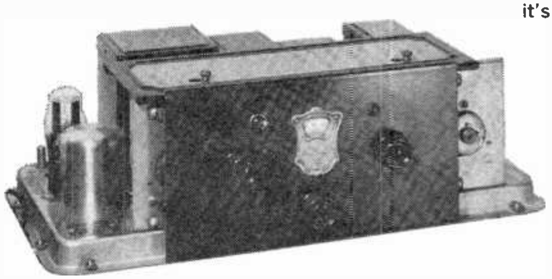
C1, C2—20-µf., 250-volt electrolytic capacitor
D1—300-ma., 400-PIV silicon rectifier
F1—1-amp, 250-volt 3AG fuse
L1—8.5-h., 50-ma. choke (Allied Radio 62G136 or equivalent)
R1—22-ohm, 1-watt resistor
R2—1500-ohm, 10-watt resistor
R3—33,000-ohm, ½-watt resistor
R4—47,000-ohm, ½-watt resistor
R5—470-ohm, ½-watt resistor
R6—3000-ohm, 10-watt resistor
R7—8200-ohm, ½-watt resistor
R8—4700-ohm, ½-watt resistor
S1—S.p.s.t. toggle switch
T1—Power transformer; primary, 117 volts a.c.; secondaries, 125 volts a.c. @ 50 ma., 6.3 volts @ 2 amps (Allied Radio 61G411)
Misc.—Dial lamp, chassis, terminal strips, line cord, solder, etc.

newspaper classified ads. Also of this era is the Silver-Marshall, considered to be an advanced set for its time.

Other receivers representative of radio's early days are the Bosch, Brunswick, Crosley (a pioneer in inexpensive sets), Day-Fan, Edison, Emerson, Freed-Eisemann, Colin B. Kennedy, Majestic, Paragon, Philco, Stewart-Warner, and Zenith.

Repairing Battery Sets. Common troubles in battery-operated antiques include open circuits in coils and transformers, and open or erratically operating volume control rheostats. Breaks in coils and transformers are often caused by

By 1930, receivers were greatly improved, thanks, in large part, to new tubes. This is the Atwater Kent Model 55C, a.c. TRF using screen-grid tubes.



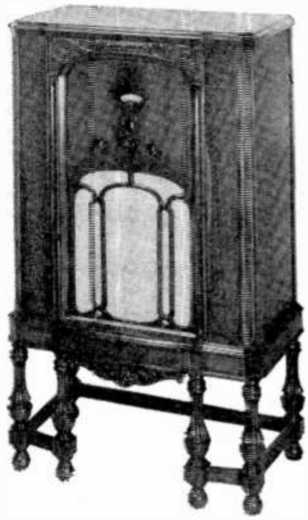
corrosion at the terminals—the cure is to clean and resolder the connection. If, however, the break is deep in the winding—and this is fairly common in audio transformers—the only practical solution is to replace it. A suitable substitute is a small interstage transformer such as Allied Radio's 62G062.

While rheostats can sometimes be repaired, it is usually better to replace them. Typical resistances are 5-40 ohms; wire-wound rheostats in this range are available from the larger electronics suppliers.

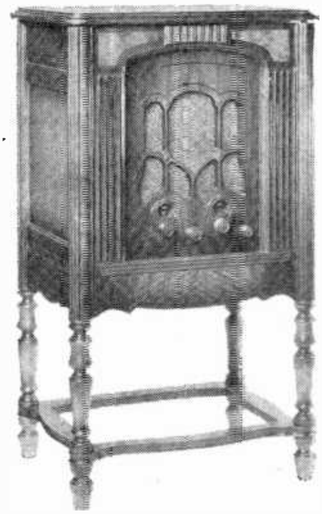
There are several ways of powering battery sets. Using all batteries over a period of time gets to be quite expensive. For a set using five-volt tubes (01A's, 71A's, 112's, etc.), a relatively inexpensive solution is to use a simple silicon rectifier supply for the plate voltages and a six-volt car battery for the filament supply. The battery can be kept charged with an inexpensive battery charger. If your set has WD11/WD12 or 199 tubes, you can use dry cells for the filaments.

Another way to provide filament power—and in the long run probably the most economical way—is to use a battery eliminator. Several are available, both ready-to-use and in kit form. Be

(*Continued on page* 102)



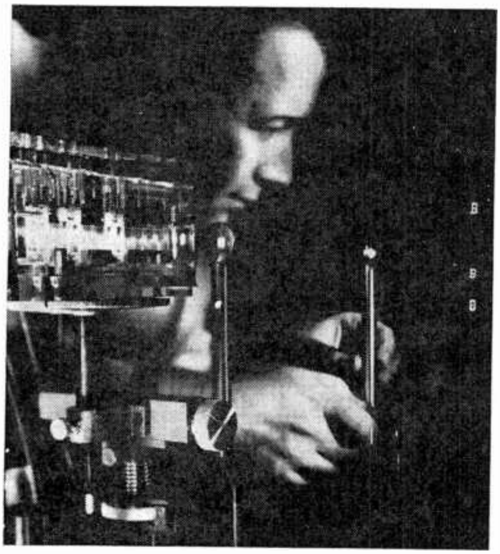
In 1932, this expensive nine-tube set, the Fada Model 97-RA, was considered a de luxe radio. And it's still an excellent set, capable of good DX.



The year 1933 saw the RCA Model 310, the latest in radio-phono combinations. By now, the basic discoveries had been made; future sets elaborated on them.

BREAKTHROUGHS

Brief news flashes on important developments in the field of electronics



DIGITAL LIGHT DEFLECTOR (above), which makes feasible the use of light for transmitting information in data processing, by IBM. Device uses laser light to project letters, numbers, or other images at high speed to exact locations. Deflection is accomplished by passing light through pairs of crystals which, under electronic control, deflect beam.

SUPERCONDUCTING MAGNET which develops a field roughly 200,000 times the average magnetic field strength of the earth, or 100,000 gauss, by Westinghouse. Wound with 20 miles of thread-thick, special high-strength superconducting wire, magnet is the first of this order that can be recycled, releasing and dissipating the energy stored in its coil without tearing itself apart. Operated in liquid helium to keep it in the superconducting state, it can be powered by a car battery which is disconnected after the super-currents are set in motion. Non-superconducting magnets of this strength require 1,000,000 watts of electric power and thousands of gallons of cooling water or oil.

HIGH-SPEED FIBER-OPTIC PRINTER, operating at the rate of 10,000 words per second, by General Dynamics Electronics. Heart of the device is a "Charactron" cathode-ray tube employing a beam-shaping matrix with 64 separate apertures, each in the shape of a different character. Fiber-optic "pipes" imbedded in the face of the tube transfer the character images onto a sheet of sensitized paper.

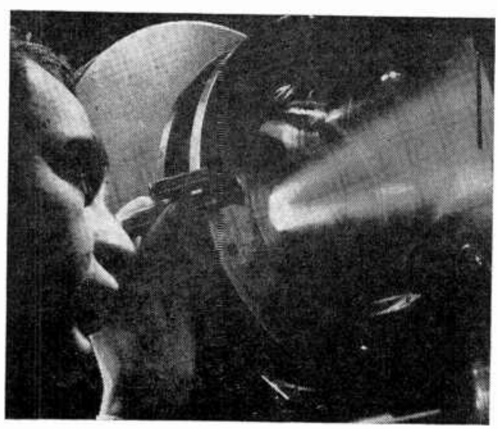
TRIODE LASER, which can be modulated by varying the voltage on a grid in a manner similar to an ordinary vacuum tube triode, by Bell Telephone Labs. The laser is excited by a beam of electrons of nearly identical energies emitted from a hot oxide cathode, and controlled by a grid; these two elements and the anode are in the form of 8-inch ribbons parallel to each other within the tube. The excitation efficiency of the laser is a hundredfold better per electron than that of an ordinary discharge laser, and the laser light beam can be switched or amplitude-modulated by simply varying the grid voltage.

THERMIONIC CONVERTER, a heat to electricity converter with no moving parts, by GE. The new device, which is eyed for space use, has an output of 30 watts per square centimeter at 20 per cent efficiency, a 50 per cent increase in power density over previous devices. Electrons are "boiled out" of a rhenium emitter, collected by nickel collector.

"ANTENNA" AIRLINER, a method of making the new 1500-mph Anglo-French "Concorde" supersonic airliner act as its own antenna, by ITT. The system involves making a "notch" in the metal skin of the plane. The "notch" system connects with the plane body, making the wings, tail, and 180-foot fuselage act as an antenna covering the whole high-frequency band with a broad radiation pattern. The new technique eliminates external wire antennas, which would be impractical for an aircraft such as the "Concorde" traveling at Mach 2 speeds.

PHONE-LINE TV by General Telephone & Electronics, a system by which handwriting can be transmitted onto a remote TV screen via ordinary telephone circuits to illustrate lectures. Possible uses include classroom sessions transmitted across the country at a fraction of the cost of closed-circuit TV.

"HOT ELECTRON" ENGINE by RCA (below) could be used to propel spacecraft to the planets at speeds of 100,000 mph or more. The engine ejects electrons and ions at a rate of six miles per second to generate sufficient thrust to accelerate an in-space vehicle. It is said to overcome the problem of deterioration of special electrodes used in other types of engines, since it accelerates directly only the electrons of its mercury "fuel" by trapping them in crossed electrical and magnetic fields.



BUILD PANIC ALARM

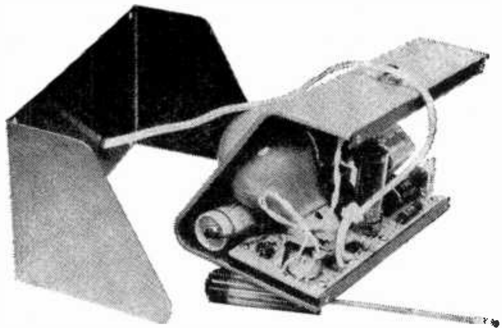
By ROY E. PAFENBERG, W4WKM

Guaranteed to start a panic every time an adventurous soul pushes that button

COINED during World War II, "push the panic button" has since become a colorful and descriptive addition to our everyday language. The phrase is used to describe any hastily conceived and ill-advised command or management reaction to an emergency situation that sends all hands racing helter-skelter in a flurry of frantic and ineffectual activity. In response to the popular appeal of the idea, dummy panic buttons can be found strategically located in the offices of many enlightened business executives.

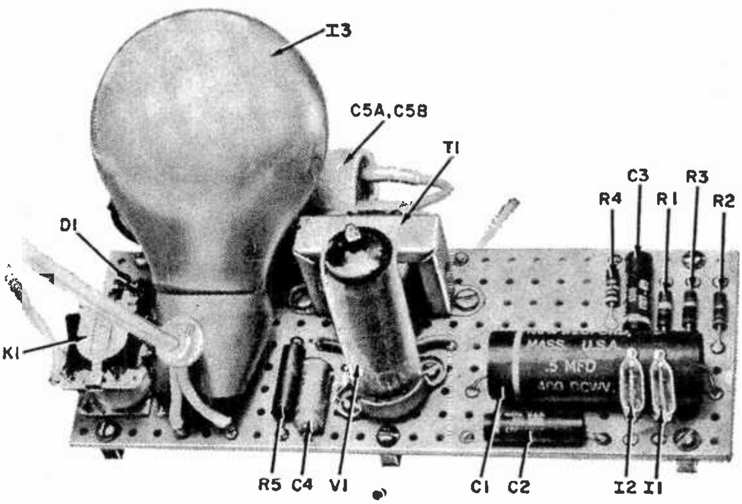
This article describes the construction of an electronic panic alarm that will electrify the deadest office. When activated, the device sounds off with a piercing blast of acoustical energy that combines the most desirable tonal character-

The author mounted his alarm in a sloping front cabinet, but there is no reason why other design housings won't work as well.



Perforated board is held to the bottom of the box with four bolts. The 25-watt lamp has no socket; the connections are soldered in place.

As mentioned above, the layout can be modified to suit the individual requirements of the builder. If you want to follow the author's model, this photograph will spot some of the more important components for you. Be sure that none of the circuitry contacts the metal chassis. See text for parts value changes to alter output tone.



istics of a fire engine siren, a submarine diving alarm, and a hound with its tail caught in the screen door.

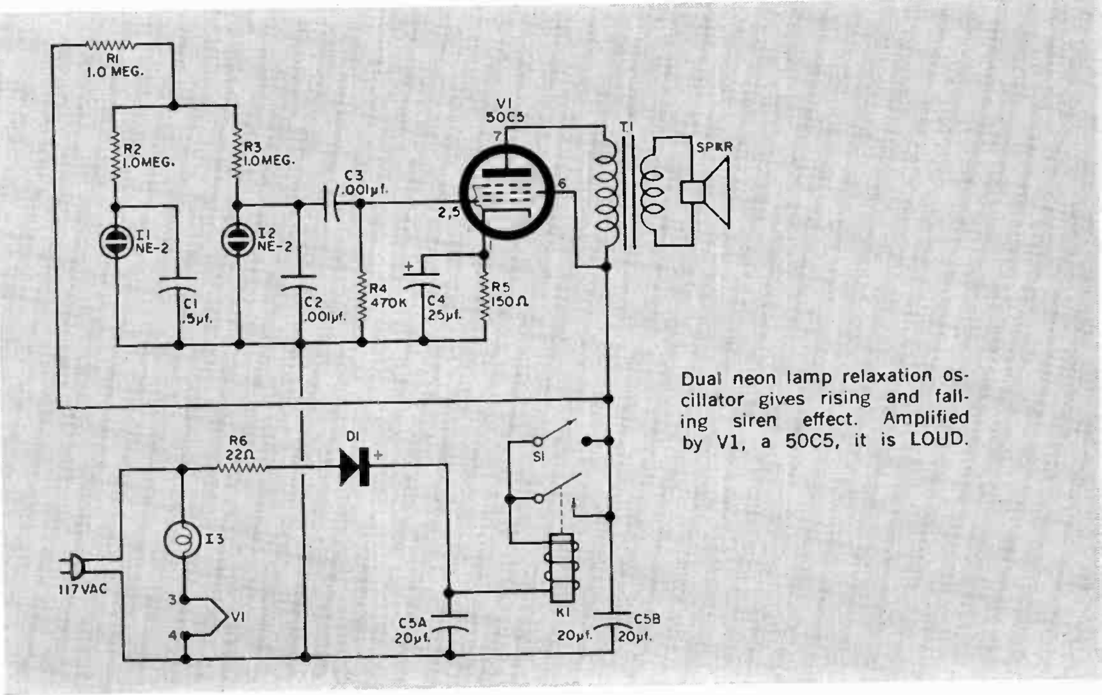
The panic alarm is activated by a deceptively labeled *PUSH TO TEST* switch. A special latching relay circuit is provided to keep the alarm sounding until the a.c. line cord is disconnected. The panic-stricken confusion that continues until someone finally unplugs the power cord adds greatly to the effectiveness (?) of the device.

A simple, easily wired circuit is used in the panic alarm. As shown in the photographs, the circuitry is housed in a small sloping-panel aluminum cabinet (Bud AC-1613). The front panel contains a speaker cutout with a red painted grille and a large matching, attention-getting red lamp. The *PUSH TO TEST* switch is mounted on the top of the cabinet.

Theory. The heart of the circuit is a rather unusual dual neon lamp relaxation oscillator. Because of the relatively long time constant of capacitor *C1* and resistor *R2*, the circuit of lamp *I1* oscillates at a subaudible rate. This results in a varying d.c. voltage at the junction of resistors *R1* and *R2*.

The time constant of capacitor *C2* and resistor *R3* is such that the circuit of lamp *I2* oscillates at an audible rate. Since the voltage for this circuit is obtained at the junction of *R1* and *R2*, the output frequency of this oscillator is swept at a rate determined by the frequency of the *I1* oscillator. Time constants of both circuits have been chosen to produce a very distinctive swept-tone siren effect. Output of the *I2* oscillator is coupled to a conventional audio output stage through capacitor *C3*.

A 25-watt, 117-volt red-frosted lamp



Dual neon lamp relaxation oscillator gives rising and falling siren effect. Amplified by V1, a 50C5, it is LOUD.

PARTS LIST

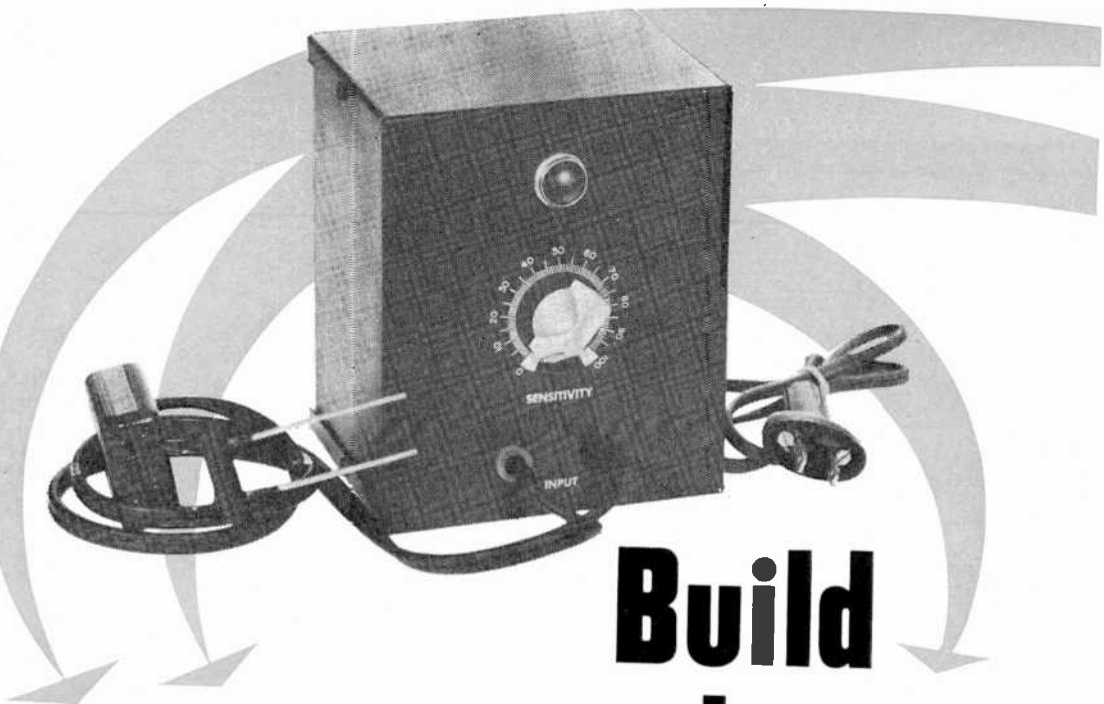
C1—0.5-µf., 400-volt capacitor
C2, C3—0.001-µf., 600-volt capacitor
C4—25-µf., 25-volt electrolytic capacitor
C5—20-20 µf., 150-volt electrolytic capacitor
D1—Silicon diode, 750-ma., 400-volt PIV (Lafayette SP-241 or equivalent)
I1, I2—NE-2 neon bulb
I3—25-watt, 117-volt light bulb, red frosting
K1—S.p.d.t. relay, 6-volt, 335-ohm coil (Potter & Brumfield RS5D or equivalent)
R1, R2, R3—1-megohm, ½-watt resistor
R4—470,000-ohm, ½-watt resistor
R5—150-ohm, 1-watt resistor
R6—22-ohm, ½-watt resistor
S1—S.p.s.t. push-button switch, normally open, momentary contact (Switchcraft FF-1001 or equivalent)
T1—Audio output transformer, 2000-ohm plate winding to 3.2-ohm voice coil winding
V1—50C5 tube
Misc.—4" speaker (3.2-ohm voice coil), cabinet (Bud Radio AC-1613 used by author), lamp cord, mounting hardware, perforated circuit board, solder, wire, etc.

(*I3*) is used in the power supply section of the circuit. This lamp, connected in series with the 50C5 tube heater, serves the dual function of indicator light and series-dropping resistor to reduce the line voltage to the 50 volts required by the tube heater.

The B+ power supply uses diode *D1* in a conventional half-wave rectifier circuit. The winding and the normally open contacts of relay *K1* are connected in series with the B+ output. The normally open contacts of the *PUSH TO TEST* switch are connected in parallel with the relay contacts. When this switch is closed, the charging current of capacitor *C5b* causes the relay to operate, and the current drawn by the 50C5 tube holds the relay closed until power is removed by disconnecting the a.c. line power cord.

Construction. Although the circuit is noncritical and parts placement can be varied, the method of construction shown in the photographs is convenient. If a different method is used, two precautions must be observed. Since the circuitry is connected directly to the power line, care must be used to insure that no portion of the circuit makes connection to the metal cabinet. Secondly, in the relay specified for use as *K1*, the movable contact is connected directly to the frame of the relay. Therefore, any method of construction used must provide an insulated mounting for this component.

The speaker is mounted on the panel (*Continued on page* 108)



Build the Multi-Trol

By RYDER WILSON

WHILE ORIGINALLY designed to provide automatic cutoff for a commercial dehumidifier, the "Multi-Trol" has proved so versatile that it has been adapted to a variety of other applications. Electrical appliances that draw up to 800 watts can be turned on or off by a signal as small as 50 microwatts. Cadmium sulphide photocells, thermistors, humidity sensors, or even a carbon microphone can be used to trigger the unit as they respond to variations in light, heat, humidity or sound. When attached to a pair of metal probes in the ground, the Multi-Trol will serve as a soil moisture indicator and can be used to turn on electrically operated valves for automatic watering.

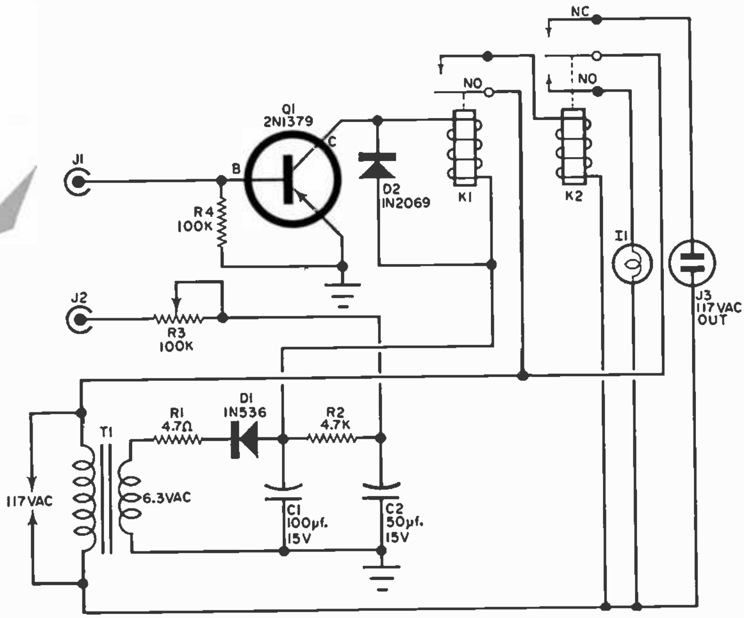
Circuit Design. The circuit was designed to provide maximum sensitivity and power handling with a minimum of parts. This is accomplished by using a very high-gain transistor (*Q1*) as a grounded emitter current amplifier to drive a sensitive relay *K1* which in turn operates power relay *K2*.

The 2N1379 transistor used had a measured d.c. current gain of 220 with a base input of 100 ma. A linear 100,000-ohm potentiometer, *R3*, in series with the base, sensor and supply voltage, controls the sensitivity by limiting the base current. Resistor *R3* may be changed to 1 megohm when the resistance across the input terminals is less than 50,000 ohms to give a little better control. Examples of such inputs would be low resistance photocells or humidity sensors.

A small silicon diode, *D2*, protects the transistor from transients developed across the coil of relay *K1*. Pilot lamp *I1* provides a visual indication that the power relay *K2* has operated, and this lamp may be replaced by a bell, buzzer, or any other warning device the builder desires.

Operating power is obtained from a

Use it to control almost any device with nearly any signal



You should have no problems in constructing the Multi-Trol as layout is not at all critical. The "NC" and "NO" designations at relays K1 and K2 refer to "normally closed" and "normally open" terminal points.

PARTS LIST

C1—100-μf., 15-volt electrolytic capacitor
C2—50-μf., 15-volt electrolytic capacitor
D1—1N536 silicon diode
D2—1N2069 silicon diode
I1—117-volt, 3-watt pilot lamp
J1, J2—Nylon insulated pin jack
J3—A.c. connector, female, recessed chassis mounting
K1—S.p.s.t., 550-ohm, 9.5-ma. relay (Sigma 11F-550-G/SIL)
K2—S.p.d.t., 115-volt relay (Potter & Brumfield MR5A)
Q1—2N1379 transistor
R1—4.7-ohm, 1-watt resistor
R2—4700-ohm, 1-watt resistor
R3—100,000-ohm linear potentiometer
R4—100,000-ohm, ½-watt resistor
T1—Filament transformer; primary, 117 volts; secondary 6.3 volts @ 1 ampere
1—4"x5"x6" aluminum Minibox

small filament transformer, *T1.* The transformer output is rectified by diode *D1* and filtered by capacitors *C1* and *C2.* This gives approximately 8.5 volts at the collector of *Q1.*

An appliance plugged into the Multi-Trol can be made normally off instead of on, by reversing the two connections to the normally open and normally closed contacts of relay *K2.*

Construction. The author's unit is built into a 4" x 5" x 6" utility box, but with some ingenuity the parts could be fitted into a smaller enclosure. Parts placement is not at all critical. The dehumidifier probe consists of a pair of No. 10 copper wires mounted in a Bakelite terminal block. This is then encased in a small plastic box and sprayed with plastic to make it waterproof. The two leads from the probe are terminated in pin plugs to conveniently fit jacks *J1* and *J2.*

When the probes are in one inch of water, the resistance across them is approximately 25,000 ohms. Neither the spacing nor the length of the probes is critical; they may be adjusted to suit the builder's convenience.

Using the Multi-Trol. Plug your dehumidifier into outlet *J3* and place the probe on top of the water bucket so that the two copper wires will be in approximately one inch of water, at the level where the dehumidifier is to be cut off.

HOW IT WORKS

The appliance to be controlled is plugged into a.c. connector *J3* which supplies its line voltage through the normally closed contacts of relay *K2*. Placing a resistance of about 50,000 ohms, such as a photocell, thermistor, or other resistive sensor, at the input causes a small current to flow in the base circuit of transistor *Q1*. This current is amplified in the collector circuit which actuates sensitive relay *K1*. This in turn supplies the power to relay *K2*. When relay *K2* operates, the a.c. voltage is removed from the load, and applied to indicator lamp *I1*.

Start with 10"-long probes, and cut them to the desired length. Plug the Multi-Trol into the nearest wall outlet, and it is ready to go to work for you.

Other Applications. An inexpensive cadmium sulphide photocell (for example, Lafayette Radio's Stock No. MS 855) can be used to convert the Multi-Trol to a controller for house lamps, photoflood lamps, or other electrical appliances. Connect the photocell to input terminals *J1* and *J2* and adjust the sensitivity control as required.

As an electronic thermostat, the circuit is just as sensitive and as easy to use as in the photocell application. Select a thermistor with a resistance of about 100,000 ohms (such as the Lafayette 51CA1), plug it into *J1-J2*, and set the sensitivity control to trigger the circuit at the selected temperature.

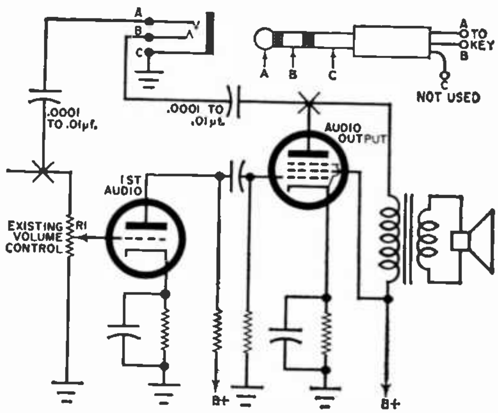
There are many other possible applications for the Multi-Trol. The average builder will enjoy discovering them for himself. -30-

Loudspeaker Code Practice

ANY RECEIVER can easily be converted to a loudspeaker code practice oscillator. By feeding a portion of the output signal to the grid of the first audio stage, a squeal is set up that is heard in the loudspeaker.

Simply hook a pair of capacitors from .0001 to .01 μf. at the points designated "x" in the schematic diagram. Mount a three-circuit (stereo) phone jack on the radio set and solder the open ends of the capacitors to the A and B lugs of the phone jack. Do NOT connect to the ground lug of the jack.

Attach a matching plug to your key, connecting as shown, and plug the key into the jack to practice code. The volume control on the radio will also serve as a volume control for code practice. And you can still use the radio as an ordinary receiver if you remove the key plug from the jack.



This modified radio code practice oscillator has plenty of pep, and is more than sufficient to sound off for a class full of budding hams.

—*Frank A. Parker*

Customize Your Pilot Lamps

TO GIVE your equipment that "ultimate touch," add pilot lamps that can be read. Cut small discs from celluloid or plastic, and letter them with such legends as "ON," "OFF," or anything else that is appropriate. Letter the discs with decals, press-on letters, or with India ink. Most materials will take the ink if you lightly sand them first. In many cases, just one letter or number ("P" for power, "A" for amplifier, etc.) will be sufficient. The completed assembly looks like any pilot lamp—until you turn it on.

—*Tim Callan*

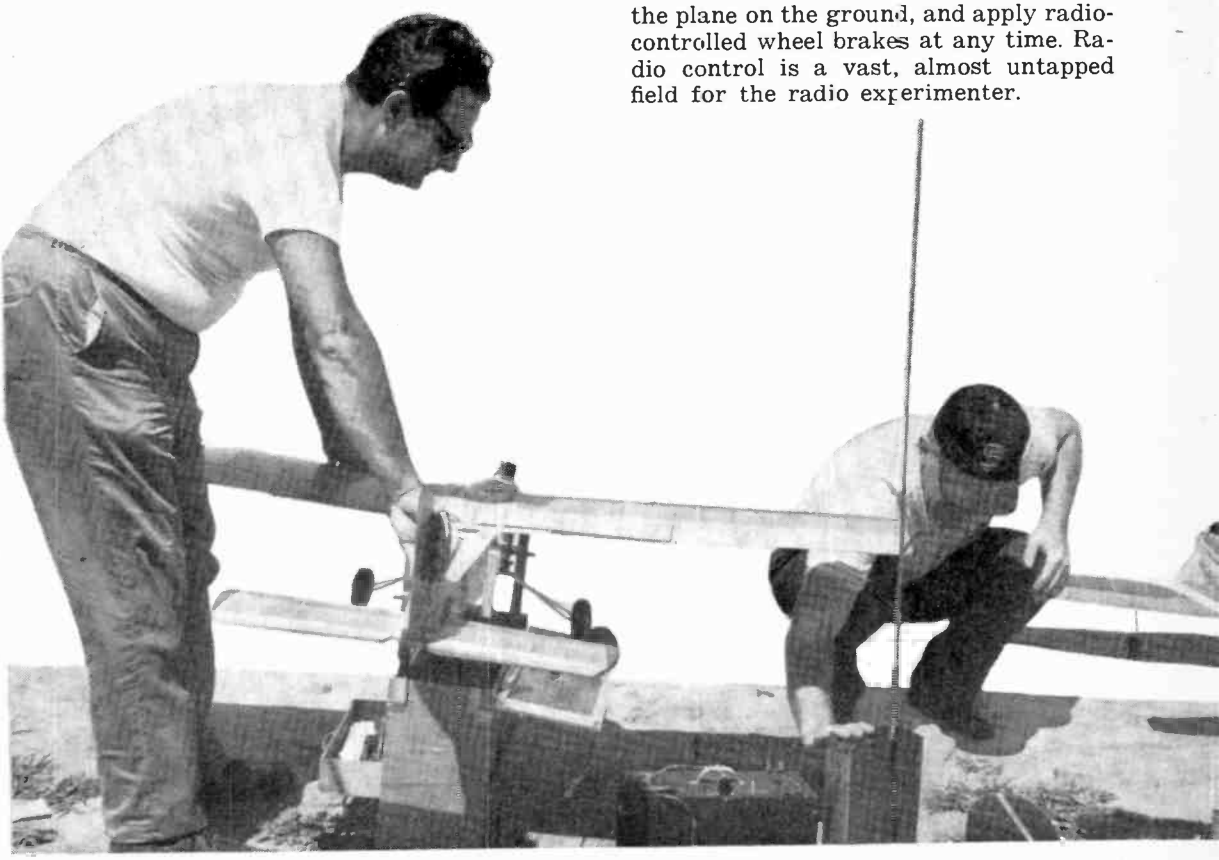
R/C MODEL AIRPLANES — REVISITED

By **WILLIAM HUTCHISON**

Where to start, with what equipment, and how

IF YOU HAVE a good working knowledge of electronics, but have passed up the thrill of radio control of models, you've missed a lot of fun. Long gone are the days when models were hand-made, either time-consuming to construct or overly expensive, and difficult to control while in the air.

Present-day model airplanes have R/C refinements that make it possible for you to take off, raise the landing gear, change speed in flight, lower the gear and land. What's more, you can steer the plane on the ground, and apply radio-controlled wheel brakes at any time. Radio control is a vast, almost untapped field for the radio experimenter.



In the early days, radio control experimentation required a ham license, and you had to pass the 13-wpm code test as well as the theory test to get your plane into the air. The models in those days were big, lumbering affairs, for there were no transistors and no NiCad batteries. The plane had to lift all this weight into the sky, and the engines were true internal combustion types, replete with spark coil, battery and all the accessories required by a gasoline engine. The later-day glo-plug engines are weight-savers in themselves.

A few years ago, one was most apt to see planes with rudder control only because of the weight problems. If the plane got into the air at all, there was no question but that it would eventually come down. The rudder assured you that you would have some say about *where* it would come down, not how.

