Build Transistorized Aero-Band Receiver

POPULAR ELECTRONICS

MARCH 1964

35 CENTS

Experiments with 60-Cycle Resonance

(see page 41)

- Automatic Battery Charger
- Auto Lights Safety Flasher
- Secret Story of the VT-158
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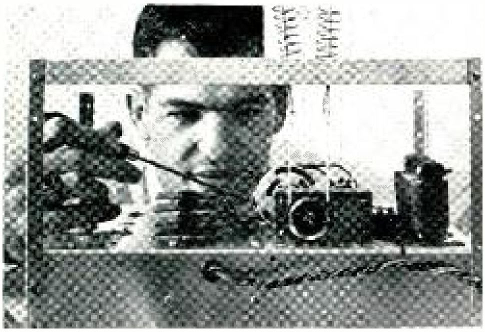

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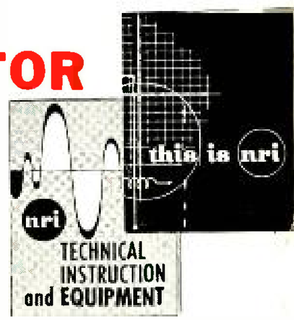

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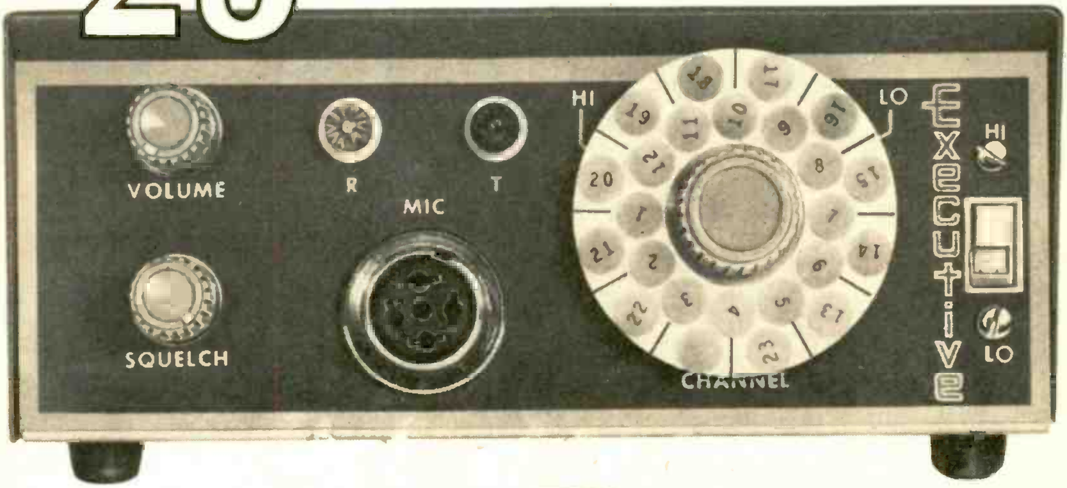

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POPULAR ELECTRONICS

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This month's cover photo by Bruce Pendleton

VOLUME 20 | MARCH, 1964 | NUMBER 3

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men 17-55

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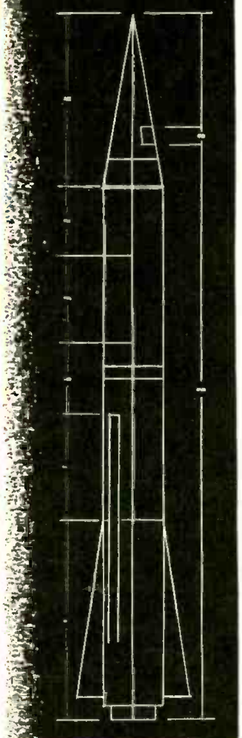

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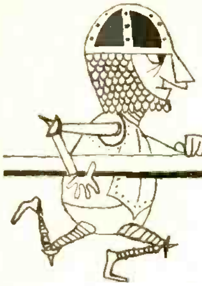


Letters from our Readers

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

Combination Simple Superhet

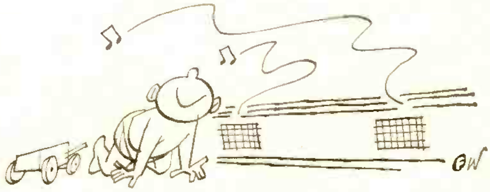
■ Since the two receiver construction projects, "Simple Superhet for 6" (April, 1963) and "2-Meter Simple Superhet" (September, 1963) were quite similar, why not combine the two with a bandswitch to save the builder on his cash outlay?

DEAN R. MCQUEEN
Minneapolis, Minn.

Bandswitching receivers are more difficult to design and construct, Dean, especially for home builders with limited test equipment. Stray inductance and capacitance pose a formidable problem. Also, the 6-meter receiver had a 2-mc. i.f., while the 2-meter version employs a 6-mc. i.f. in order to get reasonable image rejection. However, there's no reason why the same power supply and audio stage couldn't be used for both receivers. If you'd like to experiment further, you might try designing plug-in coil-capacitor combinations for the two bands in place of a bandswitching arrangement.

Slim Stereo Sixteen—Built-In

■ The articles on "Stereo Sixteen Plus Four" (January, 1962) and "Slim Silhouette Speaker Systems" (July, 1963) were very good. The second story gave me the idea of building my Stereo Sixteen into the baseboards



of my living room (8 plus 2 on on side and 8 plus 2 on the other). The completed system sounds terrific, and I hope eventually to give every room in the house the Stereo Sixteen treatment.

HARRY WALKER
Bristol, Tenn.

Master Magnet Lauded

■ Many thanks for "The Master Magnet" by Walter B. Ford (September, 1962). The magnet I built won first place at the local science fair and an award at the Hawkeye State Science Fair. Getting back to P.E., how about an all-amateur radio issue and an all-SWL issue in the near future? Congratulations on your 1963

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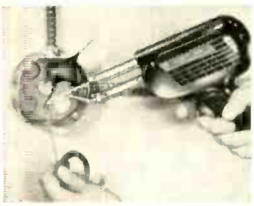


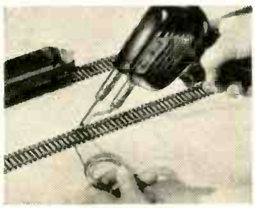
Electrical work

Repairing plastics

Sealing plastic bags

Appliance repairs

Metal work



Model RR connections

Cutting plastic tile

CIRCLE NO. 38 ON READER SERVICE PAGE

Letters

(*Continued from page* 6)

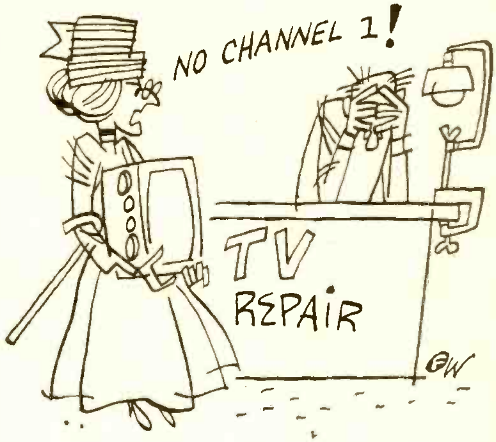
Communications Handbook—when does the 1964 edition go on the stands?

STEVEN HAMILTON, WNØGZX, WPEØDLV
Lenox, Iowa

Congratulations on your science fair awards, Steven. You'll note that another of author Ford's intriguing projects appears in this issue. Concerning special issues of POPULAR ELECTRONICS, *the idea—especially that of having an amateur radio issue—is under active consideration. Glad you asked about the 1964* Communications Handbook—*it goes on sale the end of March.*

Answer Please?

■ As a newcomer to electronics, I would like to ask the following: Are the "WPE" letters used by SWL's issued by P.E.? What are the qualifications? Here are a few more questions: (1) Why is the U.S. "K" call-sign rarely used for amateur stations compared with the "W"? (2) Why is there no channel 1 in TV? (3) What is the difference between the Novice, General, and Technician amateur radio licenses in the U.S.?



BILL WHITE
Qualicum Beach, B.C.

For details on "WPE" registrations, Bill, see page 112 of this issue. Concerning "W" and "K" call-signs, the "W" calls were issued first. When the "W" series became exhausted, "K" calls were issued in some areas. Concerning the mysterious channel 1, additional frequencies in the 30-50 mc. region were required for various utilities—gas and oil companies, police and fire departments, etc. Rather than renumber the previously allotted channels, channel 1 was simply dropped. The 5-meter ham band was moved down into part of the slot (becoming 6 meters) that would have been channel 1. So far as the licenses are concerned, the Novice license requires only a simple theory and 5-wpm code test; it's good for only one year and privileges are restricted. The Technician license requires more theory; it's restricted as to available bands, but is good for five years. The General ticket allows unrestricted operation; a code test of 13 wpm must be passed to qualify.

Proper Mobile ID Procedures

■ Herb Brier did a good job of clearing up the misconceptions many hams have regarding the use of assigned station calls ("Across the Ham Bands," Decem-

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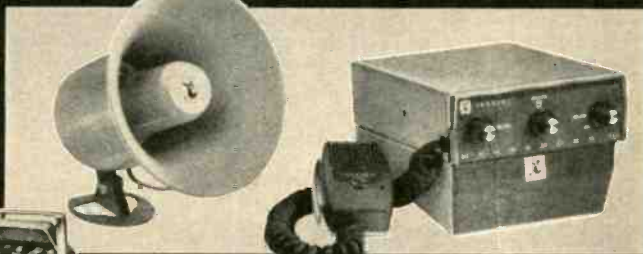

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(*Continued from page* 8)

ber, 1963), but he touched on one subject—mobile and portable operation—that should be further clarified. For telegraphy, the slant or portable sign, "DN," and the call area must follow the call-sign of the station. For phone operation, however, Section 12.82 indicates that

the station call letters "shall be followed by an announcement of the geographical location in which the portable or mobile station is being operated."

DEWEY GILLELAND, JR.
ARRL Official Observer
Jacksonville, Fla.

Out of P.E.'s, He Subscribes

■ About a year ago you published my letter offering back issues of POPULAR ELECTRONICS for sale. Needless to say, they were grabbed up almost immediately, and I had so many offers to buy and sell that I could have gone into business. Lately I've been receiving more inquiries—could my letter have gotten published again this year? You'll be happy to know that after all this I just couldn't stay away from P.E. any longer. Last week I subscribed again for three years.

LAWRENCE CHURCHILL
Watseka, Ill.

Welcome back, Larry. Old issues of POPULAR ELECTRONICS *seem to enjoy a long life—no doubt that's why you're still receiving offers.*

Ham Band DX'ing

■ As an SWL and steady reader of P.E. for over two years. I've noticed there is little or no coverage of ham band DX'ing. I find it hard to get started in this field, and I'm sure many others are in the same position.

TIM KERFOOT, VE3PE1TH
Toronto, Ontario

Several years ago, Tim, POPULAR ELECTRONICS *did publish a special column for SWL's interested only in the ham bands. It was edited by Roger Legge, but had to be withdrawn because of lack of reader support. However, we are reconsidering the situation and may have some promising words on new SWL columns in the near future.*

Refinishing Old Equipment

■ I have an NC-125 which shows its age—largely due to its battered cabinet. I would like to know how I can refinish the unit, and what means can be taken to preserve the lettering on the front panel.

BARRY DAY, WPE8FKP
Cincinnati, Ohio

If the old paint is badly scratched or chipped on your receiver, you will probably have to remove it to get a

Letters

(*Continued from page 10*)

good finish, but paint over the old paint if at all possible. If the cabinet and panel are removable, liquid paint remover can be used; otherwise, a paste-type remover is required to avoid getting it in the "works." A number of suitable paints—both in aerosol cans (Krylon, for example) and in containers for brushing on—are available from electronics dealers and mail-order houses, and from hardware stores. You can even get a crackle finish if you wish. To avoid running, face the front panel up when painting it; carefully mask areas that are not to be painted. If you're painting the panel with the receiver behind it, be doubly careful, using masking tape around controls from the back. If the control markings are engraved in the front panel, you simply rub in a bit of white lead after the paint is dry, being careful not to smear it around too much. Otherwise, you'll have to buy a decal kit (also available from electronics distributors and mail-order houses) and reletter the panel.

Electronic Stop Watch—Counter

■ I built the "Electronic Stop Watch" (October, 1963) with a magnet and reed switch instead of a cam and microswitch for quieter operation. I also added circuits for individual counting, photoelectric counting ("1-2-3 Totalizer," August, 1962), and a circuit for

latching on and off the timing network for a truly "electronic timer" without human error on starting and stopping. I'm very satisfied with the finished project, and use it to time events during physics experiments. Thank you for the ideas.

HENRY LAHORE
Seattle, Wash.

Thank you for the photo, Henry. Your project sounds like a worthwhile instrument. Perhaps other readers will be interested in making such a combination.

Antennas for TV and FM

■ Is there any difference between an ordinary TV antenna and a color TV antenna? Similarly, what is the difference, if any, between an FM and an FM stereo antenna?

STEPHEN SCHWAB
Clarksville, Md.

No difference in principle, Steve. The only thing to remember is that you may need a better antenna (higher gain) for good reception of color TV or FM stereo than you do for black-and-white TV or monophonic FM. This is due to the fact that color TV or multiplex stereo signals form a rather small part of the composite signal used to modulate the station carrier—for proper detection they must arrive at the receiver undistorted and at a relatively high level. —30—

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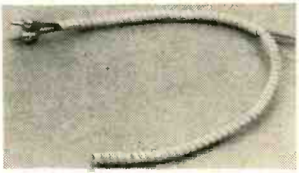
CIRCLE NO. 17 ON READER SERVICE PAGE

Tips and Techniques

SOLUTION TO STEREO CABLE CONFUSION

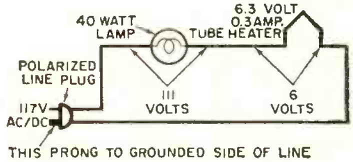
A stereo hi-fi installation made up of several components cabled together may sound great, but the cabling "backstage" often becomes a snarled mess hard to trace when a change or test is to be made. A low-cost way to keep the corresponding stereo signal cables paired along most of their length is to use several of the plastic spirals sold in dime stores to protect telephone cords. By using different-colored



spirals, you can color-code the various pairs for ready identification. And a dab of red nail polish on the jacket or connector shell at both ends of each right-hand cable in cabled pairs takes care of the channel identification problem. —*Tim Callan*

EMERGENCY FILAMENT SUPPLY SUBSTITUTES FOR TRANSFORMER

If you're stuck for a 6.3-volt supply for the heater of any of the dozens of tubes requiring a nominal 300 ma., this jury rig can be quickly hooked up to permit a test



of the circuit. Wire it as shown in the drawing, making sure that the lamp socket is between the tube heater and the "hot" side of the a.c. line. This is necessary to avoid hum and the risk of heater-to-cathode breakdown. If no polarized line plug is available, check for correct hookup with

(*Continued on page* 20)

POPULAR ELECTRONICS
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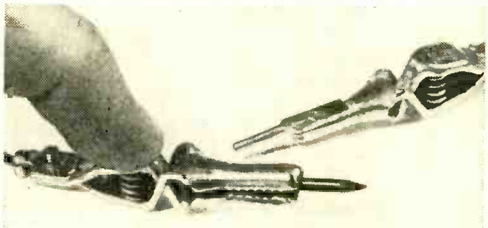
Tips

(*Continued from page* 14)

your voltmeter, and mark both the wall socket and the plug so that you can plug it in right every time. —*Walter Brown*

IMPROMPTU PIN PLUG FROM CROCODILE CLIP

Usually the test lead you grab has the wrong kind of fitting on one end or the other, following Murphy's Electronic Law, which says that whatever can go wrong, will. When the lead you have to use ends in an alligator or crocodile clip, and you

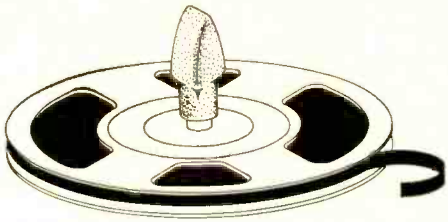


need a pin plug, just pick out a finishing nail of the right diameter, and grip it with the clip, as shown. It will serve until you again need the clip feature.

—*Jerome Cunningham*

KEEPERS FOR SMALL TAPE RECORDER REELS

Tape reels frequently drop off the spindles of the less expensive portable tape recorders when they are carried from place to place, for lack of a retaining device. Such retainers are made for large reels, but are not readily available for the smaller sizes. However, the slip-on type of pencil eraser sold in ten-cent stores fits the tape



spindles of many machines well enough to fill the bill when slipped into place as shown. Avoiding the risk of spilled tape is more than worth the trouble.

—*David Armstrong*

IMPROVISED LATHE FOR SMALL ELECTRONIC JOBS

Many electronic jobs such as coil winding could be speeded with a small lathe, but

Now enter the world of the professional. With the **Sony Sterecorder 600**, a superbly engineered instrument with 3-head design, you are master of the most exacting stereophonic tape recording techniques.

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CIRCLE NO. 39 ON READER SERVICE PAGE

Tips

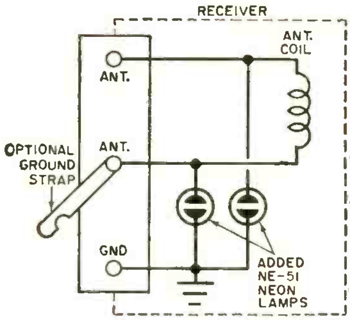
(*Continued from page* 20)

few electronics men feel that the added convenience justifies the cost of the lathe. Press the lowly ¼" hand drill into service by strapping it to the bench with bands of scrap metal, or even gripping the handle in the vice (but don't overtighten and crack the casting). Chuck the shaft of the work piece if it has one. If not, clamp it between large washers on a long ¼" x 20 machine screw as a mandrel, and chuck *that*. Now connect a soldering iron or incandescent lamp of 60- to 100-watt rating in *series* with the drill, and start it. The torque will be low enough to permit easy control with your hand on the chuck, as you guide the wire with the other. This method works for light sanding and filing, too.

—*Robert K. Dye, W8YLN*

PROTECT YOUR RECEIVER ANTENNA COIL FROM BURN-OUT BY HIGH POWER

If there's a high-power transmitter feeding an antenna located near your receiving antenna (such as that full-gallon rig next door), the antenna coil of your receiver can be burned out, even if the receiver is turned off! And nearby lightning strokes can play the same costly trick, even if your antenna is not actually struck. You can end this risk easily with no loss of



performance or resale value by connecting two NE-51 neon lamps across the antenna terminals at the input, as shown. High voltage on the line from any cause will be limited to the breakdown voltage of the lamps, yet they present a negligible shunt impedance when not conducting.

—*Bruce Balk*

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.

40-WATT STEREO AMPLIFIER

75 A 40-watt stereo amplifier has been added to the new "Allegra" line of hi-fi amplifiers and tuners now being offered by *Grommes,* division of Precision Electronics, Inc. The "Allegra 40" provides 20 watts per channel IHFM, rated ±0.5 db, 20-20,000 cycles at 1 watt. Eleven controls are featured: selector for tape, phono, tuner and

two auxiliaries; balance, loudness, bass and treble controls; stereo-mono switch, filter switch, contour switch, off-on switch, speaker off-on switch, and phones (stereo). Also available is the "Allegra 25," a 25-watt stereo amplifier providing 12½ watts per channel IHFM.

METER BURN-OUT PREVENTER

76 Used to prevent meter movement burn-out by overloads up to 10,000% f.s.d., the "Metergard" put out by *Lectrotech, Inc.* acts as a meter shunt only when overload currents are present. Under conditions of overload, the excessive or damaging current is bypassed around the meter, thus preventing damage to the movement. The Metergard will work with any make of multimeter and will cause less than ¼ of 1% change in the accuracy of the movement. It takes only a few minutes to install —you simply connect the Metergard across the movement terminals, disregarding polarity. And once installed, application of even 1000 volts to the 10-volt scale cannot burn out the meter movement. Price, $2.95.

18-INCH, 16-CYCLE WOOFER

77 The new Hartley-Luth 218MS speaker is an 18" woofer with a response down to 16 cycles. Manufactured by *Hartley Products Co.,* and designed to operate with the 10" Hartley 220MS speaker in the new "Concertmaster" system, the 18" woofer can also be used with other tweeter-midrange combinations. The 218MS features a large 14-pound magnet, a cast aluminum frame, a plastic cone, and utilizes the magnetic suspension principle. The 218MS speaker is priced at $195; it is also included in the Concertmaster, which sells for $595 (walnut enclosure) or $795 (ebony Chinese chest).