Errors were a commonplace. A foul-up in design or construction could mean that you watched helplessly, futilely pressing away at the control button while your precious plane flew out of range and, ultimately, out of sight.

About the same time that the Citizens Band came into being, transistors and flea-weight batteries hove into view. The popular glo-plug engine provided further weight reduction; this engine requires no battery power once it gets started, maintaining its own action the way secondary emission will keep a magnetron cathode going after the voltage has been removed from the heater!

The result of this revolutionary, evolutionary change was smaller payloads for the planes, smaller and sturdier planes, and with no amateur radio tests to pass, more hobbyists creating a better dollar market for the manufacturers. They, in turn, produced smaller, sturdier, cheaper . . . Well, you get the picture.

The Laws. The FCC Rules and Regulations apply to all radio transmitters and they apply to R/C as well. If you elect to use Citizens Band frequencies, you need no license at all to operate an R/C model, provided that you stay under the 100-milliwatt level. If you exceed 100 milliwatts, you need a station license, and must stay under the five-watt maximum. Unfortunately, while you can experiment to your heart's content with receivers and controls, you may not construct your own transmitter for a Citizens Band setup unless you get type approval from the FCC—which isn't so easy. If you have a ham license, the story is quite different. You can go R/C on six meters and build your own equipment; and while you certainly will never need it, you can put a gallon into the final!

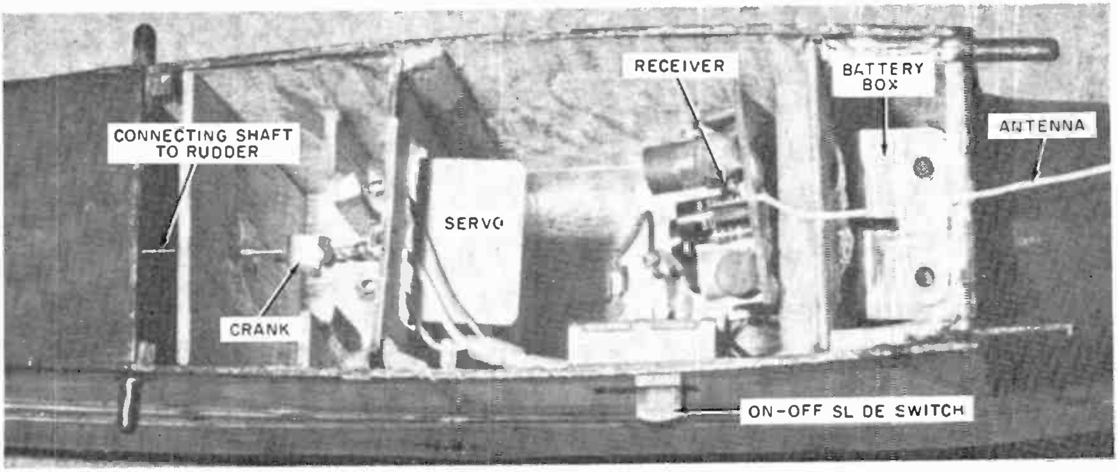
The truth of the power matter is that it is overrated. Most modelers want to watch their planes fly, and therefore keep 'em pretty close in and well within range of the transmitters.

Basic Training. As a first step toward getting you off to a flying start let's take a look at the fundamentals of R/C. The beginnings of Citizens Band R/C saw single-frequency transmitters that were pulsed by pressing a thumb switch. A device called an escapement was used. This is similar to a relay in that an arm is actuated when a pulse is received. This arm releases a ratchet mechanism, and the mechanism allows a wheel, fitted with arms, to rotate one stop.

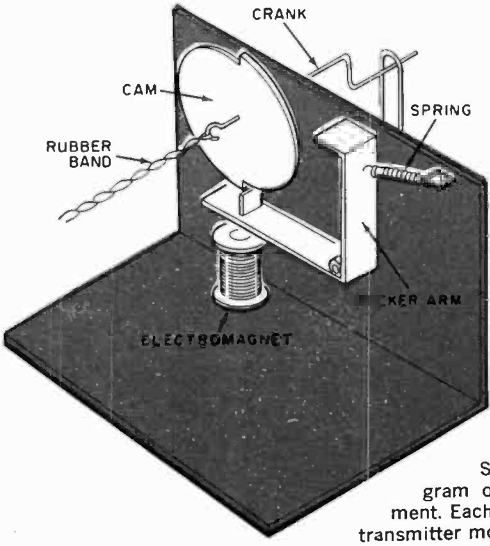
In the beginning, these escapements were used to control rudders only, and you had to press once for left rudder, twice for right rudder, and three times for neutral. Of course, if you were *on* left rudder, you only pressed once for right. Adding more arms added more controls, and you could also get up or down elevator, but you had to cycle through the rudder controls to get there! Confusion reigned supreme.

Add to this the fact that all the transmitters were on the same frequency, and you can realize why only one plane was allowed in the air at any given time. If there were two, the stronger transmitter would, of course, control both planes. The only exception to this one-at-a-time rule was where a flyer with a ham license showed up, and could fly on the six-meter band. Other hams, coincidentally operating on ten meters near a model flying field, could cause mass nose-dives by overloading Citizens Band units.

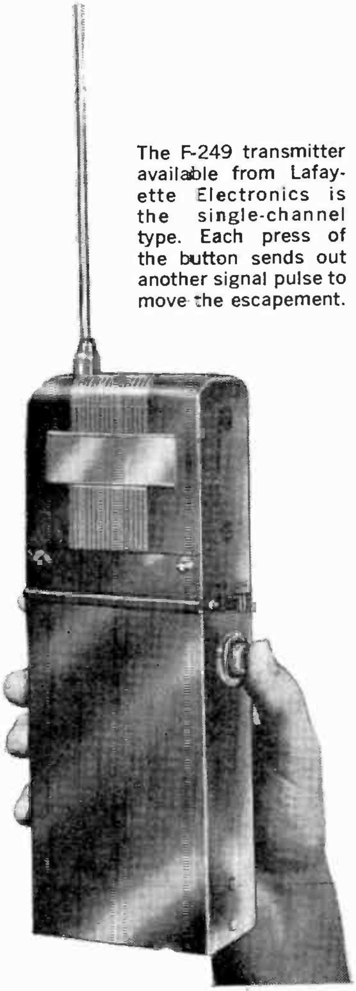
The entire operation was simplified by the addition of tone modulation. The FCC broke the band into six channels from 26.965 mc. to 27.255 mc. More sharply tuned receivers permitted multiple operation, and the tone modulation did away with the "flyer's thumb." Banks of frequency-sensitive reed relays



R/C installation in plane. Antenna goes back to rudder after wing is installed.



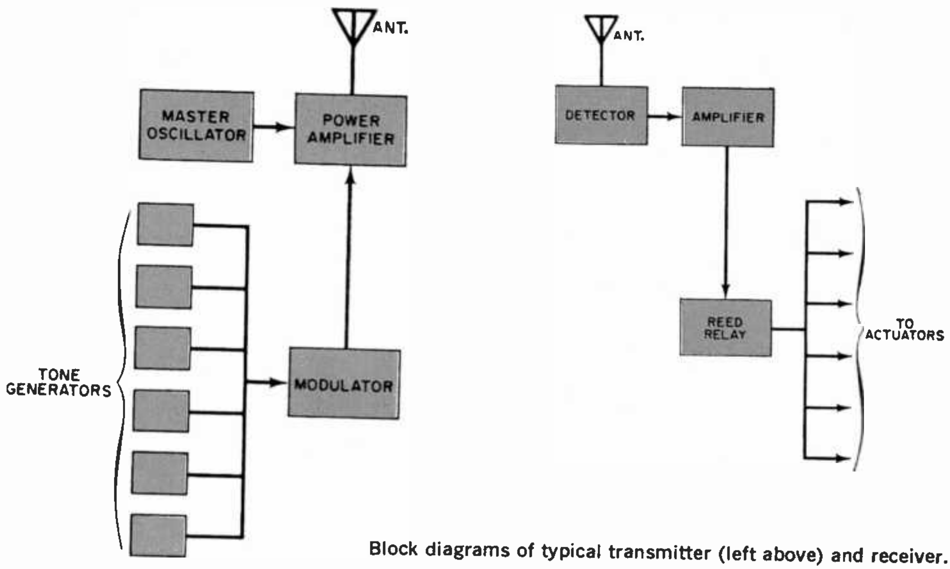
Simplified diagram of an escapement. Each pulse from a transmitter moves the cam.


The F-249 transmitter available from Lafayette Electronics is the single-channel type. Each press of the button sends out another signal pulse to move the escapement.

were used to activate different escapements, and multiple control could be achieved with relative simplicity.

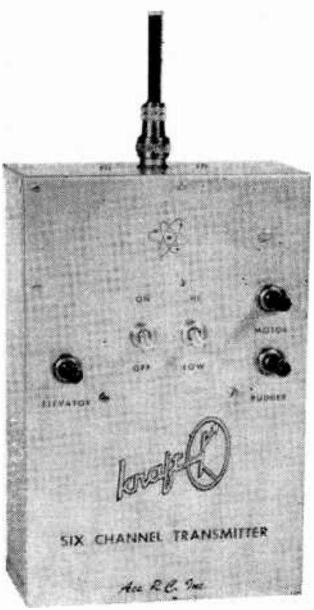
There *is* some confusion with regard to the term "channel." A receiver using reed relay selection with facilities for ten reeds is called a ten-channel receiver, but it operates on only *one frequency channel.*

The tone receiver reeds are factory-set for the frequency they will use, and usually fall between 400 and 1000 cycles. The transmitter tone modulators are adjusted to match the reed frequencies. Many transmitters for tone modulation



Block diagrams of typical transmitter (left above) and receiver.

Multi-channel transmitter has many control functions. This is the Kraft unit made by Ace.



MANUFACTURERS OF R/C EQUIPMENT

Transmitters and Receivers

Ace Radio Control
Box 301
Higginsville, Mo.

Citizen-Ship Radio Corp.
820 East 64 St.
Indianapolis, Ind.

Eck-Babcock Models
Newport Beach, Calif.

Orbit Electronics
11612 Anabel
Garden Grove, Calif.

Actuators

Ace Radio Control
Box 301
Higginsville, Mo.

Bonner Specialties
2900 Tilden Ave.
Los Angeles, Calif.

deBolt Model Engineering Co.
3833 Harlem Rd.
Buffalo, N. Y.

Eck-Babcock Models
Newport Beach, Calif.

Model Kits

Ace Radio Control
Box 301
Higginsville, Mo.

Consolidated Models
Route 130
Cranbury, N. J.

deBolt Model Engineering Co.
3833 Harlem Rd.
Buffalo, N. Y.

Carl Goldberg Models
9849 S. Claremont
Chicago, Ill.

Paul K. Guillow Inc.
Wakefield, Mass.

Ideal Models
20 West 19 St.
New York, N. Y.

Jetco Models
883 Lexington Ave.
Brooklyn, N. Y.

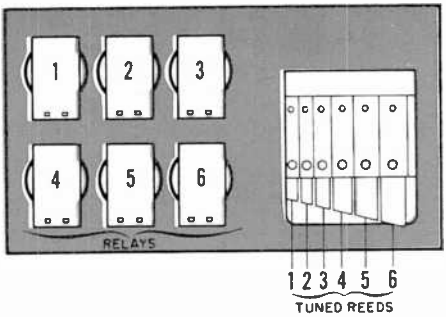
Monogram Models
8601 Waukegan Rd.
Morton Grove, Ill.

Octura Models
P. O. Box 536
Park Ridge, Ill.

Polk's Hobbies
314 Fifth Ave.
New York, N. Y.

Scientific Models Inc.
113 Monroe St.
Newark, N. J.

Sterling Models
Belfield Ave. & Wister St.
Philadelphia, Pa.



Tuned reeds of tone system activate proper relay if tone is received. Relay closes, operates controls.

are equipped with joy-stick controls to more closely simulate real life flying conditions.

These "multi-channel" rigs are meant for the experienced flyer. As a trained electronics experimenter, you would have little or no trouble with the electronics. Ten channels in the hands of a novice pilot, however, is like handing a monkey a machine gun. At the beginning, you should restrict yourself to what the modelers call "single channel," which covers one audio channel, or straight on-off carrier wave signals, both of which are considered single channel.

Actuators. Considering the radio to be merely a remote-control switch, we must give the switch something to act on, and the device so used is called an "actuator." There are two types in use today, the "servo" and the "escapement."

Escapements are of two types, called simple or compound. The escapement is not a source of power, but rather, a device that permits power to escape at a controlled rate. The power itself usually comes from a rubber band system that is wound tightly before a flight.

The servo, on the other hand, is an electrically operated device that can move the heaviest of controls smoothly. It consists of a motor, a gear train, and a selector mechanism to internally control the servo functions.

While the actuator is controlled by the receiver, which is controlled by the transmitter, it is the function of the actuator to control the model's controlling surfaces, such as rudder, elevator, etc. This is done through a system of linkages called push-rods and bell-cranks, which are in turn connected to the moving hinged surface of the model.

R/C TERMINOLOGY

Here are some of the terms that modelers use in connection with radio control:

single-channel Carrier-only or single-tone-modulated R/C transmitter and matching receiver installation.

multi-channel An installation that employs tuned reeds to supply several control functions. The basic carrier frequency remains the same, but different tones make possible a number of control "channels."

escapement A clockwork-like device which transfers power, step by step, to control surfaces (such as the rudder) of a model airplane or boat.

servo A device that contains and delivers power to move a control or controls.

push-rod A shaft that connects a servo or other actuator with the part of the model which is being controlled.

linkage All parts such as push-rod, levers, cams, etc., that connect the actuator to the part being controlled.

rudder only When single-channel equipment is used and only the rudder of the model is movable.

proportional An advanced type of control system where the rudder (and sometimes the elevator) can move as much (or as little) as the operator wishes.

full-house A multi-channel rig where all controls work to allow the model to fly a complete flight pattern.

galloping ghost Another name for proportional control.

Master these terms and you'll get along with other modelers well enough to learn the remainder of their lingo.

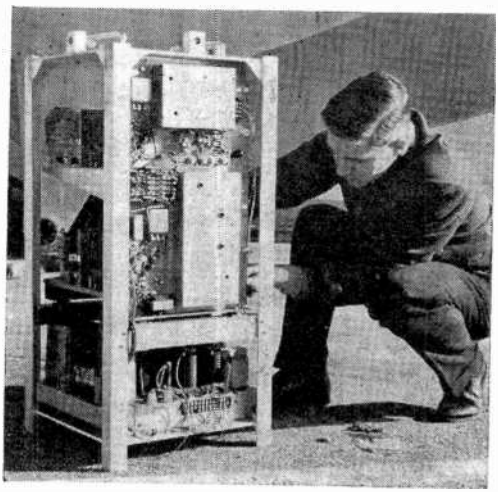
Models. Don't make the mistake of starting with a model that is too small. Try to stick to an airplane with a four-foot wingspan in the beginning, and make sure that your engine will provide the right amount of power for the model. Follow the kit manufacturer's recommendations.

You may prefer to start with a model boat. As model boats are not given to power-diving to a concrete runway from 1000 feet when a control fails, you can safely invest your time and money in a better model. Did somebody say "What if it sinks?" An easy way to prevent this is to cement some Ping-pong balls under the deck.!

(*Continued on page* 109)

MAMOS: Weather Station In a "Rowboat"

Special anchor line, made largely of buoyant nylon, holds MAMOS secure in up to 18,000 feet of water.



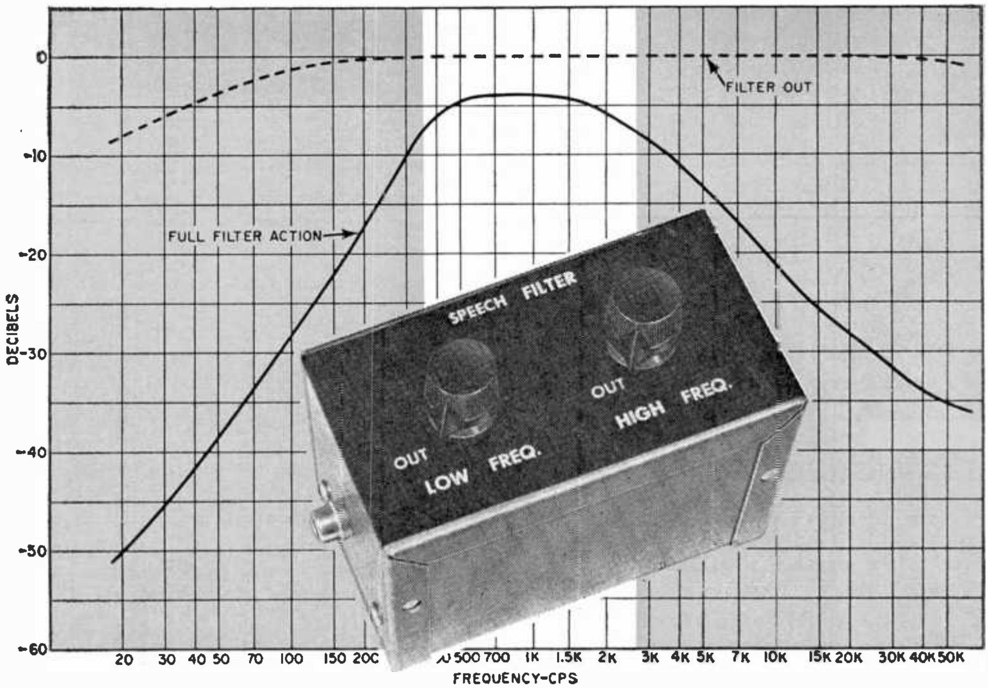
Final adjustments are made to MAMOS' rack-mounted data processor, timers, transmitters.

ANCHORED FAR OUT in the storm-tossed ocean is a tiny craft that would make the Ancient Mariner shake his head with amazement. Measuring 20 feet from stem to stern and having a beam of 12 feet, this brightly painted little vessel is topped with two whirling windmills, a flashing light, a weather vane, an anemometer, a mast, and eight tightly covered hatches. The mast supports no sails, however, and no crew members are seen to emerge from the hatches. The mast is a transmitting antenna, and the space below decks is devoted entirely to electronic equipment.

MAMOS, as the vessel is known (for *M*arine *A*utomatic *M*eteorological *O*bserving *S*tation), is actually a highly sophisticated weather station constructed and equipped by Cardion Electronics, Inc., division of General Signal Corp., for the U.S. Weather Bureau. Designed to operate completely unattended for a year, MAMOS transmits every six hours complete data on air and water temperature, barometric pressure, wind speed and direction, and integrated wind force. A special storm sensor, in operation at all times, activates MAMOS to broadcast *hourly* weather reports when wind velocity reaches 22 knots.

Power for the vessel is furnished by eight banks of storage batteries charged by three wind-driven generators. Data collected by five sensors is fed to a processor, which converts it to digital form using optical scanning methods. When the time for a transmission arrives, two radio transmitters, operating at 3362 kc. and 9947.5 kc. with peak powers of 5 kw., go into action.

Each message lasts about five seconds, and is repeated five times to insure accurate reception by shore stations over a thousand miles away. Transmission mode is keyed c.w. at a 100-wpm teletypewriter rate. MAMOS also sends the day of the week, the time, its call letters, latitude, longitude, and visibility along with the weather. —30—



An Adjustable Speech Filter

Cut out noise and increase intelligibility with this all-purpose amateur, CB, hi-fi, and recording filter

By DANIEL MEYER

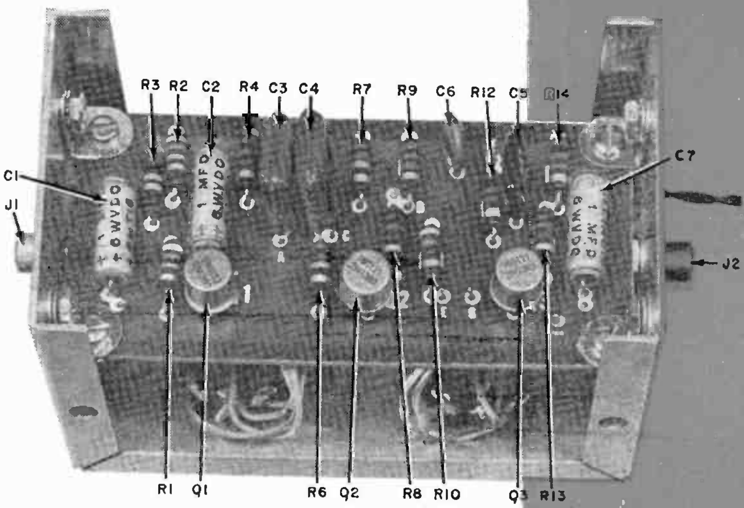
WOULD YOU LIKE to have a speech filter to use with your CB receiver that could be adjusted to give the best reception for various signals and noise conditions? A filter that can also be used with your transmitter to get more modulation in the 300 to 3000 cycle range where it will do the most good? A versatile unit which can also be used with your hi-fi system to clear up the noise on old recordings or weak FM signals? If so, here is a simple three-transistor circuit that will do these jobs and more.

Two feedback-type filters are used to produce the high and low frequency attenuation. The circuit has zero unity gain and may therefore be used at any point in a system that has a signal level of one volt or less. In addition, the amount of high or low frequency filtering may be adjusted and either filter may be switched out of the circuit to give a flat response.

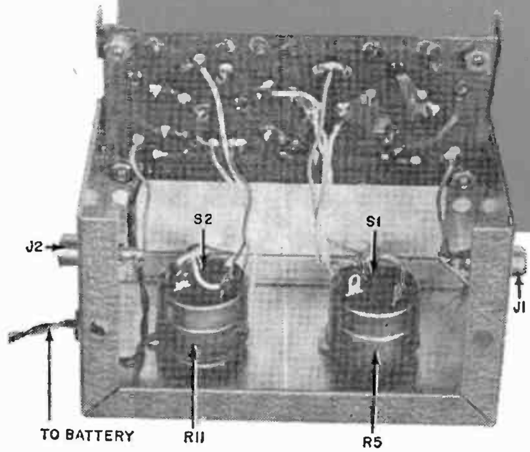
How It Works. Transistor *Q1* is an emitter follower which gives the filter a high input impedance and also provides a low impedance driving source for transistor *Q2*. Capacitor *C2* and resistor *R3* form a feedback loop around transistor *Q1* that reduces the loading effect of the bias resistors *R1* and *R2* on the input of the filter.

Transistor *Q2*, with its associated resistors and capacitors, acts as a variable, *high-pass*, active filter. Potentiometer *R5* varies the cutoff frequency of the filter from approximately 100 to 400 cycles. In the "out" position of *R5*, switch *S1* closes and shorts out the filter.

Transistor *Q3*, with its associated components, is a variable, *low-pass*, ac-



Refer to the schematic diagram on the facing page to locate the components in photo above.



Potentiometers, switches and jacks are wired before the board is installed in cabinet.

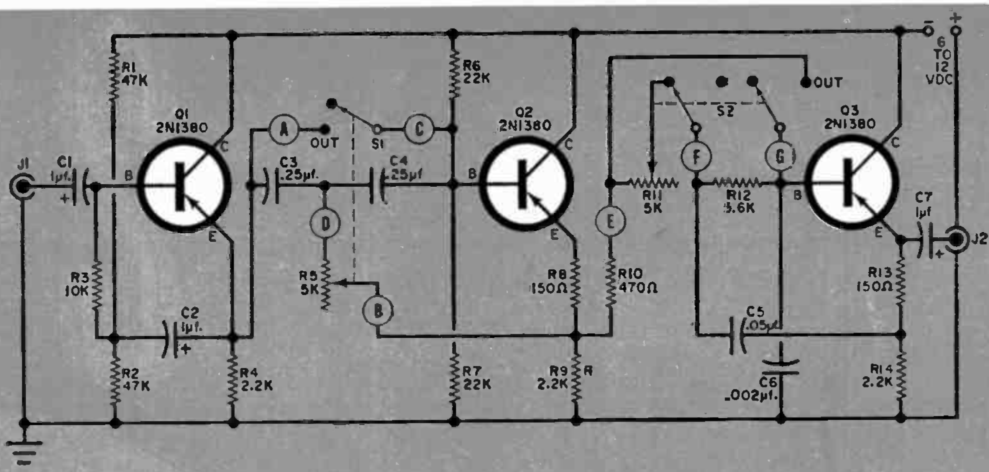
tive filter. Potentiometer *R11* is used to vary the cutoff frequency of the filter from approximately 3000 to 6000 cycles. In the "out" position of *R11*, the normally closed pole of switch *S2* opens and breaks the signal connection to *R11*, while the normally open pole of the switch closes and shunts the signal around the filter.

The input impedance of the filter is about 50,000 ohms and the output impedance on the order of 1000 ohms. The circuit draws 6 ma. at 12 volts d.c. or 3 ma. at 6 volts d.c.

Constructing the Filter. The filter is built on a printed-circuit board to simplify construction and make for compactness. Install the parts on the board in the positions indicated, and solder to the etched copper pattern on the reverse side of the board. Use rosin core solder throughout, and use an iron rated at less than 50 watts. Solder the connections as quickly as possible to avoid prolonged heating of the laminate.

Next, drill the holes for the connectors and the controls. Mark the hole positions with a punch, then use a 1/16" drill to make pilot holes. Now drill out the connector holes to 1/4" and the control mounting holes to 3/8". Place a block of wood under the metal during the drilling operation.

Cut the shafts of potentiometers *R5* and *R11* to a length of 3/8" from the mounting bushing. Mount *R5*, *R11*, *J1* and *J2* on the case. Use lock washers between the controls and the case to



PARTS LIST

C1, C2, C7—1-µf., 6-volt electrolytic capacitor
C3, C4—0.25-µf., 75-volt capacitor
C5—0.05-µf., 75-volt capacitor
C6—0.002-µf., 75-volt capacitor
J1, J2—Phono jack
Q1, Q2, Q3—2N1380 transistor
R1, R2—47,000 ohms
R3—10,000 ohms
R4, R9, R14—2200 ohms
R6, R7—22,000 ohms
R8, R13—150 ohms
R10—470 ohms
R12—5600 ohms
(*All ½-watt fixed resistors*)
R5, R11—5000-ohm potentiometer with d.p.d.t. switch, log taper (Centralab B-12 with KR-3 switch)
S1, S2—D.p.d.t. switch mounted on rear of R5, R11
4—Mounting brackets (Cambridge Thermionic Corp. 1963 or equivalent)
1—2¼"x2¼"x4" aluminum case (Bud CU-2103 or equivalent)
1—Circuit board (the author used an etched-circuit board (No. 101) which is available with three transistor sockets for $1.25 from Irving Electronics, Box 9222, San Antonio 4, Texas)

prevent slipping while using the unit.

Now wire the controls (low-frequency filter *R5*, high-frequency filter *R11*, and jacks *J1* and *J2*). Follow the schematic diagram and photographs. The wires from these controls are connected to the coded points on the board corresponding to similar points on the schematic. Fasten the board to the brackets, and mount the entire assembly in the case.

Testing. Before applying voltage to the filter, check carefully for shorts or incorrect connections. Now connect the points marked plus and minus to a 6-to-12 volt battery or power supply. Note that the positive lead is grounded and common to both the input and the output.

Do not attempt to connect the filter in an automotive electrical system if the car has a negative ground. If the filter has to be used with a mobile system, strap a 6-volt dry cell to the rear of the filter box for a power supply. This will also help keep ignition noise out of the filter and eliminate any possibility of short-circuiting the electrical system.

The input and output connections may be made to the filter at any point in the circuit having a signal level of less than one volt. The best place to connect into a receiver would be at the volume control. Simply disconnect the wire from the center terminal (wiper) of the volume control and connect the input of the filter to this terminal. The wire is then connected to the filter output.

On a transmitter, the filter can be used with a crystal microphone, but volume will be reduced due to the loading effect of the 50,000-ohm input impedance of the filter on the high-impedance crystal. In a hi-fi system, the filter can be installed between the preamplifier and the power amplifier units.

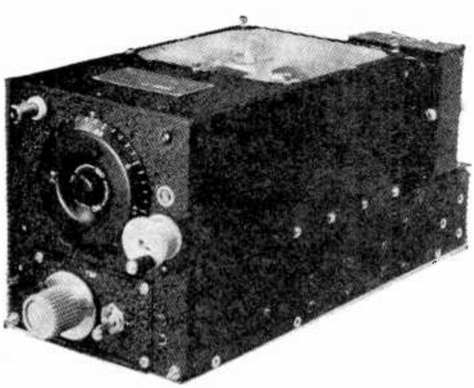
Using the Filter. Turn the control knobs to the position that will clear up the maximum amount of noise without affecting the intelligibility of the speech or distorting the music any more than necessary. For communications work, especially under noisy conditions, you will find that the narrower bandpass settings are the most desirable. If conditions on the band improve, you may want to set the filter for a wider response, but let the noise on the band dictate this. Should noise conditions clear up completely, or if you want an absolutely flat response, you can easily switch the filter completely out of the circuit by rotating the controls fully counterclockwise until the switches engage. The response will now be an essentially flat ± 1 db from 10 to 50,000 cycles. The filter itself has less than one per cent total harmonic distortion in its bandpass for any given setting of the controls.

The device can also be used for many special effects in tape recording, where it functions almost in an opposite manner to a reverberation unit or echo chamber. You can usually connect the filter into the tape recorder's recording preamplifier right at the record level controls. (Naturally, for stereo effects you will require two filters.) With the filter in the circuit, and the controls rotated clockwise, you will notice a marked decrease of high and low frequencies. Since all the high-fidelity manufacturers are trying to open up the frequency response, you may well wonder how such a filter can be considered beneficial. Speech recorded through the filter will easily simulate telephone conversations, or communications radio reception. Other applications are certain to suggest themselves upon experimentation.

In a mobile installation, you will find this filter an ideal adjunct to your electronic equipment, be it broadcast, Citizens Band or amateur radio. Static noise is largely a high frequency function, and as you can sharply attenuate high frequencies with this filter, you can reduce static.

If you follow the diagrams, photographs and instructions, you will have no trouble putting the filter together and getting it to work properly. After you have used it for a while to silence static, or break through local noise with your transmitter, you'll probably find it indispensable. —30—

ARC-5 TUBE SUBSTITUTES



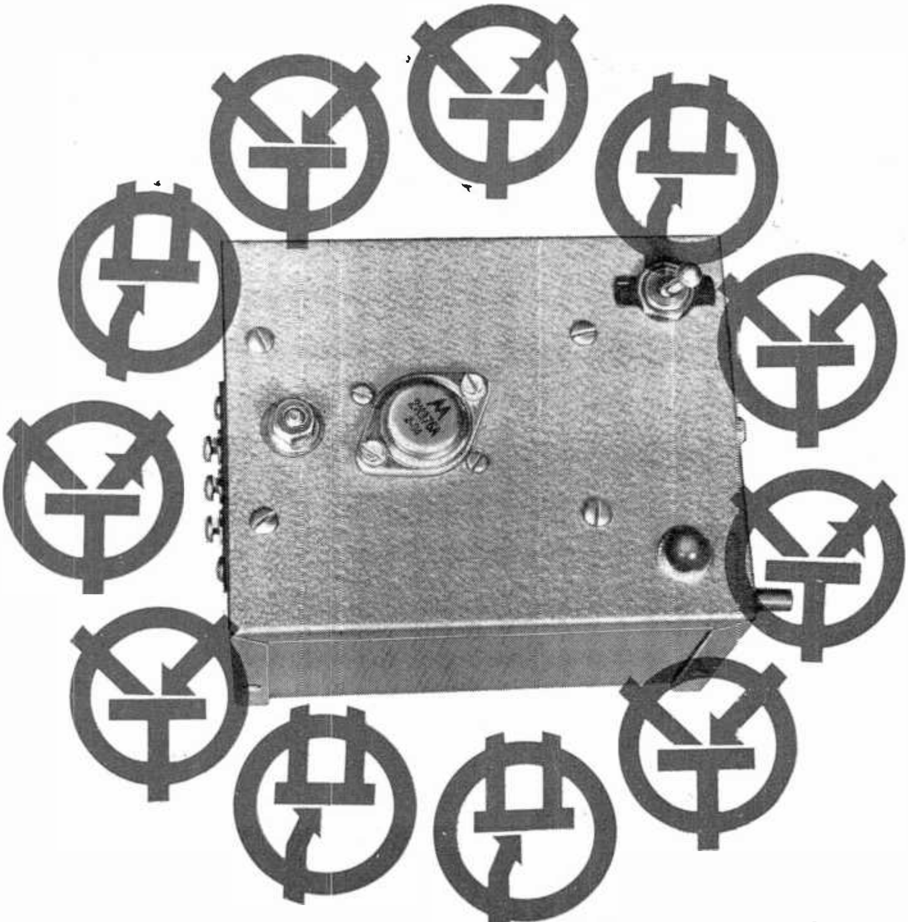
A 6-volt heater supply is easier to come by than a 12-volt supply, and 6-volt tubes are usually available.

IT IS OFTEN simpler to substitute 6-volt tubes for 12-volt types in an ARC-5 Command receiver than to worry up a power supply with a 12-volt capability. You *can* phase the 6- and 5-volt windings of the transformer and come up with a usable 11 volts, but it may be less difficult to use 6 volts, and replacement 6-volt tubes are more readily available. Here is a list of the ARC-5 tubes and their 6-volt counterparts:

12SK7	6SK7
12K8	6K8
12SR7	6SR7
12SQ7	6SQ7
12SF7	6SF7
12A6	6V6 (metal type)

In most ARC-5's, you can substitute a 6SQ7 for a 12SR7 as well as the 6SR7—in case you have trouble locating the latter. For more information, see "Converting Your First Command Receiver" in POPULAR ELECTRONICS, June, 1963. The tube substitutes listed are directly interchangeable, after rewiring the original circuit for parallel filaments.

—*E. H. Marriner, W6BLZ*



PERPETUAL TRANSISTOR POWER PACKAGE

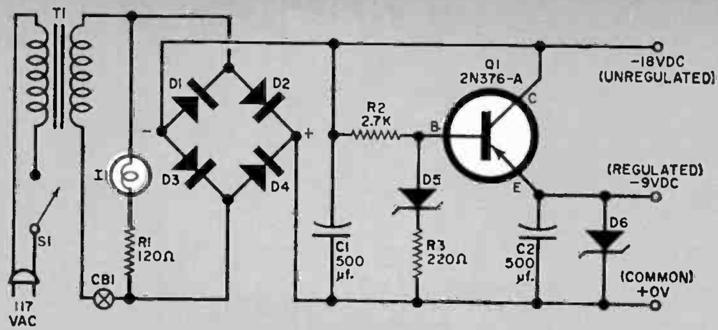
Power your transistorized electronic equipment with this well-filtered, regulated semiconductor supply

By LYMAN E. GREENLEE

FOR THE EXPERIMENTER who builds and operates transistor devices that pull a fairly heavy operating current, say in the 200 to 250 ma. range, the cost of a few sets of batteries every season can mount up. Yet batteries have advantages that are hard to beat. They don't cause hum, they're dependable, and the mercury and manganese (alkaline) types will give a relatively constant voltage under load until the end of their useful life.

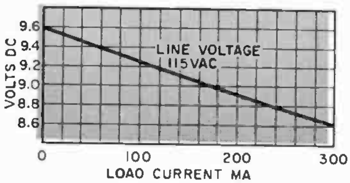
For portable use, batteries are about the only practical power supply; but why continue to buy them for use in the workshop when you can easily build an a.c.-operated substitute with the same virtues? After the battery replacement

Circuit of the regulated power supply is simple but effective. The circuit breaker provides protection from failure.

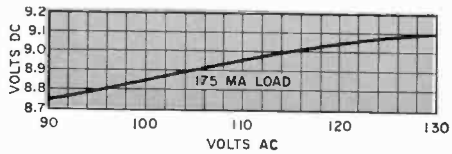


PARTS LIST

C1, C2—500-μf., 25-volt electrolytic capacitor
CB1—1-amp. circuit breaker (Allied Radio Stock No. 33B980 or equivalent)
D1, D2, D3, D4—1N2482 silicon diode
D5—1N960B zener diode, 9.1 volts, 400 ma.
D6—1N2974B zener diode, 10 volts, 10 watts
I1—6-volt pilot lamp (Drake Type 121 or equivalent)
Q1—2N376-A transistor
R1—120-ohm, ½-watt resistor
R2—2700-ohm, ½-watt resistor
R3—220-ohm, ½-watt resistor
S1—S.p.s.t. toggle switch
T1—12.6-volt, 1-amp. filament transformer
1—3" x 4" x 5" Minibox (Bud CU-2105-A or equivalent)
Misc.—Line cord, transistor socket, output terminal strip, wiring terminal strips, etc.



Load current change vs. output voltage



Line voltage change vs. output voltage.

described here has served you long enough to save back its initial cost, you pay practically nothing, for the drain on the power line is so trivial that the light bill will never notice it.

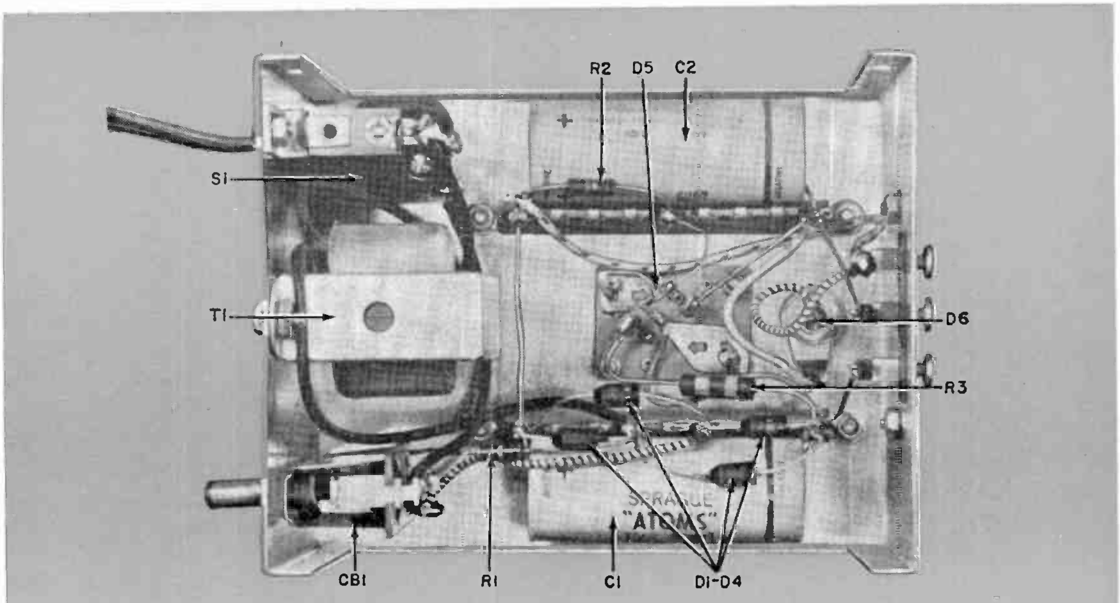
The "Perpetual Power Package" is a power supply operating from the utility a.c. power line, but it differs from the usual ones in an important respect: it's *regulated*. This adds a bit to the cost of the unit, but reduces hum to negligible proportions, insures steady voltage under big changes of load within its range, and guarantees it will last a long, long time.

As a bonus, regulation also offers protection from line voltage surges that can cause trouble when an unregulated supply is used to power transistor devices. In fact, this unit is practically fail-safe, since any ordinary part failure cannot cause damage to the transistors in the device being supplied, such as the electronic amplifiers of a transistorized tape recorder, an audio amplifier or a radio.

About the Circuit. The portion of the circuit preceding the regulator is conventional except for the use of a circuit breaker in the secondary. This device is included to provide protection in case a diode, a filter capacitor, or regulating transistor *Q1* fails. Filter capacitor *C1* provides a considerable degree of smoothing of the rectified output from the diode bridge circuit, insuring reasonable freedom from hum for the −18-volt unregulated output.

Resistors *R2* and *R3* and zener diode *D5* establish the base bias for transistor *Q1*, which is the series regulating element for the regulated −9-volt output. Capacitor *C2* provides additional smoothing, and also acts as a low-impedance path to ground for a.c. signals in circuits powered by the supply.

Zener diode *D6* is normally nonconducting, due to its 10-volt zener rating, but



Parts are placed for mechanical convenience, since there are no critical circuits.

it acts as a "safety valve" in case a failure in the regulating circuit allows the voltage at the emitter of *Q1* to rise to —10 volts for any reason. If this happens, *D6* goes into zener action and prevents the output from rising above —10 volts, thereby protecting the transistors and other parts in the load circuit from damage. Even a failure of *D6* will probably only cause circuit breaker *CB1* to open, since zener diodes almost always fail by breaking down to a short circuit rather than by becoming open-circuited. The author became convinced of the value of this feature when a failure in an earlier power supply cooked all the transistors in an expensive tape recorder's recording and playback amplifiers!

The regulating action results from the fact that an increase in current drawn by the load that causes the voltage at the emitter of *Q1* to fall tends to cause the base-to-emitter current to increase. This causes the internal resistance of *Q1* to drop, thereby holding the output voltage relatively constant despite the increase in current drawn by the load. The left-hand graph on page 54 shows the relatively small change of output voltage as the load current is varied from 0 to 300 ma.

The value of *R3* was chosen to limit the dissipation through diode *D5* to 368 milliwatts when the unregulated output is at —18 volts. Since zener diodes have a nominal tolerance of ±5 per cent, the actual output voltage will differ somewhat with individual diodes. The value of *R2* may be changed to any value between 1200 ohms minimum to as much as 3600 ohms, if it is desired to adjust the output voltage to exactly 9 volts under full load. Reducing the value of *R2* will increase the output voltage, and vice versa.

Changes of the a.c. line voltage from 90 to 130 volts also have a relatively small effect on the output voltage, as the right-hand graph on page 54 shows.

Construction. Building the unit is very simple, since there are no r.f. circuits, and hence no troubles from stray coupling or feedback. If the general layout shown on this page is followed, all parts will fit easily into the Minibox with room to spare. Transistor *Q1* and zener diode *D6* use the box as a heat sink, but must be electrically insulated from it with mica washers. After drilling the necessary holes for these parts, carefully de-burr the edges so no sharp corners will penetrate the mica and cause a short. Take the usual precaution of using a heat sink when soldering any of the semiconductor leads. A little sili-

(*Continued on page* 111)

Tuning Up on the New 460-Mc. Police Frequencies

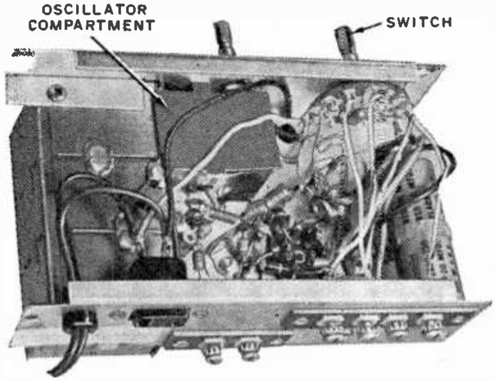
Those "mizzuble" police departments! You go out and buy a 30-50 mc. FM police and fire receiver so you can listen to their calls, and what do they go and do? They change frequencies—to 460 mc.! Well, you can still hear them. Just modify this UHF TV converter . . .

By KEN GREENBERG

WHILE MANY police departments and other services still utilize the 30-50 mc. frequencies, many more are making the switch to 450-460 mc. The police aren't the only ones you'll find up there either. There are stations in the Business Radio Service, fire departments, taxis, and also a Class A Citizens Band allocation between 460 and 461 mc.

A simple way to make these higher frequencies attainable is to modify one of the commercial UHF-TV converters, such as the Blonder-Tongue BTC-99 shown here. This unit costs about $20, and after a couple of circuit changes does a more than adequate job of receiving 450-460 mc. signals with excellent frequency stability. These signals are FM, however, so the converter output must be fed to a suitable receiver. A communications receiver with an NBFM adapter can be used, if it is equipped for 20-30 mc. operation, but it would be better to use a 30-50 mc. FM receiver, such as the Lafayette HE-51, the Monitoradio MR-33, M-40, PR-35 or DR-200, the Hallicrafters CRX-1, or the Realistic RP-30/50.

Circuit Changes. The Blonder-Tongue BTC-99 is tunable from 470 to 890 mc., and the i.f. output is between 77 and 86 mc. (channels 5 or 6). The modification



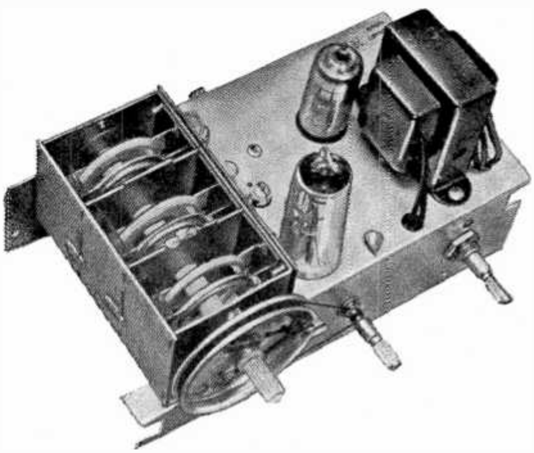
With converter removed from cabinet, up-end chassis, flip oscillator compartment cover to see C15.

is simply a matter of extending the low end to about 450 mc. and altering the i.f. to a frequency that can be picked up by a suitable receiver.

Before you start digging into the converter, be sure there are 450-460 mc. stations in your area. A list of some of the police departments using this band is included here, and you can consult the registries available from Communication Engineering, P.O. Box 629, Mineola, N.Y.

Remove the converter chassis from the cabinet by pulling off the knobs, and removing the two self-tapping screws from the back of the chassis. Slide the chassis out of the cabinet, and turn it over. Remove the oscillator tube compartment cover by sliding it toward the front of the chassis.

Top view of chassis with tuning compartment cover removed. Three double sets of rings are the coils.

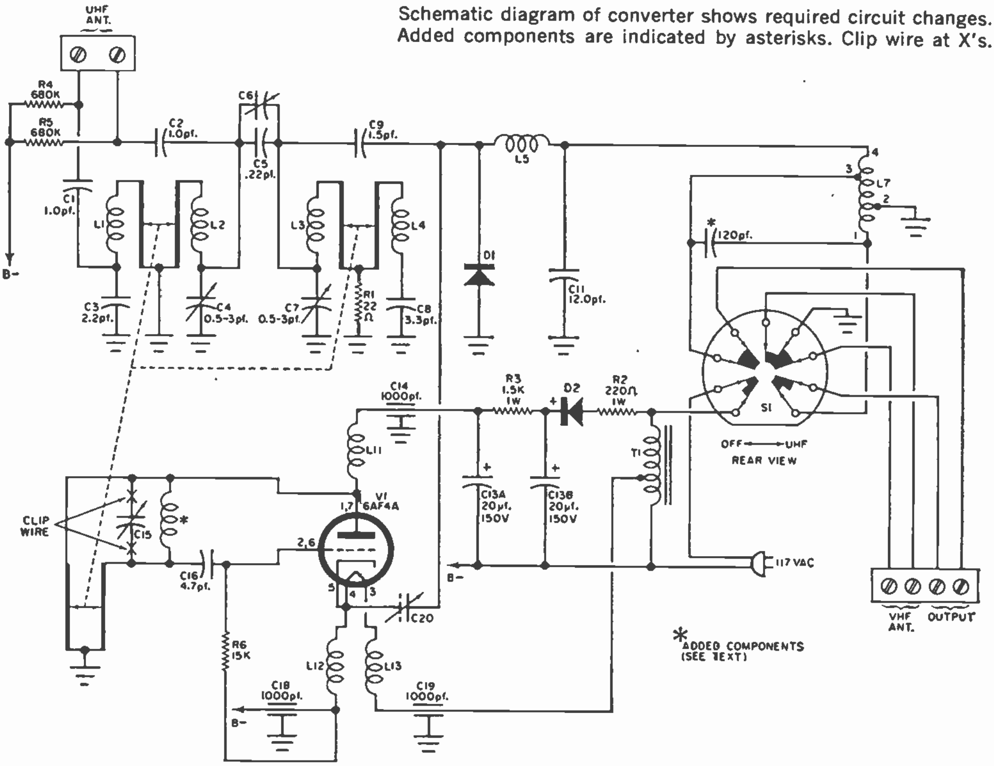


POLICE STATIONS ON 450-460 MC.

There are many stations using this particular range of frequencies. We have listed below some of the police department stations that employ them. Other stations are in the process of converting to these higher frequencies, and new ones are appearing almost daily. Tuning across the range is the best way to find out what's on. You'll hear everything from business communications to police and emergency calls—and have lots of fun.

LOCATION	STATION	FREQUENCY
Mobile, Ala.	KIA559	458.10
Coconino, Ariz.	KPI88	458.05
Phoenix, Ariz.	KPD46	458.15
Alameda, Calif.	KMK401	453.72
Beverly Hills, Calif.	KMJ240	453.65
Burbank, Calif.	KMZ32	458.90
Long Beach, Calif.	KMA651	458.45
Los Angeles, Calif.	KMF926	453.35
Pomona, Calif.	KMF375	451.25
Sacramento, Calif.	KF6904	458.90
Jefferson, Colo.	KAU96	453.05
Miami, Fla.	KIJ692	453.55
Palm Beach, Fla.	KJA51	458.85
Atlanta, Ga.	KIX73	453.35
Honolulu, Hawaii	KUT95	453.05
Hauula, Hawaii	KUT97	453.35
Blackfoot, Idaho	KBV25	453.45
Washington, Idaho	KEN95	458.75
Chicago, Ill.	KE7229	453.25
Humboldt, Iowa	KSJ745	453.25
Jefferson Co., Ky.	KET40	453.05
Penobscott, Me.	KCH32	458.25
Baltimore, Md.	KG2322	458.20
Boston, Mass.	KCF751	453.35
Warren, Mich.	KQB275	458.15
Bloomington, Minn.	KDH44	458.15
Dakota, Minn.	KAV96	458.65
Minneapolis, Minn.	KAV72	453.15
St. Louis, Mo.	KAS98	453.25
Clark Co., Nevada	KPE64	458.05
Albany, N.Y.	KEJ92	458.05
Selden, N.Y.	KEH67	453.25
Ithaca, N.Y.	KEN35	458.60
Cincinnati, Ohio	KEQ80	453.50
Harrisburg, Pa.	KGL87	458.35
Philadelphia, Pa.	KD6365	453.15
Memphis, Tenn.	KDJ91	453.90
Tacoma, Wash.	KOA801	458.55

Schematic diagram of converter shows required circuit changes. Added components are indicated by asterisks. Clip wire at X's.



A twisted wire "gimmick" capacitor (*C15*) is connected to the tuner in the oscillator compartment. Clip these wires ½" from the points at which they are soldered to the tuner. Do not disturb any other wiring in this compartment.

To lower the i.f. output to 20-30 mc., wind a 22-turn coil close-wound on a 7/64" drill as a form. Use No. 24 enameled wire, and tin the leads—which should be no more than ¼" long. Solder the coil to the remaining ½" ends of the twisted wires. If you have a 30-50 mc. receiver, wind a 35-turn coil and install it in the same fashion. Now replace the compartment shield cover.

Extending the frequency coverage down to 450 mc. requires the addition of a single capacitor. Near the rear of switch *S1* is a coil with a three-color winding. Counting the leads inward from the open end of the chassis, solder a 120-pf. ceramic disc capacitor from leads 1 to 3, as shown on the schematic diagram above. On the top of the chassis, locate the two brass hexagonal slotted screws and screw them down to the chassis, but do not tighten them. Back each screw off exactly 5⅛ turns, being careful not to loosen the mounting nuts.

Checking Operation. Using 300-ohm foam-filled twin-lead, connect your antenna to the UHF ANT terminals on the converter. A short length of twin-lead now connects the TV set terminals to the receiver antenna terminals. Depending on the receiver used, tune it to between 20 and 30 mc. or 30 and 40 mc. for reception in the 450-460 mc. range.

To adjust the converter tuning for more sensitivity, touch up the setting of the brass screws while a station is tuned in. Now replace the converter chassis in the cabinet, and replace the self-tapping screws and knobs. While it may be necessary to touch up the converter tuning dial slightly to bring the converter into the desired tuning range of the receiver, the dial of the converter will not be adjusted once set, all tuning being done at the receiver.

Antenna Problems. Antennas for this unit are not too easily available. Unfortunately, you are somewhat limited by the 300-ohm input impedance to the

(*Continued on page* 107)

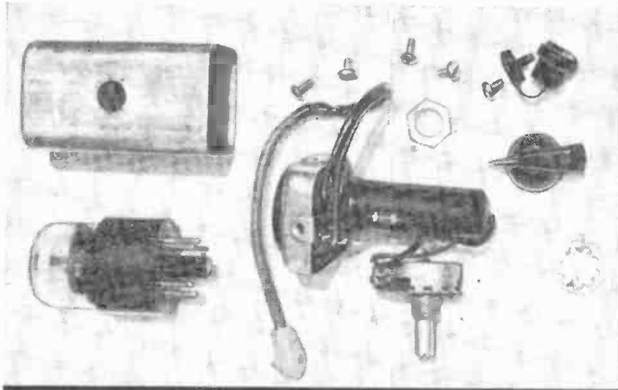
Don't get tangled in endless cords. A simple way out of this photo problem is to build a . . .

SIMPLE SLAVE STROBE SYNC

By NEAL SHEFFIELD, Jr.
W4ZPZ

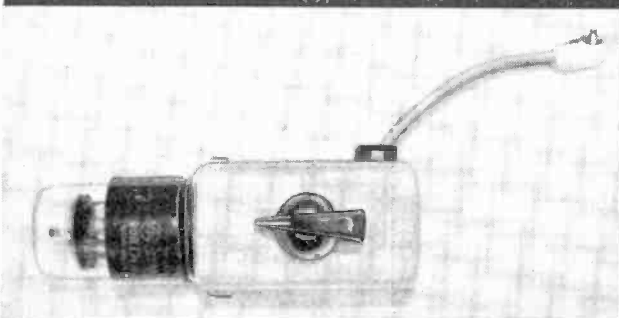
TODAY, SMALL PORTABLE electronic flash units, called "strobes," are available for less than $15. They are widely used, reliable, and in the long run less expensive than the expendable flash bulbs they replace. Photographers employ strobes in multiple flash techniques for special lighting effects with their costly professional equipment. The amateur can achieve similar results with inexpensive strobes and the "Slave Strobe Sync" adapter. The hazard of excessive shutter current and the nuisance of long cords draped about the room will be eliminated.

The strobe slave adapter will solve these problems because it is activated by light. It reacts instantly to trigger a flash simultaneously with its master. The adapter is self-contained, portable,



All parts are shown disassembled at left, While major electrical parts are wired, unit is not yet installed.

The adapter is shown removed from the can. To install, first feed pot shaft through hole in can, then tighten nut.



Here's the assembled unit, lacking its base. Use strain relief in P/C cord to avoid stressing the solder joints.

and connected only to the sync terminals of the strobe. It provides good sensitivity under varying ambient light conditions. In a medium-sized room it can respond to bounced light from more than 20 feet away.

The Strobe. The construction of the slave adapter does not require any internal alteration of the strobe itself, so DON'T dig into it. You won't be able to see much, and the large capacitor can store enough energy to burn the end off a screwdriver. Even after the strobe has fired, about 50 to 100 volts charge can remain on that capacitor for days.

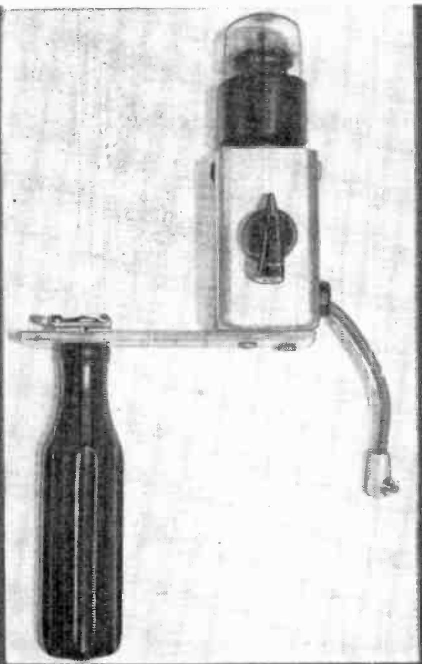
To satisfy any experimental curiosity, a typical strobe diagram is shown on the next page. Units of different models and manufacture may vary somewhat.

The necessary high voltage (300 volts to 450 volts) can be supplied directly by high-voltage batteries, by house current in conjunction with a transformer or voltage doubler, or by transistorized converters. Here, a voltage doubler circuit provides a 300-volt charge to the 1000-μf. storage capacitor. Note that the fully charged storage capacitor is connected at all times to strobe tube *V2*. This high pressure xenon gas-filled tube normally has an infinitely high resistance. No current flows until a triggering pulse of several thousand volts initiates ionization of the xenon gas. Capacitor *C3* then discharges through *V2*, and a bright flash is emitted.

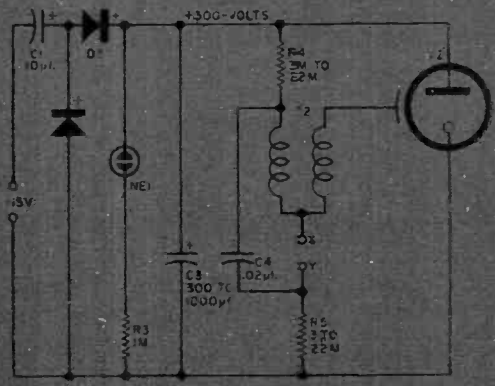
Resistors *R4* and *R5* are current limiting resistors which allow *C4* to charge. When *C4* is shunted through the primary of *T2*, a high voltage pulse is generated in the secondary winding. This pulse is sufficient to initiate the flash.

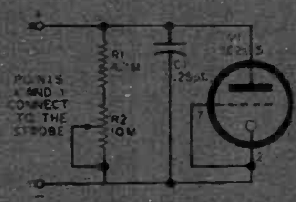
The Adapter Circuit. The heart of the adapter circuit is the 1C21 gas-filled triode (*V1*). It is a cold cathode (no filament) glow-discharge control tube which is normally used as a relay control tube or voltage regulator. In this application it might be called a light-sensitive photoelectric control tube. The cold cathode feature is important, in that no filament supply is necessary.

When the voltage on the anode, cathode, and grid reach the critical or



Mount the adapter on a bracket-mounted handle. Accessory shoe on bracket provides a convenient strobe base.





Schematic above shows typical strobe unit. At right is adapter unit.

All it takes is a triggering flash to set the slave strobe off. Adjust potentiometer R2 for best sensitivity.

ADAPTER PARTS LIST

C1—0.25-µf., 200-volt capacitor
R1—4.7-megohm, ½-watt carbon resistor
R2—10-megohm linear taper potentiometer
V1—RCA 1C21 tube (Allied Electronics Stock No. E1-1C21, $4.15)
1—Octal tube socket (Amphenol 78S8)
1—Mounting box (Vector B10M)
1—Strain relief bushing (H. H. Smith #939)
Misc.—Knob, spaghetti tubing, solder, wire, hardware, sync cable (available at most photo dealers)

breakdown point, the gas ionizes and conducts. With the 1C21 operating as a diode (grid connected to cathode), the breakdown voltage is about 180 volts. Here, the 1C21 is operated just below this breakdown point. When a burst of light energy reaches the tube, the gas ionizes, and the conduction path is established.

Capacitor *C1* is a bypass for any a.c. that might accumulate and cause false or erratic firing. It also improves the reliability of the trigger circuit. Resistors *R1* and *R2* complete a voltage divider across the strobe socket. Resistor *R2* is the sensitivity control and is used to set the operating voltage precisely.

Construction. The author used a Vector B10M as the enclosure; however, almost any small box or i.f. shield can will suffice. The original octal plug is replaced with an Amphenol 78S8 octal socket. On the other end, the miniature shield base and its two rivets are removed. The remaining Vector parts are

(*Continued on page* 110)

DX AWARDS

Last month we announced the beginning of the new States Verified contest (page 86, April issue, in case you missed it). This month we are presenting once again for your convenience the coupon and rules for the Countries Verified contest. You may be able to claim more countries than you think you can—turn to Short-Wave Report on page 93 and find out.

1 Each applicant must be a registered WPE Short-Wave Monitor, and must enter his call letters on the application form.

2 Each applicant must submit a list of stations for which he has received verifications, one for each country heard. The list should contain 25, 50, 75, 100, or 150 countries, depending on which DX award is being applied for. And the following information must be furnished in tabular form for each verification:

(a) Country heard
(b) Call-sign or name of station heard
(c) Frequency
(d) Date station was heard
(e) Date of verification

All the above information should be copied from the station's verification. Do not list any verification you cannot supply for authentication on demand.

3 All pertinent verifications, whether QSL cards or letters, should be carefully packaged and stored by the applicant until such time as instructions are received to send in some or all of them for checking purposes. Instructions on how and to whom to send the verifications will be given at that time. Failure to comply with these instructions will disqualify the application.

4 A fee of 50 cents (in U.S. coin) must accompany the applicant's list of verifications to cover the costs of printing, handling, and mailing. This fee will be returned in the event that an applicant is found to be ineligible for any of the awards. Applicants outside of the United States may send 60 cents (U.S.) in coins of their own country if they so desire. However, please do not send any International Reply Coupons (IRC's) when applying for a DX Award.

5 Apply for the highest DX award for which you are eligible. If, at a later date, you become eligible for a higher award, then apply for that award, following these rules and regulations exactly as before.

6 Mail your verification list, fee, and the application form to: Hank Bennett, Short-Wave Editor, POPULAR ELECTRONICS DX AWARDS, P. O. Box 254, Haddonfield, N. J. 08033. Include in the envelope only those items which are directly related to your entry for the award. 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). If you want to ask other questions or supply news items, reports, etc., use another envelope.

POPULAR ELECTRONICS' DX AWARD APPLICATION FORM

(please print)

WPE Call Letters ______ Name ______

Address ______ City ______ State ______ Zip Code ______

Please enter my application for the following POPULAR ELECTRONICS' DX AWARD:

(check one) 25 ☐ 50 ☐ 75 ☐ 100 ☐ 150 ☐

☐ I have enclosed a list of the required number of countries, and I hereby certify that I hold a verification from at least one short-wave broadcasting station in each of the countries listed

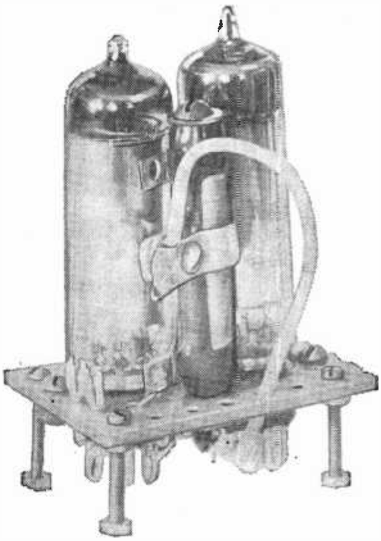
☐ I have enclosed 50 cents to help cover the costs of processing and mailing my DX Award

Signature______________________ Date__________1964

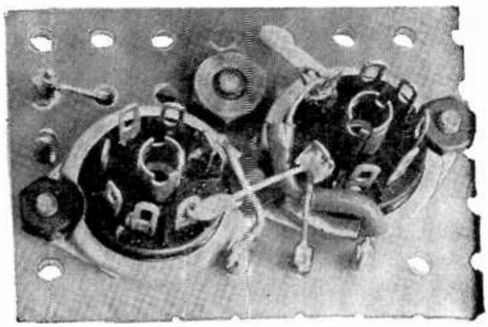
Mail to Hank Bennett, POPULAR ELECTRONICS DX AWARDS, P. O. Box 254, Haddonfield, N. J.

POWER SUPPLY REGULATION

Variable regulated power? All it takes are several VR tubes, one resistor, and your present supply



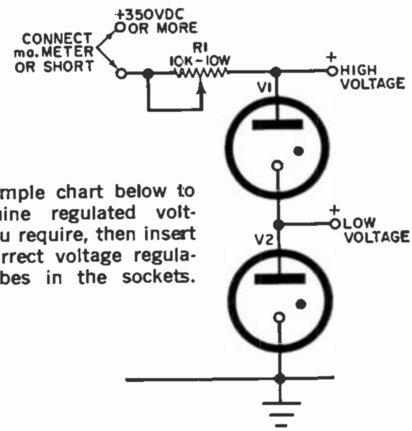
Mount the tube sockets on a piece of perforated board to facilitate installation in the power supply. Drill mounting holes in chassis.



HAVE YOU EVER built an experimental circuit and wished that you had an electronically regulated power supply? The cost of such units is usually fairly high, but an assortment of VR tubes and the device described here will probably solve most of your problems. If you already have the tubes, the additional parts required will cost less than a dollar. While you will not have a continuously variable supply, you should be able to select a suitable voltage for your application from among the eight choices offered you between 75 and 300 volts.

Building the Regulator. The regulator consists of two voltage regulator tubes (*V1* and *V2*) connected in series. Start by cutting the two holes for the 7-pin sockets and mount them using three nuts and bolts. Note that a single nut and bolt is used to mount both sockets at their junction. A 10,000-ohm, 10-watt resistor is used as the dropping resistor (*R1*), and this is mounted with cup washers and a 2½" bolt and nut. Small flea-clip connectors are used as feed-throughs to bring lead wires from one side of the phenolic chassis board to the other.

To permanently mount the unit in



Use simple chart below to determine regulated voltage you require, then insert the correct voltage regulator tubes in the sockets.

V1	V2	HIGH V	LOW V
OA2	OA2	300	150
OA2	OB2	258	108
OB2	OA2	258	150
OB2	OB2	216	108
OA2	OC2	225	75
OC2	OA2	225	150
OB2	OC2	183	75
OC2	OB2	183	108
OC2	OC2	150	75

your power supply, place a 2" bolt at each of the four corners of the board and drill four matching holes in the power supply chassis where clear space is afforded. Place nuts on the bolts, both above and below the chassis, to permit leveling and locking the phenolic board rigidly in place.

Using the Regulator. Referring to the tube chart on the previous page, choose the operating voltages you desire, and plug the indicated tubes into the sockets. You will notice that a tap is provided between the two tubes, and this gives you a choice of either a low or a high voltage to select from with every tube combination.

Applying at least 350 volts d.c. from the power supply, connect a milliammeter to the terminals shown in the diagram. Two terminals are installed so that you can either connect the meter to adjust the regulator or short-circuit the terminals for normal operation. Now adjust the slider on the resistor until the meter reads 30 ma. with no load applied to the regulator.

When a load is placed on the regulator, some of the 30 ma. will be diverted from the VR tubes to the load. If the load should draw more than the 30 ma., the VR tubes will go out and no regulation will be taking place. As long as both VR tubes are lit and the load doesn't exceed the 30-ma. limit, you will find that you have as adequate regulation as most experiments will require, and for very little cash outlay, not to mention ease of assembly.

—*Alex F. Burr, K3NKX*

Armed Forces Day Communications Tests

"POWER FOR PEACE" is the theme of this year's Armed Forces Day communications tests to be held May 16. The annual event is designed to give amateurs an opportunity to work military stations in cross-band operation, and to qualify for a certificate by perfectly copying c.w. or radioteletype (RTTY) transmissions of special messages from the Secretary of Defense.

QSL cards can be sent only to those licensed amateurs who work a designated military station, but anyone who has the equipment and ability may copy the Secretary of Defense messages and receive a certificate. The c.w. transmissions will be at a speed of 25 wpm.