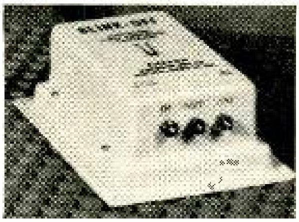
GENERAL-COVERAGE RECEIVER

78 Designed for the beginning SWL or Novice ham, *Lafayette Radio Electronics Corporation's* HA-63 7-tube receiver covers four bands from 550 kc. to 31 mc. The BFO permits c.w. reception as well; BFO pitch is fixed-tuned. Full electrical bandspread on all frequencies with a 0-100 logging scale and built-in S-meter assures accurate tuning. The superheterodyne circuit includes an r.f. amplifier and three-

section ganged tuning capacitor with separate coils for each band, providing good selectivity and a sensitivity of 1.5 microvolts. Price, $59.95. Optional speaker (an external speaker is required), $7.95.

TURN INDICATOR CANCELLER

79 Do you sometimes forget to switch off the turn indicator on your car after making a turn? "BLINK-OFF" will do it for you. It's an automatic auto-truck turn indicator canceller which is produced by *Burson Electronic Manufacturing Co.* It counts the number of flashes, and after a preset number, will stop your turn signals and hold them off until you flip your turn indicator direction switch to "off." "BLINK-OFF" is housed in a high-impact styrene plastic box about 4" x 6" x 2½", and can be installed at any convenient spot beneath the instrument panel, on the fire wall, or beneath the seat. It comes complete with hookup wire, mounting screws, and instructions. Price, about $14.98.



TRANSISTORIZED CAR RADIO

80 Instant warmup, rich tone, superior long-range reception through an r.f. stage, and rugged durability are claimed for the *Channel Master* Model 6540 AM car

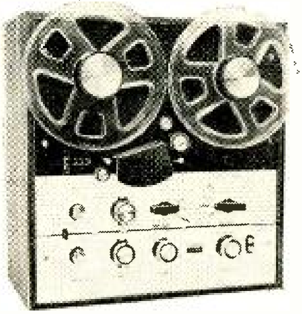
radio. The six-transistor set has no vibrators which can break down, assures trouble-free, long-life performance. Price, $39.95.

"LIFETIME" LIGHTNING ARRESTER

81 *Hy-Gain Antenna Products Corporation* has introduced a lightning arrester that will effectively reduce static build-up around any communications antenna system and safely bypass to ground 10 or more direct lightning strokes. Adapted from a surge arrester originally designed to protect electronic gear aboard military aircraft, the Model LA-1 can be installed in the 52-ohm or 72-ohm coaxial feed line leading to any communications system. Its current surge bypass ability is 10 or more surges of 15,000 amperes in 5 microseconds at 21 coulombs—each surge being equivalent to a major stroke of lightning. Price, $19.95.

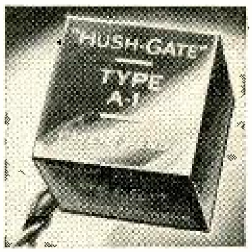
STEREO TAPE DECK

82 Available as a kit or factory-wired, the Model 2400 announced by *Eico Electronic Instrument Co., Inc.,* is a compact four-track stereo and mono recorder-player which incorporates a three-motor tape transport with electro-dynamic braking. Full record and playback equalization on both 7½ and 3¾ ips permit the greatest possible use of the economical lower speeds. Maximum reel size: 7 inches. Signal-to-noise ratio: 45 db. Frequency response: ±3 db, 30 to 17,000 cycles at 7½ ips; ±3 db, 30 to 12,000 cycles at 3¾ ips. Wow and flutter is under 0.2% at 7½ ips, under 0.3% at 3¾ ips. Prices: $189.95 in kit form; $269.95 factory-wired.



INTERFERENCE ELIMINATOR

83 The Model A-1 "Hush-Gate" manufactured by *Reach Electronics, Inc.* is a compact (¾" cube) all-silicon transistor accessory circuit for FM communications receivers. In use, it is actuated when an off-channel signal is present, and acts to prevent such signals from appearing in the receiver output. Noise bursts, intermodulation distortion signals, etc., are also eliminated if they result in an average discriminator output voltage other than zero. Connection of the "Hush-Gate" to the receiver does not in any way affect normal reception of an on-channel signal, regardless of the deviation used. The Model A-1 will function properly in virtually any communications receiver employing a discriminator and a squelch circuit. It is simple to install, requiring only the connection of four leads and no rewiring of the receiver. Price, $13.85. -30-



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From .002 to .025 blades.
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2 ¼" Drive Sockets, Square Openings: ¼"-5/16"
1 Combination Plastic Spinner Handle and Screwdriver
1 4" L Handle
1 3¾" Extension
1 Plastic Socket Holder Box
4 Box Wrenches: 3/8" x 7/16" to 13/16" x 7/8"
6 Combination Wrenches: 3/8" to 3/4"
5 Open End Wrenches: 5/16" x 11/32" to 13/16" x 7/8"
9 Allen Type Wrenches: 1/16" to 5/16"
1 Plastic Carrying Roll
1 6" Combination Plier
2 Offset Screwdrivers: ¼" Regular, $2 Phillips type
1 Hacksaw
10 Coarse Hacksaw Blades
10 Medium Hacksaw Blades
2 Cold Chisels: ½"-9/16"
1 Long Taper Punch
2 Plastic Handle Electrician's Screwdrivers
1 Plastic Handled Phillips Type Screwdriver
8 Ignition Wrenches: 13/64" x 15/64" to 11/32" x 3/8"
1 Ignition Screwdriver
1 Ignition Point File
7 Piece Spark Plug Gap Setter and Gauge, Blades: .025 to .040
1 Plastic Carrying Roll
10 Piece Feeler Gauge, Blades: .002 to .025 and steel ruler in stock holder
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18 Pc. IGNITION SET
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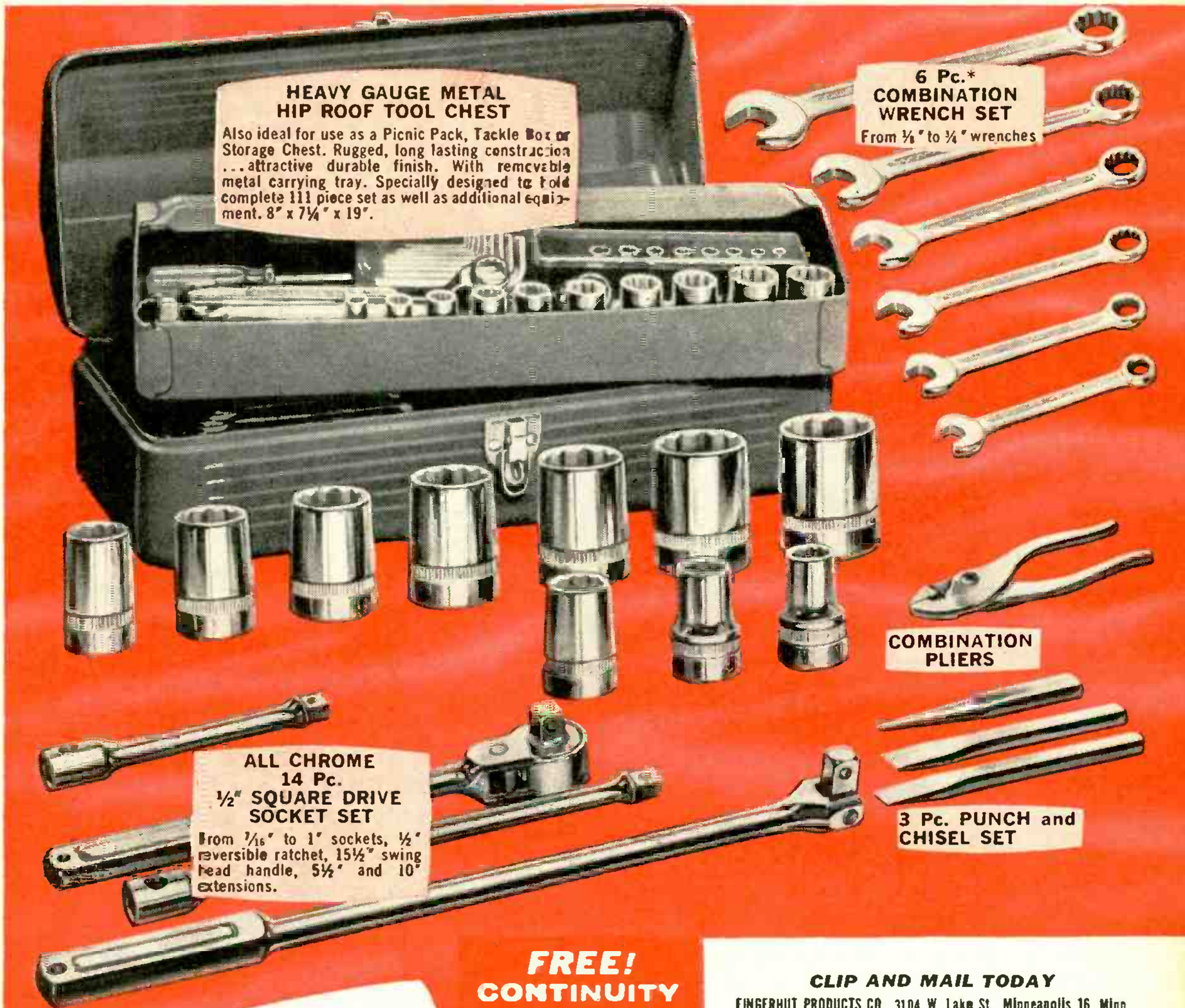

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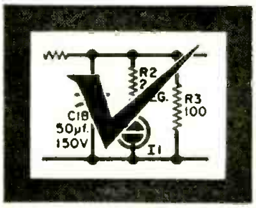

THROUGH THIS COLUMN we try to make it possible for readers needing information on out-dated, obscure, and unusual radio-electronics gear to get help from *other* readers. Here's how it works: Check over the list below. If you can help anyone with a schematic or other information, *write him directly*—he'll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

Schematic Diagrams

Triplett Model 3413 tube tester, about 1948-9. (Chas. Peacock, 3 Jenkins Drive, Indian Head, Md.)

RCA Victor Model 261 10-tube, 2-band superhet, no date. (Jakob Schuett, 3950A N. 25th St., Milwaukee, Wis. 53206)

Western Electric Model 17A receiver, uses 6A7, 6B7, etc. (Lionel F. Briggs, Toms River, N.J.)

Brunswick Model 15 7-tube console type, BC-band radio, about 1930. (Dale Quedr, P.O. Box 83, N. Syracuse, N.Y.)

Atwater Kent Model 20, 5-tube BC receiver, made 1926. (Alan L. La Pointe, 269 Talbert St., San Francisco 24, Calif.)

Triumph Model 400 tube tester, no date. (L. Olson, 1510 S. Dunsmuir Ave., Los Angeles 19, Calif.)

Zenith "Trans-Oceanic" 6-tube BC and s.w. superhet, a.c.-d.c. and battery powered, no date. (John Barr, 14 Covelee Drive, Westport, Conn.)

Philco chassis type 16, code 121, 11-tube, BC and s.w. 5-band receiver, about 1938. (Ronald Cook, 7 Montgomery St., Saugus, Mass. 01906)

Silvertone TV, chassis 110.821M-35, ser. C5276, about 1958. **Silvertone** TV chassis 110.821M-10, ser. C5212. (Harold Barnes, Box 384 Seffner, Fla. 33584)

Hallicrafters SP-44 "Skyrider Panoramic," about 1949. (M. A. Stark, Rte 2, Box 259-K, Brandywine, Md.)

DAV-2 walkie-talkie, made for Navy by Comm. Co., Inc., Coral Gables, Fla. (Thomas F. Davis, 914 Wilson Ave., Johnson City, Tenn.)

Zenith chassis N700738, 8-tube, 3-band, BC and s.w. radio, made in 30's. (Edward Chapman, 124 N. Normal St., Macomb, Ill.)

RDO Navy surplus receiver, made by E. H. Scott, no date. (Dallas H. Waltman, 17 E. Mason Ave., Alexandria, Va.)

(*Continued on page* 30)

A MESSAGE TO ELECTRONIC BUFFS—

DON'T JOIN THE ARMY UNLESS

unless you want to build a career in Electronics. The sky's the limit in this field, if you have the right training. The Army is the place to get that training. And the Army will keep you trained as you move up to positions of increasing responsibility.

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If you're good enough to get in...a proud future can be yours in the new action

Army

CIRCLE NO. 40 ON READER SERVICE PAGE

Operation Assist

(*Continued from page* 28)

Link Radio FM transmitters, type 25, ser. 4329, and 21415, about 1945. (Michael McCarthy, 21 Bel Air Drive, Orinda, Calif.)

GE Model GD-60, 6-tube superhet, no date. (Noel M. Moss, 5355 Henry Hudson Parkway, New York 71, N.Y.)

Zenith Model 12H09400, ser. D116320 radio-phonograph, about 1943. **Farnsworth** Model EK264 radio-phonograph, chassis 188572, about 1947. (David Doemberg, 1842 Windemere Dr., N.E. Atlanta, Ga. 20324)

Hallicrafters "Super Skyrider" 11-tube, 6-band receiver, ser. H-51771. (C. A. Keyser, Jr., 13552 W 21st Ave., Golden, Colo.)

Dumont RA-101-A TV, BC, FM, and s.w. console, about 1946. (Frank Demarest, 162 Mountain Ave., Summit, N.J. 07901)

Lafayette Model FE-157, no other data. (C. Profenna, 54 Tileston St., Everett 49, Mass.)

Special Data or Parts

Zenith Model 66801 a.c./d.c. and battery radio, about 1940, output i.f. transformer needed (95-1086PA), also schematic. (Larry C. Cuffin, 146 Whipple St., Pittsburgh 18, Pa.)

McMurdo Silver Model 900 "Vomax" VTVM, need operating data, schematic. (Alan Michel, 33-74 191 St., Flushing, N.Y. 11358)

Moss Model 246 portable tube tester, instruction manual needed. (Emile W. Germaine, 221-21 106th Ave., Queens Village 29, N.Y.)

R-1155 communication receiver, military surplus, need any technical data, equivalent tubes, manual, or schematic. (Ivan T. Payne, Box 146, Station E, Toronto 4, Ontario, Canada)

Philco Model 111, 11-tube radio, about 1929, alignment data, schematic needed. (P. G. Descher, Box 7 Estuary, Saskatchewan, Canada)

RCA Radiola Model AR-812, about 1925, 6 C-299 and UV-199 tubes, need tubes and any data. (Terry Kirkpatrick, Rte. 2, Cardington, Ohio 43315)

Hallicrafters Model S-52 receiver, about 1948, need main 3-gang variable tuning capacitor. (Frank Pascale, 374 Rockaway Parkway, Valley Stream, L.I., N.Y.)

Zenith Model 6-G-501M, 6-tube BC radio, date unknown, need operating instructions and schematic. (C. W. Lingard, P.O. Box 853, Brookings, Ore.)

Heathkit Model 0-8 oscilloscope, need construction manual and schematic. (William Phillips, 344 Rose Ave., Staten Island 6, N.Y.)

BC-659 FM transceiver, Signal Corps surplus, need maintenance manual and parts list. (P. M. Stacey, 22 Village St., Marblehead, Mass.)

McMurdo Silver Masterpiece VI BC and s.w. receiver, need alignment data and schematic. (Archie Gant, 1206 Daingerfield Dr., Daingerfield, Texas)

Silver Marshall Model O, 10-tube l.w., BC, and s.w. radio, need instruction book, schematic, equivalents for type BR-277 and SY-277 tubes. (Bob Johnson, 129 E. Las Flores, Arcadia, Calif. 91006)

Kolster Model K-20, ser. 19221, about 1925, need manual and schematic, any other data. (Jack LaVelle, 4616 W. 152 St., Oak Forest, Ill.)

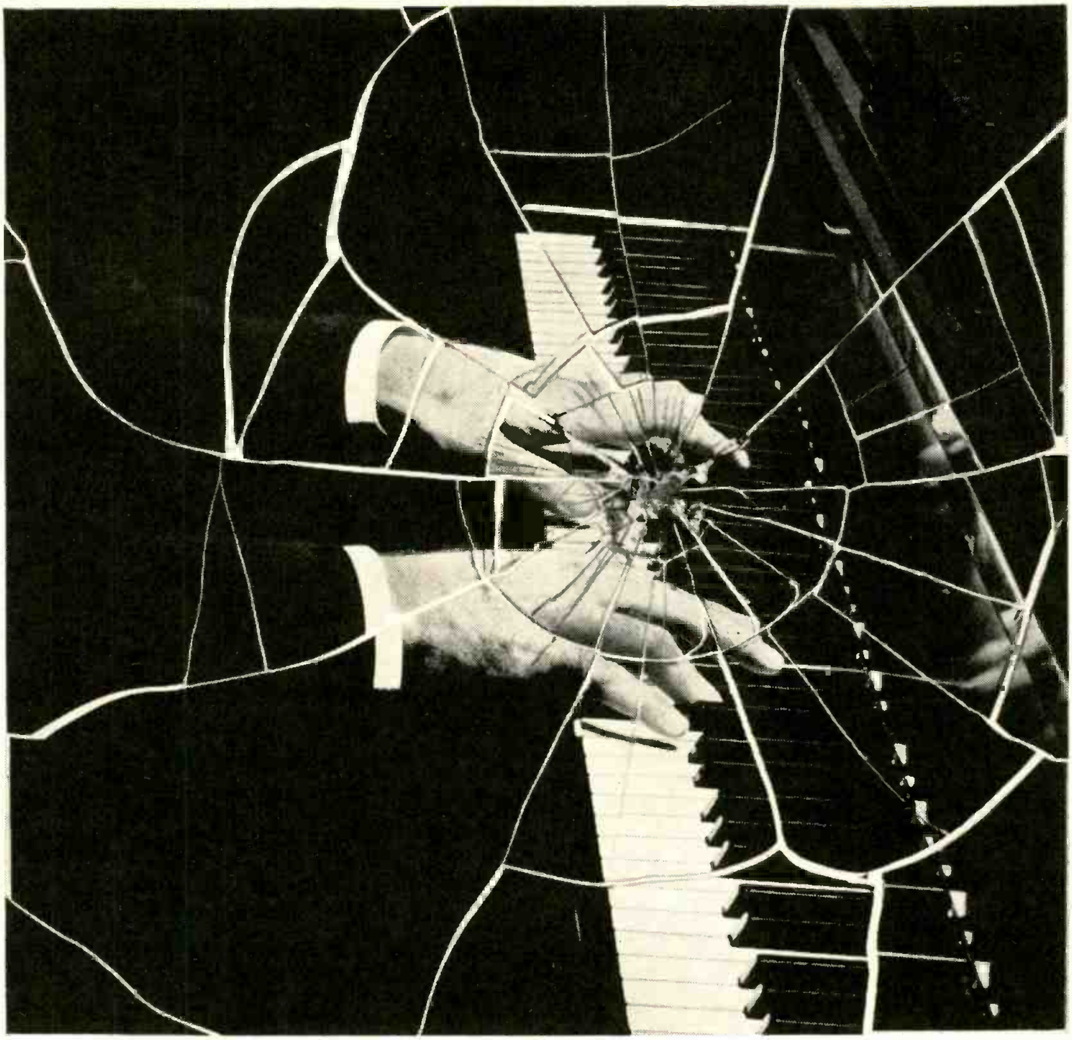
Splitdorf Model R-500 radio about 1920, need 201A tubes and matching speaker. (Ervin Kotiranta, 37 4th St., Cloquet, Minn.)

Pierce Model 55B-6 wire recorder, need recording wire and any technical data. (Robert Stupka, 102 Julia Drive, Milton, Florida)

Meissner Model 9-1085 6-tube, 2-band receiver, manual needed. **Sparton** Model 517, 5-tube, 2-band receiver, manual and schematic needed. (Larry Kane, 3249 S. Schultz Drive, Lansing, Ill.)

RCA Model 155A and 155B oscilloscopes, about 1950, manual needed. (Rad Artukovic, 8301 Arroyo Drive, S. San Gabriel, Calif.)

Solar Model C-F Exam-eter capacitor analyzer, need operating manual and schematic. (Timothy J. Murphy, 282 W. Second St., Oswego, N.Y.) —30—



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CIRCLE NO. 21 ON READER SERVICE PAGE

POP'tronics Bookshelf

GETTING STARTED WITH TRANSISTORS

by Louis E. Garner, Jr.