The receiving tests will begin with a ten-minute CQ, followed by instructions and the test message. Code transmissions will be made at 0300 GMT by WAR/NSS/AIR, Washington, D.C., on 3347, 3385, 4015, 5200, 6970, 6992.5, 7301, 7680, 13,995, and 14,405 kc. In San Francisco, A6USA and NPG will transmit on 6997.5 and on 4005, 7301.5, and 13,920 respectively. AG6AA, Hamilton AFB, Calif., will transmit on 7832.5 kc. RTTY transmissions will begin at 0335 GMT for radioteletype hobbyists.

To qualify for a certificate, send "as received" transcriptions to Armed Forces Day Contest, Room 5B960, the Pentagon, Washington, D.C. On the same sheet include the time, frequency, and call-sign of the station copied, as well as your name, call-sign (if any), and address.

Two-way contacts with amateur stations will be made from 1400 to 0245 GMT by WAR, NSS, and AIR. NPG will be on the air from 1800 to 0800 GMT. WAR will transmit using c.w. on 4001.5, 6992.5, and 7325 kc.; on 4020 using AM; and on 14,405 using upper SSB. Operators will tune the adjacent amateur band (80, 40 or 20 meters) for calls. NSS will operate c.w. on 3365, 4015, 6970, and 7301 kc.; AM on 4040 kc., and SSB on 14,385. RTTY contacts will be made using 4012.5, 7380, and 14,480 kc. AIR will use c.w. on 3397.5, 6997.5, 13,995, and 20,994 kc., lower SSB on 7305, upper SSB on 14,397, and RTTY on 7332 kc. In the West, NPG will use c.w. on 3357, 4005, 6835, 7301.5, and 13,920 kc.; AM on 4045, SSB on 13,975.5, and RTTY on 4001.5, 7375, and 13,547 kc. -30-

"THE FABULOUS DIODES"

Many electronics experts agree that the usefulness and versatility of the diode will—within another three years—exceed that of the transistor

By LOUIS E. GARNER, Jr.

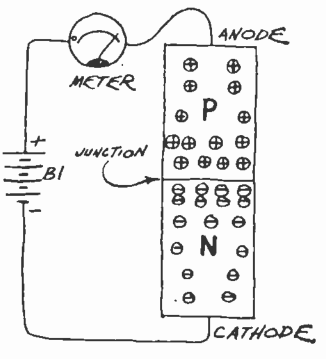
Since the transistor is only a little over a decade old, many hobbyists—and especially newcomers to electronics—feel that *all* semiconductor devices are quite young. The truth of the matter, however, is that the semiconductor diode is one of the *oldest* of radio-electronic components, predating even the venerable electron tube as a widely used device.

A majority of the early radio receivers employed a crude type of point-contact diode as their detector—essentially, a small piece of galena (a crystalline lead sulphide mineral) to which contact was made with a fine wire dubbed a "cat's-whisker." Unreliable, of varying sensitivity, and time-consuming to adjust, this early semiconductor device was widely used, and often cursed. It was, in fact, the search for a superior detector that led to the development of the electron tube.

While the semiconductor diode was eclipsed for a while by the electron tube and, to some extent, fell into disuse and was forgotten, the success of the transistor has brought the device back into its own—but not as the unreliable, finicky, open-air, and ugly galena crystal. Instead, the modern diode comes in thousands of types and styles and is indeed a fabulous creation. Like the phoenix, it has been reborn, but with more vigor, reliability, and versatility. In addition to its ability to detect radio frequencies, the modern diode—in some of its forms—has acquired the additional capabilities of amplification and oscillation.

By definition, a diode is a two-electrode device. However, many modern diodes have three and even four terminal connections. While these multi-electrode devices are still diodes as far as their basic operating characteristics are concerned, the addition of extra electrodes permits the devices to perform some new and, as we shall see later, rather interesting feats of electronic wizardry.

How Diodes Work

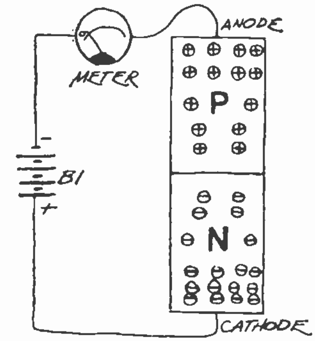


Diodes are essentially a junction of *p*- and *n*-type semiconductor materials. The diode derives most of its capabilities from its nonlinear, unidirectional electrical characteristics, i.e., its ability to conduct freely in one direction while acting as a high resistance or open circuit in the opposite direction.

The *p*-type material has a surplus of more or less evenly distributed positive-charged "holes." The *n*-type material has a surplus of evenly distributed, negative-charged free electrons. Suppose that a battery or other d.c. voltage source were connected in series with the meter and diode, so that a positive voltage would be applied to the *p*-type material and a negative voltage to the *n*-type. Under these conditions, the positive holes would be repelled by the positive voltage and would migrate towards the junction. At the same time, the free electrons in the *n*-material would be repelled and accumulate near the junction.

Thus, a surplus of positive and negative *current carriers* would accumulate at the junction, with a certain percentage "spilling over" into the opposite materials. Holes would migrate into the *n*-type material, where they would be absorbed and become neutralized by the surplus free electrons. At the same time, electrons would enter the *p*-type material, neutralizing holes there. New holes and electrons would be created by the applied d.c. potential and these, in turn, would migrate towards the junction. The result, then, would be a heavy flow of current, as indicated on the meter. The diode, under such conditions, is said to be biased in its *forward* (or conducting) direction.

Let's consider the opposite situation now. With the battery voltage reversed, the positive holes accumulate at the negative terminal, while the free electrons gather at the positive terminal. The junction region is depleted of current carriers and, therefore, there can be no "carry-over" through the junction. Under these conditions, current flow is very low and the diode acts as a high resistance. It is biased in its *reverse* (or nonconducting) direction.



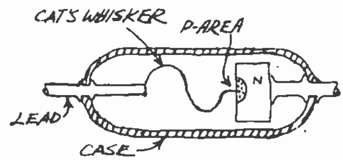
Going a step further, let's see what happens when the supply voltage is increased with the diode reverse-biased. At this point, we must remember that while there are a *majority* of holes in the *p*-type material there are also a few free electrons present (these are called, appropriately, *minority* current carriers). By the same token, there are a few positive-charged holes in the *n*-type material.

As the electrical pressure (voltage) is increased, these minority carriers start to accumulate in the junction area. Eventually, a certain amount of "carry-over" can take place, and the diode switches rapidly from a nonconducting to a conducting condition. In a way, we can say that the junction has "broken down." The diode current increases very suddenly and, unless there is something to limit current flow (such as a resistor in series with the battery), the diode will be destroyed. The voltage at which this reverse breakdown occurs is called the *zener* voltage.

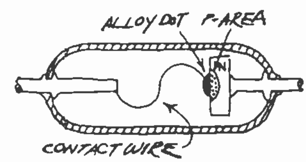
How They Are Made

Diodes are manufactured using essentially the same techniques that are employed in producing transistors. Thus, we have point-contact, alloyed-junction, grown-junction, mesa, planar, and epitaxial types. (See, also "Transistors—Types and Techniques," POPULAR ELECTRONICS, November, 1962, page 65.) The same types of semiconductor materials are used, including *n*- and *p*-doped germanium and silicon. In addition, some diodes are manufactured of intermetallic and metallic compounds, including copper oxide and sulphides, cadmium sulphide, gallium arsenide, and various selenium compounds.

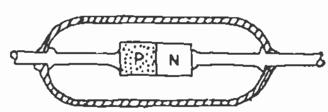
Physically, small diodes can be mounted in plastic, glass, metal or ceramic cases, while larger types can be assembled on flat plates, on cooling fins, or in electron tube-shaped envelopes. Externally, some may appear to be resistors or capacitors, others look like tiny buttons



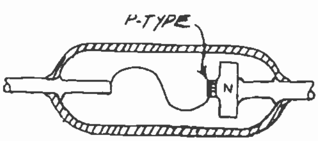
POINT CONTACT.



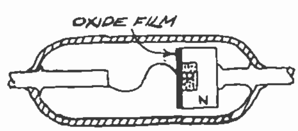
ALLOYED-JUNCTION



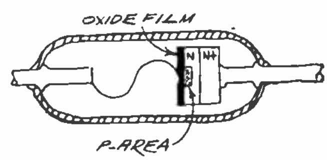
GROWN-JUNCTION



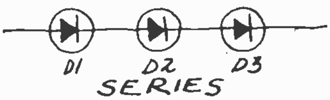
MESA

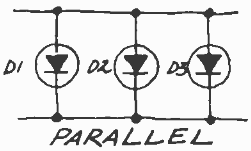


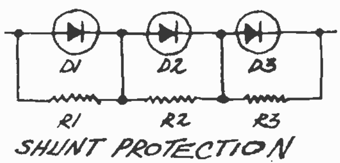
PLANAR

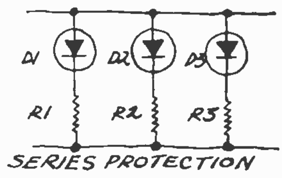


EPITAXIAL









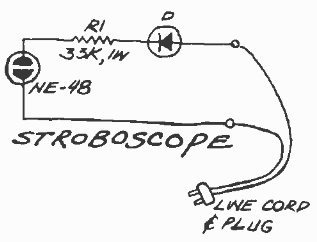
similar to a mercury cell battery, while still others seem to be transistors, for they are assembled in similar cases.

Aside from basic electrical specifications and materials of construction, there are many, many types of diodes. Some are designed for operation in their zener region . . . others are light-sensitive . . . still others have a variable capacitance characteristic. While most are single-junction devices, there are multilayer, multijunction types. Special schematic symbols are used to identify these different types.

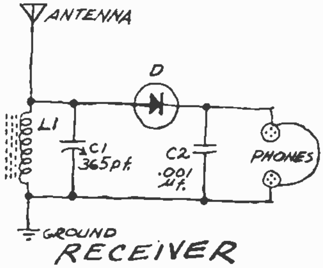
Where greater voltage or current handling capability is needed than is available in a single diode, several units can be connected in series or in parallel. The series connection is used where higher voltages must be handled, while the parallel connection is used to increase current carrying ability. A straightforward series or parallel connection can be employed where the individual diodes have virtually identical characteristics. If the diodes' characteristics are not identical, however, the voltage (or current) distribution may be such that one or more of the diodes are destroyed. To avoid this, shunt or series resistors can be employed to equalize voltages (or currents). Shunt resistors are used when the diodes are connected in series, series resistors when the diodes are wired in parallel.

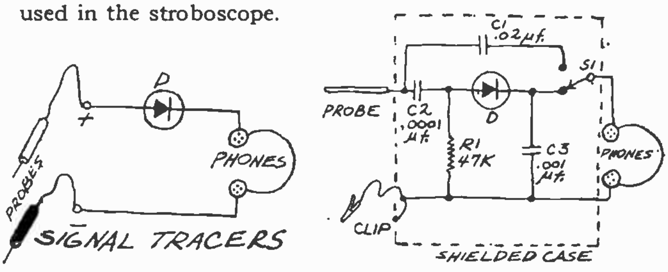
General-Purpose Diodes

Manufactured of germanium, silicon or selenium, and designed for a broad range of circuit applications, general-purpose diodes are identified by the basic diode schematic symbol. A line represents the cathode, while the anode is identified by an arrowhead. This symbol derives from the original point-contact diode, with the arrowhead indicating the direction of "classical" current flow—just the opposite of electron flow. The general-purpose types include such popular units as the 1N34 (and 1N34A), 1N38, 1N39, 1N56A, 1N58 and 1N66. In practice, the cathode lead is generally identified by a color-band, polarity marking, or similar symbol on the diode's body.



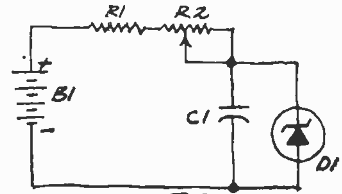
The adjacent diagrams illustrate typical general-purpose diode applications. Almost any general-purpose diode can be used in these circuits, provided the maximum ratings are not exceeded. Low-voltage types may be used in the receiver circuit, while a high-voltage type should be used in the stroboscope.





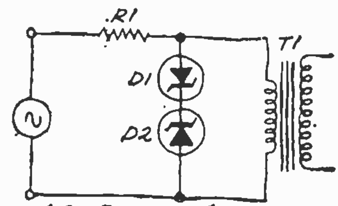
ZENER DIODES

Physically, low-power zener diodes look very much like general-purpose diodes. In fact, *any* standard diode can be used as a zener diode. Commercial zener diodes, however, are especially processed and selected for their performance in the zener region. Some zener diodes are manufactured primarily for use as voltage *regulators* and are so designated. Others are selected for close breakdown voltage tolerance and are referred to as *reference diodes*. Since the zener breakdown, when it occurs, builds up with the suddenness of an avalanche, zener types are sometimes called *avalanche* diodes. Finally, some firms manufacture special zener types which they identify as *Stabistors*.



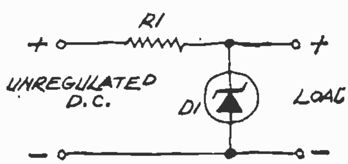
OSCILLATOR

A simple zener diode relaxation oscillator consists of a capacitor that is charged slowly by a battery through two series resistors. At the zener diode breakdown point, the diode discharges the capacitor—and the action is repeated. All components are chosen so that their combined time constant will give the audio frequency desired, while fixed resistance is used to protect the diode. The potentiometer is a frequency control. The battery voltage should be somewhat greater than the zener diode's rated breakdown voltage.



A.C. REGULATOR

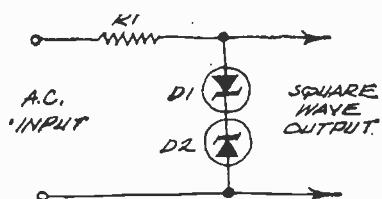
Zener diodes can be used as an *a.c. line regulator*. Two diodes are connected "back-to-back." One breaks down on positive line peaks which exceed its rated value while the other breaks down on negative peaks, in both cases dropping the excessive line voltage across the current limiting resistor.



D.C. REGULATOR

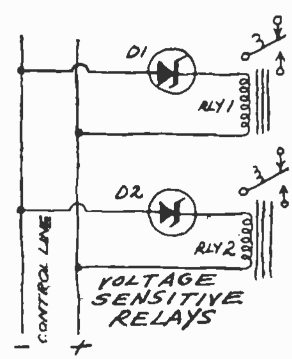
A *d.c. voltage regulator* circuit is similar to that of the a.c. regulator, except that a single diode is used.

The same principle used in the a.c. regulator can be applied in a simple *square-wave generator* or clipper. The applied a.c. voltage should be from 10 to 20 times the rated zener breakdown voltage for best action and good, sharp output square-wave signals. The series resistor is large enough to protect the diodes from excessive currents. Used in conjunction with an audio generator, this circuit will provide square waves for checking audio amplifiers and similar equipment.



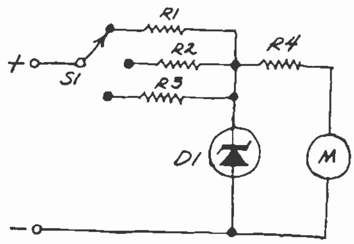
CLIPPER

A *voltage-sensitive* relay circuit can be used for remote control applications. In operation, the application of a d.c. voltage below either zener diode's breakdown voltage will have no effect. If the voltage is increased until, say, *D1*'s rating is exceeded, relay *RLY1* will close, but relay *RLY2* (assuming *D2* has a higher rating than *D1*) will remain open. If the voltage is then increased still further, until *D2*'s rating is exceeded, *RLY2* will also close. This circuit is well-suited to applications requiring sequential relay operation with remote voltage control.



VOLTAGE SENSITIVE RELAYS

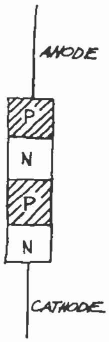
Zener diodes can also be employed in *meter protection*



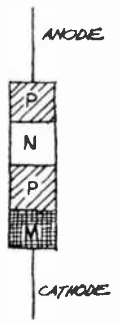
MULTIMETER PROTECTION

circuits. In the circuit shown here, *R1*, *R2*, *R3* and *R4* are the multimeter's multiplier resistors and *S1* is the range switch. The zener diode, *D1*, protects the meter against accidental overload damage. Its rating should be just slightly greater than the voltage required for a full-scale meter reading, but below the meter's maximum rating. Resistor *R4* is chosen so that its resistance, combined with the meter resistance, is considerably greater than the diode's resistance when in a breakdown state.

DIODE SWITCHES



BISTABLE

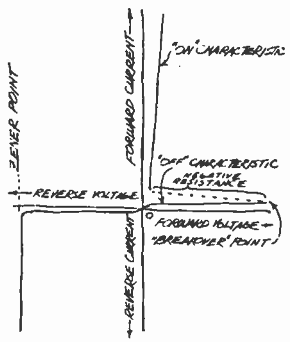


DYNISTOR

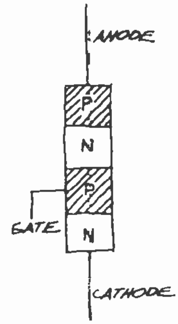
A diode switch is analogous to a mechanical switch in that it has two states—"off" and "on." When in an "off" state, it acts like an open circuit; and when "on," it conducts heavily. In practice, both standard and zener diodes may be used as switches by applying a bias voltage to hold the devices in a nonconducting state, then adding a control signal voltage of sufficient amplitude to cause heavy conduction. There are, however, a whole new class of semiconductor diodes and diode-like devices which are specifically designed for use as switches. Included in this class are the *bistable diode, dynistor, silicon-controlled switch, binistor, and double-based diode.*

The *bistable diode* is made up of four alternate layers of *p*-and *n*-type silicon. For this reason, it is also called a *4-layer diode.* In use, the bistable diode does not conduct and remains "off" when biased in its forward direction until the applied voltage reaches a predetermined trigger or "firing" voltage. At this time, the diode switches rapidly into a heavy conducting state, remaining "on" until the applied voltage is dropped to a very low value. When reversed-biased, it behaves very much like a conventional diode, acting as an open circuit until its zener breakdown voltage is reached. (See diagram below.)

Somewhat similar to the bistable diode, except that its basic material is germanium and its fourth layer is metallic rather than *n*-type semiconductor material, is the *dynistor.* The dynistor's forward characteristics are essentially similar to those of the bistable diode, but the unit does *not* block reverse current flow.

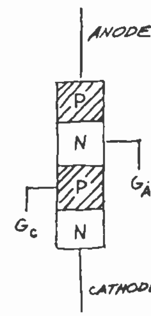


The *silicon-controlled switch* (SCS) is a four-layer device closely resembling the bistable diode, but with an electrical connection made to the third layer. A small "trigger" voltage applied to this electrode, called a *gate,* will switch the device from a nonconducting to a conducting state quite rapidly, even though the cathode-anode voltage is below that normally required to trigger. Several versions of this device are offered by various manufacturers. In its basic form, the SCS can only be switched "on" by a gate signal . . . afterwards, it can be returned to its stable "off" state only by dropping the anode-cathode voltage to a low value. Slightly modified forms which can also be switched *off* by the application of a reverse bias to the gate are called *Trigistors* (Clevite-Shockley) and *Transwitches* (Transitron). A germanium version of the device is called a *Dynaquad* by its manufacturer (Tung-Sol).



DYNAQUAD

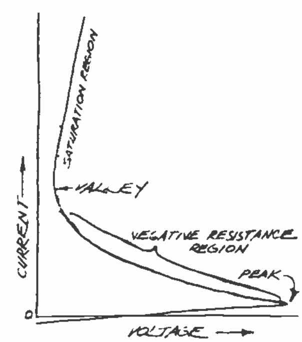
It is possible, of course, to provide an electrical connection for the second as well as the first, third and fourth layers in a four-layer device. In this case, we have another gate electrode and, to differentiate between the two gate connections, the one nearest the anode is called the *anode gate* (G_A), while the one nearest the cathode is termed the *cathode gate* (G_C).



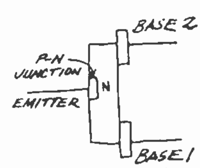
BINISTOR

One manufacturer of the four-layer, four-connection "diode" suggests that the anode gate connection be used as an output terminal. The device is then called a *binistor*, and new designations are assigned to each of the electrodes. The anode is called an *injector*, the anode gate a *collector*, the cathode gate a *base*, and the cathode the *emitter*.

At right is a generalized characteristics curve applicable to the whole "family" of four-layer diodes (except for the dynistor, which conducts when reverse biased). These devices do not conduct appreciably in either their forward or reverse direction until either their zener voltage is exceeded (in reverse bias mode) or their trigger or forward "breakover" point is reached. Once the breakover voltage is attained, the devices switch rapidly to a heavily conducting state, acting as low resistances even at low voltages. The effect of a trigger applied to a control gate is to reduce the anode-cathode voltage point at which breakover occurs. In effect, then, these four-layer switches have three forward states—an "off" state in which they do not conduct, a *transition* state during which they exhibit a negative resistance characteristic, and an "on" state in which they conduct heavily.

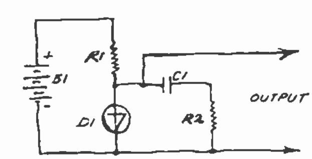


There is yet another diode switch, different in construction from the class of four-layer devices we've just discussed—the *double-based diode*, now more popularly known as the *unijunction transistor* (or UJT). This device consists of a bar of *n*-type germanium or silicon with ohmic contacts at each end, designated *Base 1* (B_1) and *Base 2* (B_2), and a *pn* junction slightly off-center. If B_2 is made positive with respect to B_1, the emitter-B_1 junction behaves like a high value resistor . . . up to a point. If sufficient voltage is applied to the emitter-B_1 junction, the device will switch suddenly from a high resistance to a low resistance (virtually a short circuit) state, passing quickly through a negative resistance transition region.



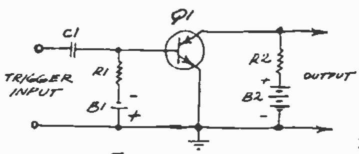
UNIJUNCTION

A *relaxation oscillator* circuit employing a bistable diode is shown at right. In operation, the voltage applied by



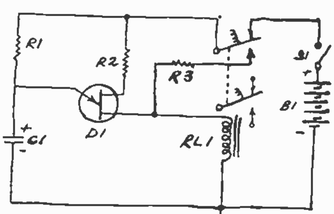
RELAXATION OSCILLATOR

the d.c. source (*B1*) charges the capacitor (*C1*) through series resistors *R1* and *R2*. The bistable diode, *D1*, remains in an "off" or nonconducting state until the capacitor voltage reaches the diode's trigger voltage, at which time the diode switches to a low-resistance conducting state and discharges the capacitor through its internal resistance and *R2*. Then the action repeats itself. In general, the battery voltage is considerably greater that the diode's trigger voltage. Resistor *R1* is much larger than *R2*. Both *R1*, *R2*, and *C1*, are chosen so that their combined time constant is appropriate to the repetition rate (frequency) desired.



FLIP-FLOP

The *flip-flop* circuit shown here is similar to those used extensively in computers. A controlled switch such as a Trigistor or Transwitch might be used (*Q1*). In operation, *Q1* is normally in a nonconducting or "off" state, and full battery (*B2*) voltage appears at its upper terminal. If a positive pulse is applied to the device's gate through blocking capacitor *C1*, the device switches to a heavily conducting state, dropping *B2*'s voltage across the load resistor, *R2*, and developing a negative output pulse. The device remains "on" until a negative pulse is applied through *C1*, at which time it reverts to the original "off" state, developing a positive output pulse. Battery *B1* applies a fixed gate bias to the device through *R1* to insure stable operation.



TIME DELAY

A *time-delay relay* using a unijunction transistor is at left. The relay closes a specified period of time after *S1* is closed, and then remains closed until *S1* is opened to "reset" the circuit. A simple *RC* time constant network is formed by *R1* and *C1* to furnish the delayed emitter voltage which "fires" the UJT. Base 2 voltage is furnished through *R2* and, of course, the upper relay contacts. Once the UJT fires, the relay is pulled in, removing the emitter and base 2 voltages and applying a "holding" voltage to the relay coil through *R3*. The second set of relay contacts is used to actuate an external circuit.

PHOTODIODES

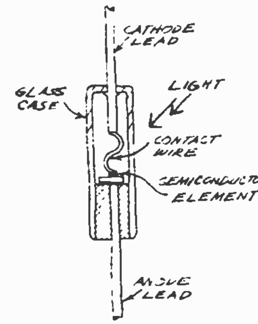
Nearly all semiconductors are sensitive to light. When light strikes the surface of the material, electrons are freed from their valence bonds and, in some cases, positive-charged holes are created. Under the proper conditions, enough electrons may be released so that a small voltage develops. This has led to the development of a large group of light-sensitive semiconductor diodes—or *photodiodes*.

Commercial photodiodes may be divided into three broad groups—*photoresistive* devices, *photovoltaic* devices, and *light-activated switches.*

Photoresistive diodes have a resistance inversely proportional to the amount of light falling on their sensitive surface—the stronger the light, the lower their resistance. Any of the standard semiconductor materials, including germanium, silicon, and selenium, can be used for their manufacture, but a good many are made with semiconductor compounds such as cadmium sulphide.

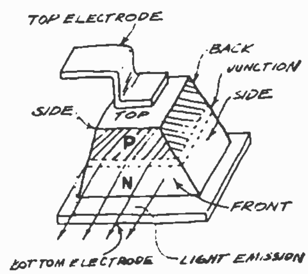
Photovoltaic diodes ("sun batteries") generate a d.c. voltage when light falls on their surface. In general, the amplitude of the voltage developed is proportional to the intensity of the light, up to a maximum fixed by the type of material used in construction, while the amount of current that can be delivered is proportional to the unit's exposed sensitive area. Most present-day photovoltaic diodes use either silicon or selenium as their basic material.

Light-activated switches are similar to four-layer diode switches, except that they are mounted in a transparent glass (or partial glass) enclosure to enable light to reach the junction area. Their operation is similar to that of diode switches, too, but with the gate trigger signal replaced by light energy. The *Photran,* a unique type, has an electrical connection provided for the normal gate terminal, resulting in a three-electrode light-sensitive device.



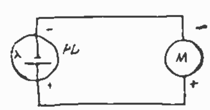
LIGHT ACTIVATED

The semiconductor *laser* is a special type of "photodiode" which *emits* light. Typically, these units are made of intermetallic compounds. Such a device may consist of a small *pn* junction of gallium arsenide with the front and back faces cut perfectly parallel to each other perpendicular to the junction plane and highly polished. When heavy current pulses are passed through the device, intense coherent light is emitted perpendicular to the polished surfaces along the *pn* junction. Typical pulse currents may run as high as 20,000 amperes per square centimeter. Electrical-to-light energy diode converters of this type are nearly 100 per cent efficient. The emitted light, for a gallium arsenide diode, is in the infrared region.



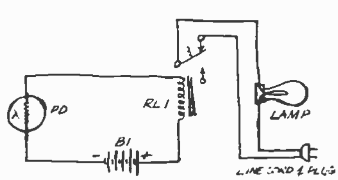
LASER

The standard *photographic light meter* circuit at right is basically just a photovoltaic diode connected to a sensitive microammeter. The meter scale may be calibrated either in terms of foot-candles or in camera shutter/iris settings.



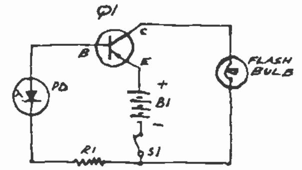
LIGHT METER

The *automatic light switch* consists of a photoresistive diode connected in series with a sensitive relay and a d.c. power source. As long as there is sufficient light on the diode, its resistance is kept low and it passes sufficient current to hold the relay closed. When darkness falls, the diode's resistance increases, reducing relay coil current and allowing the relay to drop out, closing the lamp contacts.



LIGHT SWITCH

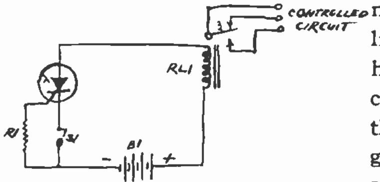
Another photographic instrument circuit is a remote *slave flash.* A light-activated switch is connected in series



SLAVE FLASH

with a current limiting resistor (*R1*), a power source (*B1*), and a power transistor's base-emitter circuit. In operation, light from the main flash triggers the photodiode, causing it to fire and applying a heavy base current to the transistor. The transistor, in turn, conducts heavily, firing the flash bulb. The power switch, *S1*, must be open before a new bulb can be inserted.

A *lock-in relay* uses a Photran with its gate biased by means of *R1*. In operation, the relay remains open until light strikes the Photran's sensitive surface. When this happens, the Photran switches to a conducting state, closing the relay. The relay then remains closed until the power circuit is interrupted (by opening *S1*). This general type of circuit might be used as an automatic switch for, say, a darkroom, or in alarm applications.

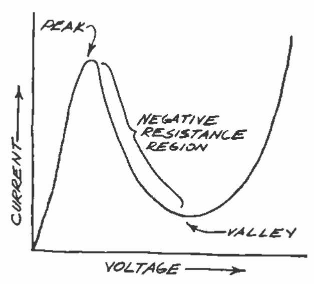


LOCK-IN RELAY

TUNNEL DIODES

Sometimes called the *Esaki diode* in honor of its Japanese inventor, the tunnel diode is an extremely versatile device. It is capable of being used as a detector, amplifier, or oscillator, is extremely efficient and, in some types, is useful at frequencies up to 10,000 megacycles or more.

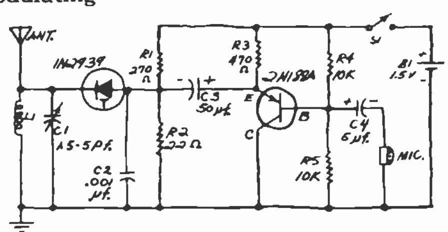
Manufactured from standard semiconductor materials such as germanium as well as from intermetallic compounds such as gallium arsenide, the tunnel diode is basically a *pn* junction, but with the junction depletion region made very thin. The result is that the device is essentially in a "reverse breakdown" condition even when a small forward bias is applied. As the bias is increased, there is an increase in current, up to a point. As the reverse breakdown condition is neutralized, the diode's current *decreases with increasing* voltage until a valley point is reached—afterwards, the tunnel diode behaves much like a conventional diode. A decrease in current with increasing voltage is the basic characteristic of a *negative resistance* (as distinguished from a "positive" resistance, in which current increases as applied voltage is increased). It is this characteristic (negative resistance) which makes the tunnel diode useful as an oscillator.



In a conventional semiconductor device, the current carriers move rather slowly, diffusing through the crystalline structure of the material. In a tunnel diode, the current carriers (electrons, for example) traverse the junction area at what appears to be the speed of light. In effect, when an electron enters the junction, another suddenly appears at the other side, much as if there were a "tunnel" through the junction area (hence the device's name).

A practical *FM wireless microphone* based upon a circuit suggested by GE, is shown below. The resistors are all half-watt units, while *C3* and *C4* are electrolytic capacitors, *C2* a small ceramic disc unit, and *C1* a tiny air variable capacitor. Coil *L1* consists of six turns of No. 16 wire, air-spaced 3/8" in diameter. The antenna is a 4¾" length of No. 14 wire, and the microphone is a Shure Brothers No. 420 or equivalent.

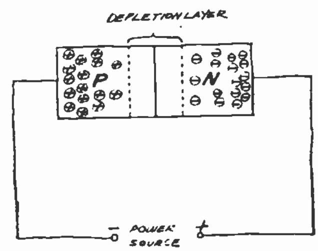
The tunnel diode serves as an oscillator in conjunction with tuned circuit *L1-C1*, with its d.c. operating voltage supplied by voltage divider *R1-R2*. The audio signal obtained from the microphone is amplified and superimposed on the d.c. voltage through coupling capacitor *C3*. This varies the tunnel diode's instantaneous supply voltage in accordance with the audio signal, frequency-modulating the r.f. signal developed by this device.



FM WIRELESS MICROPHONE

CAPACITOR DIODES

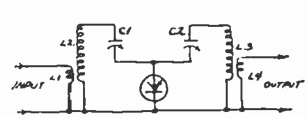
The application of reverse bias to a junction diode will cause the junction area to be depleted of current carriers (electrons and holes) and thus act as a high resistance, insulator or dielectric. There is still an electrical capacitance between the *p* and *n* areas, however. This characteristic of the semiconductor diode has led to the development and production of a variety of voltage-variable semiconductor capacitors. These devices are identified by a variety of names, including *varactor* (for *variable reactor*), *Semicap* and *Varicap*.



VOLTAGE-VARIABLE DIODES

The operation of a varactor is easily understood. If a semiconductor diode junction is reverse-biased, the central junction area is depleted and acts as an insulator (dielectric). There is always an interelectrode capacity between the *p* and *n* areas. As the reverse bias is increased, the depletion layer expands, reducing the interelectrode capacity. Conversely, as the reverse bias is decreased, the depletion layer shrinks, increasing capacity. Maximum capacity is obtained when the device is operated at zero bias.

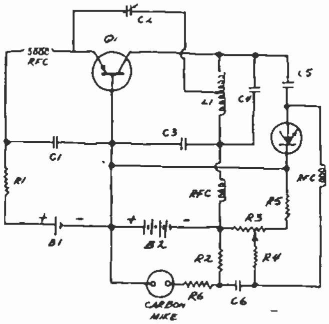
Commercial varactors can be made of germanium or silicon and are generally specified in terms of *maximum working voltage, capacitance* (at a specific voltage), and typical "*Q*." The latter characteristic indicates the "quality" of the device and is obtained by dividing its reactance



FREQUENCY DOUBLER

(in ohms) by its equivalent series resistance (in ohms). A Q may range from less than 5 to 100 or more.

In practice, varactors are used for electrical tuning in circuits such as the basic *frequency doubler* shown on page 75 or the *FM wireless microphone* at left.



FM WIRELESS MICROPHONE

POWER DIODES

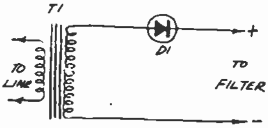
Power diodes are basically similar to small signal diodes. They are manufactured of the same materials, have similar characteristics, and, in general, are produced using the same construction techniques. The chief differences between power and small signal diodes, then, lies in their physical size and actual specifications. Power diodes have larger junction areas in order to pass heavier currents and, in some types, have thicker junctions to permit them to handle high voltages without breakdown. At the same time, the larger junctions mean greater interelectrode capacities and hence limited high frequency capabilities.

As do their smaller cousins, power diodes conduct heavily when biased in the forward direction and block current flow when biased in their reverse direction. Their forward and reverse resistances are likely to be lower than small signal types with, of course, correspondingly higher forward and "leakage" currents. Power diodes are rated and specified in the same general terms as are applied to small signal types—typically, maximum forward current, nominal reverse current, nominal reverse voltage, and peak inverse voltage (PIV).

Rectifier Diodes

Designed primarily for use in a.c.-to-d.c. power supplies, power rectifiers can be manufactured of selenium, germanium, or silicon. A few types are made using copper oxide, copper sulphide, and various magnesium compounds, but these have been largely supplanted by the former types. Since they are intended primarily for power supply use, some types may be specified in terms of *maximum a.c. input voltage, output d.c. volts* and *current* rather than in the more general terms mentioned above.

In a *half-wave rectifier* using a single diode, the PIV is twice the output d.c. voltage or 2.83 times the a.c. input voltage with a capacitive input filter under "no load" conditions; the nominal d.c. output is 1.41 times the r.m.s. (a.c.) input voltage. The ripple frequency (which must be



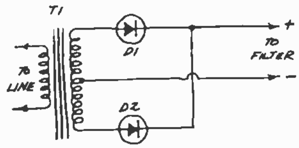
HALF-WAVE RECTIFIER

removed by the filter circuit used) is equal to the line frequency.

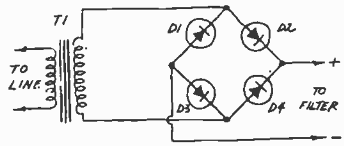
The *full-wave rectifier* requires a center-tapped source (such as the transformer secondary) and uses two diodes. Under the conditions described above, the PIV is twice the output d.c. voltage or 2.83 times the r.m.s. (a.c.) input voltage, while the nominal d.c. output is 1.41 times the a.c. voltage from half the secondary winding. The ripple frequency, in this case, is twice the line frequency.

A center-tapped source is not required for the *full-wave bridge* rectifier, but four diodes are used. Here, the PIV is equal to the d.c. output voltage and is 1.41 times the r.m.s. (a.c.) voltage supplied by the transformer's secondary winding.

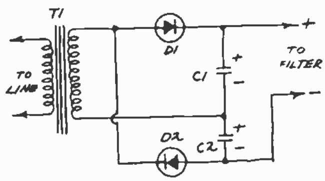
The *voltage doubler* supplies an output d.c. voltage which is twice the peak input voltage—or 2.83 times the r.m.s. (a.c.) input voltage. The PIV is equal to the d.c. output. In operation, diode *D1* conducts on one half-cycle, charging *C1* to the peak supply voltage. On the next half-cycle, *D2* conducts, charging *C2* to the peak supply voltage. The two capacitors (*C1* and *C2*) are discharged in series through the filter to the load.



FULL-WAVE RECTIFIER



BRIDGE RECTIFIER

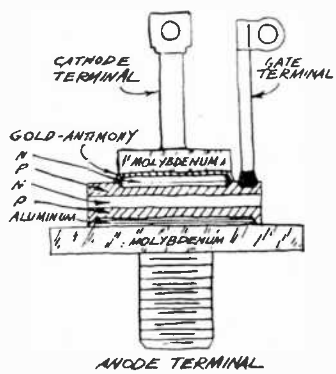


VOLTAGE DOUBLER

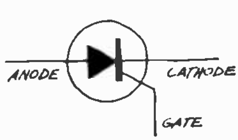
Silicon Controlled Rectifiers

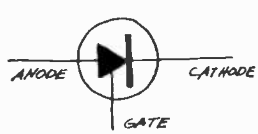
The *silicon controlled rectifier,* or SCR as it is commonly called, is a "big brother" version of the silicon controlled switch (SCS). It is a four-layer semiconductor device with an "all or nothing" characteristic. When forward-biased, it does not conduct until its breakover voltage is reached *unless* it is triggered by a control signal applied to its gate electrode; afterwards, it conducts heavily and will continue to conduct until its anode-cathode voltage is dropped to a low value. When reverse-biased, the SCR blocks current flow until its zener voltage is exceeded and junction breakdown occurs.

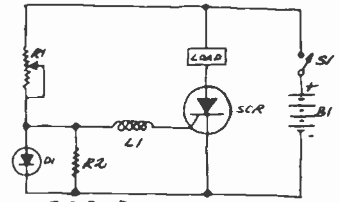
Most SCR's have the gate connection made to the third layer of the four *pn* layers making up the device. Those SCR's with a *cathode gate* are identified by the schematic symbol shown at left below while a few types are equipped with an *anode gate* (at right below) and are identified by a slightly different symbol.



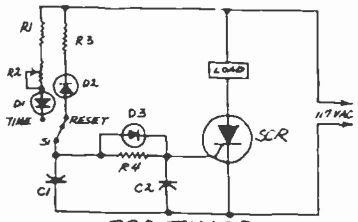
SILICON CONTROLLED RECTIFIER



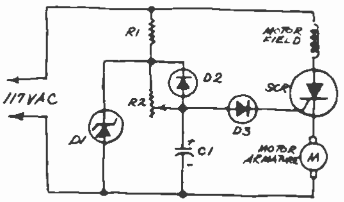




SCR REMOTE CONTROL



SCR TIMER



SCR MOTOR SPEED CONTROL

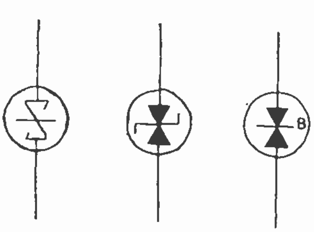
Commercial SCR's are sold in sizes with current ratings of less than 1 ampere to well over a hundred amperes, and with voltage ratings up to 500 volts or more. While standard SCR's can be turned "on" by the application of a trigger signal to their gate—and "off" only by dropping or reversing the anode-cathode voltage, there are several new types which can be turned "off" by the application of a reverse bias trigger to their gate.

A *remote control* SCR circuit is shown at the left. In this circuit the gate is biased just below its firing point by voltage divider *R1* and *R2*. Diode *D1* is included for temperature compensation. A radio signal from a nearby transmitter, picked up by antenna coil *L1*, "fires" the SCR, actuating the *Load*, which might be, as an example, a motor in a toy.

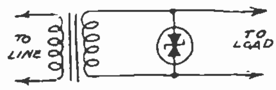
This *timer* circuit is designed for operation on a standard a.c. line. When the control switch, *S1*, is turned to its "TIME" position, *C1* is charged through *D1*, *R1* and *R2*. When sufficient voltage is built up across this capacitor, the SCR is triggered, supplying power to the load device. Potentiometer *R2* sets the time delay, which is a function of the *R1/R2/C1* time constant. The circuit is reset by turning *S1* to the "RESET" position, which discharges the capacitor and applies a reverse voltage to the gate. The SCR, of course, stops conducting on alternate half-cycles. Although a polarized capacitor is shown for *C1*, this normally would be a large-value metalized paper unit.

You can use an SCR to rectify line voltage and power a d.c. motor—while furnishing control over motor current in this *motor speed control* circuit. The motor speed adjustment control is *R2*, while the zener diode, *D1*, stabilizes the gate voltage. The point at which the SCR "fires" on alternate a.c. half-cycles is determined by its gate voltage. If *R2* is set for maximum voltage, the SCR conducts over virtually an entire half-cycle, supplying maximum power to the motor's field and armature windings. If *R2* is set for minimum voltage, the SCR conducts only during the last half of each alternate half-cycle, or for a quarter-cycle, supplying minimum power to the motor.

SURGE SUPPRESSORS

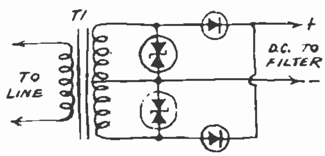


Electrical circuits, whether operated on a.c. or d.c. voltages, are often plagued by transient voltage peaks or surges, either externally or internally generated. Silicon and germanium semiconductor devices are especially sensitive to surge voltages, and a high-voltage transient or "spike" can destroy a semiconductor junction. Manufacturers have introduced special semiconductor devices to guard against and suppress transients. Most of these devices are made up by connecting a suitable pair of selenium zener diodes back-to-back and are identified by a variety of trade names, depending on the manufacturer, including *Voltrap, Thyrector, Klip-Sel,* and *Silgard.*



SURGE PROTECTION

Typical surge protector applications are illustrated here. A single unit is used in one circuit to protect the a.c. voltage supplied to a load by a transformer. A pair of units are frequently used in a full-wave rectifier to protect the rectifier diodes against transients. Circuit operation is similar in both cases. Under normal conditions, the surge suppressors act as open circuits, since one or the other of the two diode elements making up the device is always reverse-biased. If a transient voltage spike or surge occurs which exceeds the device's rating, the unit goes into zener breakdown, shorting out the surge.

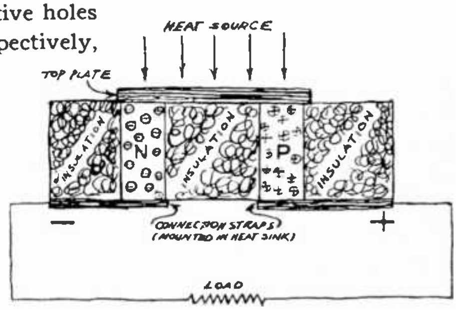


FULL WAVE SURGE PROTECTION

THERMOELECTRIC DIODES

Although not a "diode" in the classical sense, the thermoelectric diode is a thermocouple-type device with a variety of applications. It consists of *p*- and *n*-type semiconductors bonded together by copper or similar high-conductivity metal. Straps are connected to the opposite ends of the semiconductor bars for electrical connections and the two ends of the bars are thermally insulated.

If the connection straps are attached to an insulated heat sink and heat is applied to the sides of the semiconductors which are bonded together, the electrons and positive holes in the *n*-type and *p*-type semiconductors, respectively, undergo thermal diffusion from the high- to the low-temperature side, developing a potential difference. This voltage can be used as an effective *power source* for a standard electrical load as long as a temperature difference is maintained between the two sides of the device. Thus, the unit becomes a heat-to-electrical energy converter.



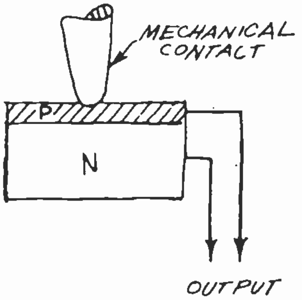
THERMOELECTRIC DIODE

The output voltage supplied by a single element is relatively small, and commercial thermoelectric generators generally are made up of a number of elements in a series-parallel arrangement to obtain usable voltages at fairly high currents. The *3M* Type 18A thermoelectric generator is a typical unit: it can supply up to 15 watts—3.5 volts at 4.3 amperes—while consuming 0.15 lb. of propane fuel per hour.

Essentially the same type of thermoelectric diode can be used in a different manner. If power is *applied to the device* by an external d.c. source, with the negative terminal of the power supply connected to the *p*-type semiconductor and the positive terminal connected to the *n*-type material, the top plate becomes cool and the lower connectors warm. In effect, the device absorbs heat at one end and releases it at the other and becomes a type of electronic *heat-pump.*

Commercial thermoelectric heat-pumps of this general type are used in the manufacture of motorless refrigerator and air-conditioning units and as "spot coolers" for high-power transistors, diodes, SCR's, and similar semiconductor devices. One firm identifies its line of thermoelectric cooling elements as *Frigistors.*

SPECIAL DIODES



PIEZOELECTRIC DIODE

While the diodes described on the preceding pages constitute the overwhelming majority of commercially available semiconductor diodes, there are a number of important special-purpose units. Most are experimental, but are expected to be useful in the very near future.

The *piezoelectric* diode is one that is currently under development. It consists of a *pn* junction to which a mechanical pressure contact is made. The junction's resistance (and hence its effective output) is proportional to the mechanical pressure exerted. Undoubtedly, piezoelectric diodes will have potential applications in microphones, hi-fi phono cartridges, and vibration pickups.

THE FUTURE

As we have seen, the semiconductor diode is one of the most versatile of simple electronic components. It has, today, more applications than the proverbial dog has fleas. If past performance is any criteria, we can expect many new applications in the future—and many new types of semiconductor diodes. Of the various experimental types now being tested, the semiconductor *laser,* the tunnel diode (and its first cousin, the "camel" diode), and the thermoelectric "diode" hold the greatest promise for startling future developments. But even the best of prophets can be wrong. A completely new type of semiconductor diode may even now be in the development stages in our nation's research laboratories!

AT LAST! A COLOR TV KIT

They said it just couldn't be done—but the Heath Company removed most of the roadblocks to perfect its color receiver

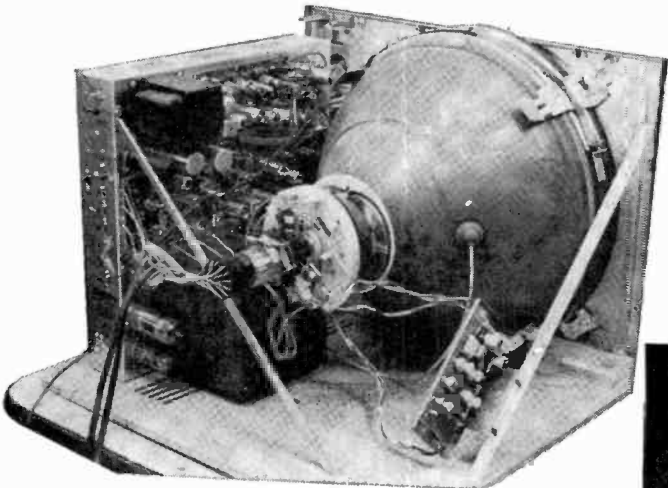
FROM THE MOMENT you open the first box of parts for your Heathkit GR-53A color TV receiver, you'll know that somehow this kit is going to be different. Not that it is any more complex than one might expect but the results will be different—you'll have a *real* feeling of accomplishment after you've put it together. Sure, you can build test equipment; but who sees test gear besides yourself? The hi-fi was nice—as a kit—but everyone and anyone can put together a stereo amplifier or tuner. Color TV! That's something to build from a kit that you'll be proud of for years to come.

Does all of the above sound like a lot of advertising? Well, you may not believe it, but that feeling of accomplishment is just what happens to everyone who completes the new Heathkit GR-53A color TV receiver. Selling at $399 (including chassis, color tube, mask, mounting kit, VHF plus UHF tuners, and special speaker, many of the monetary savings involved in building the set are hidden.

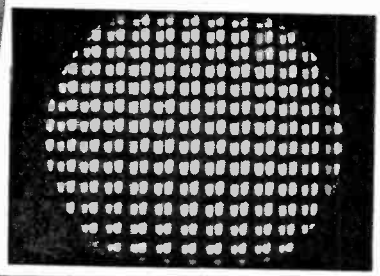
First, you won't have to bother with a "service contract" to keep your color TV in topnotch operating condition. This alone is a saving that mounts up year after year. Secondly, the GR-53A is not a skimpy receiver in which corners have been cut to keep costs down and still provide color TV. Instead, 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.

Wiring It Up. The advertisements for this receiver make capital of the fact that it can be wired in 25 hours. Well, it's true—and if you're a moderately experienced kit builder, it can be fully assembled and working in 20 hours. The time spent breaks down something like this: actual electronic wiring and soldering 14½ hours; assembly to mounting board, setting up picture tube, and degaussing 2 hours; convergence and setting gray scale 3½ hours.

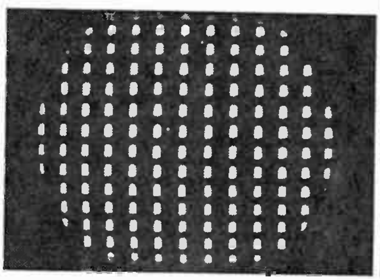
The Heath Company has vastly simplified the building of the GR-53A by prewiring some of the more critical circuits. For example, the picture i.f. strip is a pre-soldered and pre-aligned printed-circuit board—you just bolt it into place. The high-voltage cage (your color TV needs 5000-8000 volts more than the typical black and white receiver) is also ready to be attached to the chassis. Of course, both tuners are pre-aligned and matched to your i.f. strip.

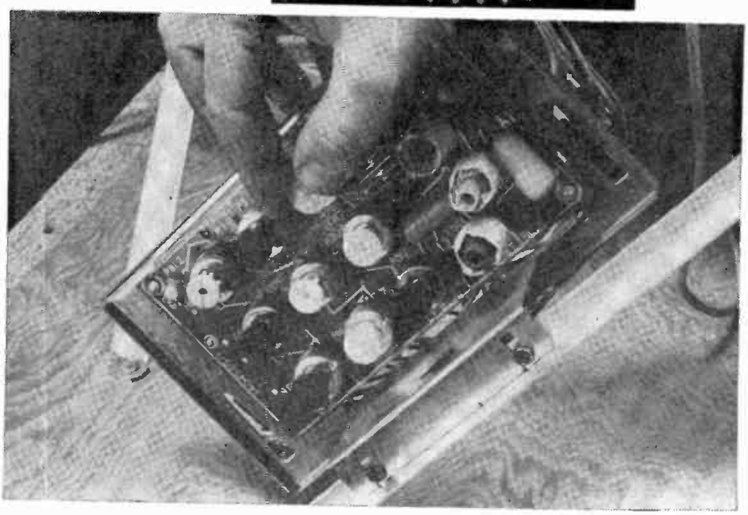


For custom mounting, the GR-53A looks like this. A console cabinet is available from the manufacturer for $49 extra. Picture tube is held in place by metal bands attached to the mask. Chassis is upright, with power supply cage in the box at the lower left corner.



The secret of color TV is the convergence or joining up of the three electron beams so they hit the proper miniscule green, red, and blue dots on the TV tube face. Above right, the beams are badly out of convergence. They must be properly converged by manipulating controls at right. Proper convergence and linearity is shown **(the dots are white) below.**





The kit builder works up the sound i.f. strip and the involved printed-circuit board containing the signal separating circuits for color reception. Point-to-point wiring to interconnect the three printed boards is simplified through the use of a supplied wiring harness with colored wire "breakouts" clearly identified.

The GR-53A instruction book is probably one of the best that Heath has ever published. Over half of the manual is devoted to explaining color TV circuitry in such a fashion that practically all servicing problems can be solved in the home. In order that you will properly appreciate the meaning of convergence, and the setting of such controls as "purity," "color killer," "tint," etc., a variety of full-color illustrations show exactly what the picture should and should not look like.

Words of Advice. This is not a kit with which the builder can skim through the instruction manual. The Editors of POPULAR ELECTRONICS have repeatedly noted this "skimming" tendency amongst experimenters who have built three or four kits. Don't assume anything—read the manual!

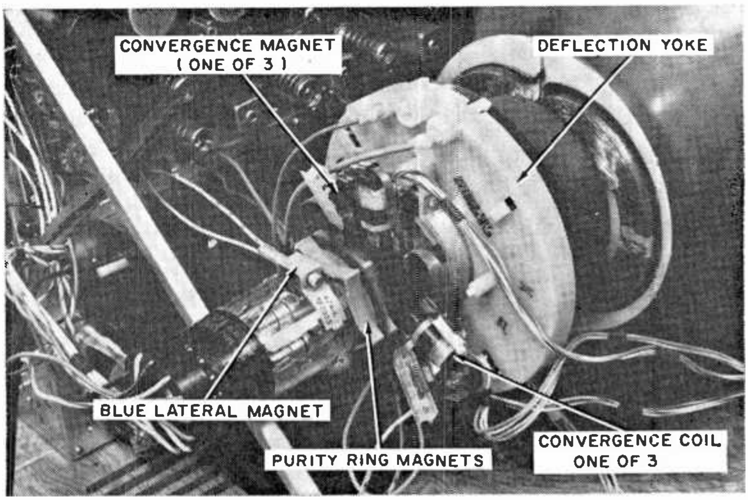
Don't get discouraged if your first efforts at purity and convergence aren't right. In all probability your family will be too enamoured by color TV to note the subtle differences. Try convergence several times — preferably spaced one or two days apart. Be leery of large changes in the rotation of the purity rings—small changes of 5° or 10° can make a lot of difference.

Be prepared to degauss your receiver picture tube several times. If you get a green or reddish tinge on the right-hand side of the screen that you cannot converge out of existence, it's probably due to an errant magnetic field upsetting the beam from the green or red gun. Be prepared to reset the entire gray scale of the receiver after you have used it for about three weeks. This is not a sign of weakness in the receiver—simply an "aging in" problem.

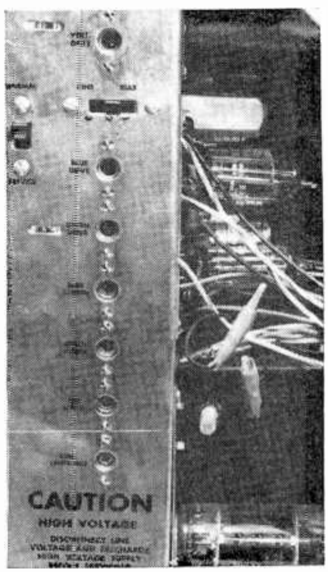
Show your family how the three controls (fine tuning, color, and tint) interlock, and spell out how each control function differs. Lastly, if you have assembled your set when no color program is being transmitted, set the fine tuning (on most NBC and some ABC broadcasts) almost to the point where the picture breaks down into grains, and see if the station is transmitting a color swipe on either side of the black and white picture. This swipe should be about 1" wide and should be out of sync, i.e., rolling from top to bottom through the color spectrum.

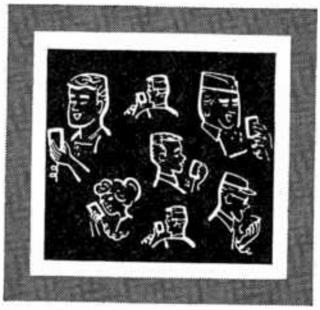
Have fun! Gloat! –30–

Each of the three electron beams in the neck of your receiver's color TV tube must be deflected just so to put all of the colors in their proper places. This is where the initial adjustments are made.



Rear skirt of color receiver is filled with recessed controls and switches which set up intensity levels of three electron guns.





On the Citizens Band

with MATT P. SPINELLO, KHC2060, CB Editor

THOUSANDS of CB'ers will be looking forward shortly to the hundreds of jamborees, banquets, and get-togethers that will be held throughout the nation during the months to come. The spring weather seems to have put long-range plans of last winter into action, and announcements of many forthcoming events are rolling in. While some jams drew an attendance of up to 2500 in 1963, several clubs have already claimed they will top 5000 at their individual gatherings this year.

1964 JAMBOREE CALENDAR

Citizens Banders have been known to drive hundreds (and even thousands) of miles to attend and participate in these events, which enable local CB'ers to meet and exchange views with other CB'ers from all over the country. Among the features of these get-togethers are equipment displays; QSL card-swapping; lectures by FCC officials, CB and amateur technicians; name entertainment; and plenty of chow. And most of the jamborees have activities for the whole family to enjoy.

Here is the first edition of our *1964 OTCB Jamboree Calendar.* We'll continue to keep you posted of up-coming events as information on them is received.

Aberdeen, Miss. The Monroe County CB Rangers will sponsor the "Midsouth CB Jamboree" to be held *May 17* at Stinson Skyport, located one mile north of Aberdeen on U.S. Highway 45. The club's headquarters (a former administration building) will serve as the center of activities, and facilities will be provided for jamboree guests. The headquarters building will house a registration center, first-aid and communications facilities, a large concession stand, and equipment displays by area CB dealers. Several acres of parking will be provided. A shaded picnic area will be available, and a bundle of CB equipment prizes will be given away during the day. For general information and motel or hotel reservations, write to Jamboree, 115 Highland Ave., Aberdeen, Miss.

Danville, Ill. The Kickapoo 5-Watters Radio Club is planning their jamboree for *May 30 and 31,* to be held at the Eastern Illinois Fairgrounds in Danville. For more information, contact Hubert Jacobs, 6W6465, Advertising Chairman, 839 Commercial Ave., Danville, Ill.

Birmingham, Ala. E. S. Darden, vice president of the Cee Banders Radio Phone Club, has announced the Birmingham group's plans for a *June 6 and 7* jamboree to be held at Camp Cosby, a lake resort near Birmingham. Requests for more information should be directed to v.p. Darden at 4317 9th Ave., Wylam, Birmingham, Ala. 35224.

Beloit, Wis. The Channel Choppers Citizens Band Radio Club expects an attendance of 5000 (or more) at its two-day jam to be held *June 20 and 21* at South Beloit Park, South Beloit, Ill. CCCBRC secretary Irene E. Keeney, KHD8268, reports that this spectacular should lure those from ages 2 to 92. The group promises several exhibit tents, entertainment, prizes, refreshments, ample parking facilities (including provisions for electrical hookup to mobile trailers), recreation for the YT's (young tots), and available overnight motel and hotel accommodations. For more information, write to Channel Choppers CB Radio Club, 834 Grant St., Beloit, Wis.

Nashville, Tenn. The Donelson Citizens Band Radio Club, Inc., will play host at a *June 27 and 28* jamboree. This group also anticipates a crowd of 4000 to 5000. Among the events and facilities planned are: food and drinks, entertainment and square dancing, free prizes, indoor and outdoor show areas, plenty of asphalt parking area, motel and hotel facilities, and a Saturday night performance of the Grand Ole Opry within two miles of the jamboree grounds. Interested parties should contact the Donelson CB Radio Club, Inc., P. O. Box 2301, Donelson, Tenn., for more information.

Martinsville, Ind. Morgan County CB Radio Club members have obtained the county's 4-H Club building and fairgrounds for their *July 4 and 5* jamboree. Displays

From on top of one of the many 400′ hills at Camp Crown, Wis., Bob Ray, a Post 71 Explorer Scout, coordinates the "man hunting" efforts of several other Explorers equipped with hand-held transceivers. In the photo below, Gary Wilson, another scout, takes instructions on his "walkie-talkie."

Photos by Jim Rafferty

will be set up in completely enclosed buildings, and the entire affair will be held within a fenced-in area. Details are available from George B. Alexander, Morgan County CB Radio Club, P.O. Box 533, Martinsville, Ind.

Terre Haute, Ind. Terre Haute CB'ers will hold a jamboree at the Vigo County Fairgrounds on *July 12*. The grounds are being made ready to accommodate 10,000 people, gate prizes, "grand" prizes, and several displays are promised. Write to Lester L. Morton, KHD2205, c/o T. H. Police Department, Terre Haute, Ind., for more information.

The seven events itemized above are just a sampling of the CB jamborees slated for 1964. More to come, without a doubt! If *your* club is planning a jam, banquet or get-together, be sure to let us in on it well in advance. Information should be sent to: *1964 OTCB Jamboree Calendar,* POPULAR ELECTRONICS, One Park Avenue, New York, N. Y. 10016.

Operation "Man Hunt." Jim Rafferty, KHA4487, has advised us that the Explorer Scouts from Libertyville, Ill., really depend on their hand-held transceivers during trips to Camp Crown, Wisconsin. Thirty-seven square miles of Camp Crown, located about seven miles north of Antioch, Ill., are set aside for Explorer use. No electricity within the area and the fact that the Explorers camp overnight in tents seem like very potent reasons for having "walkie-talkies" on board at all times!

Jim relates that a dozen Explorers make up the communications group within Libertyville's Post 71—each equipped with a hand-held transceiver. Besides keeping the entire camp linked during the Explorers' monthly "overnights," the equipment is used during "raiding" games held with other posts in attendance at the camp. It is also used during Operation "Man Hunt" in which two boys get lost and are then tracked by the rest of the post. And transceivers are the determining factor as to "who" is located "where" on hikes and field trips.

On one of the Explorers' recent expeditions, a transceiver operator's voice was suddenly cut off in the middle of a sentence, and he could no longer be raised. An emergency search plan was put into effect and in short order the lost voice was found. The silent Explorer had tripped, fallen, and then rolled down one of the many hills at Camp Crown. The boy was unhurt but the walkie-talkie had uttered its last transmission. The Explorer landed on top of it!

(*Continued on page* 118)

FOR THE BIRDS

By
JOHN T. FRYE
W9EGV

THE BEAUTIFUL, warm, calm, mid-May Sunday was made for picnicking, and Carl, Jerry, Jodi, and Thelma were taking advantage of it. With final examinations at Parvoo University looming immediately ahead, the four of them realized that this would probably be their last opportunity for an outing together before they separated for the summer.

Their blankets were spread on the grassy bank of a small creek running near the little-traveled road. Lunch was over, and Jodi was replacing the empty dishes—there was nothing else left to replace!—in the hamper while Carl and Jerry lolled contentedly on the grass and admired the girls in their tailored shorts and pretty blouses.

"There now," Jodi said in her rich southern drawl. "You all can put the basket back in the car and then tote these blankets over there into the sun so that Thelma and I can be working on our sun tan while we play bridge."

The boys obeyed, and the four of them had just settled down in the warm, relaxing sunshine when a lonely crow perched on a dead limb atop a nearby oak let out a disapproving "Caw!" Carl and Jerry exchanged a look and then ran with one accord to the car and began unloading a transistorized tape recorder and a parabolic reflector mounted on a collapsing stand.

While the girls watched in wordless amazement, Jerry hurriedly pointed the open face of the dish at the crow and connected the shielded lead from a small microphone mounted at the focal point of the parabolic surface to the recorder. At this point the crow left his perch and went flapping soundlessly away over the treetops.

"Let's leave things set up," Carl suggested. "Maybe he'll come back."

"What on earth are you trying to do?" Thelma wanted to know.

"It's kind of a long story," Jerry replied, sitting back down on the blanket. "You probably know that scientists have recently taken a renewed interest in trying to communicate with non-human creatures. I say 'renewed' because man has always wanted to talk to animals and birds, but up until now no one has had much luck. Oh it's true we've taught parrots and mynah birds to imitate speech, but imitation is not communication—not unless you know what the sounds really mean.

"Anyway, it seems that trying to teach birds to talk human language is going at things the wrong way. A superior intelligence should always try to speak the language of an inferior intelligence. We do this without thinking about it by talking 'baby-talk' to children just learning to speak, or by using pidgin-English for communication with the natives of some countries. The trouble in trying to learn the language of an animal or a bird has been that there was no way of 'freezing' the strange, fleeting sounds they make so they could be studied in detail and related to observed behavior patterns. It looks like electronics may now give us a way to do this."

"Yeah," Carl chimed in. "Just the other day I saw a Sperry advertisement that showed a man holding a microphone in front of a happy-looking dolphin. The mike was connected to a tiny computer developed by Sperry with a 'brain cell' of minute optic fibers. This SCEPTRON™ Pattern Recognizer can memorize, distinguish between, and react to different sights and sounds. It's not too far out to hope that before long such a device may be able to translate the language of the dolphin, a very smart mammal, into human terms and vice versa. We know for certain that dolphins *do* talk to one another. Sonar operators hear them doing it all the time."

"I GOT INTERESTED in this creature-man-communication bit," Jerry explained, "but I didn't see how we could do anything about it. We didn't have either a SCEPTRON Pattern Recognizer or a dolphin to talk to. Then we read a story in *Time* about a German physician, Dr. Erich Baeumer, who has been studying the language of chickens for nearly sixty years. He has recorded many hours of chicken talk while taking pictures of the birds at the same time. Study of these recordings gave him about thirty sentences of chicken talk that he could recognize and imitate."

"An interesting thing is that chickens speak a kind of Esperanto, or universal language," Carl added. "A Russian Orloff rooster or an Italian Leghorn hen will instantly recognize and react to the danger call of a New Hampshire Red. And what do you suppose a hen is saying when she starts cackling after laying an egg?"

" 'Ouch!' " Thelma guessed.

"She's probably boasting, 'Will you all just come and look what I've done?' " Jodi suggested.

"Nope, you're both wrong. After having been in seclusion while laying the egg, she wants to rejoin the flock; so she's saying, 'Hey, where is everybody?' "

"This story reminded us that we *did* have a crude sound pattern recognizer in our tape recorder," Jerry continued. "It can remember and reproduce any sound pattern it hears. Furthermore, by keeping careful notes on what a bird or animal was doing when it uttered the recorded sounds, we might be able to correlate the two and possibly arrive at a meaning for the sound. Since Dr. Baeumer seems to have the chicken chatter pretty well sewed up, we decided to concentrate on crows."

"As any farmer will tell you, there's no smarter bird flying," Carl said.

(*Continued on page* 112)

Transistor Topics

By **LOU GARNER,** Semiconductor Editor

QUITE OFTEN, military electronic developments precede commercial designs and, eventually, filter down to the general public, resulting in better consumer products. Radar component developments, for example, led to reliable low-cost TV receivers, to microwave ovens, and to small pleasure boat radar systems. Sonar developments led to depth- and fish-finders. This might also be the case with the newest developments in personal communications equipment.

With the increased firepower made possible by modern weapons, the individual combat soldier assumes an importance unmatched since the days of the heavily-armored knight. Along with this has come a definite need for direct communication between isolated men without the use of hand signals, shouts, or other methods which might expose troops to enemy detection. The logical solution, of course, is to equip every man with a lightweight, limited-range, two-way radio system.