If you have ever had occasion to experiment with transistors while reading P.E., this author needs no introduction. Lou is one of POPULAR ELECTRONICS' Contributing Editors, and has written the monthly "Transistor Topics" column since 1956. In addition to his column, Lou is a prolific author of books and magazine articles aimed at the electronics hobbyist. Typically, this latest work does him credit. Written in the free and easy style that characterizes the author's sure grasp of transistor theory, this book is different in that it doesn't back into the subject of transistors through vacuum tubes, but forges straight ahead—just as if tubes never existed. It brings the reader along from the fundamental fundamentals of semiconductors, through routine project-building, to all of the latest solid-state innovations. Either as a reference or an introduction to transistors, this volume will make an excellent addition to your workshop bookshelf.

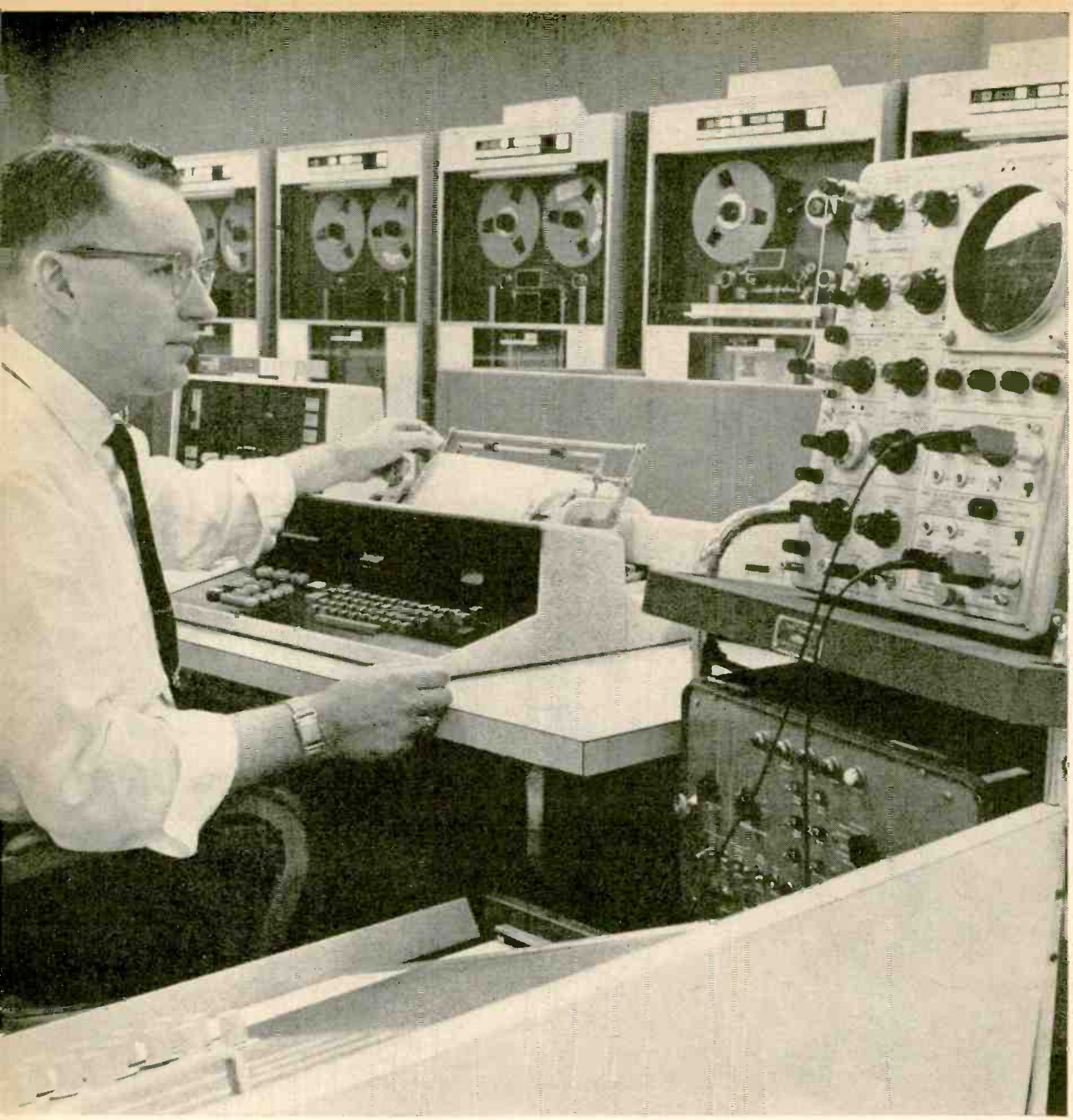
Published by Gernsback Library, Inc., 154 West 14 St., New York, N.Y., 10011. Soft cover. 160 pages. $3.95.

MODERN DICTIONARY OF ELECTRONICS, Second Edition

by Rudolf F. Graf

The task of keeping a dictionary abreast of the rapidly changing and expanding field of electronics is next to impossible—new terms are coined almost daily. However, Rudolf Graf certainly deserves an "A" for effort. The second edition of his *Dictionary* includes up-to-date, well-written definitions for 12,400 terms, catchwords at the top of each page, and extensive cross-referencing. An excellent reference text of its type, it

(*Continued on page* 38)



Why Fred got a better job . . .

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

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

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

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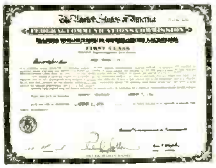

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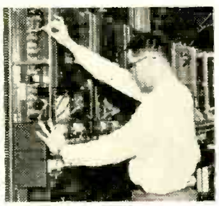
Mobile Radio, Microwave, and 2nd Class FCC preparation are just a few of the topics covered in this "compact" program . . . Carrier Telephony too, if you so desire.



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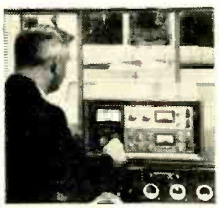

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Dept. PE-15, 1776 E. 17th St., Cleveland 14, Ohio

Bookshelf

(*Continued from page 32*)

would be a good investment for anyone with an interest in one or more branches of electronics.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis 6, Ind. Hard cover. 435 pages. $6.95.

MAGNETIC RECORDING FOR THE HOBBYIST

by Arthur Zuckerman

If you have recently become the owner of a tape recorder, or if you intend to buy one in the near future, you can gain considerable insight into the techniques of successful recording from this small volume. This book would be of more value to the general consumer than to the advanced electronics hobbyist, but it does contain much useful information.

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

Free Literature

Whatever your hobby, interest, or sport, Edmund Scientific Company's latest catalog (No. 641) should have something in it for you. It's crammed with the latest buys in more than 4000 product areas. For your free copy of this handy 148-page source for hard-to-find items, write to Edmund Scientific Company, 101 E. Gloucester Pike, Barrington, N.J., 08007 . . . A new eight-page brochure available from Empire Scientific Corp., 845 Stewart Ave., Garden City, L.I., N.Y., describes the technical features of their latest line of record playback components. You'll also find in it helpful hints on the care and evaluation of record playback systems and recommendations for a basic stereo record library . . . Leece-Neville's eight-page booklet entitled "What's This Alternator Talk All About?" explains the operation of a typical automotive electrical system in layman's terms, and discusses the operation and advantages of today's automotive alternators. You can get a copy from The Leece-Neville Co., 1374 East 51 St., Cleveland 3, Ohio . . . And POLY PAKS, P. O. Box 942E, So. Lynnfield, Mass., has available an eight-page catalog of new and surplus bargains which lists the latest in semiconductor merchandise and offers a $1 special sale. —30—

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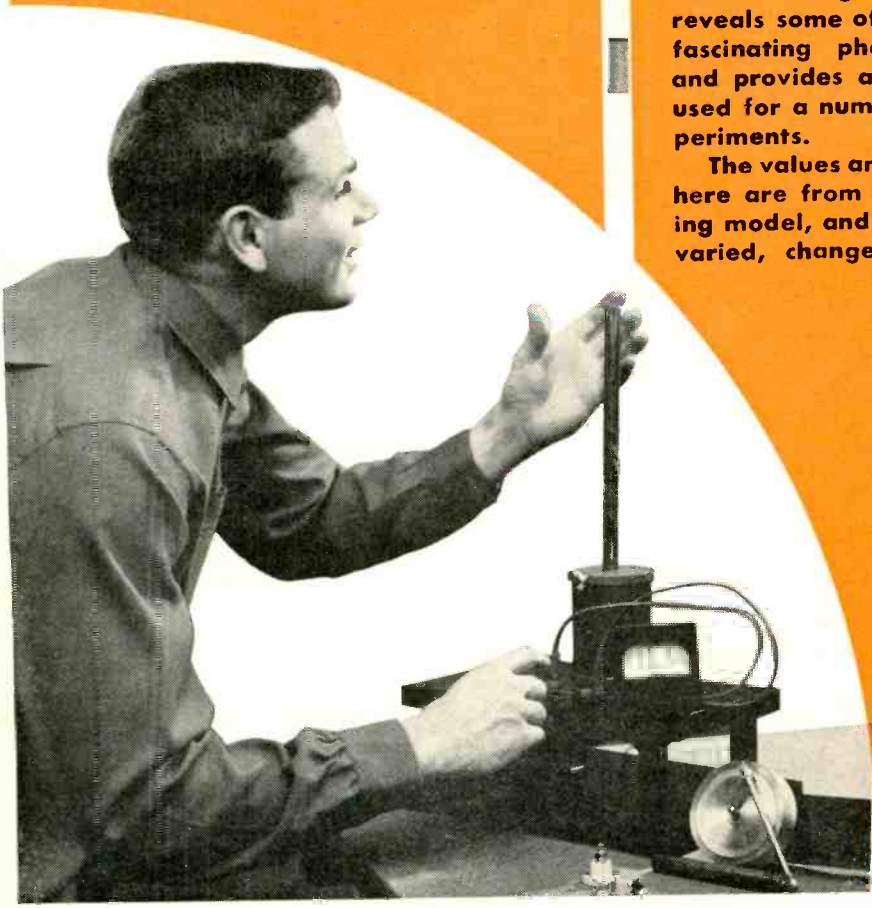
CIRCLE NO. 8 ON READER SERVICE PAGE

A 60-CYCLE REPULSION COIL-RESONANCE ENGINE

Startle your friends with this dynamic demonstration of low-frequency resonance and other dramatic a.c. effects. This Science Fair project works on ordinary 60-cycle house current

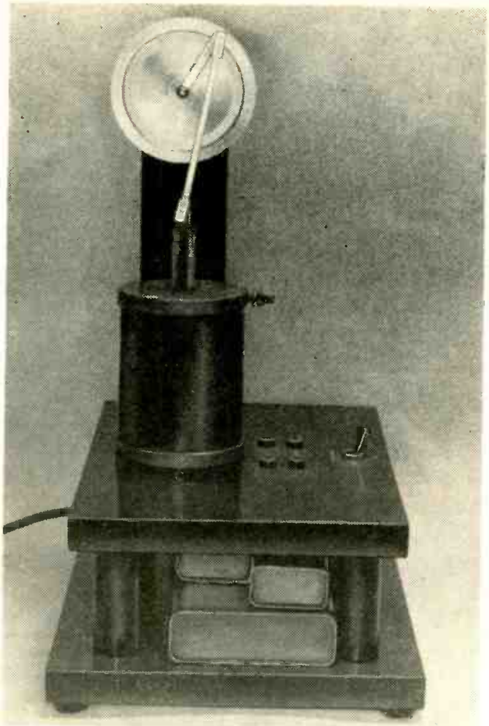
By WALTER B. FORD



NEARLY EVERY electronics experimenter is familiar with the process of adjusting a circuit to resonate at a specific radio frequency—you do this every time you tune in your favorite radio or TV station. Much more mysterious and surprising, however, are resonant circuits operating at the low 60-cycle frequency of our home lighting circuits. The repulsion coil—resonant engine described here reveals some of the secrets of this fascinating phase of electronics and provides a unit that can be used for a number of exciting experiments.

The values and dimensions given here are from the author's working model, and while they may be varied, changes are not recom-

COVER STORY



Constructed on a black lacquer wooden base, the resonant-coil engine is an impressive-looking unit.

mended unless the experimenter understands what effect the changes will have on the operation of the unit. If, for example, capacitors of lower value are used, the stroke of the engine piston will change. This will mean that there will have to be a proportionate change in the length of the flywheel crank.

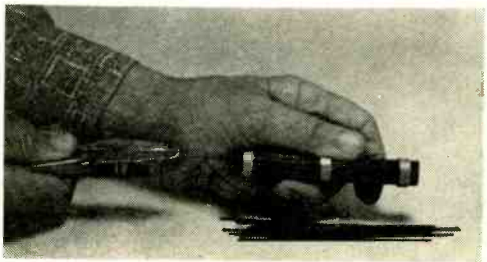
Making the Coil. The inductive part of the series-resonant *LC* circuit used in the unit is in coil *L1*. Begin by making up a coil form as shown in Fig. 1 (page 43). Although plain wood discs may be used for the ends, plywood, fiber, or Micarta is preferred, since there is less chance of breakage if the coil is accidentally dropped. The center tubing can be Micarta, bakelite, or fiber, or can be made by drilling a ⅝" hole lengthwise in a piece of ¾" dowel rod. Whichever material is used, make sure the inside surface is smooth, sanding if necessary, so the engine piston will travel freely.

Complete the coil form by drilling holes in the end discs that make a snug fit around the center tubing, and gluing the ends and tubing together with epoxy glue. This step is important because there will be considerable pressure against the ends when the wire is in place on the coil. Drill 1/16" holes through one end of the coil form for the coil leads as indicated in Fig. 1. Drill and tap two holes for *6-32* machine screws in the same end of the form to hold the completed coil to its base (if wood is used, wood screws can be used and the threaded holes will not be needed). Wind the coil form with 2½ pounds of 24-gauge magnet wire. While it is not necessary to wind the coil perfectly, like thread on a spool, it should not be allowed to pile up at any one point.

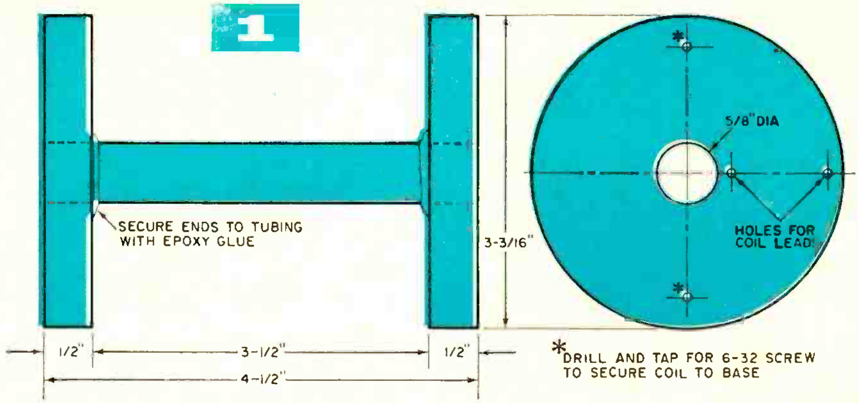
Constructing the Cores. Uncoil enough 16- or 18-gauge soft iron wire to make the engine core, grip one end in a vise, grasp the opposite end with a pair of pliers, and pull until you can feel the wire stretch somewhat. This will straighten the wire. Cut the wire into 4¾" lengths and make forms to hold the bundle in cylinder form from pieces of thin-wall metal or plastic tubing. Holes (9/16") drilled in small pieces of wood or hardboard can also serve the purpose. Since the forms must be cut away after the core is glued, keep their outside dimensions down to a minimum.

Bundle the 4¾" wires together and insert them in the forms. Press the end of a screw eye into the center of one end of the core, and cut off the ends of the wires forced out of the core at the opposite end. Withdraw the screw eye—it will be fastened permanently later. Apply epoxy glue to the areas of the core not covered by the forms holding the core wires and allow the glue to set. The type of epoxy glue that will set with artificial heat is preferred for this, since

Straighten the iron wire for the cores by stretching it as explained in text. Then cut and bundle the wires into cylindrical form as shown in Fig. 2.

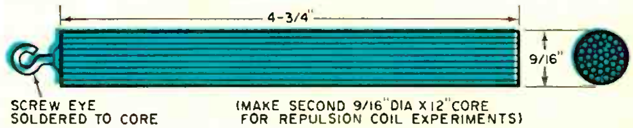


1

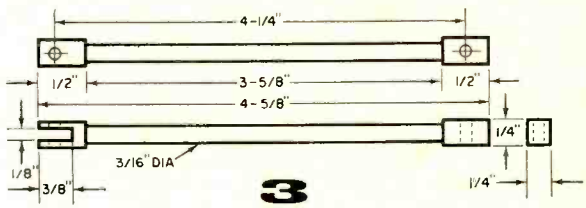


Coil form may be made of fiber or a laminated plastic. End plates must be strong and firmly glued to center.

2



Both cores are made of #16- or #18-gauge soft iron wire. Straighten the wire as shown in the photograph on the bottom of the facing page.

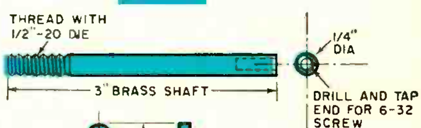


3

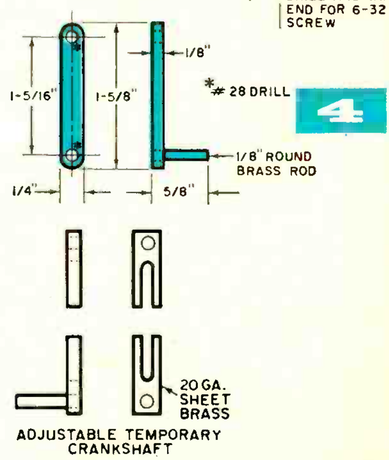
This arm couples the flywheel to the core, which acts as the piston. Prototype was cut from brass stock.

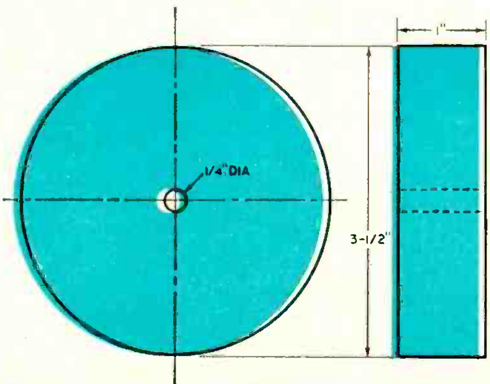
Several small parts must be fabricated to connect the arm to the flywheel. At right, below, are two possible ways of constructing the engine crankshaft.

5

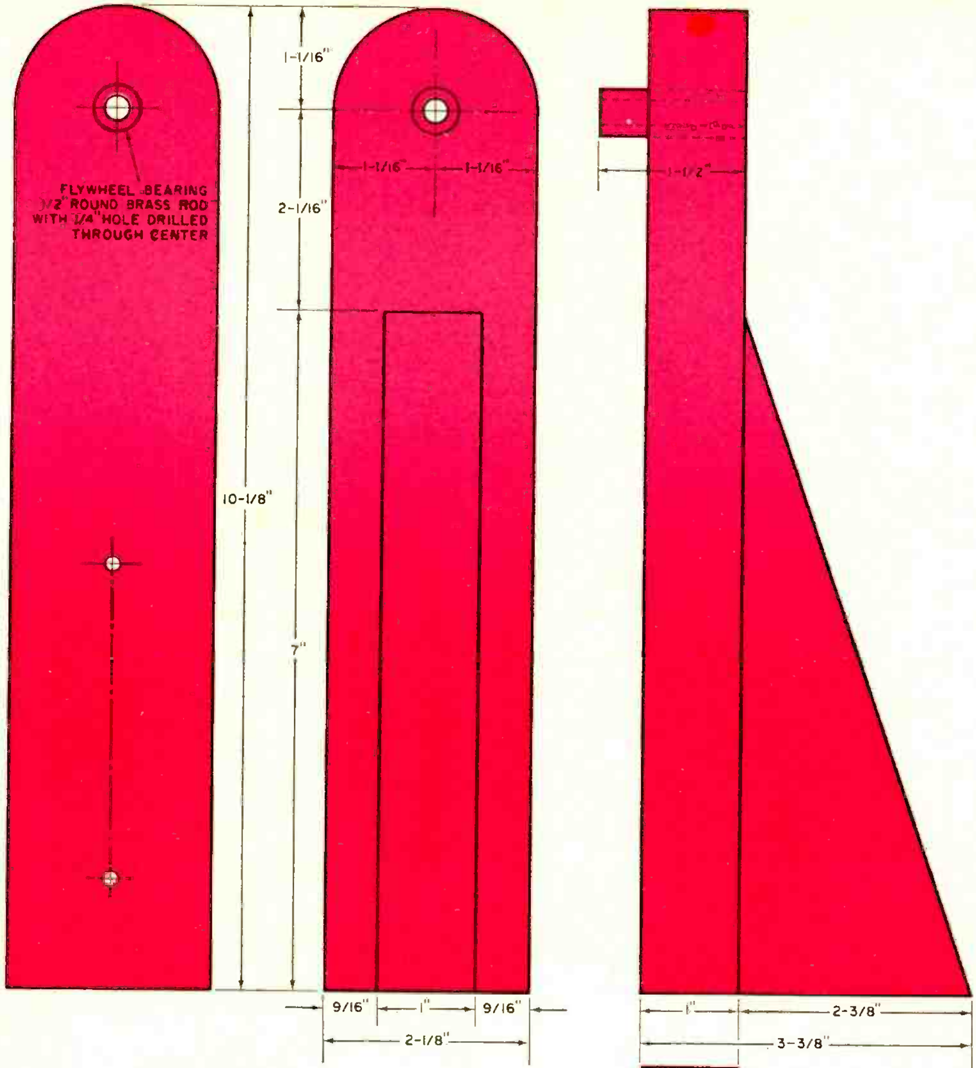


The flywheel weighs about 15 ounces. The author used aluminum, but plastic or brass would serve as well. War surplus stores or machine shops may have such flywheels for sale.



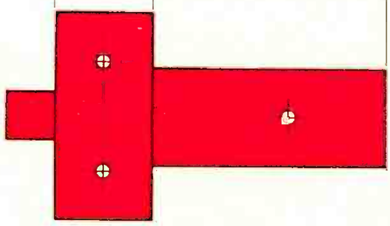


6



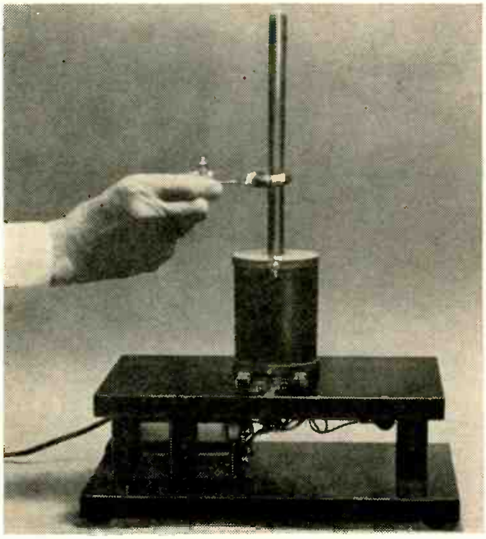
The size of the stand necessary to hold the flywheel for experiments will depend on the length of the shaft (Fig. 3) and diameter of the flywheel (Fig. 6).

7



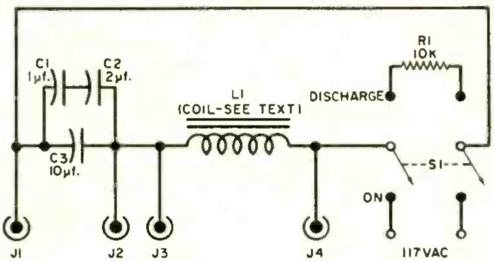
BILL OF MATERIALS

C1—1-μf., 600-volt non-electrolytic capacitor
C2—2-μf., 600-volt non-electrolytic capacitor
C3—10-μf., 600-volt non-electrolytic capacitor
J1, J2, J3, J4—Insulated pin jack
L1—See text
R1—10,000-ohm, 10-watt resistor
S1—D.p.d.t. (center-off) 10-amp toggle switch (motor start type)
1—2½-lb. spool of 24-gauge magnet wire, cotton- or enamel-covered
1—1-lb. spool, 16- or 18-gauge soft iron wire
2—3½"-diameter, ⅜"-thick discs of fiber, Micarta, or wood
1—⅝"-i.d., 4¼"-long piece of fiber or Micarta tubing, or wood dowel
1—3½"-diameter, 1"-thick flywheel; aluminum, brass or plastic—see text
Misc.—Brass rods for crankshaft and connecting rod, wood for bracket and base of engine, brass bearing, wood screws, machine screws and nuts, wire, solder, a.c. line cord, epoxy glue, etc.



A small coil connected to a flashlight bulb illustrates transformer action of mutual inductance.

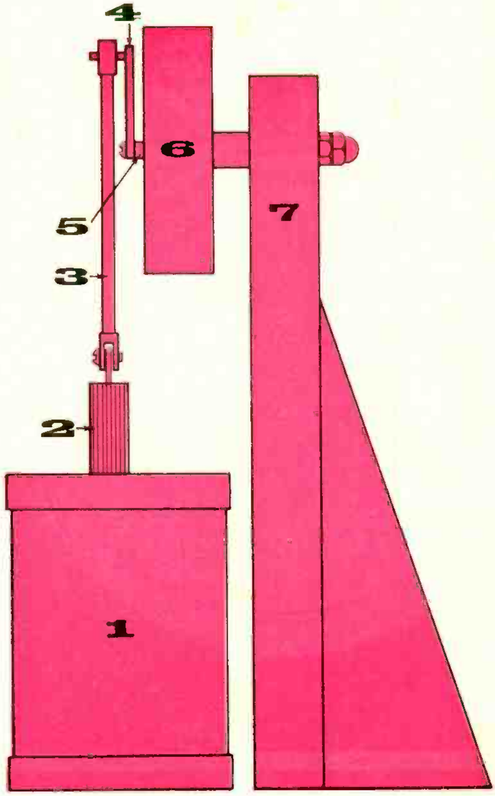
Permissible changes in certain component values are discussed in text. However, do not eliminate discharge function of the d.p.d.t. toggle switch.



drying time is shortened and because surplus glue may be more easily pared off. After the glue has set, remove the forms and apply epoxy to the uncovered core areas. When this second application is dry, remove any rough spots on the core with a coarse file. Solder a screw eye in the hole that was made in the end of the core. The finished core should look like Fig. 2, on page 43.

For the repulsion coil experiments, make another core following exactly the same procedure outlined, but using 12″ iron wires and omitting the screw eye.

Parts for the Engine. The connecting rod (Fig. 3, page 43) is made with 3⁄16″ brass tubing soldered into pieces of ¼″-square brass, the ends of which have been drilled and shaped as shown. This



This is how the various pieces for the resonant engine shown in detail on page 43 are assembled.

construction was used to "dress up" the prototype, and need not be duplicated exactly. A rod made from a single solid piece of brass will work as well.

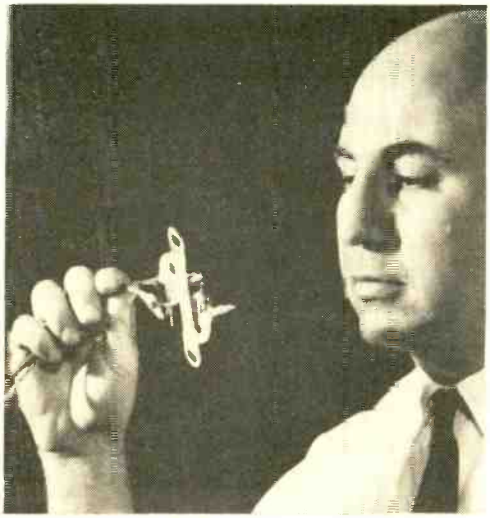
The engine crankshaft is shown in two forms in Fig. 4. If you want to experiment with different values of capacitors, or longer or shorter piston travel with a corresponding change in speed, build the slotted version so you can adjust its length. The two parts are held together with a small machine screw and nut. Since this is made of lighter material, it is not recommended for permanent use. If all the values and measurements given for the engine are followed, make a solid crankshaft exactly like that shown.

The engine flywheel is made of brass or aluminum, and is 1″ thick and 3¼″ in diameter. It is supported by a ¼″ brass shaft 3″ long (see Figs. 5 and 6, page

(*Continued on page* 100)

BREAKTHROUGHS

Brief news flashes on important developments in the field of electronics



MINIATURE LASER (above) shows increasing sophistication of laser technology. A helium-neon gas type developed by Bell Labs, it measures just two inches, operates on d.c. at room temperature, and emits a single frequency of visible red light. Precise tuning within a 1500-mc. range centered at 473,000 kilo-megacycles is accomplished with a piezoelectric transducer attached to one of the end mirrors forming the laser's resonant cavity.

THE SUN may be a source of electrical power for astronauts, as a Hughes scientist shows. Firm is developing inflatable solar collectors for space.

ULTRASENSITIVE TV TUBE that almost "sees in the dark," by Westinghouse. Accelerated photoelectrons from a cathode, which responds to light, generate large numbers of secondary electrons in a thin, porous target which, in turn, is swept by an electron gun. The tube can tolerate wide variations in lighting and builds up weak images over a period of time, making it ideal for space missions such as photographing dark side of moon.

WORD-SYNTHESIZER capable of saying "Mary" or any other word up to four phonemes in length. Developed by Philco, the electronic device will generate synthetic speech to aid researchers in unlocking the secrets of ordinary human speech.

ELECTRONIC HUMAN HEART, actually a mathematical model, devised by Drs. John J. Osborn and James G. Defares in cooperation with Beckman Instruments. An analog computer was used to simulate the complex mechanical functions of the heart chambers, blood volume, elastic properties of arteries, pumping characteristics, blood flow. It has given good results in confirming heart defect diagnoses and in predicting patient reaction to various types of treatment.

HOME TV PROJECTOR may result from research into light-modulating cathode-ray tubes being done by Motorola. The revolutionary CRT's would use crystals on which a picture could be developed, and an external light source—with no limitations on brightness—to project a picture.

FLEA-POWER TELEMETRY has been proven practical by experiments conducted by ITT. Reliable reception of digital data over 600 miles from radio-equipped buoys transmitting less than one watt of power on a frequency of 6970 kc. was recently reported at the firm's Long Island facilities. In hundreds of tests buoys radioed data on ocean currents.

ELECTRON MICROSCOPE designed for biologists by Associated Electrical Industries Ltd., England. A short focal length objective lens lowers to 2.2 angstroms the limit set to resolving power by diffraction and spherical aberration.

WIDE-BAND PHASE-SHIFT AMPLIFIER using a varactor, by David K. Adams of the University of Michigan. Other amplifiers based on the varactor (parametric types) do not have the bandwidth or stability of the phase-shift type, it is claimed.

STABLE MAGNETIC FIELD that can also be readily changed, by Bell Labs. A strong magnetic field is applied along the axis of a thin-walled superconducting tube, inducing a current flow in it. Once the current is started, it will persist as long as the tube is kept cooled to −269° C. The current creates a magnetic shield around the portion of the field within the tube, keeping it constant even if the applied field changes slightly.

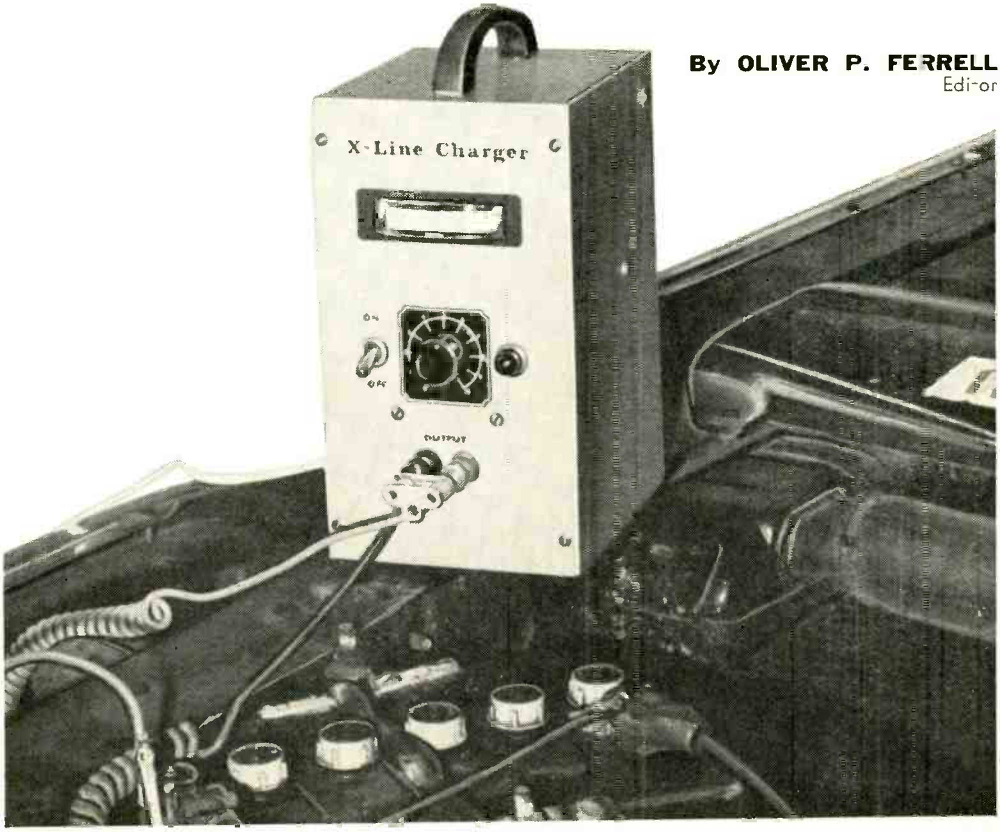
X-LINE CHARGER

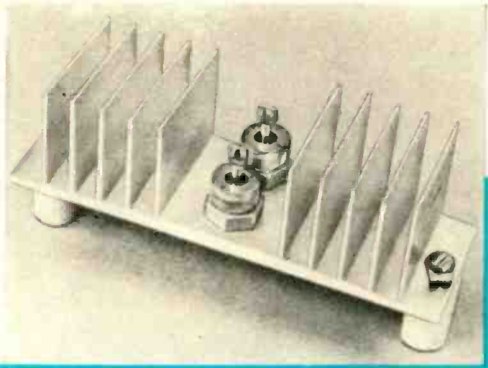
Advanced design using silicon-controlled rectifiers permits automatic operation

THE DEMANDS upon the lead-acid battery in the American automobile are ever-increasing. In wintertime, the ampere-hour capacity is reduced by freezing temperatures. Summertime woes include more frequent short trips, more use of radio equipment, and last—but not least—the electrical requirements of air conditioning. Recharging the battery with a typical generator setup is usually not enough for year-round trouble-free battery performance.

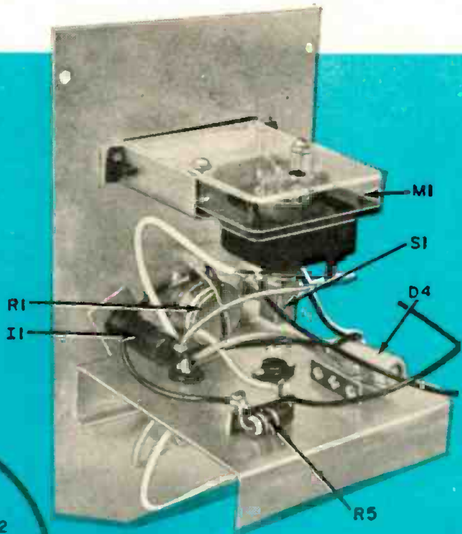
Electronics experimenters are aware of the good and bad things about battery chargers. Low-cost, low-amperage chargers selling for around $5 are sometimes helpful—if you want to wait five to ten times as long as necessary for the battery to recharge. Higher-amperage chargers (3-6 amps) are better built, but must be watched

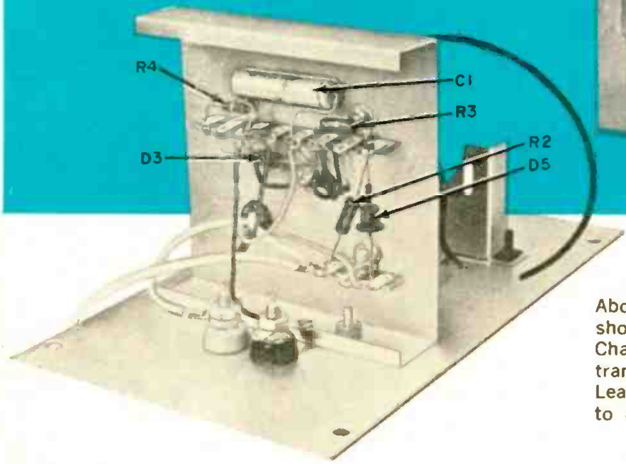
By OLIVER P. FERRELL
Editor





High-amperage silicon rectifiers D1 and D2 are mounted side by side on a Delco heat sink. Steatite stand-off insulators electrically isolate heat sink from metal cabinet.





Above and below open-end chassis views show location of various components. Chassis is assembled after heat sinks and transformer have been attached to box. Leave sufficient wire length for connection to a.c. line, transformer, and heat sinks.

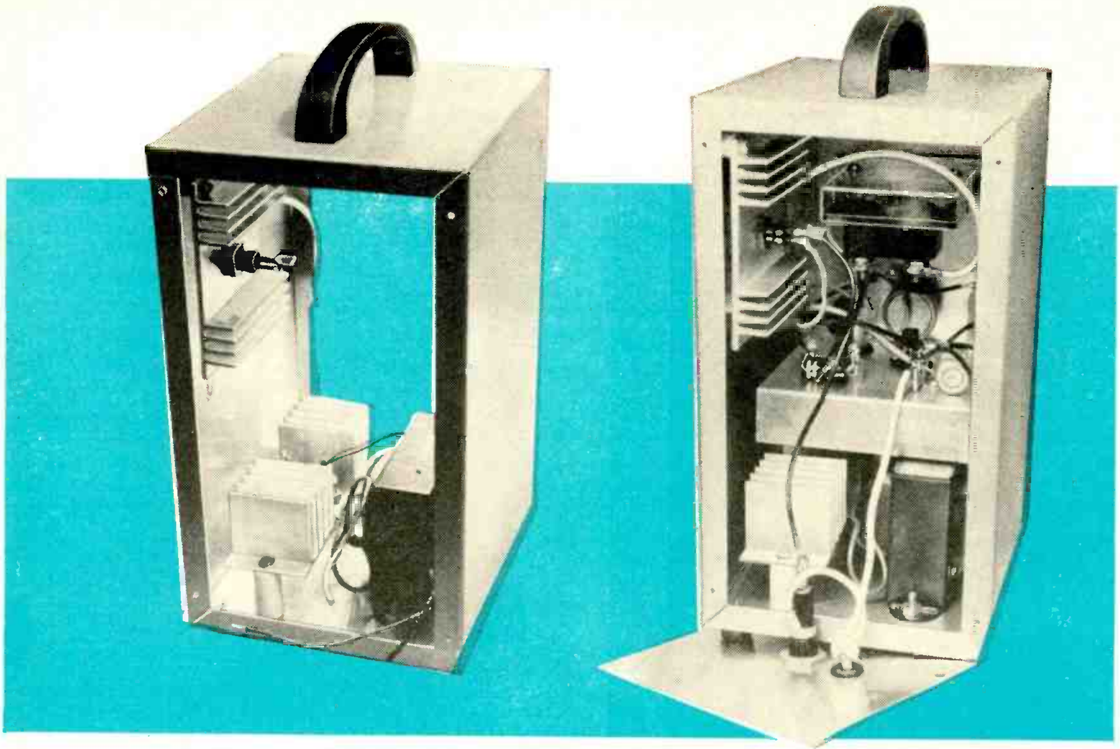
closely since only the most expensive models have provisions to eliminate the hazards of overcharging. Leave a high-amperage charger connected to the battery for too long and either the electrolyte boils away, or the plates start to warp.

If you have been plagued with any of the above problems, you need the "X-Line Charger." This is an all-electronic gadget that is set up once for your optimum battery charge. It need never be set again. When connected to the car battery, it senses the battery's condition. If it is low and needs a charge, the X-Line Charger automatically goes into operation. As the charge level comes up, the charging rate goes down. When the preset level has been reached, the X-Line Charger automatically turns itself off.

No relays are used in the circuit of the X-Line Charger; instead, it is built around silicon-controlled rectifiers now offered at moderate prices by the General Electric Company. These SCR's—and other semiconductors—are sold in numerous radio stores as the GE "Experimenter Line."

The basic circuit of the charger was obtained from the GE "Hobby Manual." Cost of building this project will vary between $25 and $45—depending upon refinements and whether or not the charging rate is metered.

How It Works. The circuit surrounding transformer *T1* and rectifiers *D1* and *D2* is that of a full-wave rectifier. Connected to the primary of *T1* is a fuse, switch, neon pilot light indicator, and Thyrector (*F1*, *S1*, *I1*, and *D4*, respec-



Transformer is bolted to bottom of box. Rectifier heat sink is at left and heat sink for SCR1 is attached to the side.