Several approaches are being investigated. The Army, for example, has developed a 9-ounce FM receiver and complementary 15-ounce transmitter (see "Popular Electronics News," February, 1964). In use, the GI can either clip the receiver to his helmet and listen to a built-in loudspeaker, or slip the unit into one of his pockets and use a small earphone. The transmitter can be operated either at high or low power levels with maximum ranges of 500 yards and a mile respectively; it can be clipped to the soldier's pack harness or hand-held as required by circumstances.

Circuit-wise, the receiver is a crystal-controlled, double-conversion superhet design employing 14 transistors and 8 diodes. It has a sensitivity of 0.5 μv. for a 10-db signal/noise ratio. The transmitter, too, is crystal-controlled and uses 13 transistors and 2 diodes. The latter unit has a power output of 70 mw. on low power and 350 mw. when used in a high-power mode.

Another approach has been suggested by a West Coast manufacturer (Tiffany Labs., Inc., Midpines, Calif.) This firm has developed a subminiature transceiver designed for mounting in a standard rifle stock. The microphone and earphone are covered by small weatherproof lids when not in use, while the retractable whip antenna is mounted in the butt; extended, the latter can be used in either a horizontal or vertical position. One possible civilian application for this new development is in sporting rifles and shotguns, where it could be quite valuable for maintaining contact between individual members of a hunting party.

The military's eventual goal is the production of transceivers with the ruggedness and reliability of the battle-tested "walkie-talkie" but a fraction of the latter's size and weight. Other solutions to the general problem are still in the preliminary development stages. The ultimate in miniaturized personal transceivers will be achieved, of course, when integrated circuits can be adapted to this application. As this is written, the limiting factor in the miniaturization of receivers and transmitters is the gross size of the tuning elements and audio transducers (earphones, loudspeakers and microphones) as compared to the transistors, diodes, resistors, and other components used.

Readers' Circuits. Our featured circuits this month came from readers on opposite coasts. The first, Fig. 1, was submitted by West Coast reader Jeff Sorensen (12552 Carmel Way, Santa Ana, Calif.), who adapted it from a design suggested by W. J. Fisher, Jr. in our September, 1962, column. The East Coast contribution, illustrated in Fig. 2, came from reader Michael Ross (795 Pelham Parkway North, Bronx 67, N. Y.). Both circuits employ general-purpose *pnp* transistors in the common-emitter configuration.

Jeff has devised a *light-sensitive audio oscillator* suitable for use in burglar alarms, controls, and similar applications. Referring to the schematic diagram, *Q1* is used as a modified Hartley oscillator. In operation, *T1* matches *Q1*'s output to the loudspeaker's voice coil winding and, by virtue of its center-tapped primary, provides the feedback necessary to start and sustain os-

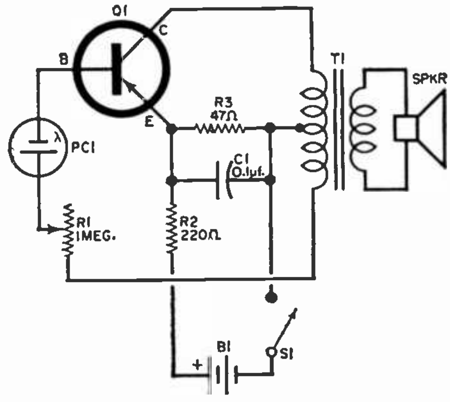


Fig. 1. In the light-sensitive audio oscillator circuit submitted by reader Jeff Sorensen, transistor Q1's operation depends on the amount of light striking the photocell (PC1).

cillation. Transistor *Q1*'s base bias is furnished through *R1* and photocell *PC1;* thus, the transistor's operation depends on the amount of light striking the photocell. Series current-limiting resistor *R2* and shunt resistor *R3,* bypassed by *C1,* provide proper operating voltages. Power is supplied by a 9-volt battery, *B1,* controlled by a s.p.s.t. switch, *S1.*

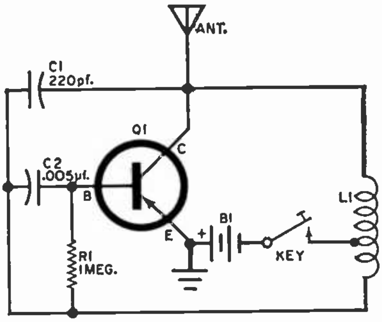
Standard components are used. Transistor *Q1* can be a CK722 or a 2N107. Resistors *R1* and *R2* are half-watt units, while *C1* is a small paper capacitor. Transformer *T1* is an Argonne AR-119. Photocell *PC1* is a small selenium type (such as an International Rectifier B3M). The loudspeaker should have a 3-to-4 ohm voice coil, but otherwise can be any standard type. A toggle, slide, rotary or push-button switch can be used for *S1,* while *B1* can be either a Burgess 2N6 or six penlight cells connected in series.

With neither layout nor lead dress critical, Jeff's circuit may be assembled either breadboard fashion or on a small chassis, depending on individual requirements. Once the wiring is completed and checked, light is applied to the photocell and *R1* adjusted for the desired operation.

A combination CPO and short-range c.w. transmitter, Michael's circuit (Fig. 2) should be of particular interest to Novice hams. It is similar to Jeff's circuit in that *Q1* is used as a modified Hartley oscillator—but at an r.f. frequency. The circuit's basic operating frequency is determined by tuned circuit *L1-C1,* with *L1* tapped to provide the feedback necessary for oscillation. Transistor *Q1*'s base bias is provided through *R1,* with *C2* serving as a conventional coupling capacitor. In operation, *R1* and *C2*'s values are chosen to cause "blocking" at an audio rate, thus developing a modulated output signal. The d.c. power is supplied by *B1,* controlled by a standard hand key.

Again, readily available parts are used. Transistor *Q1* is a CK722 or 2N107. Resistor *R1* is a half-watt unit, while *C1* and *C2* are small mica or ceramic capacitors. Coil *L1* is a standard tapped variable loopstick (Lafayette MS-299). According to Michael,

Fig. 2. This short-range c.w. transmitter circuit was received from reader Michael Ross. With the antenna disconnected, the instrument can be used as a CPO by connecting a crystal earphone in parallel with capacitor C2.



battery voltage is not critical and *B1* can supply from 3 to 9 volts; the power supply, therefore, may be either a small 9-volt transistor battery or may be made up of several series-connected flashlight cells.

You can follow your own inclinations when duplicating Michael's circuit, assembling it on a small chassis, in a Minibox or shield can, or on a printed-circuit board. The antenna, too, is noncritical, and may be either a small whip or a short length of hookup wire. If desired, a standard s.p.s.t. switch can be substituted for the key.

With the antenna disconnected, the completed instrument can be used as a CPO by connecting a *crystal* earphone in parallel with *C2.* To use it as a code transmitter, on the other hand, depress the key and tune to its output signal on a nearby AM broadcast receiver, adjusting *L1*'s slug, if necessary, so that the signal is picked up at a "dead" spot on the dial.

Transitips. Reader Charles D. Rakes (Oak Grove, Mo.), who has contributed to this column in the past, feels that many

(*Continued on page* 115)

Relay Switching for Transistor Ignitions

Do away with the weak link in the new electronic ignitions

By JOHN MOLNAR

TRANSISTOR IGNITION systems provide both improved engine performance and increased breaker point life when compared to conventional ignition systems. While these advantages make the new transistor systems very attractive, there is at least one minor problem—the life of a component that normally lasted the life of the car is greatly reduced.

Figure 1 shows a typical ignition and the path of the primary current as it flows through the ignition switch and the breaker points. Figure 2 is a typical transistor ignition circuit. Following the arrows in Fig. 2, one of the advantages of the system becomes immediately obvious: While the primary current still flows through the ignition switch, it does not flow through the breaker points. Since the points carry only the control current, their life is greatly extended.

Going back to the ignition switch, however, we find that it is carrying a much higher current in Fig. 2 than it was in Fig. 1. This is due to the fact that the transistor circuit must operate at a higher current level for top efficiency—as a matter of fact, it draws almost twice as much current as its predecessor. Since the ignition switch is not designed to carry this load, it becomes the one weak link in an otherwise faultless system.

Figure 3 shows an ideal solution to the problem which has been successfully tested in a number of installations. Simply install a relay with a 12-volt, 60-ohm coil in series with the ignition switch, and connect its contacts to break the primary current. The author paralleled the two 10-amp contacts of a d.p.s.t. relay, since the unit was considerably cheaper (about $5) than a relay with one 20-amp contact. —30—

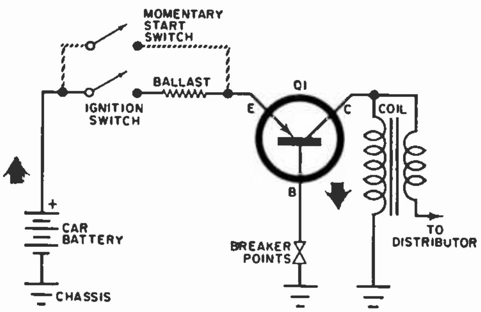


Fig. 2. While points don't carry heavy primary current in transistor circuits, ignition switch does.

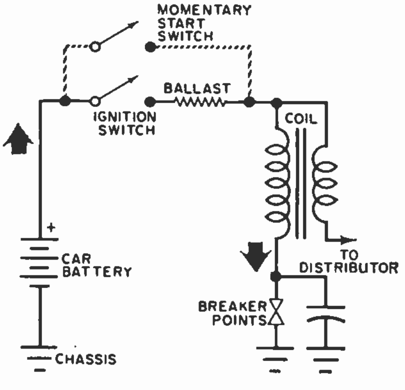


Fig. 1. Conventional ignition; current is about half that drawn by transistor types.

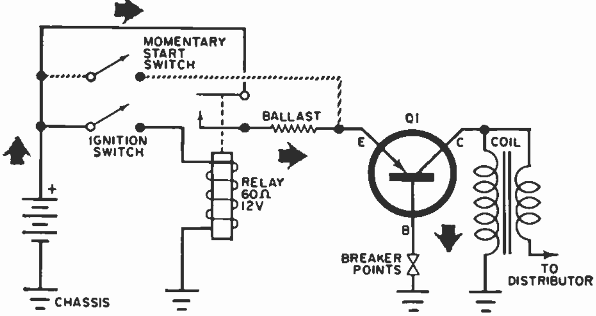


Fig. 3. Relay switching eliminates ignition switch breakdown; wire in relay (see text) as shown here.

Predicted Radio Receiving Conditions

How the short-wave bands will sound throughout the summer months

By **STANLEY LEINWOLL,** Radio Propagation Editor

DURING the late spring and summer months, mysterious dense clouds frequently form in the ionosphere. Unlike the clouds that make our weather, these are invisible, and have the unique property of being able to reflect back to earth radio frequencies much higher than those ordinarily reflected by the ionosphere during normal communications conditions.

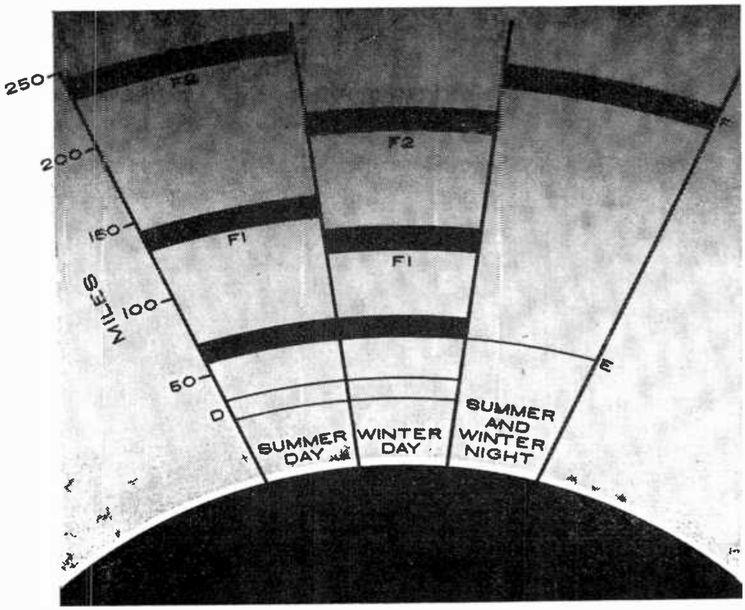
The ionosphere is the region far above the earth's surface which can reflect radio waves back to earth the way a mirror reflects a beam of light. It is formed by radiation from the sun acting on the thin, rarefied gases in the earth's upper atmosphere. Since the intensity of solar radiation reaching the ionosphere is subject to considerable variation, the radio frequencies that the ionosphere is capable of reflecting are also subject to wide variation. These frequencies vary from day to night, from one season of the year to the next, between one location on earth and another, and from year to year over an 11-year cycle.

Ionospheric Layers. As we ascend in height from the earth's surface, we find that the ionosphere is broken down into three well-defined regions at different altitudes. Within each region are one and sometimes two distinct layers. These regions have been given arbitrary designations: *D*, *E*, and *F*.

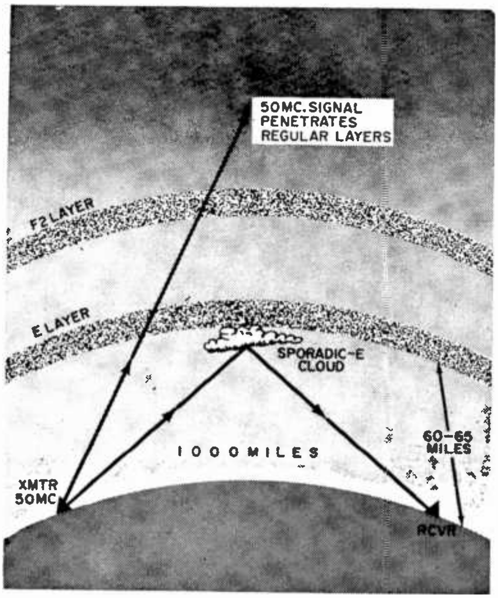
The lowest region in the ionosphere contains the *D* layer, and it is at a height of approximately 30 to 35 miles. This layer is of little use in propagating short-wave radio signals, and is instead primarily responsible for absorbing high-frequency radio signals during unusual sunspot flare-ups.

The next layer, at a height of about 60-65 miles, is in the *E* region. The ionization in this layer closely follows the angle of the sun, and reaches a maximum at "sun-dial" noon, dropping to nearly zero during the night hours.

Above the *E* region is the *F* region, which is divided into two individual layers. The *F1* layer is at a height of about 125 miles, on an average, while the *F2* layer is at a



The normal ionosphere is composed of arbitrary layers and regions. There are variations in the densities and heights of each according to the season of the year and the time of day. In this pictorial representation the relative positions of the layers are shown for summer and winter, day and night. Note particularly the absence of the D layer at night and the recombination of the F1 and F2 layers into a single F region at a great height.



Artistic liberties have been taken here to show a "cloud" of sporadic-E layer ionization. Scientists are not sure of the exact nature or appearance of this phenomenon.

height between 150 and 250 miles. Normally, radio signals that travel over great distances are reflected almost entirely from one of these two layers.

Increase in DX Openings. During May, June, July, and August, there occurs in the *E* region an unexpected increase in its ability to reflect very high radio frequencies. This is of great importance to the short-wave listener and the radio amateur, as well as the DX-TV enthusiast, since it often results in DX signals being heard as high as 50 mc., and sometimes in excess of 100 mc., over distances of 1000 miles or more.

The "clouds" or "patches" which form in the *E* region to reflect these frequencies are made up of very high concentrations of electrons which act like a sheet of metal in their impenetrability to radio waves. They cover areas that are relatively small in size—of the order of 50 to 100 miles—and they are rather short-lived, seldom lasting for more than a few hours. Because of their sporadic nature, and the location of these patches within the *E* region of the ionosphere, they are most commonly referred to as "sporadic-*E*" clouds, shortened to *Es*. Although their origin is not fully understood, it is believed that the *Es* clouds are the result of a shear effect caused in the *E* region by extremely high winds which blow in opposite directions at slightly different altitudes.

The next several months will see a significant increase in the number of DX-TV, amateur 6-meter, and CB "openings" to distances of up to 1200 miles because of the sporadic-*E* phenomenon. These openings will "peak" around noon, local time, since the occurrence of *Es* clouds is at a maximum during the period from around 10 a.m. to 2 p.m. local time. These are not the only hours during which *Es* occurs, however, and it is also possible that there will be many openings during early evening hours.

Summer Band Conditions. Most of the world's broadcasters will make major schedule changes on May 3, in accordance with International Radio Regulations. For the most part these schedules will remain in effect during the four months which comprise the summer season: May, June, July, and August.

The following is a general summary of band conditions expected during the summer.

11 Meters. This band will be completely dead. No broadcasters have any program material scheduled in the 26-mc. band due to expected poor propagation conditions.

13 Meters. Activity in this band will be sparse. The *Voice of America*, the British Broadcasting Corporation, and the U.S.S.R. will be the principal users of the 21-mc. band. Peak activity will be between 1000 and 1400 GMT, or 0600-1000 a.m. EST. The activity will continue until approximately 1800 GMT, when it will drop off. Best reception, when possible in the United States, will be in the early afternoon hours.

16 Meters. This band will be in use by all the major broadcasters. Look for stations between 1000 and 1600 GMT. Best reception time will be around 1800 GMT, 2 p.m. EST, but there will be nothing during the evening hours.

19 Meters. Your best bet for daytime DX, this is the most heavily scheduled band from 1200 to 2200 GMT. DX should be possible into the evening hours, perhaps later on good nights. Latin Americans will sometimes be heard throughout the night.

25 Meters. This band will be constantly in use by some stations, and, depending on propagation conditions, signals should be heard at times during the day or evening. Maximum usable daytime frequencies are normally at their lowest during the summer months, and during days when con-

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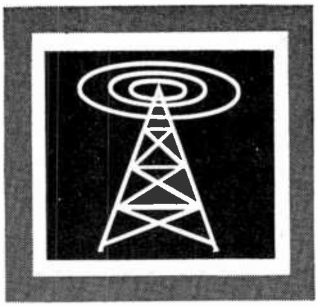


Monthly Short-Wave Report

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

HELPFUL HINTS ON THE DX AWARDS PROGRAM

THE WPE Monitor DX Awards Program continues to move along with many new award winners being announced each month. Since applications for the Countries Award are still pouring in, this award is being continued in 1964, contrary to previous plans, and is running parallel to the States Award which was announced in the April issue of POPULAR ELECTRONICS (page 86). You'll find an application form for the Countries Award on page 62 of this issue.

In checking over the countless applications and station lists submitted for the Countries Award, it has been found that many monitors can claim more countries than they actually do. For example, in most lists Moscow is almost always claimed for "U.S.S.R.," while in reality it counts only for European Russia. The mere fact that you have verified Moscow does not mean that you have verified the entire Soviet Union.

All of the following countries are within the territory generally referred to as "U.S.S.R.," and you can claim any of them—provided, of course, that you have veries from them: Asiatic Russia, Azerbaijan, Estonia, Georgia, Kaliningradsk, Kazakh, Kirghiz, Latvia, Lithuania, Mongolia, Tadzhik, Turkmen, Ukraine, Uzbek, and White Russia. You may have to go to the ham bands to log some of these countries, but it can be done. There is well over half of a 25 Countries Award right here.

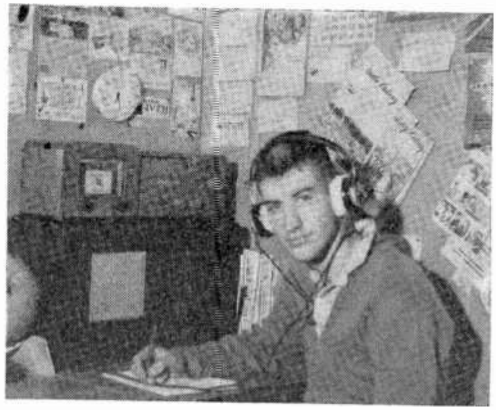
Also virtually unknown is the fact that you can log East Berlin and East Germany, or West Berlin and West Germany, and have solid claims for two countries. North and South Korea also qualify as separate countries, as do North and South Vietnam. In addition, you can list verifications from *Voice of America* transmitters in Washington, Wooferton, Rhodes, Munich, Monrovia, Tangier, Thessaloniki, Colombo, Honolulu, Okinawa (Ryukus), and Malolos or Poro, and have no less than 11 countries.

Did you claim Alaska and Hawaii for your Countries Award? You now can also claim them for the States Award. But don't be fooled by Puerto Rico and the U.S. Virgin Islands; they can be claimed as countries but *not* as states. The States Award, incidentally, is the first one we have had that is comparable to the WAS (Worked All States) Award which radio amateurs have been enjoying for so long.

We have been asked if we use the American Radio Relay League's country list as our guide in judging the Countries Award applications. No; we use the country list of one of the major radio clubs. The ARRL list

Holder of both a WPE registration (WPE8FU), and a ham call-sign (K8UNI), Marvin Prusinski of Detroit, Mich., divides his time between short-wave listening and amateur radio. The Hammarlund HQ-180 receiver with which he does all his SWL'ing is featured prominently in his shack full of equipment.

James Prout, Jr., WPE8DLS, (right), of Huntington, W. Va., has logged 36 countries on his German Mendes MS225W receiver and verified 24 of them. His other equipment: a National SW-54 receiver, a Pilot FM tuner, and an antenna cut to the 49-meter band.



Robert Reinhard, Middletown, Pa., (left), uses a Hallicrafters S-120 receiver with a 30' inverted-L antenna. To date he has 30 countries heard, 25 verified. Bob is a member of the Benelux DX Club.

ENGLISH-LANGUAGE NEWSCASTS TO NORTH AMERICA

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

COUNTRY	STATION	FREQUENCY *(kc.)*	TIMES *(EST)*
Australia	Melbourne	17,840, 15,220 9580	2030, 2130, 2330 0745
Bulgaria	Sofia	6070 (and/or 9700)	1900, 2000, 2300
Canada	Montreal	9625, 9585, 5990	1800 (Caribbean) 0215, 0300 (W. Coast)
East Congo	Leopoldville	11,755	1630, 2100, 2230
Czechoslovakia	Prague	11,905, 9795, 9550, 7345, 5930	2030, 2330
Denmark	Copenhagen	15,165 9520	0700 2100
Finland	Helsinki	15,185	1530 (Mon., Fri.)
West Germany	Cologne	11,795, 9735 9640, 6160 9735, 9575, 6145	1010 2035 0000
Hungary	Budapest	9833, 7215, 6234	1930, 2030, 2200, 2330
Italy	Rome	11,905, 9575	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 (and/or 9740)	2105, 2305
Spain	Madrid	9360, 6130	2215, 2315, 0015
Sweden	Stockholm	17,840 9660 6065	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

DX Awards Presented

The following DX'ers have qualified for awards this month (150. 100, 75, 50, and 25 countries verified). Congratulations, and welcome to the Awards List!

One Hundred Fifty Countries

Bill Dennis (WPEØDSD), Omaha, Nebr.

One Hundred Countries

Gregg A. Calkin (VE1PE3L), Saint John, N. B., Canada
Peter W. Drew (VK6PE1E), Nedland, West Australia

Seventy-Five Countries

James Gill (WPE3CGF), Philadelphia, Pa.

Fifty Countries

Don Clark (WPE8GUF), Columbus, Ohio
Lee Van Valen (WPE2DLF), Bergenfield, N. J.
Mark B. Holton (VE2PE6Z/VE3), Peterboro, Ont., Canada
Gerry Klinck (WPE2FAH), Buffalo, N. Y.
Louie A. Stober (WPE7OO), Tigard, Oregon
Phil Cutler (WPE9EFL), Barrington, Ill.

Twenty-Five Countries

Mike Baker (WPEØBXH), Wichita, Kansas
Jim Kline (WPE9DZP), Genoa, Ill.
Albert Jelinek (WPE2CWA), Neptune City, N. J.
James S. Wilkie (WPE7BTB), Columbia, Mo.
Bernard Sash (WPE2GQZ), Brooklyn, N. Y.
Stanley Cohen (WPE3DHO), Philadelphia, Pa.
Michael Fedorka (WPE1FIW), Trumbull, Conn.
Allan Belanger (VE1PE1FS), Baie d'Urfe, Quebec, Canada
Ronnie Moody (WPEØCQL), Houston, Mo.
Paul Rephen (WPE1EZK), Brooklyn, N. Y.
Paul C. Jablon (WPE2FVZ), Flushing, N. Y.
Tom McCarthy (WPE3DWD), Baltimore, Md.
Carl F. Olsen (VE7PE7V), Cumberland, B. C., Canada
Gene Melton (WPE9FTD), Kirkland, Ill.
David Kaplan (WPE1FIJ), Kargford, Conn.
Jerry McNeill (WPE4FOZ), Asheboro, N. C.
Michael H. Peters (WPE9EEC), Burnett, Wis.
Ronald Rhodes (VE3PE1WY), Windsor, Ont., Canada
Jody Coles (WPE5CSW), Houston, Texas
Nathan and David Gould (WPE1FCY), Woodstock, Conn.
Richard Silva (WPE1FMY), New Bedford, Mass.
Mrs. L. V. Markwalter (WPE4FQJ), West Palm Beach, Fla.
Robert Smith (WPE5DHZ), Lubbock, Texas
Halleck W. Pollard II (WPE4HFE), Vienna, Va.
Bobby Dungan (WPE6FEP), Norwalk, Calif.
Dan Knepper (WPE8HGR), Toledo, Ohio
Bruce J. Turner (VE3PE1LU), Toronto, Ont., Canada
Wally Wazyei (WPE2DSL), Rochester, N. Y.
Jack Hubby (WPEØARS), Colorado Springs, Colo.
Donald Newquist (WPE9FDZ), Rochelle, Ill.
Philip Drago (WPE6FAV), Santa Monica, Calif.
John Feldman (WPE3EHU), Feasterville, Pa.
David Enegess (WPE1EKS), Newton, Mass.
Richard Markell (WPE6DXC), Los Angeles, Calif.
Frank Ciniglia (WPE2JEI), Harrison, N. Y.
George Wilson (WPE8GXO), Columbus, Ohio
Walter A. Smart (WPE9EKW), Pittsfield, Ill.
David Brodsky (WPE4GNZ), Arlington, Va.
Ray Wasky (WPE8FCK), Cleveland, Ohio
Tom Moffitt (WPE8BMH), Jackson, Mich.
Richard Beatie (WPE4DUG), Tampa, Fla.
Edward Kaczmarek (WPE2KDH), Sayreville, N. J.
Wilbur Grant (WPE4GMA), Roanoke, Va.
Robert Woods (WPE6EMH), Long Beach, Calif.
Fred Willshaw (WPE2EQN), Whitesboro, N. Y.
James M. Gaylord (WPE7WQ), Tacoma, Wash.
Karl Kristiansen (WPE1FLY), New Bedford, Mass.
Frederick Seaman (VE1PE5S), Wolfville, Nova Scotia
Barry C. Brown (WPE3FBC), Baltimore, Md.

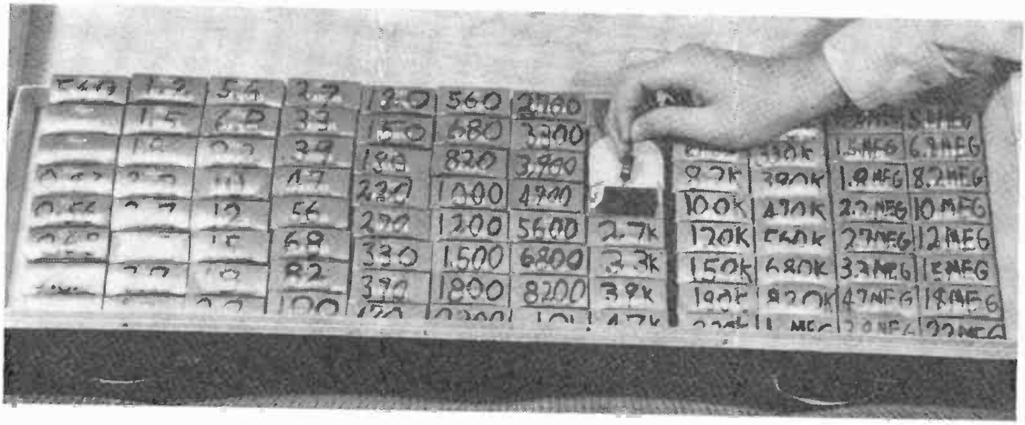
is fine for its purpose, but the list used for the P.E. DX Awards is a bit more liberal as to country designations. In the Caribbean area, for example, the ARRL lists several countries under one heading while the P.E. list breaks that area down into separate countries.

There have been several changes in the country list in recent weeks. British North Borneo is now known as Malaysia; the Celebes and Molucca Islands are now known as Sulawesi, Maluku, and Lesser Sunda Islands; and Borneo and Indonesia are now known as Kalimantan. A new listing is Glorioso Island. Netherlands New Guinea is now classed as West Irian, and this also includes Biak Island. Those who have verified Iwo Jima should claim the Bonin and Volcano Islands. There will be other changes from time to time—watch for announcements as they occur.

Club Notes. The long-awaited association of North American radio clubs is finally coming into being. Mr. Don Jensen, WPE9EZ, has been appointed acting executive secretary in order to get the association organized. His first duty will be to form a constitution in conjunction with all of the participating North American clubs. Mr. Jensen's appointment is for a period of six months following approval of the constitution, after which an executive secretary will be elected by the representatives of the clubs; this election will cover a two-year period. Unfortunately, no provision is being considered at this time for representatives of short-wave listeners who are not members of any club. But there are a number of first-rate organizations that you can join if you fall into this category. Complete details on these clubs can be obtained from your Short-Wave Editor by requesting Leaflet H (revised) and enclosing return postage.

The Benelux DX Club is attempting to compile a listing of short-wave stations that, for any one of a number of reasons, will *not* verify listeners' reports, and WPE monitors are invited to take part in this compilation. Make up a list of those stations to whom you have reported without success, including

(*Continued on page* 120)



THERE'S A RAISIN [box] FOR EVERYTHING

Parts storage is no problem— just keep an eye on the grocery list

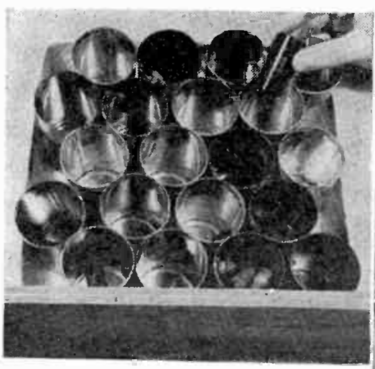
A HAPHAZARD junk box need not be the rule in your home workshop. A few simple containers, salvaged from the week's groceries, can help bring order out of chaos.

Raisin boxes, all of a uniform size, are excellent for storing resistors. A marking pencil indicates the value on the top flap of the box. Small frozen juice cans provide neat storage for capacitors. The values can be marked on the tin with a felt marking pen.

Perhaps the most difficult shop item to store safely is the radio tube. Your octals, novars, and compactrons will find a secure berth in an egg carton, and the versatile raisin box provides storage space for four miniature types. Using a marking pencil on the top flap will tell you what's inside.

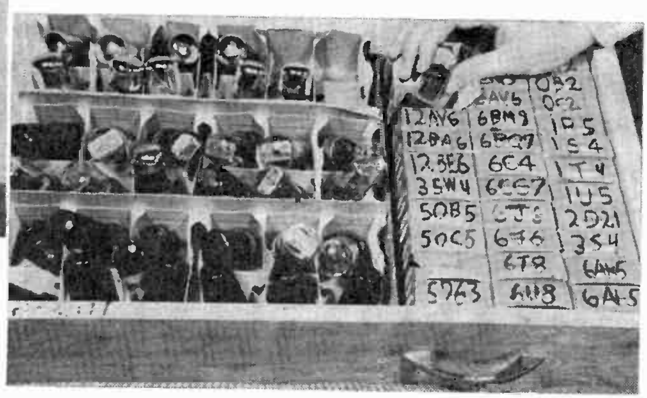
So don't throw away that "garbage." You may have a use for it!

—Greg Danner



Tin cans (above) salvaged from frozen juices make capacitor banks.

Place the egg cartons, raisin boxes, tin cans or what have you inside a convenient drawer, and find what you want the easy way.



Across the Ham Bands

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

MEASURING TRANSMITTER POWER

IF you are a mite confused about the power ratings of modern amateur transmitters, take heart; you are not alone. Although the FCC amateur regulations clearly specify that the maximum permissible amateur transmitter power input is 1000 watts (75 watts for Novices), many SSB phone operators nonchalantly announce over the air that they are using 2000-watt peak envelope power (PEP) transmitters! But other amateurs never claim that they use more than 1000 watts of power. Does this mean that there is one power limit for SSB transmitters and another one for the other types of transmitters?

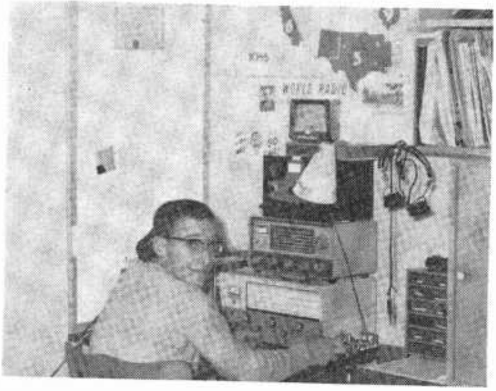
The answer to that question is "no," but there is the matter of interpreting the regulations. As all amateurs learn, transmitter power input is equal to the d.c. plate current in amperes drawn by the tube or tubes feeding the antenna multiplied by the d.c. plate voltage. Thus, a transmitter using a 6146 tube in the output stage operating at a plate potential of 600 volts and a plate current of 100 milliamperes (0.1 ampere) has a power input of 60 watts. And an oscilloscope set up to measure the transmitter's power output will display an output envelope pattern of a certain height.