Prior to attaching the back panel, the completed X-Line Charger looks like this.

tively). Any one—or all—of these components may be eliminated from your working model—depending upon the conditions under which your X-Line Charger will be operating. Thyrector *D4* is a special semiconductor consisting of two selenium diodes mounted back to back. Rated at 120 volts, *D4* protects the solid-state rectifiers in the charger from harmful a.c. power line surges.

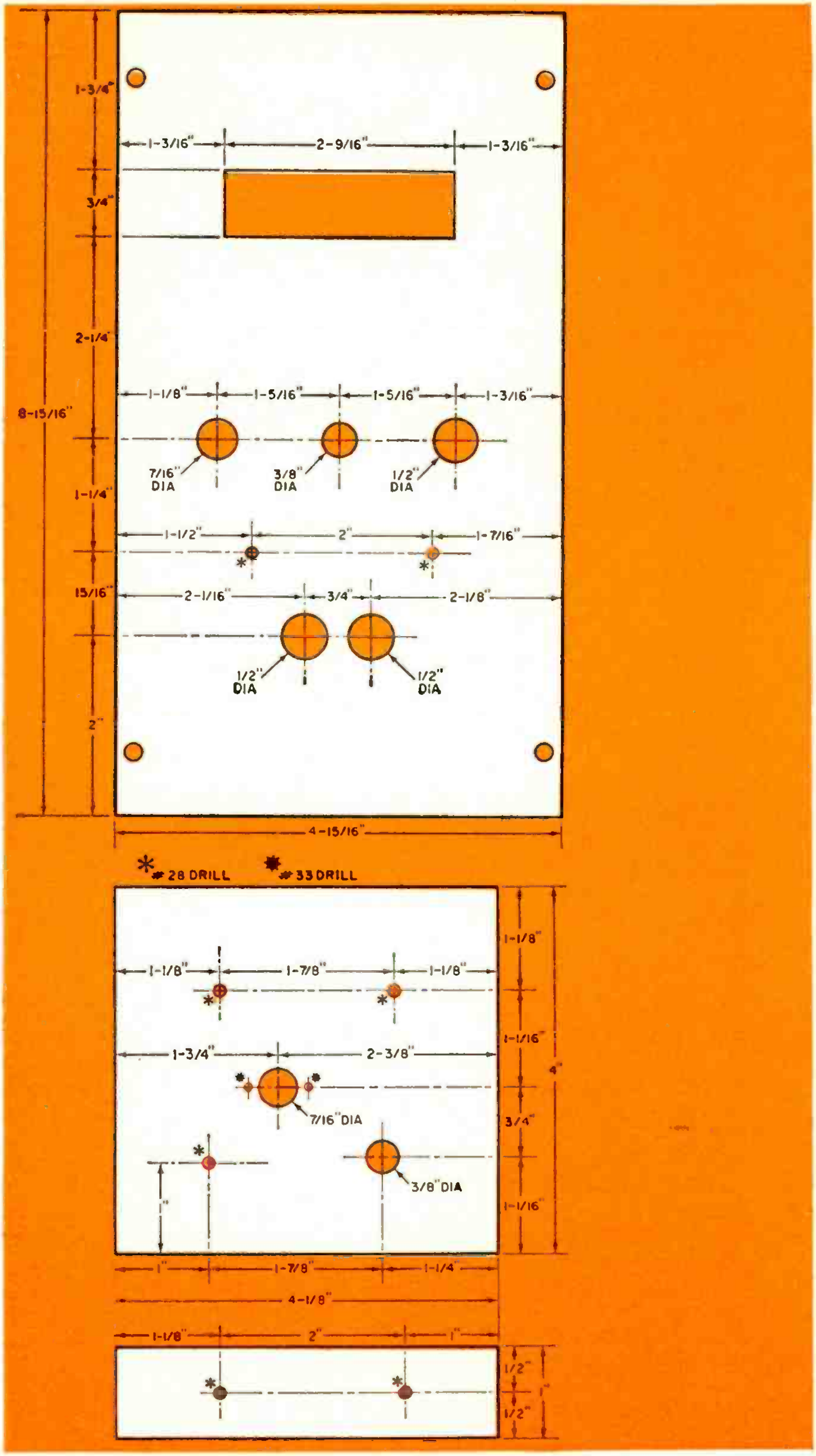
Heavy-duty *SCR1* is operated as a switch in series with the battery and rectifiers. A positive-voltage gating signal to turn on *SCR1* comes from *SCR2* through *R3* and *D5*. The gating signal to turn on and off light-duty *SCR2* is established by the battery voltage according to the setting of *R1* and the charge held by capacitor *C1*. As the battery voltage rises and the charge of *C1* increases, zener diode *D3* conducts, turning on *SCR2*. Since *R2*, *R3*, and *SCR2* are all in series, a voltage divider is formed; and when current flows through this circuit, the gate of *SCR1* cannot receive a positive signal and is therefore turned off—preventing further battery charging.

Construction. All components can be made to fit comfortably into a 6" x 9" x 5" box. A Premier gray hammertone Model PAC-695 suited these requirements. Four rubber feet were attached to one 6" x 5" end of the box. A metal handle salvaged from the junk box was affixed to the opposite end. The box now rests so that both the front and rear panels (9" x 5") are removable.

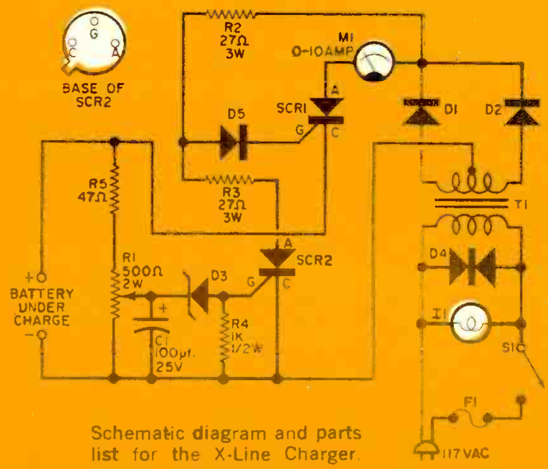
A drawing of the cutout dimensions for a front panel is shown on the next page. Sufficient room is left near the top of the panel to mount any 0-10 ampere meter, although the cutout shown is for an edgewise Simpson Model 1502 meter.

Mounted in the three holes below the meter are *S1*, *R1*, and *I1* (from left to right). Near the bottom are two holes on ¾" centers for heavy-duty binding posts. Attached to the front panel is a small open-end chassis used to mount some of the small components. Transformer *T1* is bolted to the bottom of the

Front panel dimensions are those of a Premier PAC-695 aluminum box. An oblong cutout near top of panel is for an edgewise Simpson meter. Any round or square meter can be mounted in this position by adjusting the necessary cutout size. See text for data on three holes directly below meter. Holes near bottom are for heavy-duty output lead binding posts.



Small open-end chassis holds socket for SCR2 and other miscellaneous components. Hole in lower right corner is grommeted to pass leads above and below chassis deck. Two holes in lip align with holes in panel for rigidity when assembly is complete.



Schematic diagram and parts list for the X-Line Charger.

C1—100-µf., 25-volt capacitor
D1, D2—15-amp., 50-volt silicon rectifier (GE X-4 Kit)
D3—8.2-volt, 1-watt zener diode (GE X-11 Kit)
D4—Transient voltage suppressor (GE Thyrector Type 6RS20SP4B4)
D5—100-volt, 600-ma. silicon rectifier (GE Type 1N1692 or equivalent)
F1—2-amp. fuse
I1—120-volt neon indicator light (Calrad N.P.L. or equivalent)
M1—0-10 amp. meter (Simpson 1502 or equiv.)
R1—500-ohm, 2-watt linear scale potentiometer (Ohmite CU-5011 or equivalent)
R2, R3—27-ohm, 3-watt resistor
R4—1000-ohm, ½-watt resistor
R5—47-ohm, 2-watt resistor
S1—S.p.s.t. toggle switch
SCR1—Silicon-controlled rectifier (GE X-3 Kit)
SCR2—Silicon-controlled rectifier (GE X-5 Kit)
T1—Power transformer: primary, 117 volts a.c.; secondary, 24 volts, CT (Triad F41X or equivalent)
Misc.—Cabinet (Premier PAC-695), heat sink handle, rubber feet, binding posts, stand-off insulators, fuse holder, line cord, etc.

X-Line Charger has clean-cut appearance. Althougn not visible in photos, two screened ¾" holes are cut in the bottom and back panel for ventilation.

box with *8-32* machine screws and bolts.

Two heat sinks are required for the mounting of *D1-D2* and *SCR1*. Almost any sink of reasonable size can be used at these points. The sink retaining *D1-D2* is electrically isolated from the box by Steatite stand-off insulators. Cathode connection to *D1-D2* is made to a soldering lug that also serves to hold the sink to the insulator. An insulator manufactured by E. F. Johnson (Type 501) works well in this application. Controlled rectifier *SCR1* is electrically isolated from its heat sink, but it is also held away from the aluminum box with stand-off insulators (Type 500). A lead is soldered to the anode before mounting the sink to the box wall.

Wiring of the X-Line Charger is not difficult as long as the polarities of the diodes and SCR's are observed. Details on mounting and wiring *SCR1* are included in the GE "Experimenter Line" X-3 package.

Operation. After double-checking your wiring, bench-test your X-Line Charger by inserting a high-wattage, very low ohm wire-wound resistor across the output terminals. Read the output amperage—a 3-ohm resistor should give a reading of about 4 amperes.

Now make sure your car battery is fully charged by measuring the specific gravity. Connect the charger to the battery and rotate *R1* until the meter reads zero. Turn on the bright headlights and see if the charger operates. Turn off the headlights and the charging rate should slowly taper off and gradually return the meter to a zero reading. —30—

THERE'S a 'arge and growing group made up of SWL's and other radio enthusiasts who like to eavesdrop on the goings-on in the 30-54 mc. and 108-148 mc. bands, but who find the receiver problem a tough one. A good commercial receiver for a part of this region of the VHF spectrum can cost from one-tenth to one-third of a kilo-buck, a non-trivial sum for most of us.

In addition, home construction of a good superhet, such as the "VHF Adventurer" (POPULAR ELECTRONICS, October, 1963) requires a rather uncommon amount of test gear and experience. The usual alternative, the very simple super-regen receiver, has serious shortcomings. It tends to be unstable, seldom gives equally good results all across its tuning range, causes interference in other receivers, and hisses like a nest of angry copperheads when there's no signal input.

If these obstacles have kept you from the VHF listening ranks in the past, the "VHF Listener" is the answer to your prayers. For sensitivity, simplicity, and low cost, the superregen circuit has been retained, but with modifications that cure its major ills.

The actual unit described here covers the 108-130 mc. aircraft communications band, but the basic circuit can be built to cover other bands between 10 and 170 mc. with very little change other than the use of different values of inductance and capacitance in the tuned circuits. Required departures from the values used in the unit are given later in this article for similar receivers to cover the Citizens Band and 2-meter ham band.

About The Circuit. Signals picked up by the extendible whip antenna are applied via *C2* to a tap on *L1,* shown in Fig. 1. Capacitor *C1* resonates *L1* at the center of the band covered, and once set, does not need retuning. Coil *L2* is a single turn of wire which acts as a low-impedance secondary to *L1,* to match *Q1's* input impedance.

Transistor *Q1* is the r.f. amplifier, operating in a grounded-base circuit. Power is shunt-fed to the collector via *L3,* which has relatively high impedance across the band covered. Resistors *R1, R2,* and *R3* set *Q1's* operating bias.

The *Q1* output is applied to the *Q2* detector stage via *C5,* shown in Fig. 2. Tuning capacitor *C6* and coil *L4* make up the oscillator tuned circuit which is connected to the *Q2* collector. Capacitor *C7* is the feedback path for superregeneration. The 60-kc. quench frequency is determined mainly by the values of *C8, C9,* and resistor *R7.*

This detector differs from most superregens by providing, in addition to the audio signal, a d.c. output proportional to the r.f. input. This d.c. component controls the squelch circuit, which silences the set when there is no input.

The audio signal and d.c. squelch control voltage are taken from the detector through a filter made up of *C10, C11,* and *R8.* This prevents the 60-kc. quench frequency from reaching and overloading the audio amplifier input.

The squelch circuit is a d.c. amplifier

VHF LISTENER

There's exciting listening in the VHF bands. Here's a potent transistor receiver that will let you in on it for under $30

By WALT HENRY

that controls diode *D1*, which acts as a gate. The audio signal reaches *D1* via *C13*, but cannot pass through when the diode is reverse-biased. When a signal is received, the d.c. level at the junction of *L4* and *R4* rises. This rise is amplified through *Q3* and *Q4*, overcoming the reverse bias on the *D1* diode gate. This permits the audio signal to pass to the audio amplifier input. If the incoming r.f. signal is cut off, *D1* is again reverse-biased by the voltage at the junction of *R17* and *R18*, and the detector hiss cannot pass through.

The audio amplifier shown in Fig. 5

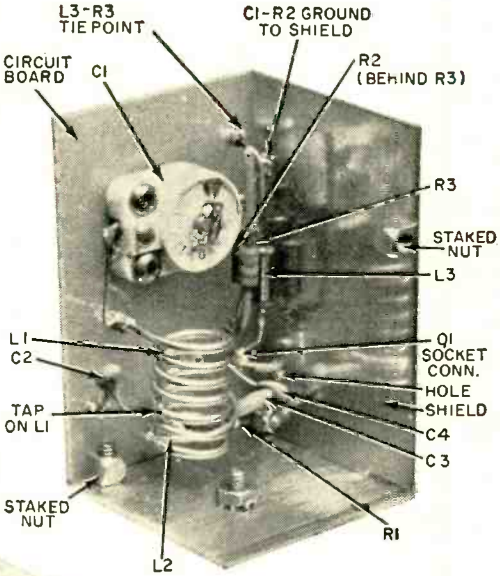


Fig. 2. Follow layout of Q1 r.f. stage closely. Ground ends of L1 and L2 are soldered to circuit board tie point (hidden behind coils) and C3-R1 junction.

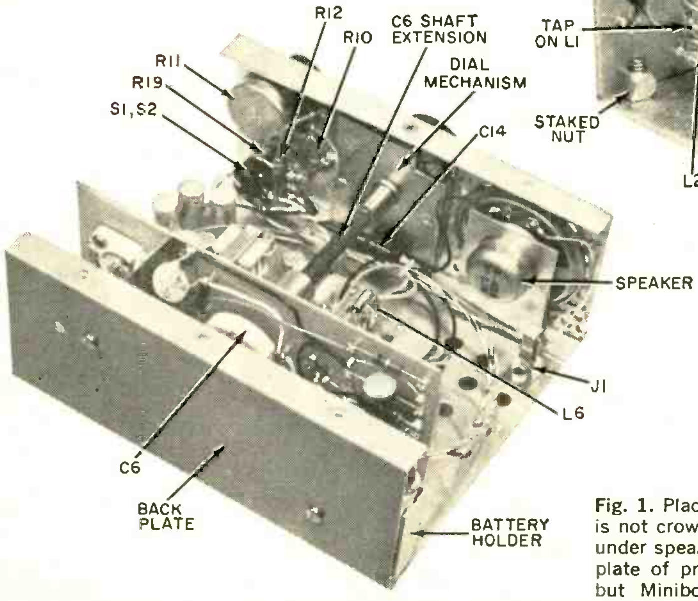


Fig. 1. Placement of major parts is not crowded. Holes in chassis under speaker are optional. Back plate of prototype is removable but Minibox assembly is O.K.

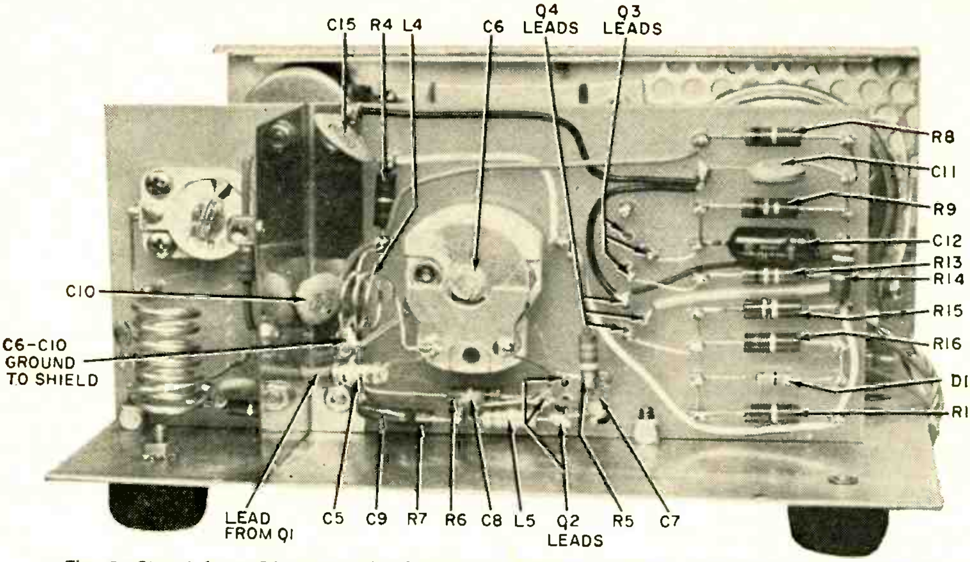


Fig. 3. Signal from Q1 stage left of shield is coupled to detector by wire through hole in shield. R.f. and squelch circuit transistors mount in sockets on front face of circuit board.

was made by the author, but the manufactured units given in the Parts List are equally good, and require less work.

Separate batteries are used to power the r.f. and audio sections. Use of a single battery tends to cause some motorboating due to interaction between the squelch circuit and the audio amplifier when the battery internal impedance increases with age and use.

Construction. The mechanical construction of the author's unit includes staked nuts for holding the circuit board and shield in the case. These are not readily available to most home constructors, but the small angle brackets sold in the "five-and-ten-cent" stores will serve just as well. Alternatively, short lengths of aluminum or brass angle bracket can be used with either self-tapping or machine screws.

The r.f. and squelch circuits are assembled on a 2½" x 5½" piece of insulated circuit board. The author used a non-perforated board and drilled 1/16" holes for small push-in terminals for solder connections. However, a piece of pre-punched Vectorbord and the "flea-clip" terminals made for it are ideal, and are called for in the Parts List.

The only part of the circuit that must be laid out with care is the r.f. amplifier shown in Fig. 2. Such a grounded-base amplifier stage works very well at VHF, but is inherently slightly regenerative and may tend to oscillate if leads are not kept short and direct. The 2N1517 transistor has an internal shield which should be grounded. This may be done by connecting the shield lead directly to ground, or by connecting it to the base lead, which is, in turn, effectively grounded by *C4*. The metal shield between r.f. and detector stages provides a convenient ground for both.

The detector stage may be laid out almost any convenient way as long as the leads are kept reasonably short, as shown in Fig. 3. During construction, omit *R5* temporarily, as its optimum value will be determined by experiment. It probably will be approximately 22,000 ohms. The shield lead of *Q2* can be wired to ground, but this step is not vital.

In case you have some high-frequency transistors in the spare parts box, any of the following types will work quite well in either the r.f. or the detector stage. Tested examples include Philco's 2N502, 2N1742, 2N1743, and 2N1744, the Amperex 2N2084, and Texas Instruments' 2N797. Silicon *npn* types 2N743 and 2N744 will also give excellent performance. If *npn* transistors are used in your version of the "Listener," however, the polarities of *B1, C12, C14,* and *D1* must be reversed, *R6* must be 3300 ohms, and *Q3* and *Q4* must be interchanged.

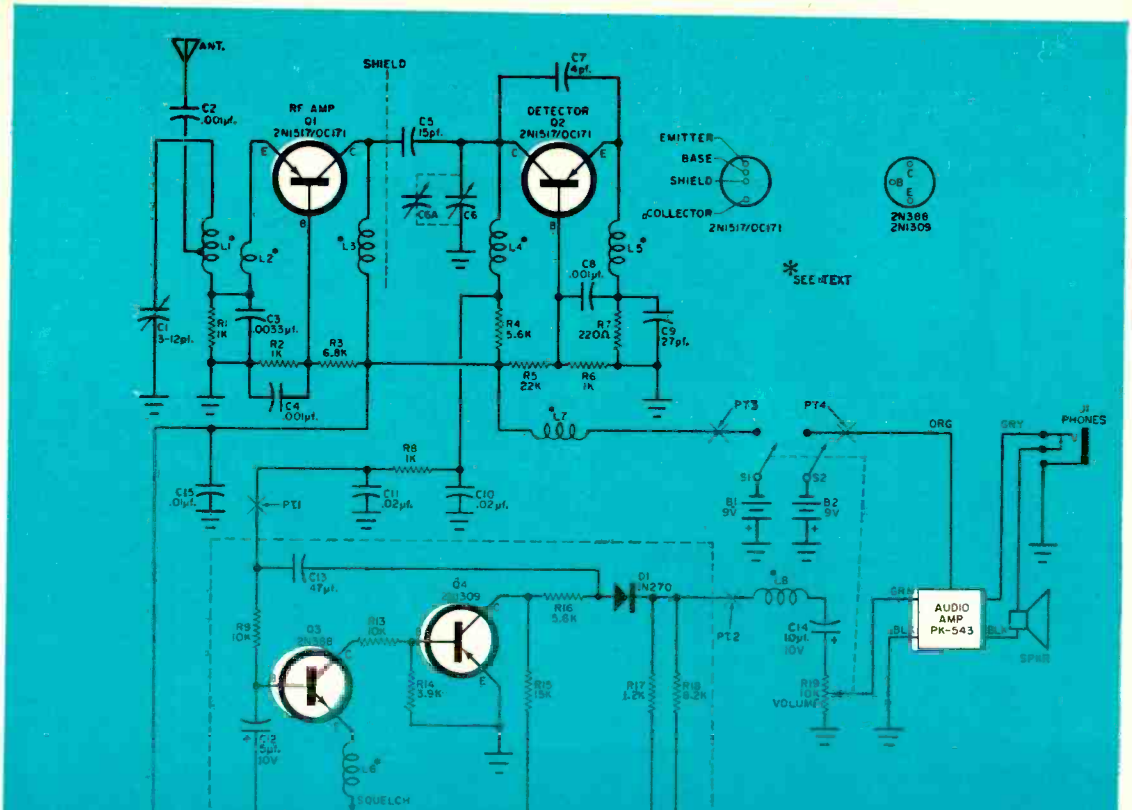


Fig. 4: Leads for connecting signal, supply voltages, and ground paths may run on either face of circuit board, but should be direct.

PARTS LIST

B1—9-volt manganese transistor battery (Burgess 2MN6 or equivalent)
B2—9-volt transistor battery (Eveready 216 or equivalent)
C1—3-12 pf. ceramic trimmer capacitor
C2, C4, C8—0.001-pf., 100-volt disc cer. cap.
C3—0.0033-pf., 100-volt disc cer. capacitor
C5—15-pf. tubular ceramic capacitor
C6—2.8-17 pf. variable capacitor (Hammarlund APC-15B or equivalent, modified as per text)
C7—4-pf. tubular ceramic capacitor
C9—27-pf. silver mica capacitor
C10, C11—0.02-µf., 100-volt disc cer. capacitor
C12—5-µf., 10-volt electrolytic capacitor
C13—0.47-µf., 100-volt tubular paper capacitor
C14—10-µf., 10-volt electrolytic capacitor
C15—0.01-µf., 100-volt disc cer. capacitor
D1—1N270 germanium diode
J1—Subminiature phone jack, shorting type
L1, L2, L4—See text
L3, L5, L6, L7, L8—4.7 µh.—see text
Q1, Q2—2N1517/0C171 Amperex transistor (available from Newark Electronics Corp., 223 W. Madison St., Chicago, Ill., stock nr. 21FX2612—see text)
Q3—2N388 germanium transistor
Q4—2N1309 germanium transistor
R1, R2, R6, R8—1000 ohms
R3—6800 ohms
R4, R16—5600 ohms
R5—See text
R7—220 ohms
R9, R13—10,000 ohms
R10, R12—2700 ohms
{all resistors ½-watt carbon unless otherwise specified}
R11—3000-ohm potentiometer (IRC Q11-112 or equivalent)
R14—3900 ohms
R15—15,000 ohms
R17—1200 ohms
R18—8200 ohms
R19—10,000-ohm potentiometer, with switch (Mallory U-20, with US-27, or equivalent)
S1, S2—D.p.s.t. switch, on R19 (Mallory US-27 or equivalent)
1—7" x 5" x 3" Minibox (Bud 80P350 or equivalent)
1—Transistor audio amplifier (Lafayette PK-543 or equivalent)
1—Vernier dial mechanism (Lafayette F-753 or equivalent)
1—Shaft coupler (Lafayette MS-201 or equiv.)
1—Extension shaft (Lafayette MS-197 or equiv.)
1—Telescoping whip antenna (Lafayette F-440 or equivalent)
1—2-inch speaker (Lafayette SK-189 or equiv.)
1—2½" x 5½" preperforated Vectorbord
Misc.—3-lug terminal strip, hookup and coil winding wire, transistor sockets, knobs, screws, etc.
Note: *For Citizens Band, R5 is 680 ohms, C5 is 51 pf., C7 is 10 pf., and C9 is 62 pf.*

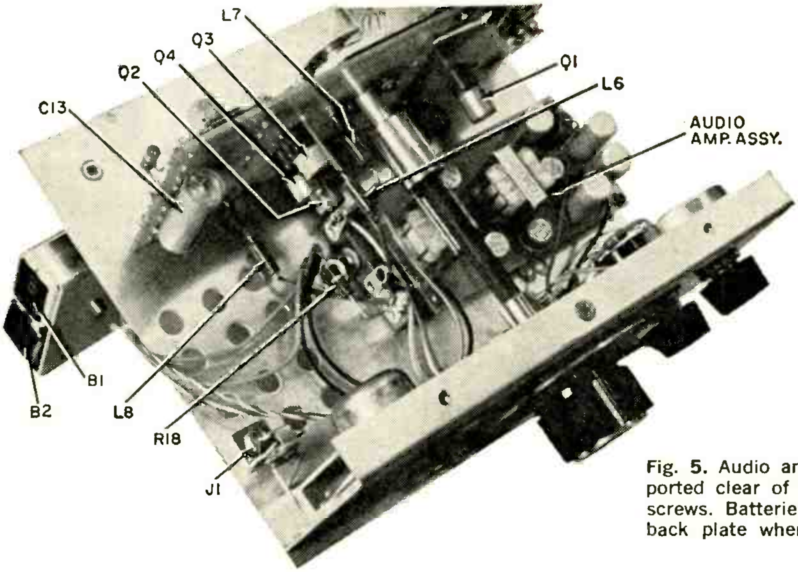


Fig. 5. Audio amplifier board is supported clear of chassis on four long screws. Batteries in holder attach to back plate when unit is assembled.

The specified tuning capacitor *(C6)* should be modified for use in the 108-132 mc. aircraft or 2-meter amateur bands. Remove all but one of the rotor plates, and all but two of the stator plates, the rotor plate meshing between the two remaining stator plates.

Coil *L1* is made by winding 6½ turns of #18 tinned copper wire on a ½" rod, spaced ¾" long. After removing the forming rod, solder the tap at a point 2½ turns from the ground end of *L1*.

Coil *L2* is ¾ of a full turn of #18 around the ground end of *L1*. It should be grounded at the same point as *L1*, but should not contact *L1* elsewhere. Coil *L4* is 3 turns of #18 wound on a ⅜" rod, in a ¼" length.

For the Citizens Band, *L1* requires 23 turns of #28 enameled copper wire on a J. W. Miller 20A000RBI form, tapped 8 turns from the ground end. Coil *L2* is 2½ turns of the same wire close-wound over the ground end of *L1*. Coil *L4* is 17 turns of the same wire on the same type of coil form.

Chokes *L3* and *L5* are 23µh. units, Miller 9310-44 or equivalent, and *L6*, *L7*, and *L8* are omitted. Also, *C6a* must be added in parallel with *C6*, which is not modified for the Citizens Band.

If you decide to build the unit for the 2-meter band, simply use one less turn in making both *L1* and *L4*, and tap *L1* two turns from the ground end. No other construction changes are necessary.

R.f. chokes *L3*, *L5*, *L6*, *L7*, and *L8* may be commercial 4.7-µh. units, but cheaper ones that work just as well can be made by winding 36-gauge copper wire on one-megohm resistors. Wind the turns closely and cover the full length of a half-watt resistor. Strip the enamel off the ends of the wire with fine sandpaper, wind around the resistor leads, and solder. Note that different choke values are required for the Citizens Band.

Layout is not important in the squelch circuitry, but the construction shown in Fig. 3 is compact and neat. If you are leaving out the squelch feature, omit all circuitry in the dotted rectangle on the schematic, and connect point 1 directly to point 2. Also connect point 3 directly to point 4 and eliminate *B1* and *S1*.

The color coding given on the schematic is for the Lafayette PK-543 preassembled audio amplifier. It comes with two orange leads which are meant to be connected to a volume control on-off switch. Since a different arrangement is used, cut off the orange lead running to one of the (now disconnected) battery leads and leave the other one intact. Save the battery clip for connecting to the battery leads later on. The other needed battery clip may be salvaged from a worn-out battery of the same type.

The phone jack is connected so that the speaker is turned off when the phones are plugged in.

(*Continued on page* 88)

THE SECRET TUBE THAT CHANGED THE WAR

Today it's junk—a bargain-priced surplus special—but it is also history, the WW II tube no one knew about

By **WILLIAM I. ORR,** W6SAI

THE YOUNG RADIO AMATEUR saw the dull glint of glass in the bottom of the dusty box and immediately plunged his hand into the receptacle, searching for the unknown object that caught his attention. Grasping something, he slowly drew forth a curious, large misshapen radio tube. Holding the dusty object up to the bare light bulb dangling from a faded sign that read "UR CHOICE—29c," he examined his find carefully. Puzzled, he turned to the proprietor. "Hey, Sam! What do you know about this tube? Can I use it on two meters?"

"Surplus Sam," owner of the radio junk shop, took the tube and examined it as if it were a fine jewel. He sighed. "Who knows? Buy it! I don't know what it is, but you can't go wrong for twenty-nine cents!"

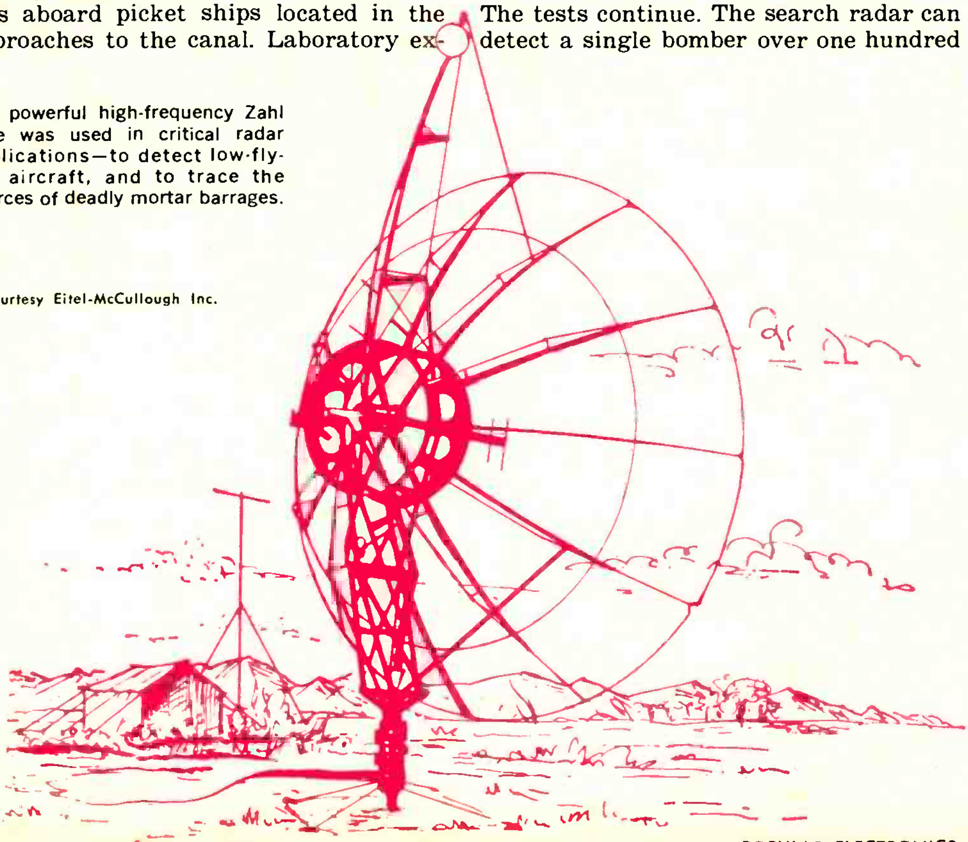
WHERE SHALL WE start the story of the curious tube? On a June morning twenty years ago in Normandy? Or before that, at the Panama Canal, or years later on the slope of a numbered hill in Korea? It's a strange tale of a unique tube, an Army major and American ingenuity—a true story whose obsolete residue was finally found by the inquisitive amateur in a surplus shop.

Panama, 1940: America is not yet at war, but it is obvious to some that we soon will be. The Panama canal is a tempting and vulnerable target from the air. Radar, the radio eye, had been invented a few years before, but the only available equipment worked on the relatively low frequency of 110 megacycles, and then not very well. The safety of the canal could not be trusted to this primitive, unsensitive gear which showed an almost complete blindness in detecting low-flying airplanes.

A decision is made to construct a small number of radically new and powerful radar sets capable of locating and detecting small planes, and to put these sets aboard picket ships located in the approaches to the canal. Laboratory experiments show that a good frequency for the new sets would be 600 megacycles, but no available tubes can produce the required power at what was then regarded as an unusually high frequency.

By a stroke of fortune of the kind that often changes history, a radar tube is invented by young Major Harold Zahl of the Army Signal Corps that *can* produce the power required. A prototype of the vital search radar employing the major's radically new tube is to be secretly built and tested as fast as humanly possible.

On the *M.S. Nordic* off the New Jersey coast: The vessel is equipped with the new radar, and testing is going forward. Suddenly, a German submarine, intent on spying, surfaces close by. It does not go unnoticed, and as the sub's periscope turns, it sees a destroyer closing in together with a blimp overhead, both carrying depth charges. The sub crash-dives as the depth charges drop. The new radar and those aboard the *Nordic*—shaken up by the explosions—are safe. The tests continue. The search radar can detect a single bomber over one hundred



The powerful high-frequency Zahl tube was used in critical radar applications—to detect low-flying aircraft, and to trace the sources of deadly mortar barrages.

Courtesy Eitel-McCullough Inc.

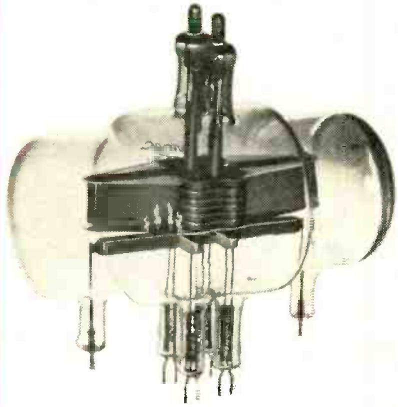
miles away with the radar antenna mounted only fifteen feet above the surface of the water!

THE SECRET, revolutionary canal radar equipment was so successful that the Air Force asked the Signal Corps to repackage the equipment into a light-assault type radar which could be airlifted to a battle zone and then hand-carried to the front. A prototype of the repackaged radar was built in February, 1943. To prove it was air-transportable, the unit was loaded aboard a bomber at the Newark (N.J.) airport and flown to Florida. It was up and in operation four hours after it arrived at Orlando.

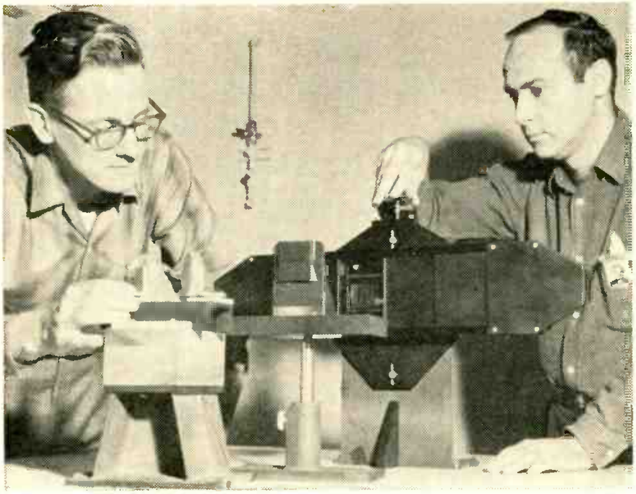
This cleared the way for a crash program to construct a small number of the secret radars (by now called the AN/TPS-3) for immediate shipment to critical war theatres. Twelve sets were built at Camp Evans Signal Laboratory in New Jersey with the aid of GI operating crews who later flew into combat with the equipment. The AN/TPS-3 could be assembled and put on the air by a crew of four men in thirty minutes.

(*Continued on page* 103)

The AN/TPS-3, known as "Tipsy Three" is shown below installed in a tent. It was the first radar set to operate at high power in 600-megacycle range.



The Zahl tube and its inventor, Dr. Harold A. Zahl, now director of the Army's Research and Development Laboratories, Ft. Monmouth, N.J. The radically new tube—four triodes in parallel with tuned plate and grid lines to make it an oscillator—marked a point of departure for modern tube designs containing resonant circuitry within the tube. Fortunately for the Allied cause during World War II, the Germans never obtained a Zahl tube intact, or guessed its secret. It was, without doubt, one of the factors that won the war and saved countless lives.



Lensless Laser Photography

Juris Upatnieks, left, and Dr. Emmett Leith adjust lensless camera. Film is placed in opening below Leith's hand; object to be photographed is in device to left. Reference beam of light reflects from mirrors Upatnieks is adjusting, past object and onto film, producing interference pattern with all phase and intensity data.

THE LASER—fantastic forerunner of a new generation of electronic devices—has played an important role in a new discovery: that of lensless photography. Recently announced by a team of researchers at the University of Michigan, lensless photos offer great promise in recording important phenomena where glass or magnetic lenses are impractical or impossible. In addition, lensless cameras, enlargers, and microscopes—completely free of distortion inherent in lens systems—may someday become a reality. Also noted as a possibility with the new technique is the storing of several different "negatives" on the same frame of film.

The researchers, Dr. Emmett N. Leith and Juris Upatnieks, used a lensless camera to photograph the defraction pattern produced when a transparency was illuminated by an intense beam of single-hue laser light. Since ordinary film cannot record the *phase* of the light used to illuminate an object, Leith and Upatnieks converted phase variations to intensity variations by diverting part of the laser beam through a prism and part through the transparency. The mingling of the two beams produced an interference pattern containing all necessary phase and intensity data. To convert the defraction pattern—which looks like a series of smudges—into a picture, it's only necessary to project it with laser light.

Another point of interest reported by the researchers is that by changing the position of the film each time a picture is taken several scenes can be recorded on the same film without deterioration of quality. —30—

The blurred, smudged photo at the far left is actually a defraction pattern containing all of the information needed to reproduce the picture of the little girl. Unlike an ordinary photo which results when light rays are focused on film with a lens to create an image, a defraction pattern is simply a representation of unfocused light. The defraction pattern produces the clear image of the child when monochromatic light—of the same wavelength used in making it—is projected through it onto screen.

The materials? Oh, yes. A cardboard shipping carton, packing crepe, paper tape, and a bit of glue!

A HI-FI SPEAKER SYSTEM FOR $7.61

By FORREST H. FRANTZ, SR.

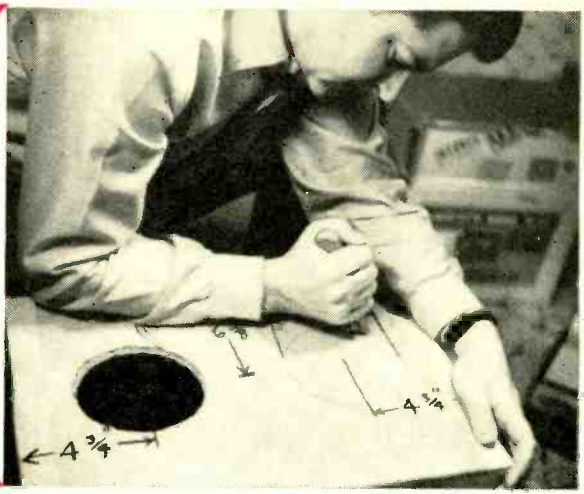
THE PROBLEM of how to make an inexpensive—as a matter of fact, *cheap*—speaker system is intriguing. In the author's case, previous experience had singled out a speaker that had good response and cost very little. The enclosure was, of course, another matter.

Since small size was important, a vented enclosure was the logical choice,

the use of a *ducted* vent further reduced enclosure size requirements. Then came the problem: how to build such an enclosure and still keep the author's "low-price special" in the low-price class? Considered were the use of a wastebasket, a garbage can, a built-up wood enclosure, a small ready-made cabinet, and any number of zany choices. They all had disadvantages—too large, poor performance, too costly, etc.