If this same 6146 is used as a Class A or Class AB linear amplifier in a single-sideband transmitter, the plate meter will bob up and down as the operator speaks into his microphone. Obviously, under these conditions, the power is constantly varying, but legally, the power input is still the plate voltage multiplied by the *maximum* plate current indicated by the meter.

Now, if the microphone gain control is adjusted so that the pattern on the oscilloscope kicks up to the same height on voice peaks as it reached on the steady c.w. signal, it will be seen that the meter pointer is swinging up to only half of the value it reached on the steady signal (50 ma. in our example), although the oscilloscope proves

Novice Station of the Month

Skip Long, WN6GWK, operates 40- and 15-meter c.w. and 2-meter phone from his San Carlos, Calif., QTH, but he prefers code. WN6GWK will receive a 1-year subscription to POPULAR ELECTRONICS for submitting this photo in the Novice Station of the Month contest for May. If you would like to enter the contest, send us a clear photo of your station showing you at the controls, along with some information about yourself, your equipment, and your operating achievements. Send it to Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Indiana.



John Lewis Getz, III, WN4RIJ, Jacksonville, Fla., spent his first two weeks as a ham trying to make contacts with a shorted piece of coax in his antenna. He now has 27 states and Canada worked.

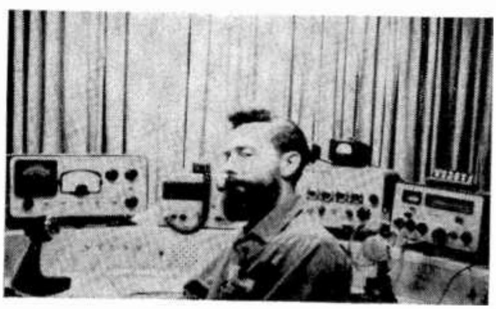
that the transmitter is putting out exactly the same peak envelope power as before.

The explanation is that the plate meter's mechanical inertia prevents it from following each pulse of plate current; consequently, the plate meter of an SSB amplifier amplifying voice signals will swing up to approximately half of the true peak currents—the exact value depending somewhat on individual voice and transmitter characteristics. Put simply, the d.c. ma. plate meter (and voltmeter) establishes the transmitter's nominal or legal power input, but in a properly operating single-sideband transmitter, the peak input is normally double this amount.

For comparison, in a c.w. transmitter the meter and "PEP" input are the same, since there are no modulation peaks to contend with. In a conventional plate-modulated AM transmitter, the peak envelope power (or instantaneous envelope power) on peaks is four times as great as the input indicated by the plate meter. (The modulator supplies the extra power.) However, only one-third of the output of an AM transmitter is used for useful, intelligence-carrying sidebands—the other two-thirds is carrier power—whereas in an SSB rig, *all* of the power goes into *one* modulation sideband.

If you're still confused, just remember that the nominal d.c. input of all amateur transmitters is limited to 1000 watts; the *useful* input of your transmitter depends on which mode of operation you choose. "Peak envelope power" is a way of describing useful input, and it's approximately double nominal d.c. input.

Norman S. Ross, VE3EJJ, Dorchester, Ontario, Canada, is literally surrounded by his station—it's installed in a home-built console. Norm operates on all bands between 80 and 2, has six antennas.



ALL-CONTINENT AWARD

Hammarlund is cooking up big plans for a "Dx-pedition of the Month All Continent Award." A beautifully scrolled certificate confirming contacting of the Hammarlund Dx-peditions on all continents will be awarded to every ham and SWL who qualifies. For more details, write to P. O. Box 7388, GPO, New York 1, N. Y.

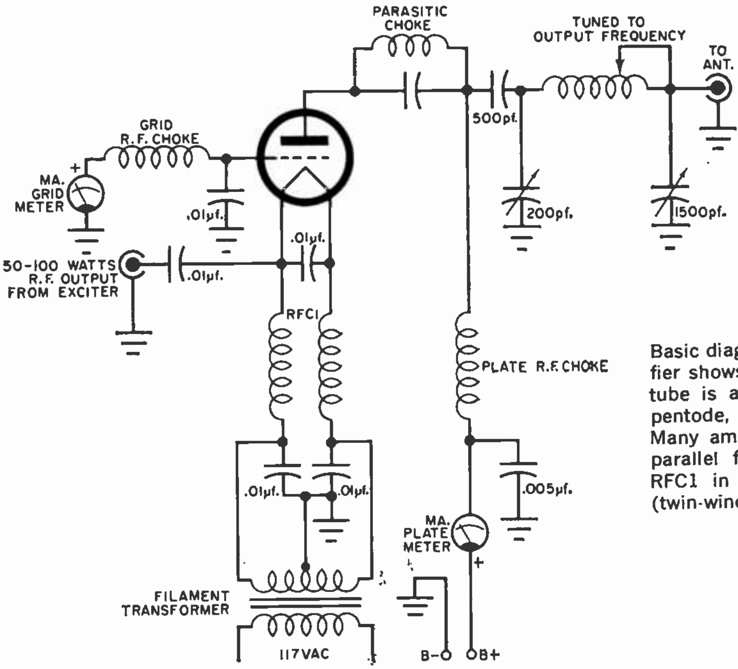
CLASSIC HAM CIRCUITS

In all but the simplest low-power transmitters, the r.f. signal generated in the oscillator stage is amplified before being fed to the antenna. There are two basic r.f. amplifiers used for the purpose. One is the conventional amplifier in which the input signal is fed to the control grid of the amplifier tube and the output signal is taken from its plate circuit. The second one is the *grounded-grid r.f. amplifier*. In it, as you might suspect, the control grid is grounded, and the input signal is fed into the cathode circuit.

Less than ten short years ago, the grounded-grid amplifier was nothing more than an electronic curiousity described briefly in some electronics handbooks for hams and engineers. Today it is the preferred output r.f. amplifier in most high-power amateur transmitters.

Advantages of Grounded-Grid Amplifier. One obvious advantage of the grounded-grid r.f. amplifier is its simplicity as revealed in the accompanying diagram. Compared to the conventional tetrode or pentode r.f. amplifier, it requires neither screen-grid nor bias power supplies; nor does it normally require neutralization for stability. In addition, it produces measurably less distortion than the conventional amplifier circuit.

An apparent *disadvantage* of the grounded-grid r.f. amplifier is the large amount of driving power it seems to require. Upon closer examination, however, the grounded-



Basic diagram of grounded-grid amplifier shows its inherent simplicity. The tube is a high-mu triode, tetrode or pentode, with all grids grounded. Many amplifiers use several tubes in parallel for increased power. Choke RFC1 in the heater line is a bifilar (twin-winding) high-current r.f. unit.

grid amplifier turns out not to be excessively hard to drive after all.

How It Works. When the input signal is applied across the cathode circuit (which may be simply a bifilar choke in the heater leads or, preferably, a tuned circuit resonant at the operating frequency), an r.f. voltage is developed between the cathode and ground. As the control grid is at r.f. ground potential, this has much the same effect as feeding the signal directly to the control grid. Consequently, through the amplifying properties of the tube, an amplified replica of the input signal is developed in the plate circuit of the tube.

The r.f. component of the plate current flowing through the common cathode circuit develops a voltage exactly 180 degrees out of phase with the original excitation voltage. This makes it necessary to increase the excitation signal about ten times over what would be required to drive the same tube in a conventional grounded-cathode amplifier.

But this extra driving power isn't lost; most of it simply flows through the tube and appears as useful output in the plate circuit. For example, a tube that requires 10 watts to drive as a conventional amplifier may require 100 watts to drive in the grounded-grid circuit. On the other hand, the latter amplifier will also deliver about 90 more watts to the antenna, so nothing is really gained or lost.

The reason for the low distortion of grounded grid amplifiers when compared to conventional types is the degenerative feedback introduced in the cathode circuit by the plate current flowing through the common cathode circuit.

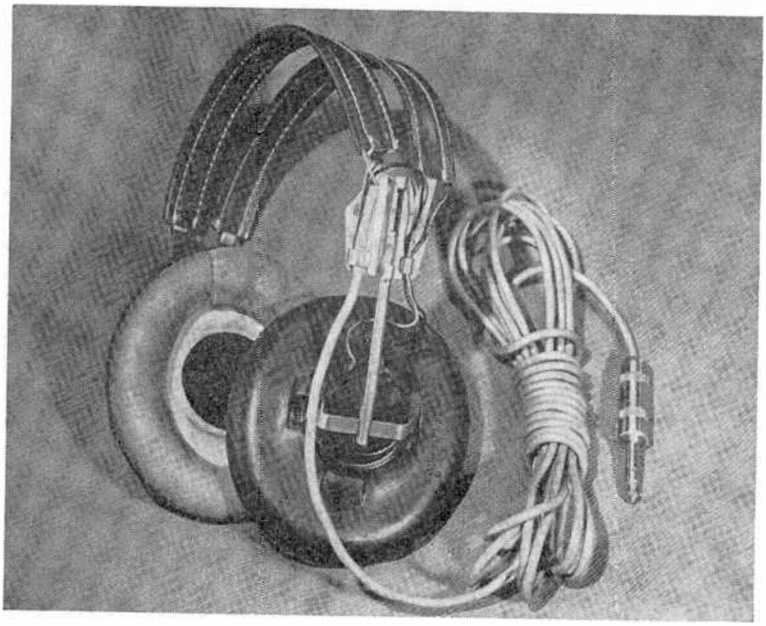
Obviously, high-power grounded-grid amplifiers are not particularly suited for use with flea-powered exciters, but they are ideal for giving a 10:1 power boost to 50- to 100-watt output transmitters.

Grounded-Grid Evolution. A few hams experimented with the grounded-grid power amplifier in the early 1950's, but the first full-fledged articles on the subject that we could find in the amateur press were "Notes on the Grounded-Grid R.F. Amplifier," by T.H. Puckett, W5JXM/1, in *QST*, December, 1954; and "Grounded Grid and the 304TH," by Thomas P. Leary, WØVTP, in *QST*, January, 1955. Both articles stressed the high values of r.f. excitation power required by the circuit and didn't stir up much interest.

But in the June, 1955, *QST*, E. L. Hoover, W9SAR, and R. L. Peck, W9MOW, described a zero-biased grounded-grid amplifier using four modified 1625's in parallel which was relatively easy to build. Norm Loughlin, W6CEG, also described zero-biased grounded-grid amplifiers in *CQ*, July and September, 1955. From these early beginnings, the circuit gradually achieved its high popularity of today.

(Continued on page 117)

Surplus Stereophones



By JON H. LARIMORE

HOW WOULD YOU LIKE a good pair of stereophones for less than eight dollars? Sound unbelievable? Read on.

The HS-33 military headset is available in large quantities and at popular prices from several of the surplus dealers; when modified slightly, it can be used for stereo. In ordering your HS-33 'phones, go the added cost of the rubber ear cushions—the improved audio and added comfort are well worth the small increase in price.

The modification is a simple one. Start by loosening the two setscrews on each phone and removing the two wires from each one. Clip the small phone tips from the wires and slip them out of the headbands. Prepare a new three-conductor cable (Belden #8443) by removing about 14" of the outer insulation. Cut the red and black wires to about 5", saving the excess black. Remove the insulation from the ends of the red, green and black wires, as well as from both ends of the extra black piece. All of the stripped ends should expose about 1" of wire, which should be tinned.

Insert the new cable through the clamp that was used to hold the original cable so that the cable extends 1" beyond the clamp. Pinch the clamp tight.

Insert the green wire through the nearest headband and the extra black through the other. The red and black wires go through the other clamp on the left phone, and the green goes through one clamp, the black through the other, on the right phone. By folding the wire ends back on themselves, enlarge them until they fit comfortably in the screw connectors in each phone. Be sure the two black wires are connected together where the cable enters the headset.

Terminate the other end of the cable with a Switchcraft #297 stereo plug. To insure that you will put the left channel earphone on the left ear each time, and the right over the right ear, use white paint and a small brush to mark the phones with an "L" and "R."

While the HS-33 was originally designed for communications work, the illusion of depth that stereo provides will more than compensate for any high or low end frequency losses that the completed earphones may possess. -30-

New 1964 Heathkit® All-Channel* Color TV

GR-53A

$399.00

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

Everything you need for the best in color TV viewing-Build it in 25 hours-Save hundreds of dollars!

***FCC Requires UHF As Of April 30!** A new Federal law requires that all TV sets built or imported after April 30, 1964 be equipped to receive *all* VHF & UHF channels, 2 thru 83.

As a result, Heathkit now offers you a *new* model consisting of chassis, tubes, mask; a *new* wall mount; a *new* all-transistor UHF tuner; and a special 6" x 9" speaker ... everything for complete high fidelity *all-channel color* and *black & white* TV reception for only $399!

Cabinet Or Custom Installation! After assembly, just slip the complete unit into the handsome, walnut-finished hardboard cabinet! Or mount it in a wall or custom cabinet.

Anyone Can Build It! No special skills or knowledge required! All critical assemblies are factory-built & tested! Simple step-by-step instructions take you from parts to picture in just 25 hours!

Exclusive Built-In Service Center Ends Costly Maintenance! You align, adjust, and *maintain* the set yourself with the degaussing coil, service switch, and built-in dot generator! *No* other set has these self-servicing features!

No Expensive Service Contract! Since you can maintain the set, there's no need for a costly service contract. Heath warrants picture tube for 1 year, all other parts for 90 days!

No Trade-In Required! Keep your present TV as a handy "second" set!

Quality & Performance Comparable To Sets Costing $600 & More! • 26 tube, 8 diode circuit • Deluxe Standard-Kollsman nuvistor tuner with "push-to-tune" fine tuning • RCA 70° 21" color tube with anti-glare bonded safety glass • 24,000 volt regulated picture power • Automatic color control & gated AGC • 3-stage high gain video I.F. • Line thermistor & thermal circuit breaker protection.

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Kit GR-53A, chassis, tubes, mask, VHF & UHF tuners, mounting kit, speaker, 132 lbs.................$399.00
GRA-53A-1, walnut-finish cabinet, 70 lbs..........$49.00

Limited Supply Of "VHF Only" Models Left! If you want a color set *without* UHF, hurry & order now!

Kit GR-53, chassis & tubes, 118 lbs.......$349.00
GRA-53-1, walnut-finished cabinet, 70 lbs...$49.00
GRA-53-3, custom mounting kit (order for wall or custom cabinet installation) 10 lbs..........$4.00

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CL-174R

CIRCLE NO. 8 ON READER SERVICE PAGE

Restoreth Thy Relic Radio

(*Continued from page* 35)

sure, though, that the output is well-filtered; otherwise, you will have hum problems.

For the typical receiver using six 01A's, you will need six volts at 1.5 amperes for the filaments. For the plate circuits of most battery sets, you will need 90 to 135 volts for the r.f. and audio tubes and 22 to 45 volts for the detector. The power supply shown in the schematic diagram provides a choice of various plate voltages at currents of up to 50 ma. The best source of external bias voltage ("C" voltage), for those sets which require it, is a small transistor-type battery. Because current drain is negligible, the battery will last a long time. The amount of bias required varies with the type of tube used and with plate voltage; typical values range from 4.5 to 13.5 volts.

A.C.-Operated Antiques. Ills common to a.c. sets include bad bypass, coupling, and filter capacitors, noisy volume controls, resistors changed in value, open center-tapped filament resistors, and burned-out transformers. Can-type, wet electrolytics can be replaced with 450-volt tubular electrolytics of the same or higher capacitance. The multi-section Mershon electrolytics found in some sets can be replaced by single or multi-section tubular capacitors; usual values are 8 to 25 μf. per section.

The resistor color code used in old receivers was really no code at all, since it varied from manufacturer to manufacturer and from year to year. The first standard coding, which came into use during the 1930's, was the "BED" code: *B*ody, *E*nd, *D*ot. Colors and values were the same as are used today, but they were arranged differently. The body color is the first figure, the end color the second, and the dot color the multiplier. The tolerance, if one is shown, is at the opposite end.

Most older radios used dynamic (field coil) speakers and the coils sometimes burn out. A good replacement is a PM speaker and, for the field coil, a suitable choke or resistor.

Until the mid-1930's, almost all a.c. receivers used tubes with 2.5-volt heaters, and replacement transformers furnishing this voltage are hard to find. One source known to the author is the SNC Manufacturing Co., P.O. Box 277, Oshkosh, Wisconsin. If either a 2.5-volt winding, or a 5-volt rectifier filament winding, is bad and the rest of the transformer intact, simply use a separate filament transformer with the correct voltage and current ratings.

Another solution to the transformer problem is to use a replacement transformer with a 6.3-volt filament winding and replace the 2.5-volt tubes with their 6.3-volt equivalents (type 76 for the 27 or 56; 6C6 or 77 for the 57; 6D6 or 78 for the 58; etc.). Unfortunately, there is no exact 6.3-volt equivalent for the very widely used 24A. Your best bet here is to try to find a 2.5-volt transformer.

One problem with transformers in general is that they are sometimes sealed in metal cans (this is particularly true of Atwater Kent receivers). To get to the windings and internal connections, you have to melt your way through a layer of pitch. It can be done, but it's a messy job.

Circuit Information. Probably the best source of schematics for early radios are the John F. Rider Manuals. Volume 1 covers the period from 1919 to October, 1931; Volume 2 from October, 1931 to May, 1932, and so on. Long out of print, these books can now be found only in large libraries and in some radio service shops. Another source is *Radio News* magazine; issues of the early 1930's carried circuit diagrams (sometimes, however, without parts values) of the more popular sets of the day. Volume 1 of Supreme Publications' *Most-Often Needed Circuit Diagrams* contains schematics of many receivers of the 1926-1938 era; this is still available from either Supreme Publications or Allied Radio and Lafayette Radio Electronics for $2.50 postpaid.

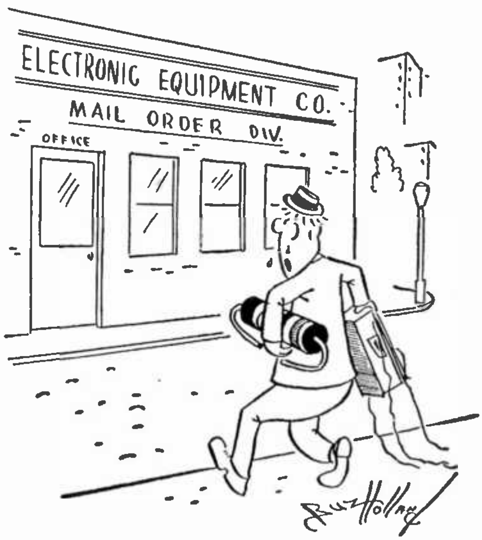
Although it contains no schematics, Ghirardi's *Radio Troubleshooter's Handbook* is a useful publication to have. This 740-page manual contains "case histories" of troubles common to almost every radio made before 1940. Also included are the i.f.'s of over 20,000 super-

hets, tube tables, and other data. Copies may be found in libraries or in used book shops.

Parts and Tubes. Once the value of a defective part is known, a replacement can usually be obtained from any of the usual electronics suppliers. In size, the new part will probably be considerably smaller, but electrically it will be the same or better.

Although the old tubes never seem to burn out, they do get weak and they sometimes short. If you need replacements or if you want to get a set of spares while they are still available, you have several sources to choose from. Of the commonly used old tubes, only types 24A, 27, 47, and 80 are still being made. These are available from mail-order houses and larger parts suppliers. Less expensive sources for these tubes—and probably the only sources for many others—are tube dealers such as Barry Electronics Corp. (512 Broadway, New York 12, N.Y.) and Arcturus Electronics Corp. (505 22nd St., Union City, N.J.). Here you can find almost any tube ever made, from the 01A to the latest type, at a moderate price. A post card to either company will bring you a price list.

A word about tube substitutions. Long-pin 01A's will replace the original short-pin type, but not vice versa. The 01A will, incidentally, replace types 00, 01, and 01B. Better performance at low-



"Smart alecks!"

er heater current will be obtained by replacing 27's with 56's. Type 47 is directly interchangeable with type PZ. The 1V rectifier will replace types 1 and KR1. In old Sparton receivers, the type 71A will replace the 182B, 183, 482B or 483 tubes. Sparton types 484 and 485 can be replaced by the 27 or 56, but only if a suitable voltage-dropping resistor is added to the heater circuit.

If the various tube designations seem confusing, just remember that only the last two digits (plus a letter if one is used) are significant. Thus, the 201A and 301A are simply the 01A; the ER227, UY227 and C327 the type 27; and the UX280 and CX380 the type 80. The various prefixes originally identified different manufacturers and socket arrangements.

While it is impossible to cover completely the lore of early broadcast receivers in one article, the foregoing will give you some insight into this fascinating hobby. And who knows? Once you have your relic radio back in peak condition, you may find yourself deserting the TV screen to just listen. . . -30-

Tuning Up on 460 Mc.

(*Continued from page* 58)

converter, and while a balun, or matching device, could be employed to permit the use of antennas with different impedances, there are several alternatives that may prove more attractive.

The simplest way to obtain an omnidirectional antenna would be to form a folded dipole with a total length of 12". This can be made of foam-filled tubular twin-lead, and fed at the center. Mount the dipole on a piece of wood, and set it up. Remember, however, that most of these stations broadcast with vertical polarization, so for best results, keep your folded dipole vertical.

Another easy way to handle the question of antennas is to obtain one of the standard UHF bow-tie antennas, which come with a reflector. If there is only one station you want to hear (the local police department, for instance), set the antenna up so it points to that station's transmitting antenna. Again, make sure you use a vertical polarization, regardless of how strange the antenna may look when it's up there!

Still using the UHF bow-tie, you can solve the problem of directivity by adding a small TV rotator mechanism and point the antenna where you want to at any time. (If you flop the antenna over on its back, you will have a figure-eight pattern, but horizontal polarization.)

Whatever antenna configuration you decide upon, be sure to use the foam-filled twin-lead as a feed line.

UHF communications are reliable, but the range is not excessive. Don't expect any cross-country DX on these bands. You will notice, however, that the static which plagues the lower frequencies is almost gone here. So if the pioneer spirit possesses you, get up there on the short-short wave bands, and listen! -30-

Build Panic Alarm

(*Continued from page* 39)

behind a 2¼" cutout, and a scrap of perforated sheet metal stock is painted red and used as the speaker grille. A matching 2¼" round hole is cut in the panel to allow the bulb of the 25-watt lamp to protrude. The balance of the components are mounted on a 2 7/16" x 6½" piece of Vector perforated breadboard stock, which is secured to the bottom of the cabinet using ½"-long, ⅜"-diameter, internally threaded brass stand-off posts.

Although assembly is not especially crowded, care must be exercised in the placement of components to insure adequate clearance for the 25-watt lamp and the speaker. The writer used brass eyelets for component connection; push-in terminals may be used if desired, however. A socket was not used for the 25-watt lamp in the writer's model. Instead, the lamp was inserted in position with the base against the perforated board, eyelets were installed in the board and #16 solid copper wire used to secure the lamp base and make the required connections. Since brass—instead of the more common aluminum—is used in the base of the red-frosted lamp, soldering the lamp in place provides a simple and effective method of mounting.

Testing and Adjustment. Check your work carefully, using an ohmmeter to test for continuity and the absence of shorts. Be sure that no portion of the circuit is shorted to the metal cabinet. When you're satisfied that the wiring is correct, apply power to the unit. The 25-watt lamp should glow at approximately half brilliance and the 50C5 heater should light. A voltmeter connected across capacitor *C5a* should measure approximately 150 volts d.c. Now brace yourself and push the panic button. Relay *K1* should close and a *very* loud rising and falling audio tone should be heard from the speaker. Lamp *I1* should flicker at a rate corresponding to the warble of the tone and lamp *I2* should appear to glow continuously.

The time constants of the two neon lamp oscillators have been selected for optimum results. However, you may want to change the frequency of the output tone or the rate of warble. To increase the rate of warble, reduce the value of resistor *R2*; to decrease the rate of warble, increase the value of this resistor. Reduce the value of resistor *R3* to increase the frequency of the output tone, and increase the value of this resistor to reduce the frequency. You will note some interaction between the two oscillator circuits, and trial and error adjustment of the resistor values may be required to obtain exactly the effect you desire.

When the alarm functions to your satisfaction, button up the project. Decals will serve to give it a commercial appearance, and a very light coat of clear spray lacquer will protect the decals after they have been applied.

Furnishing application instructions for the panic alarm would be gilding the lily. Analyze the moods of your boss, and when the prognosis is favorable, introduce the panic alarm and prepare for the fun. If you *are* the boss, simply have fun. -30-

R/C Model Airplanes

(*Continued from page* 47)

Prices. What it will cost you to get involved in R/C is a direct function of how you choose to go about it. In any event, here's a rough run-down on the various items and approximate prices for each.

The model in which the R/C equipment will be mounted can cost anywhere from $10 to $50 exclusive of the engine. The cost is determined by what is given to you in the model and what extras you have to purchase as well as how much of the work is done for you. Obviously, you'll pay more for a fully formed fuselage kit than you will for a kit with a built-up fuselage. The engine, depending on make, displacement, etc., can run from $10 to $25. This does not include such essential accessories as a starting battery, connectors, tank, fuel tubing or, in many cases, propeller.

R/C receivers start at about $9 for the barest minimum, and range on up to $50. Transmitters can be had for as little as $15, but with the addition of tuning meters and other accessories such as pulsers and control boxes, the price rises.

While we're talking dollars and sense, consider that the power for both transmitter and receiver comes from dry batteries. To save cost, many R/C enthusiasts have taken to using rechargeable batteries and recharging power packs. In the plane itself, the NiCad rechargeables are most popular. These are small and light in weight—ideal where size and weight are a major problem.

Actuators add to the cost. Simple two-arm escapements can start at $6, and a compound escapement will cost at least $8. Servos cost a bit more, ranging from about $10 to $25.

The other accessories, such as steerable landing gear, aileron and engine control, and wheel brakes, can be added later, and all tend to increase the cost.

Finally. Radio control equipment has been fantastically improved in the past few years, but there is much additional improving to be done. If more electronically oriented experimenters would take an active interest in the hobby, learn what has been done this far, the hobby itself would benefit. -30-

For additional information on radio control, the following periodicals will keep you right on top of the latest developments: Model Airplane News, 551 Fifth Ave., New York 71, N.Y.; Flying Models, 215 Park Ave. South, New York 3, N.Y.; and American Modeler, 420 Lexington Ave., New York 17, N.Y.

Simple Slave Strobe Sync

(*Continued from page* 61)

not used in this project but can be saved for a future project.

Use a drill or pocket knife to cut mounting holes for the sensitivity control and connecting cable. Do not use the unused tube socket lugs as tie-points; in fact, it is a good idea to clip and remove lugs 1, 3, and 8 from the socket. The completed adapter should be mounted near the strobe with a bracket.

Observe polarity through the use of a polarized mating connector (available at most camera stores) or by identifying marks. The 1C21 will probably come with a coat of light-shielding black paint on the outside of the glass shell. This can be removed with a razor blade.

Testing the Adapter. Connect the adapter to the sync terminals of the strobe. Rotate sensitivity control *R2* to the least sensitive position (minimum resistance). Now slowly advance the control to increase the sensitivity until the unit fires spontaneously; then decrease the resistance until the unit does not fire from random light. It is now at its most sensitive setting. You will find the variable sensitivity control a valuable asset if you work under varying conditions.

Now, from 10 to 20 feet away, fire another strobe. Both units should fire together. Don't blink or you'll miss them.

The parts values given for *R1* and *R2* should be sufficient for most strobes. If your unit fails to work, your strobe may not be providing sufficient voltage. Measure the voltage between pins 2 and 5 of the 1C21 with a VTVM. If it is not about 180 volts with potentiometer *R2* near center, decrease the value of *R1* to compensate. -30-

Perpetual Power Package

(*Continued from page* 55)

cone compound (General Cement No. 8101) between faces of the mica washers and the box and *Q1* and *D6* will further improve heat transfer.

Note that all wiring is isolated from the box itself. This makes it possible to ground either side of the output, as desired, providing due care is taken with regard to the unregulated output terminal. All three output leads are brought to a terminal strip as shown.

Once put into service, the "Perpetual Power Package" will outlast dozens of sets of equivalent batteries, and most likely many of the devices it supplies power to, since all parts have been conservatively selected. If the extra protection of diode *D6* across the output is not needed, this part can be eliminated, with a saving of about $7.50, thus reducing the cost of this permanent battery replacement still further. -30-

For The Birds

(Continued from page 87)

"Crows are very wary, so we rigged up the parabolic reflector to concentrate the sounds on the mike and enable us to make good recordings of crow calls from a distance. It works, too. For the past two or three months we've been sneaking around out here in our spare time making crow recordings. A twelve-year-old boy who lives in that farmhouse down the road has been tagging after us, and we've left the recorder with Steve a couple of times to see if he could tape some calls on his own."

"What's the point in going to all this trouble to talk to other creatures?" Jodi asked thoughtfully. "Surely we know everything they know."

"There's where you're wrong," Carl said promptly. "Dolphins could tell us a lot about secrets of the sea. And if we could talk to them, think how they could help in locating wrecks, in pinpointing storms, in saving lives when a plane is down at sea, or even in penetrating enemy mine fields and submarine nets in time of war."

"Actually we already have a good example of how being able to understand and imitate bird language can be a big help," Jerry interrupted. "Birds can be a real menace to modern high-speed jets. They can easily wreck a plane if they're sucked into the engines on take-off or landing. Zoologist Johann D. F. Hardenberg of the Dutch ministry of agriculture was asked to help with this problem, and he tried playing recordings of American gulls to frighten off Dutch herring gulls infesting the Leeuwarden military air base. This didn't work. Unlike chickens, gulls seem to have their own dialects, and the Dutch gulls didn't dig the American birds. But when Dutch gull distress calls were played over loudspeakers mounted along the runways, they frightened the herring gulls away. Dr. Hardenberg says nearly all birds are frightened away by their own distress calls."

"How do you like these guys?" Thelma asked poutingly. "We get this sumptuous lunch together, get all dressed up, and what happens? They dash off and try to communicate with an old crow! It's downright humiliating to a girl."

"Cheer up, Thelma," Jerry laughed. "You communicate better than a whole flock of crows. If you don't believe it, just listen to this."

Retrieving a roll of tape from the car, Jerry brought the recorder over to the blanket, placed the reel on the machine, and turned up the volume.

"THIS FIRST RECORDING is that of a crow giving an alarm," Jerry said, consulting a notebook. "It was the sound the sentinel bird gave when he first spotted us creeping up on him. A bunch of crows busy pulling up little corn sprouts in a nearby field took off when they heard it. The next one is the sound of crows holding some kind of a caucus. About fifty of them were all perched in the same tree talking away like mad. Just listen."

A great cacophony of raucous cawing poured from the speaker.

"You're wrong," Thelma shouted, leaping to her feet and starting to twist wildly. "They're having a hootenanny! Don't you hear that beat?"

When they stopped laughing, Jerry put away his notebook and announced: "I don't know what this next recording is. Steve, that kid we were telling you about, wasn't home when we picked up the recorder; but his dad said he had got some kind of recording and would tell us about it later."

The previous recording had been loud, but what came from the speaker now put it to shame. The voices of several different birds could be heard screaming with obvious anger and hatred, and there was another sound of beating, flapping wings. And then suddenly the recording came alive—or so it seemed. Out of nowhere came dozens of screeching, dive-bombing crows making precisely the same sounds heard on the tape recorder. Jodi and

Thelma started to scream as they felt the bird claws touching their hair and the wings beating against their faces.

Carl and Jerry grabbed up the blankets and beat off the attacking birds while all four ran toward the car. Once inside, they rolled up the windows and were safe from the crows who were still flying back and forth overhead and uttering warlike cries.

"Whew! Wasn't that something!" Carl exclaimed.

"It certainly was," Jodi answered. "I

feel exactly as though I'm in the middle of one of those horror movies in which birds suddenly turn against people. What's the matter with those crazy crows?"

"It must be something about that recording Steve made," Jerry mused; "and we're going to drive to his place right now and see where he got it."

CARL started the car, and the angry crows followed it down the road for a few hundred yards before they finally gave up the chase. When the car arrived at the farmhouse, Steve, a tow-headed slender boy in overalls, was sitting on the front porch. He came out and listened to their story while a mischievous, deepening grin spread across his freckled face.

"I reckon I know why it happened," he admitted. "I lugged that recorder all around without finding any crows to record. Then I spotted this crow's nest in the top of an old pine. I decided to climb up and see if maybe I could get a recording of young crows in their nest, so I fastened the recorder to my belt and shinnied up the pine. Just as I was getting close to the nest and had turned on the recorder, a whole bunch of them durned crows attacked me. Man, I mean they were all over me, cawing, pecking, scratching, and hitting me with their wings. I tumbled out of that old pine and beat it, but I managed to get the whole thing on the tape."

"Now it makes sense," Jerry observed. "What we have on that recording in crow language is probably a combination of 'Stop, thief!' and that old carnival rallying call of 'Hey Rube!' When the birds heard this coming from the recorder, they reacted just as they did when they discovered Steve threatening their nest."

"Well," Jodi drawled, "picnicking with you two fellows may not be very quiet and restful, but you certainly can't call it dull."

"You better believe it," Thelma piped up as she anxiously examined a couple of tiny claw scratches with the aid of the sun visor mirror. "I'd say this picnic was for the birds!"

But the grin she flashed at the boys revealed that she didn't really mean what she said. -30-

Transistor Topics

(*Continued from page 89*)

experimenters may be interested in measuring the power relationships in transistor amplifier stages. We agree, Charles.

A typical audio output stage is shown in Fig. 3. Transistor *Q1* is used in the common-emitter configuration. Capacitor *C1* serves as the input coupling capacitor, while base bias is furnished by voltage-divider *R1-R2*. Transformer *T1* matches *Q1*'s output to the low-impedance load (typically, a small loudspeaker). From a practical viewpoint, the most important power values in this circuit are: *d.c. power input*, *Q1's collector dissipation*, and *power output*.

Of these, the d.c. power input is the easiest to measure. Simply open the circuit at the point marked "X" and insert a suitable milliammeter to measure *Q1*'s collector current. This value, multiplied by the battery voltage, gives the power input (the base input power is extremely small and, for practical purposes, may be disregarded). If a 9-volt battery is used and the collector current is, say, 5 ma., then the power input is:

$$P = E \times I = 9 \times .005 = 45 \text{ milliwatts.}$$

Transistor *Q1*'s collector dissipation can be determined by measuring its d.c. emitter-collector voltage and multiplying this by its collector current. The meter is connected as shown by the dotted lines. For example, if this value measures 5 volts, then the collector dissipation is:

$$P = E \times I = 5 \times .005 = 25 \text{ milliwatts.}$$

Finally, to measure power output, we replace the normal load (loudspeaker) with a noninductive resistor having a value equal to the load's impedance (generally, 4 or 8 ohms). An *a.c. voltmeter* is connected across

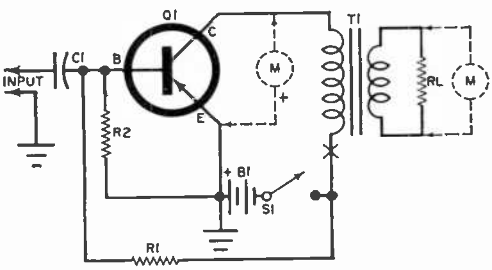


Fig. 3. Typical power amplifier stage. Meter connections shown by dotted lines are used to measure power dissipation and power output. See text above.

the load, as shown, to measure its r.m.s. voltage. A test (sine-wave) signal is applied to the stage, and the load voltage is measured. With the resistor's value known, power output is determined by squaring the voltage across it and dividing by the resistance in ohms. Assuming, say, that 0.37 volt is measured across an 8-ohm resistor, then:

$$P = \frac{E^2}{R} = \frac{(.37)^2}{8} = \frac{.1369}{8} = .0171 \text{ watt,}$$

or $P =$ approximately 17 milliwatts.

A few precautions are necessary if an accurate measurement is to be obtained. First, a good-quality sine-wave test signal must be used. Secondly, the signal amplitude must be comparable to normal signal levels . . . preferably, high enough to drive the stage to maximum output, but not enough to overload *Q1*. Third, the frequency chosen for test must be within the "flat" response region of *both* the amplifier stage and the voltmeter used.

The methods described here are suitable for checking all Class A amplifiers, whether transformer or resistance loads are employed, for *Q1*'s average d.c. input remains the same whether or not a signal is being handled. Special techniques, which space limitations prevent our discussing at this time, are needed for tests of Class B and Class C stages.

Returning to Fig. 3, the sum of the transistor's power dissipation and power output should equal power input, but, in practice, this sum will always be less due to transformer losses. In the example cited, the power input was 45 milliwatts. Transistor *Q1*'s collector dissipation was 25 mw. and power output was 17 mw.—a total of 42 mw. The difference (3 mw.) represents power loss in the transformer.

Once again, reluctantly, we come to the end of another column. I'll be back next month with more news, circuits and tips . . .

—*Lou*

Predicted Receiving Conditions

(*Continued from page* 92)

ditions are rather poor on higher frequencies some good DX should be possible on 25 meters, particularly in the late afternoon and evening.

Although generally a bit too high in frequency for reliable *nighttime* DX, the band should be hot on days when propagation conditions are exceptionally good. The Latin Americans, of course, will be coming in fairly regularly even after dark.

31 Meters. This band is most heavily scheduled from 1400 to 0400 GMT, 10 a.m. to midnight EST. During the day it will generally be too low and in the noise for much DX, although some nearby stations will be heard. On disturbed days, however, daytime DX may be possible, with the result that some good listening can be had.

Generally, good nighttime propagation conditions should prevail, particularly over circuits into Latin America, Africa, and southern Europe. This will be the best band for DX during the early evening.

41 and 49 Meters. These will continue to be the best bands for DX during the late evening and nighttime hours, although crowding will be a major factor after 1800 GMT, with every channel occupied by at least one station.

The 6- and 7-mc. bands will not start coming in (except for locals and short-skip stations) until about an hour after local sunset, but good propagation conditions should continue all night long.

Standard Broadcasting Band. Because of normal seasonal increases in atmospheric noise levels, plus a seasonal trend toward higher useful nighttime frequencies, there will be very little in the way of unusual nighttime DX in this band. Toward the latter half of August, however, when absorption begins to decrease, there should be some improvement in medium-wave DX at night. -30-

Across the Ham Bands

(Continued from page 99)

News and Views

Rod Paulson, WNØHYI, 1437 Second Ave., South, Fargo, N. D., 58101, has cooperated in putting the "rare" state of North Dakota in the logbooks of hams in 33 states and Canada—all on 40 meters. He uses a Knight-Kit T-60 transmitter, a Lafayette HE-40 receiver, and a 40-meter dipole to perform this noble work . . . **John Harris, WN9KMS,** 1919 Raismore Rd., Rockford, Ill., hopes to work all states before he gets his "big" license. So far, his 40-meter dipole, Heathkit DX-40 transmitter, and Hallicrafters SX-28 receiver have 40% of the job done . . . **Hank Holcomb, WN5IUE/WA5IUE,** 405 N. Burnet, Baytown, Texas, can work both the Novice and Technician bands, but he prefers 80 meters—where he uses a Heathkit DX-35 transmitter and a home-built receiver. In addition, he has a Heathkit HW-12 75-meter SSB transceiver waiting for the day his General ticket arrives. On six meters, Hank uses the 6-meter transmitter described in P.E., July, 1961, and receives with the help of a home-built converter.

The annual **Georgia QSO Party** will be held from 6:00 p.m., EST, (2300 GMT) May 9 to midnight, EST, May 11 (0500 GMT, May 12). If you want to participate, you should work as many hams located in different Georgia counties as you can, exchanging signal reports and the names of the respective counties and states with each station worked. You earn two points per contact and your final score will be your contact points multiplied by the number of Georgia counties worked. Mail your contest log to: Columbus Amateur Radio Club, Inc., c/o Clifford R. Watson, K4ADU, 5224 Morris Ave., Columbus, Ga. 31904, before June 15. High scorers will receive certificates . . . **Bob Entman, WA4RBX,** 5300 West Grace St., Richmond Va. 23226, blasts out—usually on 40 meters—with 12 watts of power to a home-built transmitter. A Lafayette HE-30 receiver, and a folded dipole antenna complete his equipment catalog. Twenty-five states, Puerto Rico, and Canada are checked off as worked in his logbook. Bob can fix you up with a Rag Chewer's Club certificate or a QSL card from Henrice County, Va., if you need either . . . **Paul Neil Schacknow, WN2KFY,** 603 East 86th St., Brooklyn, N.Y. 11236, and his dad, Max, WN2LQR, share the same equipment. It consists of an

Eico 720 transmitter running an even 75 watts to feed a 40-meter dipole antenna via a Johnson "Matchbox" antenna coupler, and a Drake 2B receiver. Paul is on 15 meters occassionally but prefers 40 meters, where he has worked 25 states . . . It's pretty hard to keep up with **Dot, WN4DQZ,** Box 6333, Mobile, Ala., whom we mentioned last month. Her states-worked total has increased to 45—all confirmed, too!

John Summers, Jr., WNØHHO, 1312 Pikes Peak, Colorado Springs, Colo., is the proud owner of the Hallicrafters twins—the SX-140 receiver and HT-40 transmitter—used in conjunction with a 40-meter dipole. Operating mostly on 40 meters, John has worked 16 states; 12 of them are confirmed . . . **Charles, WN9INK,** 1644 76th Court, Elmwood Park, Ill., recommends the use of separate antennas for receiver and transmitter for the sake of simplicity. The practice does have some advantages; however, most hams have trouble enough getting up one good antenna, let alone two; and using an inferior antenna on either receiver or transmitter would obviously reduce the efficiency of a ham station . . . In two months, **Elliot Shulman, WN2LLK,** 16 Largo Lane, Livingston, N.J. 07039, has tooled his Johnson "Adventurer" transmitter around the three low-frequency Novice bands. QSO's with 27 states, Canada, and Puerto Rico are the result. A Drake 2A receiver and a 3-band dipole antenna help Elliot make contacts. When not hamming, he SWL's as WPE2HRV.

Jerry Passino, WA8HKM/WN8HKM, 4142 Drummond Rd., Toledo, Ohio, divides his radio time three ways. He works 40 meters with a Heathkit DX-20 transmitter and a Hammarlund HQ-110C receiver, and operates on 6 meters with a Gonset "Communicator III" which he uses both mobile and "fixed." The other third of his time is spent SWL'ing, of course . . . **Rick Samuels, WN6GPP,** (son) and dad, (WN6GPQ), 8809 Rhea Ave., Northridge, Calif., operate another father-son Novice station. They share a Heathkit DX-60 transmitter, Heathkit HR-10 receiver, and a multiband, vertical antenna. Rick has worked 24 states on 15 and 40 meters, and both operators hope to earn their General Class tickets soon.

Keep your "News and Views" on things amateur—and your pictures—coming. Send them to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Ind. 46401. 73,

Herb, W9EGQ

On the Citizens Band

(*Continued from page* 85)

Club Chatter. The Metro CB Club of Toronto, Canada, recently issued Vol. 1, No. 1, of *Modulation,* the organization's official news bulletin. Among other interesting items, efforts by *Modulation* editor J. DeZorzi, XM41-085, include a "Letter Tray" for reader comments, a "Calendar" column featuring goings-on at the club's last meeting, plus news from around the area. The "President's Page," of course, features an executive editorial; the "Listening Post" receives the same attention from the paper's editor; and the "YL" column is naturally done in a feminine hand.

A word to the wise! The following was taken from a letter written by an FCC Field Engineering Bureau official to a CB club that had submitted a copy of its newspaper to the bureau: " . . . it is with some dismay that I see on page 1 of this publication that (your organization) has engaged in a transmitter hunt. Transmitter hunts by their very nature constitute operation of Citizens Radio stations as a hobby, and not as a communications facility in connection with some personal or business activity. The Citizens Radio Service does not parallel the amateur radio service where transmitter hunts and other types of hobby activity are permitted. Transmitter hunts are prohibited by the provisions of Section 19.61 . . . Your continued cooperation in assisting in obtaining compliance with the Citizens Radio rules in (this) area will be sincerely appreciated . . ."

The Citizens Radio Assistance Club. Huntsville, Ala., is well prepared for handling emergencies if and when called upon. The group has a jeep panel truck that has been fully overhauled and repainted. The unit is equipped with extra lights, log chains and hooks, 12-foot jumper cables, 6-and 12-volt battery system, automatic battery charger, tire chains, and four-way signal lights that were donated by an auto parts company. And that's only the beginning! A Huntsville motor company also donated a half-ton jeep pickup truck. It's equipped with a new motor and is in excellent mechanical condition; all it needs is a new paint job (the paint has already been donated), and the physical efforts of the C.R.A. membership should take care of the painting in short order. As if this wasn't enough, the members will also begin work on their *bus* shortly—they've been given the go-ahead! In the meantime, the club's *boat, motor* and *boat trailer* have been reworked, painted, lettered, and are ready for use.

Okay, you hold-outs, let's have it! If you don't hurry and get on the stick, you're gonna be left off the 1964 CB Club Roster. We can't tabulate a "who's-who" if you don't fill us in on your latest membership total, club officers, correct club address, and all that jazz! You might also include that picture you've been meaning to send us—we just might print it! And don't forget to put us on the mailing list for your club newspaper each month.

—Matt, KHC2060

Short-Wave Report

(*Continued from page* 95)

the name of the station, location, frequency, and the number of reports you made. Send your list directly to Mr. J. Vastenhoud, President, Benelux DX Club, Willem Pijperlaan 5, Baarn, Netherlands.

The New York City Chapter of the American Short Wave Listeners Club invites prospective new members to attend their monthly meetings which are held in Brooklyn. For complete information, write directly to the area headquarters at 1318 East 86th St., Brooklyn, N.Y.

Beacon Stations. There are quite a number of beacon stations operating in the 1600-1750 kc. range. One that is often reported is RAB, Rabinal, Guatemala, on 1613 kc. Others heard include PLT, SDM, EGS, TIPM, CGW, TGU, TBU, and CUC. Who can identify the locations of these stations?

We should point out that beacon station call letters usually do not follow the standard call-sign allocation scheme but, rather, are somewhat indicative of their location.

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.

Angola—*Emissora Official de Angola,* Luanda, now uses this schedule: weekdays at 0100-0230 on 4955, 6025, and 7235 kc., at 0600-0830 on 4955, 6025, 9555, 9705, and 9765 kc., and at 1230-1800 on 3955, 4955, 6025, and 7235 kc.; Sundays at 0300-0600 on 4955, 6025, 9555, and 9705 kc., at 0600-1200 on 4955, 6025, 9555, 9705, and 9765 kc., at 1200-1300 on 6025 and 7235 kc., and at 1300-1800 on 3955, 4955, 6025, and 7235 kc.

Australia—"Australia Calling DX'ers" is aired to S. E. Asia at 2145 on 7220 and 9570 kc.; to East Asia and N. W. Pacific Islands at 1700 on 11,810 and 15,240 kc.; to Africa at 1345 on 9600 and 11,955 kc.; to N.A. at 2115 on 15,220 and 17,840 kc.; and to the British Isles and Europe at 0400 on 9570 and 11,710 kc. The African xmsn is very well received in Eastern N.A.

Austria—The schedule from Vienna, though often changed, currently reads: to N.A. at 1800-2330 on 6155 kc., at 1900-2330 on 9770 kc., and on Saturdays, Sundays, and Mondays at 1700-1800 on 6155 kc. Mostly in German, there are a few Eng. xmsns. Other channels noted include: 7200 kc. at 1900 in Spanish; and 15,225 kc. (new) at 0640 with an Eng. talk.

Azores—Try for *Emissora Regional,* Ponta Delgada, on 4865 kc., from 1830 to 1903 s/off with the program "Musica Portuguesa."

Bonaire—The new super-powered *Trans World Radio* outlet will reportedly operate on 800 kc. with a power of 525,000 watts. The operational target date is May 15th. This information comes from an official of a church group that plans to broadcast over the station.

Brazil—*R. Brazil Central,* ZYY2, 4995 kc., Goiania, is noted around 0220 with a Portuguese ID. The schedule is 0600-2000, but it is believed that the station operates 24 hours daily.

R. Sirena, Leopoldina, is thought to be the station noted on 2410 kc. at 0620-0650 with orchestral music, some band marches, and talks in Portuguese.

Burma—Rangoon has been tuned on 5045 kc. from 0900 to 1100 with musical programs; a newscast is given at 0915. This is in the Home Service.

Canada—Station CFCX, Montreal, 6005 kc., now broadcasts to the West Indies as well as to Canada's Northlands. Reports go to 405 Ogilvy St., Montreal, Quebec.

Canary Islands—*R. Atlantico,* Las Palmas, 9400 kc., was heard from 1440 to 1521 s/off with music and talks in Spanish. This frequency is somewhat removed from their normal frequency and the xmsn may have been a test.

Chile—Station CE960, *R. Presidente Balmaceda,* 9600 kc., is noted with news in Spanish at 2345. An Eng. ID is given at 0000 s/off. Reports go to P. O. Box 13650, Santiago, Chile.

Colombia—Station HJIQ, *La Voz de Llano,* Villavicencio, 6095 kc., can be heard around 2245 with Latin American pop tunes. This is a move from 5950 kc.

Ecuador—A new station is *Ondas LaJanas,* Loja, on 4767 kc. Listed for 4770 kc., it is heard with Ecuadorian music until 2157; ID and s/off at 2200.

Formosa—The B/C Corp. of China, Taipei, has this current schedule in English: to N.A. and Japan at 2150-2250 on 6095, 7130, 11,825, 15,345, 15,395, and 17,890 kc.; to Japan and Korea at 0510-0555 on 6095, 7130, 11,825, and 11,860 kc.; to S. E. Asia at 1030-1115 on 7130, 9685, and 11,725 kc., and at 1030-1050 also on 6095 kc. The "Dragon Show" is aired at 0730-0800 on 6095, 7130, 11,825, and 11,860 kc. Cantonese and French are heard during the Malagasy Service at 1215-1320 on 7130, 9685, and 11,725 kc.

France—*Paris Vous Parle* reports that the following xmsns are among the most frequently heard and reported in N. A.: to the West Indies daily in French at 0530-0600 on 17,765 and 21,580 kc.; to the Far East daily in French at 0800-0900 (Eng. at 0800-0815) on 15,245, 17,765, and 21,620 kc.; to Canada Monday through Thursday in French at 1230-1245 (Fridays to 1250) on 15,160 and 17,850 kc. and daily at 1400-

SHORT-WAVE CONTRIBUTORS

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Albert Sauerbier, Washington, N. J.
Alan Zimble, Swampscott, Mass.
Sweden Calling DX'ers Bulletin

1430 on 15,160 kc. (The same program is sent to Africa on 15,130 kc. and to the Middle East on 11,845 kc.); to Latin America daily in Portuguese at 1815-1900, French to 1930, and Spanish to 2115 on 9755, 11,845, and 11,920 kc.; to the West Indies daily in French at 1830-2000 on 9560 and 11,885 kc.

Germany (West)—*Deutsche Welle*, Cologne, is now using 6075 kc. for these xmsns: to the Far East at 1610-1700; to the Middle East at 1225-1255 and 1410-1510; to Latin America at 1710-1850; to Eastern Europe at 0830-0930 and 0940-1040; and to N.A. at 1900-0100.

Radio Europa I, Saar, a long-wave station operating on 180 kc., has an Eng. xmsn of the "Voice of Prophesy" at 2000. Does anyone in N. A. have the equipment to tune this station in?

Ghana—The Eng. schedule from Accra reads: to W. Africa at 0945-1030, 1200-1245, 1500-1545, and 1630-1715 on 6070 kc.; to S. Africa at 1500-1545 on 9545 kc.; to W. Africa at 1630-1715 on 9545 kc.; to Europe at 1550-1635 on 11,800 kc. (this is generally well received in Eastern N.A.—*Ed.*); to Sudan and Ethiopia at 0900-0945 on 15,190 kc.; to E. Africa at 0945-1030 and to Central Africa at 1130-1215, both on 17,910 kc. Reports go to P. O. Box 1633, Accra.

Iceland—Station TFJ, Reykjavik, has abandoned 11,778 kc. in favor of 9720 kc. and broadcasts in the Foreign Service can be heard Sundays at 0800-1000 and irregularly in Icelandic between 1525 and 1700.

India—*All India Radio*, Delhi, transmits Eng. to Australia and New Zealand at 0500-0600 on 9750, 11,710, and 15,290 kc.; and to the Near East and Asia on 11,770, 15.105, and 17, 865 kc. English has also been picked up on 15,225 kc. in a news period at 0830.

Indonesia—Eng. xmsns are currently scheduled at 0600-0700 on 9865 kc. to New Zealand, Australia, and the Pacific areas; at 0830-1030 on 9865 kc. to S.E. Asia, India, Pakistan, and

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SHORT-WAVE ABBREVIATIONS

B/C—Broadcasting	N.A.—North America
Eng.—English	R.—Radio
ID—Identification	s/off—Sign-off
IS—Interval signal	s/on—Sign-on
kc.—Kilocycles	xmsn—Transmission
kw.—Kilowatts	xmtr—Transmitter

Japan; and at 1400-1500 on 9865 and 11,715 kc. to the British Isles and Europe. The Home Service is aired on 9710 kc. Djakarta also has Eng. news on 7270 kc. at 0945. Another Home Service program comes from YDQ, a 3000-watt outlet in Makassar, Sulawesi, from 0010, with news, music and chanting in Indonesian.

Israel—The SCDX Bulletin reports *Kol Zion* is using 9625 kc. in addition to the regular 9009 kc. for French at 1430 and Eng. at 1500. The Eng. xmsn, which runs to 1530, is generally well reported in many areas.

Korea (South)—Japanese sources report a station named *Voice of Hope* operating late in 1963 on 6170 kc. with tests in several languages. Reports were to be sent to the Military B/C Station, Headquarters of Republic of Korea Military, Seoul. Does anyone know anything more about this station?

Malaysia—*R. Malaysia,* Kuala Lumpur, is heard on 4985 kc. at 0900 with commentary and music. The program "Music from Germany" is broadcast at 0945-1000, and "Easy to Remember" from 1000.

Monaco—*Trans World Radio,* Monte Carlo, has German daily at 0630-0645 and 1135-1200 on 5960 kc., at 1400-1425 on 5970 kc., and on Sundays at 0535-0600 on 5960 kc.

New Zealand—"DX World" by Arthur Cushen will replace "This Radio Age," on the air for 13 years. The new program will consist of 15 minutes of DX news, including a recording of the most interesting station heard each month. The program will be aired the first Wednesday of each month at 0140 and 0530 on 9540 and 11,780 kc., and repeated the following Saturday at 2000 on 15,110 and 15,280 kc.

Nicaragua—A newly listed station is YNOLA, *Ondas de Luz,* Managua, 15,229 kc., with a schedule of 0700-2300 and a power of 250 watts. Has anyone logged it as yet?

Papua—*Radio Australia* xmtrs in Port Moresby are now operating on this schedule: 1500-1700 on 3925 and 4890 kc., 1715-0145 on 4890 and 9520 kc., and 0200-0900 on 3925 and 4890 kc. The stations are VLK3 on 3925 kc., VLT4 on 4890 kc., and VLT9 on 9520 kc. (What country do you claim for the Monitor Awards Program? You may claim Papua; Australia and New Guinea are both separate countries. *Ed.*)

Peru—A new station is *R. Ilo,* Casilla 90, Ilo (Dep. to de Moquegua), 5036 kc., noted to 2300 s/off with many ID's, report requests, and request music. Station OAZ4G, *R. La Oroya,* La Oroya, 4820 kc., belongs to the "Cadena de R. Victoria" network and uses the same IS before s/off at 2310; their programs consist mainly of Latin American pop tunes and request music. *R. Tropical,* Tarapoto, 4938 kc., is now parallel to 9710 kc. and is fair from 2030 to 2300 close. Station OAX4Z, *R. Nacional del Peru,* Lima, is noted nightly with news at 2200-2210, then Latin American music, on 6080 kc.

Portuguese Guinea—Bissau, 5017 kc., is noted from 1600 to as late as 1815, which would seem to indicate a schedule change. Broadcasting in Portuguese only, the station uses the "Voice of the West" (Portugal) IS. The ID is *Radiodifusora da Guine, Estacao CQM,* Bissau.

Reunion—*R. Reunion,* St. Denis, was noted on 3380 kc. at 1810 with Arabic chanting. After an ID at 1835, it went into French news.

Tanganyika—Dar-es-Salaam seems to have changed their s/on as they were not noted at the usual 2215 but at 2232. On 5050 kc., this station gives *R. Tanganyika* ID's around 2245, 2252, and 2300.

U.S.S.R.—As of this writing, Kiev is scheduled at 2100 on 7180, 7190, and 7290 kc.; at 2300 on 7190, 7280, and 7310 kc. English was noted on 7180 kc. at 2100-2110 only, very weak; English is listed for Monday, Thursday, and Saturday only, and reports are requested.

Windward Islands—The Windward Islands B/C Service, St. Georges, Grenada, has closed 9499 kc. and is now operating on 5010, 3280, and 2460 kc. at 1740-2115. The 11,895-kc. channel is used at 1500-1545 to the United Kingdom. Many reporters claim that the station does not want reports on broadcasts made on frequencies under 9000 kc.

Unidentified—One of our West Coast reporters sent in a note on a station that calls itself KPIP. Operating irregularly on 840 kc., it is fair to good in the Los Angeles area with rock-and-roll records, frequent ID's, and some time checks. There are no commercials, the location is not given, and evidently there is no fixed schedule. At s/off time the power was given as 100 watts. Can anyone further identify this station? —30—

"It comes complete with directions on how to take it apart and send it back to the company in kit form."

CLASSIFIED MARKET PLACE

COMMERCIAL RATE: For firms or individuals offering commercial products or services. 75¢ per word (including name and address). Minimum order $7.50. Payment must accompany copy except when ads are placed by accredited advertising agencies. Frequency discount: 5% for 6 months; 10% for 12 months paid in advance.
READER RATE: For individuals with a personal item to buy or sell. 45¢ per word (including name and address). No Minimum! Payment must accompany copy.

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.

FOR SALE

FREE! Giant bargain catalog on transistors, diodes, rectifiers, components. Poly Paks, P.O. Box 942, Lynnfield, Mass.

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

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

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

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

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

CB QSL Cards—Over 45 highly attractive designs, 2 colors on glossy white. Other CB novelties. Call Record Books, Plastic Card Holders, Warning Stickers and Gag Signs. Catalog Free! Woody, 2611 Shenandoah, St. Louis 4, Mo.

ROCKETS: Ideal for miniature transmitter tests. New illustrated catalog, 25¢. Single and multistage kits, cones, engines, launchers, trackers, technical information, etc. Fast service. Estes Industries, Penrose 18, Colorado.

IGNITION! Kits $14.95: Transistors, Coils, Parts. Free lists. Transfire, Carlisle, Massachusetts.

ELECTRONIC Parts Bargains Semiconductors, Tubes, etc., free catalog for postcard. Franklin Electronics, Box 51A, Brentwood, N. Y. 11717.

JAPAN & Hong Kong Electronics Directory. Products, components, supplies. 50 firms—just $1.00. Ippano Kaisha Ltd., Box 6266, Spokane, Washington 99207.

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

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

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

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.

PRINTED Circuit Kit makes two 3½x5 printed circuits. Materials and instructions postpaid in Cont. US-$2.95. Trans-O-Pack, 275 Seames Drive, Manchester, N.H.

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

CB-WPE-QSL Cards. Call Letter Decals 15 samples 10¢. Dick, W8VXK, 1996 P N. M-18, Gladwin, Mich.

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

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.

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.

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

TRANSISTORIZED Ignition parts kit for "Popular Electronics Operation Pickup." Complete with recommended parts and special heat sink. For 6 and 12 Volt negative ground automobiles. Shipped prepaid USA. Only $14.99 Order Today. Electronics Kits, Box 1504, La Jolla, Calif.

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

BUY direct from the manufacturer and save! Test instruments, cabinets, radios. Free catalog. Tattershall Manufacturing Co., Hamilton, Mo.

WEBBER Labs. Transistorized converter Kit $5.00. Two models using car radio 30-50Mc or 100-200Mc, one Mc spread. Easily constructed. Webber, 40 Morris, Lynn, Mass.

C. B.er's. More effective audio with a transistor clipper. Internal and external models. From $13.95. Write Dept. P2, J-A Electronics, Box 645, Teaneck, N. J.

SELF-Service console tube tester originally $149.00. Reconditioned, $19.95. Money back guarantee. Delmar Engineering, 3606 Delmar Road, Indianapolis, Indiana.

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

HAMMARLUND HQ180A. Short Wave Receiver, Speaker, and Earphones $450.00—Never Used. Cecil A. McCoy, 1434 Fernwood Drive, Oakland 11, Calif.

16 TESTED Transistor plans—25¢. "Coil Winding" Handbook—50¢. Catalog. Laboratories, 1131-L Valota, Redwood City, Calif.

RADIO and Electronic Supplies: Transistors, 2n250-35¢, 2n456,457 & 458-35¢, 2n511-75¢, 2n1046-95¢, 2n1038, 1039, 1040-50¢, 750 ma epoxy diodes: 200 piv-10¢, 400 piv-25¢, 600 piv-30¢, 100 assorted precision resistors-$4.95, Nickle Cadmium batteries: 6 oz. cell-95¢, 10 oz. cell-$1.50, 2½ Lb. cell $2.95. Fully Guaranteed. Write for our catalog—10¢. Interstate Electronics, P. O. Box 8848, University Park, Denver, Colorado.

HEAR Aircraft, control tower emergencies, weather! Pocket transistorized VHF receiver $9.95 postpaid. No COD's. Free bargain flyer. Transco, Box 13482, North County Station, St. Louis 38, Mo.

SURPLUS Electronics, radio, test gear, parts—25 precision resistors $1.00 postpaid—Free Catalog. General Surplus Sales, 10 Alice Street, Binghamton, N. Y.

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

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

QSLs—ham or CB. Glossy, two colors, $2.00 per 100 postpaid. Free sample. Hobby Print Shop, Umatilla, Fla.

TRANSISTORIZED Products Camera other General Merchandise Catalogue $1.00. Gitai Shibamuro No. 10, Sendamachi, Koto-Ku, Tokyo, Japan.

JIFFY-Mast. No Holes, clamps, brackets; just slip into chimney. Ideal for light weight T.V., F.M. antenna. Adjustable, fits openings to prox 11"x11". Send $1.95 plus $.25 postage USA. Van Allan Co., P.O. Box 8246, Cleveland 33, Ohio.

CODE Oscillator—Highly stable transistorized module gives pure clean tone. All you need is a key, battery, and speaker. Same electronic circuitry as oscillators costing many times more. Mail $2.95 to: Communications Specialties, Box B, 210 San Lorenzo, Pomona, Calif.

SURPLUS Electronics Parts—Equipment. Free Catalog. Bigelow Electronics, Bluffton, Ohio.

HEARING Loss? Getting Loud-TV complaints, after-hours? Relax! Enjoy Radio/TV, Symphonically; others listen/sleep comfortably. Build finest headphone/speaker combination available! Plans $2.00. Bottcher, 809 Rogers, Brooklyn, N.Y. 11226.

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

SILENCE TV commercials. Two transistor wireless remote control. Complete construction details and four glossy photos $2.00. Electroni-Kit, 23958 Archwood Street, Canoga Park, Calif.

CBERS-CB callbook directory of all registering. Register and get list. Send Name, Address, channel, $1.00: Box 86, Station "T", Toronto 19, Canada.

FREE Transistor Ignition information. Save gas, money. Cut maintenance. Ignitioneering Company, Box 38-CG, Wilton, Connecticut.

CBER'S Dual Conversion easy-do adapter-kit improves selectivity, increase sensitivity. HE- 15, A; 15B; 115B; 20, A, B, C; 90; 800, 910, B; Mark VII; 770, 1, 2, Messenger; GW-10 etc. $15.50, with tubes $17.50. Also, Speech Clipper-kit complete, $17.85 or $5.00 deposit, plus C.O.D. Results! Not promises. Free literature, Dept. #5, Bainbridge Radio, 2839 Briggs Ave., New York 58, N. Y.

ELECTRONIC Surplus, list 10¢ Commercial Type Power Transformers 2900VCT at 800ma W/CHOKE $60., 5600V at 6KVA W/CHOKE $110. Fertiks, 9th Tioga, Phila. 40, Pa.

CB Transmitters $6.00. Other bargains, catalog 10¢. Vanguard, 190-48—99th Ave., Hollis, N. Y. 11423.

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. C. Carrier Co., 6311 Yucca St., Hollywood 28, Calif.

TV CAMERAS and parts at lowest prices. Catalog 10¢. Vanguard, 190-48—99th Ave., Hollis, N. Y. 11423.

RECORD TV Programs at home. Easy to construct. Watch your favorite TV Shows whenever you wish. Complete construction details $4.75. DB Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

COLOR TV. Convert your black and white TV to color. Completely Electronic. No mechanical gadgets. Costs about $35. Complete construction details $4.75. DB Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

ANSAPHONE. Automatic Telephone Answering Machine delivers and takes messages. Build under $40. Plans $4.75. Seaway Electronics, 6311 Yucca St., Hollywood 28, Calif.

TAIL Transmitter. Tiny Transistorized Transmitter for the Private Eye. Signals its location for miles. Construction Details $4.75. DB Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

TV Camera. Build for less than $50. Construction details $4.75. DB Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

TELEPHONE Extension in your car. Answer your home telephone by radio from your car. Complete diagrams and instructions $2.75. C. Carrier Co., 6311 Yucca St., Hollywood 28, 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 28, Calif.

100 VARIOUS miniature components such as transistors, diodes, capacitors, pots, resistors, mounted on circuit boards $1.95 plus postage. Paul's Surplus Electronics, 1240 Gill Hall Rd., Clairton, Pa. 15025.

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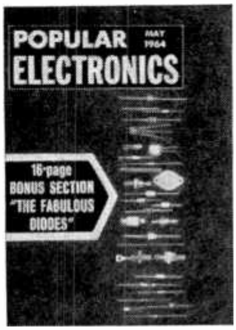

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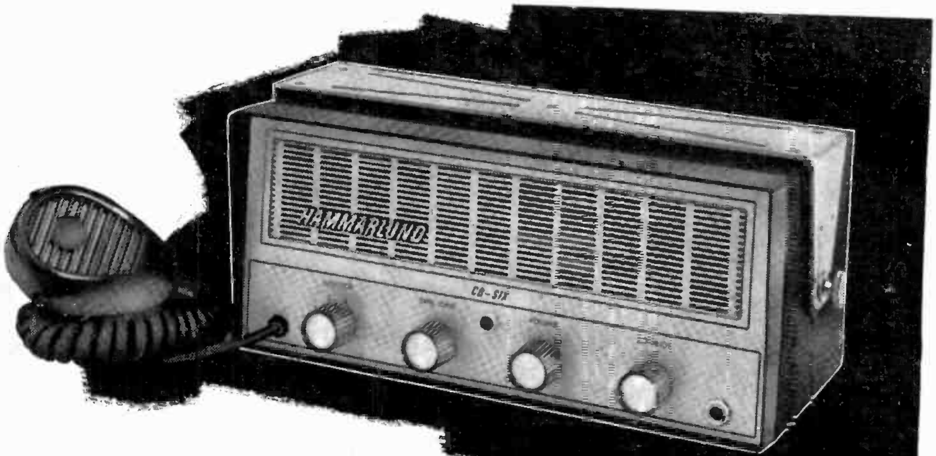

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