The light dawned when a hasty search for materials revealed a corrugated cardboard shipping carton. It looked like what it was—the measurements proved to be 17¾" x 13" x 13"—roughly the two cubic feet of air space needed. Admittedly, a shipping carton doesn't have sides as rigid as you'd like for a speaker enclosure, but with a little trickery you

A HI-FI SPEAKER SYSTEM FOR $7.61



After reinforcing and sealing box bottom, cut two 5¼″ holes, spaced as shown, for speaker and vent.

can beef them up. And what's less expensive than a cardboard carton you get for free?

Shipping Carton Enclosure. Assuming you use the speaker referred to in the Bill of Materials (the Lafayette SK-97) or another speaker with roughly the same resonant frequency (70 cycles), use a box with the same amount of space as the author's. Larger or smaller cartons or speakers with different resonant points will introduce new design problems too extensive to cover here.

BILL OF MATERIALS

1—6½″ coaxial speaker (Lafayette SK-97 or equivalent, $6.95)
2—Five-way binding posts (16 cents)
1—Roll of 2″ gummed paper tape (25 cents)
1—Elmer's Glue (25 cents)
1—17¾″ x 13″ x 13″ corrugated cardboard carton (free)
Misc.—Extra cardboard for duct and reinforcement, packing material for sound absorption (free)

Total cost. $7.61, minus "optional" extras such as grille cloth, paint, or contact paper

The foremost objectives in building the enclosure are to make it as stiff and as airtight as possible. Seal the bottom and any cracks in the box with gummed paper tape, glue the flaps together, and strengthen the bottom with fill-in cardboard (obviously you'll need some extra corrugated cardboard for this and other parts of the structure).

The next step is to cut holes for the speaker and ducted vent in the bottom of the box which becomes the front of the enclosure. Using a sharp knife, cut two holes 5¼″ in diameter, spacing them as shown in the photos. To simplify forming a circular duct, roll a 3½″ x 35″ piece of cardboard, with the corrugations running across the 3½″ dimension, into a two-layer pipe with a 5¼″ inside diameter. Use gummed tape to hold the duct in shape and to seal the corrugation openings on the ends. Glue the duct into the enclosure over one of the holes. When the glue is dry, apply more to fill the corrugation openings around the edges of both enclosure holes.

Final Assembly. Punch mounting holes for the speaker with an ice pick, and mount it with four 6-32 1¼″ machine screws and nuts. Place the washers furnished with the speaker under the screw heads and tighten the screws till the cardboard just seems to start to give. Line the inside of the enclosure with a ½″ layer of sound-absorbent material such as soft multilayer packing crepe, cotton, packing sponge, or plastic foam.

You'll often find some of the materials mentioned in packages you receive, or in the shipping department of any store or business. If you can't get the stuff free, you can buy a big roll of soft cotton at a reasonable price in the sewing sections of some stores.

The binding posts for the system are mounted at the rear in a place where

The duct is made by rolling a strip of 3¼" x 35" cardboard into a 5¼"-i.d. tube; fasten with tape.

Glue the duct over one of the holes before putting padding in place. Mount terminals, wire to speaker.

they won't interfere with the inner box flap. Connect them to the speaker terminals, place glue on the inner flaps, and close the back. Place the enclosure bottom-down on a table (terminals at the edge) and slip weights into it to hold down the inside flaps until the glue dries. Finally, seal the back of the cabinet with gummed tape.

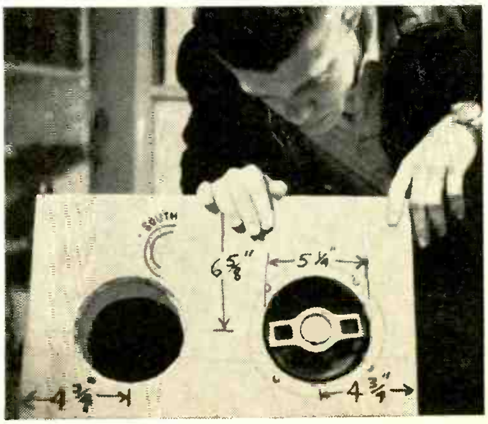
The system is now ready to use, but you can make it better by reinforcing it by gluing pieces of corrugated cardboard (with corrugations running in opposite directions to those in the box) to the sides and back. This measure will stiffen the box considerably.

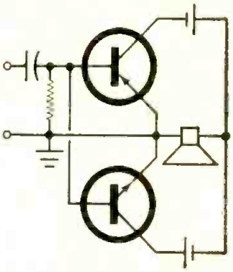
Finally, to increase your chances of continuing to live at home, you may want to dress up the box with grille cloth, paint, adhesive-backed contact paper, or by covering the entire front, sides, and top with cloth. On the other hand, if you're the kind of nut (like the author) who's proud of making something good out of nothing, you have no problems. Beatniks may also prefer an unadorned enclosure. Of course, if you can hide the speaker system behind a drape, you can eliminate the decorating.

The 8-ohm speaker is rated at 5 watts and shouldn't be driven beyond this point. Response range for plus or minus 5 db is roughly 50 cycles to 16,000 cycles, which is pretty good for less than eight bucks! —30—

The speaker is bolted to the reinforced cardboard bottom—punch holes for the screws with ice pick.

Completed enclosure can be improved by reinforcing the sides and back with another layer of cardboard.





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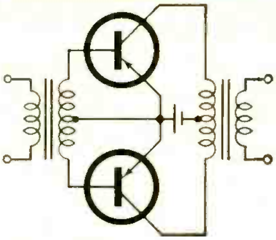

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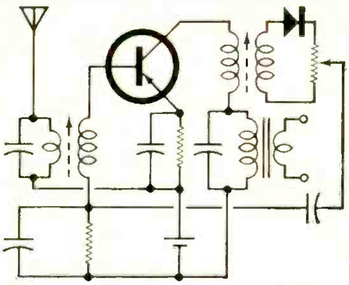

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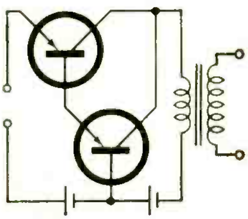


D

AMPLIFIER QUIZ PART 2

By ROBERT P. BALIN

Old-timers had a slight edge in the tube amplifier quiz last month. The Young Squirts with ink still damp on their diplomas get a break here, as transistors came in after the oldsters left school. Try to match the circuits (A-F) with the names (1-6) widely (but not universally) given them in electronics handbooks. Four right without cracking a book is par; five without guessing is excellent. Next month's brain busters will deal with metals used in electronics.

1 Compound-connected amplifier ____

2 Reflex amplifier ____

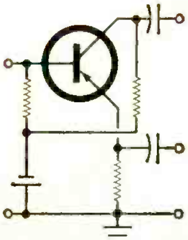
3 Bridge amplifier ____

4 Push-pull amplifier ____

5 Complementary symmetry amp. ____

6 Paraphase amplifier ____

(*Answers on page* 99)



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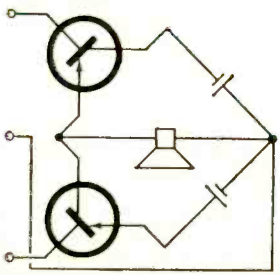

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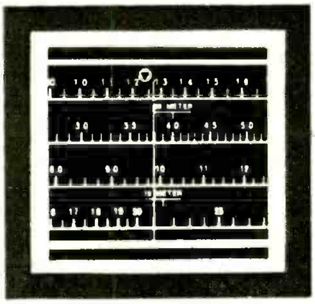


Across the Ham Bands

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

ANNUAL ARRL DX CONTEST

AS you read this, the first half of the annual ARRL DX contest (0001 GMT, February 8, to 2400 GMT, February 9, on phone, and identical hours on February 22 and 23 on c.w.) has probably ended. Many successful DX-minded hams are now impatiently awaiting the second half of the contest (March 14 and 15 on phone, and March 28 and 29 on c.w.), so they can rack up more countries and build up a big multiplier.

But many other hams who entered the first round with high hopes are moaning the blues in frustration at their inability to snag those DX contacts that make the multiplier grow. If this is your problem, maybe a few tips will help you hook those rare ones, both during the contest and after.

Any time a DX station puts a signal into the U.S., it's an odds-on bet that a "pile-up" of W and K calling stations will build up around, and probably on top of, the DX station's frequency. Such pile-ups can reach staggering proportions during a DX contest, yet some stations consistently succeed in working the DX station despite the bedlam. And quite a few of these successful DX chasers run far less power than the legal full gallon, too.

How do they do it? Mainly by dint of superior operating ability, which is something you can't buy in any store. This is *one* aspect of ham radio where the size of the bankroll just does not count; you have to *make* yourself into a good operator. You can do it, too, with patience and will power, and plain common sense.

First of all, put yourself in the DX station operator's position for a minute. With ten or twelve powerful stations calling him dead on his own frequency, who can he read? Why, someone calling a little above or below his frequency,

Novice Station of the Month

"I wish I had discovered ham radio 30 years ago," is the wistful complaint of 48-year-old Fred G. Godfrey, WN2GAL. Fred operates out of Fort Edward, N.Y. A tugboat captain by profession, he is home only one week out of every three. To increase his limited on-the-air time, Fred is planning to have a maritime/mobile rig installed on his tugboat. The equipment at WN2GAL includes a Hammarlund receiver and E.F. Johnson transmitters. For submitting the winning photo in our March Novice Station of the Month contest, Fred will receive a one-year subscripion to POPULAR ELECTRONICS. If you would like to enter the contest for future months, just send us a clear photo of your station—preferably one showing you at the controls—along with some information about yourself, your equipment, and your operating achievements. All contest entries should be addressed to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, Box 678, Gary, Indiana.

Valley Stream North High School (N.Y.) history students were afforded a unique opportunity last November to see ham radio in action. Using Hallicrafters equipment at the school station, WB2KFG, the students spent 45 minutes discussing governmental topics with K3UIG, Barry Goldwater. Arrangements for this unusual 40-meter SSB contact were made by WA2IFA.

that's who. And that fellow can be you, if you listen a bit first and note how he is working.

Most veteran DX station operators know perfectly well that regardless of how carefully they specify "ans 10U" or "5D" (meaning "answer me 10 kc. above my frequency" or "5 kc. down"), that most of the pack will blindly zero-beat them and blast away. It goes without saying that if you answer him on the frequency to which he has his receiver tuned, you've a reasonable chance to be heard, even though a few other smart operators may be there, too.

If he comes back to you, you may have a very rough time reading him, for there will *still* be stations calling him on his frequency, even if he gives you a long call. If, instead, he comes back to some other station, DON'T try to break into their contact to make yourself known. Now is the time to play it cool! Note carefully the exact dial setting of the DX station, and when he signs, tune your receiver quickly to find the frequency of the U.S. station to which he responded, which will be acknowledging the report from the DX station. *Without* putting your transmitter on the air, tune it zero-beat with this station, and the instant he finishes signing (if that ends their contact) give the DX station a quick call, at the same time retuning your receiver to the DX station's frequency. This kind of "tailgate" call is resented by a very few DX stations, but is depended on by many others as a means of making at least a few contacts in the clear, before the pack moves in again.

Here are some shorter tips. Don't make the call of the DX station you are after more than two or three times before making your own call. Doing so will advertise his presence to the dozens of receivers in other stations that are tuning that part of the band. Besides, if you're on the right frequency, he will probably hear the *first* call if he can hear you at all.

Don't call CQ DX! DX stations will not come back to this unless yours is the only signal they can hear on the band. Instead, make sure that your equipment is in good order, that you really know how to get the most out of it, and listen, listen, LISTEN! And when you hear a pile-up, don't assume that's where to call and jump on top of the heap.

These few tips won't make you a real DX wizard overnight, but chances are they *will* help you improve your score in the last half of the DX contest.

CLASSIC HAM CIRCUITS

In the early 30's, practically every ham had a variable-frequency oscillator in his transmitter. In fact, the oscillator was often the whole transmitter, and fed the antenna directly. Raucous and unstable signals were naturally the rule rather than the exception. Heat, vibration, voltage changes, and the wind blowing the antenna (among other things)

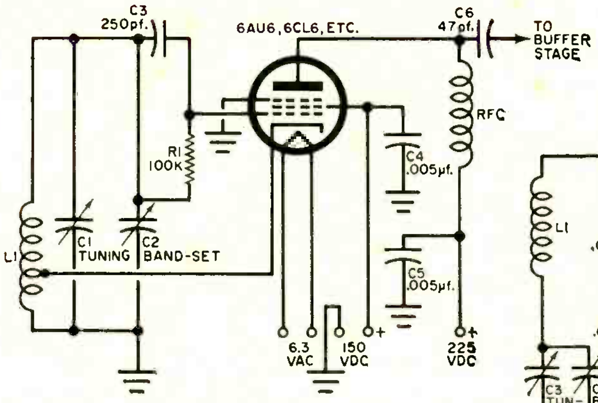
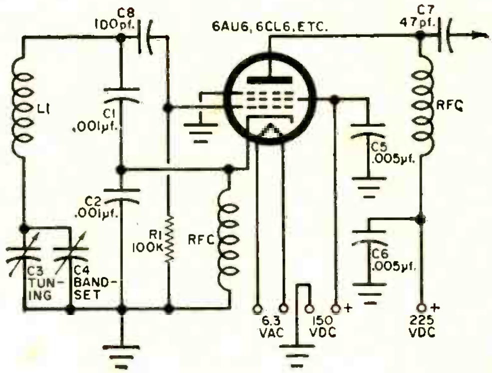


Fig. 1. Hams welcomed this classic circuit with open arms. Called the ECO, this oscillator helped rid the bands of wavering signals due to transmitter instability.

Fig. 2. Most modern VFO's now incorporate this Clapp circuit, which provides greater stability.



caused their frequencies to quiver and quake, and the receiving operator to mutter unprintable things as he twisted the tuning knobs.

The dream of the average ham in those days was, therefore, to own a crystal-controlled transmitter with its distinctive, rock-steady signal. And by the start of World War II, crystal-controlled transmitters were generally standard equipment in most ham shacks.

After the war, however, the rapid increase in the ham population and the resulting crowding in the ham bands made the ability to shift the transmitter to any frequency in the band look more and more attracive—*if* the VFO could provide stability comparable to a crystal-controlled signal. This was a big "if," as the chirpy, wobbly, jumpy, hummy signals emitted by most VFO-controlled transmitters in those days amply demonstrated.

Evolution of a VFO. Actually, there were a few first-class VFO's in the hands of skilled amateur engineers even in the middle 30's. Practically all of them used the electron-coupled oscillator (ECO) circuit first described by J. B. Dow in the article "A Recent Development in Vacuum-Tube Oscillator Circuits," which appeared in *The Proceedings of the I. R. E.*, December, 1931.

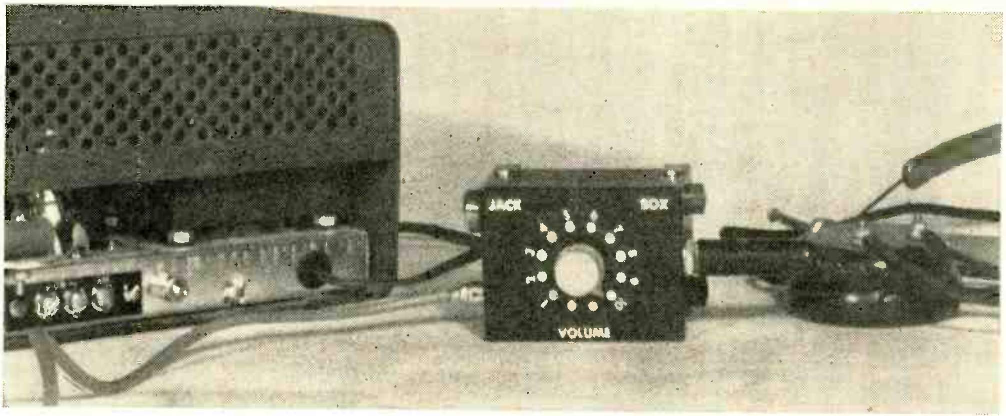
The ECO (Fig. 1) gets its name from the fact that the coupling between the frequency-determining portion of the circuit (*C1*, *C2*, and *L1*) and the load is via the electron stream between the cathode and plate inside the tube—the screen grid shields the plate from the control grid (and cathode) of the tube. As a result, variations in load have little effect on the oscillator frequency. Also, the proper ratio of d.c. plate-to-screen voltage minimizes frequency changes caused by variations in power supply voltages.

The Clapp Oscillator. Over the years, many other VFO circuits were devised and tested. Most of them worked well enough, but the ECO was at least as good as any, until the series-tuned oscillator developed by J. K. Clapp was introduced in *The Proceedings of the I. R. E.*, March, 1948.

One cause of instability in a self-controlled oscillator is variation in the oscillator tube's interelectrode capacitances as the tube heats up, particularly the grid-to-cathode capacitance. Any change in this capacitance changes the oscillator frequency, since it is effectively a part of the tuned frequency-control circuit.

In the Clapp circuit (Fig. 2), the control grid and cathode of the tube are connected across (in parallel with) large values of capacitance (*C1* and *C2*) in the tuned circuit. The effect of tube input capacity variation is therefore very small because it is a small fraction of the total capacity across the coil. Then, by having a variable capacitor (*C3*) in series with the coil (*L1*) to tune the oscillator, a comparatively large inductance can be used, in spite of the large values of

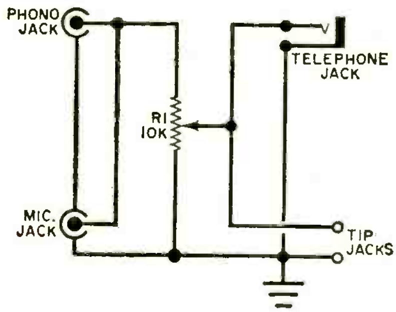
(*Continued on page* 97)



Jacks In Box

Patching different connectors together is no problem with this unit on hand. Headphones are connected to tuner output—and a volume control provided—in the photo above.

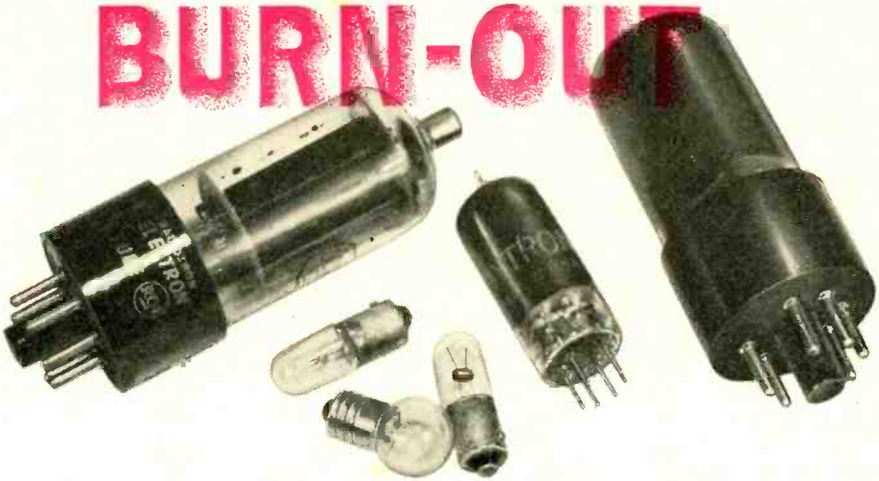
HERE'S A WAY to get rid of those problems that crop up every time you attempt to patch together two cords that terminate with different types of connectors—simply build a "Jacks In the Box" incorporating all types of connectors and a volume control for good measure! As shown in the photo, the author mounted an RCA phono jack, tip jacks, a standard phone jack, and a coax-type mike connector in a small Minibox along with a miniature 10,000-ohm volume control. As the schematic indicates, all four connectors are in parallel, so any combination of jacks can be used. The volume control is not strictly necessary, and it may be desirable to delete it for some applications. This handy gadget can be built in an evening for a few dollars. *—James A. Fred*



New Life for Electrolytics

EVER RUN ACROSS an electrolytic which—while not open or shorted—has much less than its rated capacity and a high power factor? Many minor hum problems due to poor filtering can be traced to just such a defective unit. Loss of capacity is caused by the drying out of the electrolyte, which consists of borates, acids, and water. All that is required to restore it is a hypodermic needle and syringe, distilled water, and boric acid. Mix two ounces of boric acid to one quart of distilled (not tap) water. With tubular cardboard electrolytics, insert the needle through the side of the capacitor, being careful not to go too far and short it out—this is quite critical. Capacitors encased in metal cans are more difficult, but most have a gas port in the positive end where you can inject the solution. *—Jerrel T. Doster*

UNDERSTANDING BURN-OUT



Why do filaments blow? Here are the answers, with some preventive measures

By LUIS VICENS

VACUUM TUBE and pilot lamp filaments *seem* to have the unpleasant habit of burning open at unexpected times—in the middle of a favorite radio or TV program, for example. In fact, however, filament burn-out generally occurs when power is first applied. Why does this happen and how can it be prevented?

A filament is usually a length of flat or round high-resistance tungsten wire which may be coiled, suspended in "V" or "W" fashion, mounted as a short, straight wire, or, in the case of high filament-voltage tubes such as the 50C5, folded back and forth along its length many times. Support and connection points and sharp bends are weak spots in filament construction; breaks often occur at these points.

Other causes of burn-out are mechanical and electrical stresses. Mechanical stresses occur when the tube is subjected to vibration or shock *and* whenever power is applied or removed. Current surges, for example, may result in strong electromagnetic forces which pull a filament away from its terminals. In addition, a heated filament expands while a cold one contracts. This expansion-contraction cycle causes cracks to develop at weak spots.

Electrical Stresses. A filament has a much lower resistance when cold than when heated to operating temperature. The result is that a heavy surge of current takes place each time power is applied. As an example, consider a pilot lamp rated at 6.3 volts, 150 ma. When hot, its resistance (by Ohm's law) is: $R = E \div R = 6.3 \div .15 =$ 42 ohms. When cold, on the other hand, its resistance may measure a tenth (or less) of this value—typically about 4 ohms. In this case, the current surge would be: $I = E \div R = 6.3 \div 4 = 1.57$ amperes!

But this is only part of the story. When a filament is powered by a.c., the peak voltage is 1.41 times the r.m.s. value. If power is applied at the instant when line voltage is at its peak, the voltage is 1.414 x 6.3 = 8.9 volts. The surge current is then: $I = E \div R = 8.9 \div 4 = 2.2$ amperes, over *fourteen times* normal rated current.

Lamps suffer from yet another major electrical stress—the development of small-diameter hot spots due to uneven evaporation of the tungsten filament. Such spots run hotter and hotter and even more tungsten evaporates until the lamp filament breaks, often when power is first applied.

Minimizing Burn-Out. Mechanically, tubes and lamps should be mounted to eliminate vibration. Electrically, filaments can be operated at slightly less than rated voltage. Where equipment is used on a semi-continuous basis, filaments can be kept heated at all times to eliminate "turn-on" surges and repeated expansion and contraction. Finally, special resistor-thermal relays can be connected in series with tube filaments to reduce current surge by applying power gradually. Low-cost commercial versions (Surgistors) are available for use in radios, TV sets, and other pieces of equipment. —30—

A Carl and Jerry Adventure in Electronics

The Hot Hot

FOUR-THIRTY A.M. on a raw March morning found Carl and Jerry walking briskly along the dark campus of Parvoo University toward the electrical engineering building.

"There's gotta be some good reason why I'm staggering around in the dark at this unholy hour," Carl muttered, turning up his coat collar to ward off the cold, damp wind, "but you better spell it out again. I was pretty sleepy when you explained it to me last night."

"The local Tuncan Meter Company is making very compact, highly accurate running-time meters for a government agency—possibly NASA," Jerry said. "These meters record the running time of an electrical device to which they are connected down to a small fraction of a second and cost almost a thousand dollars each—and they're no bigger than biscuits. For the past two weeks someone has been stealing them at the rate of about one a day. The plant manager dropped in last night while you were on a Coke date with Jodi and said the police chief suggested we might help catch the thief. I went with him to the factory to look the setup over."

"What would anyone want with the things?"

"They could be easily converted into very accurate electric stop watches for timing just about anything. Anyway, I found out why they're having so much trouble keeping track of them. They've got a crash program going, and the meters are practically built by hand in one small section of a large factory. Thirty-three men assemble, paint, calibrate, test, and box them. The meters are simply handed from one operator to another. If a test shows that something is wrong with a meter, that meter is taken back to the station which has the equipment to fix it.

By
JOHN T. FRYE
W9EGV

Meter

"In other words, the meters are constantly moving back and forth and up and down the whole line. Watching all of them would be like trying to keep track of the disappearing peas in a dozen shell games all going at the same time. The only thing the management has found out is that the meters disappear between four and five in the afternoon, just before quitting time, when things are the most hectic."

"Why not search the men on their way out?"

"That's a ticklish business. Honest workers would resent the implication. Besides, with only a little warning, the guilty one could easily get rid of something as small as one of those meters. Even if he didn't, he couldn't technically be charged with stealing the instrument until he took it out of the plant. The company needs a way of knowing that the thief has the meter with him when he passes through the gate. Then they can arrest him and try to recover the rest of the loot. The manager thought maybe we could rig up an electronic metal detector at the gate that would show when the thief went through with a meter, but the trouble is that a gadget sensitive enough to react to the small amount of metal in the meter would also react to lunch buckets, keys, or even pocket change."

"So what did you suggest?"

"I came up with the idea of tagging the meters with a slightly radioactive substance and then secretly checking the men with a scintillation detector as they passed through the gate. We called Doctor Bowers, head of the department of nuclear engineering, and he got in touch with Professor Dailey, supervisor of the nuclear reactor in the EE building. They agreed to go along with it, and Professor Dailey said we should meet him here at five this morning to start the ball rolling."

"Why so early?" Carl asked, but before Jerry could answer they saw Professor Dailey and two young men waiting for them at the door.

"Mr. Johnson and Mr. Selden here are graduate students," the professor said, as he led the way down a flight of steps to where the reactor was housed in the old high-voltage lab. "Two people, one licensed by the AEC, must be present when the reactor is activated."

JERRY estimated that the windowless room they entered would measure about 30 by 35 feet with at least a 20-foot ceiling. Rising waist-high from the floor was a thick-walled circular concrete basin some eight feet in diameter filled with clear, glass-blue water. At one side a cluster of large-diameter metal tubes emerged vertically from the water. Moving closer, the boys saw that the bottom of the tank was several feet below the floor level.

"This is called a 'swimming pool' reactor," the supervisor explained. "You can see the reactor core, about the size of an egg crate, there at the bottom of this seventeen-foot-deep tank with the control rods inside their guide tubes going down into it. Six thousand four hundred gallons of crystal-clear pure water provide effective shielding against radiation released by the core, yet leave the core clearly visible.

"The core itself consists of sixteen fuel assemblies, each containing uranium two thirty-five in the form of long, thin plates. Outside the core are the isotope tubes in which materials to be irradiated are placed. Surrounding the entire assembly are twenty pieces of high-purity graphite that reflect neutrons back into the core to prevent their escape from the system."

"Is it working now?" Jerry asked.

"No. Three of those tubes going down to the core contain stainless steel rods which can be raised or lowered by electric motors. Two of the rods also contain boron, which is an even better absorber of neutrons than stainless steel. When the rods are shoved all the way into the core, as they are now, they absorb

(*Continued on page* 90)

Transistor Topics

By **LOU GARNER,** Semiconductor Editor

MANY EXPERIMENTERS think of photocell applications only in terms of burglar alarms, light meters, and power supplies (solar batteries). In actual fact, however, these versatile semiconductor devices can be used in a wide variety of projects, including even such exotic applications as the remote control of models. As an example, last year one prominent manufacturer (International Rectifier Corporation, El Segundo, Calif.) introduced a light-controlled model car kit (see photo). Light-operated remote-control circuits can be applied equally well to model trains and boats, to home appliances, and even to shop and hobby equipment.

As a general rule, most light-controlled circuits are similar. A photocell senses a change in light intensity and delivers a corresponding electrical signal. This signal, then, is amplified and used to actuate an electrical or electromechanical output device, such as a relay, motor or meter. If the output device is a relay, it, in turn, can serve as a simple switch to operate other equipment, including lamps, motors, electromagnets, solenoids, counters, or alarm buzzers and bells.

Two basic photocell relay circuits are illustrated in Figs. 1 and 2. Either of these circuits can be used for general control applications, depending on the degree of sensitivity needed, and either can be modified easily for special purposes. Each requires relatively few electrical components.

In Fig. 1, a self-generating (voltaic) photocell, *PC1*, is direct-coupled to a *pnp* transistor amplifier, *Q1*. The common-emitter configuration is used, with the coil of *K1* serving as *Q1*'s collector load, and operating power supplied by battery *B1*. In operation, light striking the photocell generates a small signal current. Transistor *Q1* amplifies this small signal current and the resulting larger collector current closes the relay. The relay's contacts, in turn, serve to switch power to the controlled device, such as a small motor, *M1*.

A much more sensitive control circuit is shown in Fig. 2. Here, two transistors (*Q1* and *Q2*) are connected in cascade as a two-stage direct-coupled amplifier. Transistor *Q1* is used as an emitter-follower and *Q2* as a familiar common-emitter stage, with *R1* serving as *Q1*'s emitter load. Except for the added stage, the circuit's basic operation is similar to that of the one in Fig. 1. Again, a small signal current is supplied by the photocell when light strikes it; this signal is amplified by the two-stage amplifier and the resulting collector current of *Q2* closes the relay.

In practical circuits, *PC1* can be any of a variety of small selenium or silicon photocells . . . typically, International Rectifier Types B3M (selenium) or S1M (silicon). Virtually any general-purpose small signal *pnp* transistors can be used for *Q1* and *Q2*, including low-cost experimenter types such as the CK722 and 2N107. Resistor *R1* (Fig. 2) is a half-watt unit. The relay should have a high-resistance (3000 to 5000 ohms) coil and, for best results, should be a sensitive type similar to those used in radio control work. The battery can be a 6-, 9- or 12-volt unit, depending on the type of relay chosen.

Either circuit's over-all sensitivity—the amount of light required for operation—depends on a number of factors, including photocell efficiency, transistor gain (*beta*),

An unusual example of a photocell application is this light-controlled model car kit placed on the market by International Rectifier Corporation.

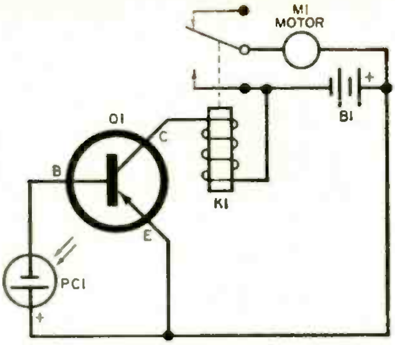
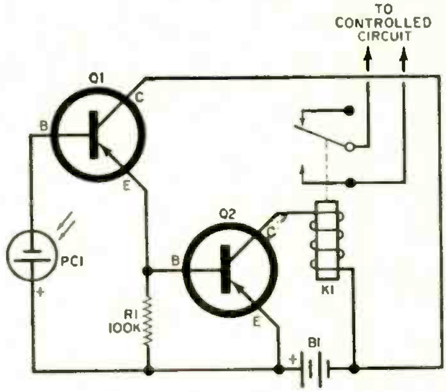


Fig. 1. Basic single-transistor photocell circuit can be used for general control applications or easily modified.

Fig. 2. This two-transistor photocell circuit is more sensitive than that of Fig. 1 but operation is similar except for the added stage.



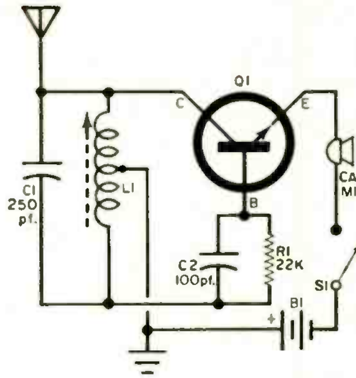


Fig. 3. Wireless microphone circuit submitted by reader Richard Sady can be assembled in one evening. Other npn transistors can be substituted for Q1 provided that resistor R1's value is changed.

and the electromechanical relay's sensitivity. For *maximum* sensitivity, choose a high-efficiency silicon photocell, high-gain (but low-leakage) transistors, and a sensitive-type relay. If desired, a large lens can be used in front of the photocell to gather light and focus it on the cell's sensitive surface.

The circuits can be assembled on a conventional metal chassis, on a plastic or Bakelite sheet, on an etched-circuit board, or even breadboarded on perforated Masonite, as preferred, since neither layout nor lead dress is critical. Care must be taken to observe d.c. polarities, or course, and to avoid accidental heat damage when soldering components in place.

A number of modifications can be made to meet special needs. For example, transparent optical filters can be used in front of the photocells to restrict circuit sensitivity to specific light colors. If desired, *npn* transistors can be substituted for the *pnp* types, provided both battery *and* photocell polarities are reversed. Other types of relays may be substituted for the simple s.p.d.t. type shown, including d.p.d.t. units, latching types, and stepping relays. Finally, a low-current d.c. motor may be used instead of a relay in the second circuit (Fig. 2).

The completed circuits are adaptable to a wide variety of applications. If the relay's *normally-closed* contacts are employed for switching purposes, for example, the basic circuits will serve in burglar alarms, doorway annunciators, automatic door openers, counters, industrial production and safety controls, and automatic light switches. In these applications, a drop in light intensity (or breaking a light beam) initiates operation. On the other hand, if the relay's *normally-open* contacts are employed, the circuits may be used in "commercial killers" (shorting a radio or TV loudspeaker's lead when light is focused on the photocell), darkroom safety alarms, controls for model cars, trains and boats, slave photoflash units, garage door openers, and so on. In these latter applications, an increase in light intensity initiates operation.

Readers' Circuits. In response to continued reader interest, we are once again featuring a pair of limited-range AM "broadcaster" circuits: a wireless microphone and a phono oscillator. Both circuits employ a single *npn* transistor in the common-emitter configuration and both are relatively simple. Either can be assembled in a single evening by the average hobbyist.

The wireless microphone circuit in Fig. 3 was submitted by Richard Sady (783 Newbury St., Springfield, Mass.). He writes that his model had a range of about 30 feet when used with a short whip antenna.

The circuit's operating frequency is

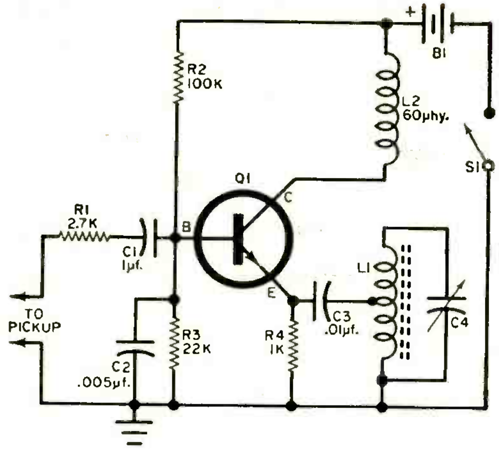


Fig. 4. Eugene Richardson's phono oscillator circuit is designed for use with a high-output crystal cartridge, has an effective range of 6 to 20 feet.

determined by tuned circuit *L1-C1*, while base bias is furnished through *L1* and *R1*, the latter bypassed by *C2*. The audio signal is injected in *Q1*'s emitter circuit by means of a carbon microphone. In operation, the feedback necessary to start and maintain oscillation is provided by the part of *L1* below the tap, which drives *Q1*'s base in the correct phase. Power is furnished by a single battery, *B1*, controlled by push-to-talk switch *S1*.

Standard components are used. Coil *L1* is a tapped broadcast-band Vari-loopstick, while *C1* and *C2* are small ceramic or mica capacitors. Resistor *R1* is a half-watt unit. A type 2N170 is used for *Q1*, but other *npn* transistors should give acceptable performance if *R1*'s value is changed. A standard carbon microphone cartridge is employed. Switch *S1* is a push-button s.p.s.t. switch, while the power supply is a small 9-volt transistor battery (typically, a Burgess 2N6).

Eugene Richardson (Alexandria, Va.) submitted the phono oscillator circuit in Fig. 4. (Eugene has contributed to this column on several previous occasions.) He indicates that this circuit is one he adapted from several suggested by GE a few years ago. The unit is designed for use with a high-output crystal phono cartridge and has an effective range of from 6 to 20 feet, depending on receiver sensitivity.

Transistor *Q1* is used in a "tickler feedback" arrangement, with *L2* serving as the feedback coil and operating frequency determined by tuned circuit *L1-C4*. Transistor *Q1*'s base bias is established by voltage divider *R2-R3* in conjunction with emitter resistor *R4*. Capacitor *C2* serves as an r.f. bypass and *C3* as a coupling capacitor to *L1*. The audio signal from the phono cartridge is coupled to *Q1*'s base through load resistor *R1* and d.c. blocking capacitor *C1*. Power is supplied by *B1*, controlled by *S1*.

As in Fig. 3, readily available components are used here. Coil assembly *L1/L2* is a Stanwyck #1129. Capacitor *C4* is a 360-pf. padder, while *C2* and *C3* are small disc ceramics or micas. Capacitor *C1* is a paper tubular (100- or 200-volt) unit. The resistors are all half-watt units. Transistor *Q1* is a type 2N170, and the power switch, *S1*, may be any standard s.p.s.t. type . . . toggle, slide, or rotary. The 6-volt battery *(B1)* is made up of four penlight cells connected in series (a single Burgess *Z4* may be used if preferred).

Both broadcaster circuits can be assembled either on small boards or metal chassis, for neither layout nor wiring is critical. Good wiring practice should be observed, of course. Many builders will prefer to assemble the wireless microphone in a hand-sized case, the phono oscillator on a small board suitable for mounting in a record player's base. The phono oscillator antenna connection is not shown since, in many cases, a separate antenna lead will not be necessary. If an antenna is required, however, it may be connected either to *Q1*'s collector or to the "hot" side of *L1*.

In operation, the broadcasters' frequency should be adjusted for pickup at a "dead spot" on a standard AM receiver (where no local stations are received). The wireless microphone's frequency is adjusted by means of *L1*'s slug, while the phono oscillator's frequency is set by adjusting *C4*.

Transitips. Semiconductor devices are quite susceptible to heat damage, whether applied externally or generated internally. As a result, care must be taken to avoid excessively high temperatures in storage as well as during installation and operation. Thus, transistors, diodes and similar devices —or equipment containing these units—should not be kept near furnaces, radiators, hot air registers, or similar high heat sources.

Heat sinks are frequently used to conduct generated heat to the air during operation. *Temporary* heat sinks conduct heat away from a device's leads during installation and thus serve to protect against externally applied heat.

A heavy alligator clip or a pair of long-nose pliers make excellent temporary heat sinks. The basic method for using them is shown on page 95. The heat sink is attached to the lead being soldered at a point between the body of the semiconductor de-

(*Continued on page* 94)

It's night. Suddenly a tire blows. You pull over to the side, but another car is coming up fast from behind . . .

Photo courtesy National Safety Council

By LOUIS F. CORTINA

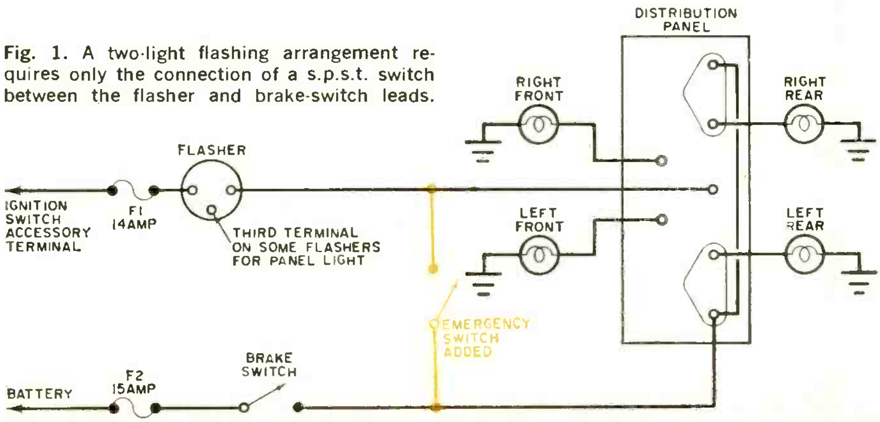
For Greater Safety–Flash Those Lights!

IF YOU'VE ever had to stop your car on or near the road while driving at night, you know how nerve-wracking this experience can be. Most of us have thought at one time or another of buying flares for use in such an emergency, but how many drivers actually carry them? The news stories concerning rear-end collisions with stalled vehicles point up the danger involved in not having some positive means available to alert other drivers.

Of course, you can pump your brake pedal to flash your rear lights, but this becomes tiresome very quickly. However, there is a practically tireless device on almost all cars which can be used to perform the same job—the flasher which operates your turn-signal lights. Some stalled drivers have the presence of mind to use this device in its normal manner, that is, to operate the turn signals. The danger here is that the driver in back may not realize until too late that the car is not moving, but standing still.

Two-Light Flasher. The additional wiring needed to make the flasher operate *both* rear lights is quite simple. The

Fig. 1. A two-light flashing arrangement requires only the connection of a s.p.s.t. switch between the flasher and brake-switch leads.



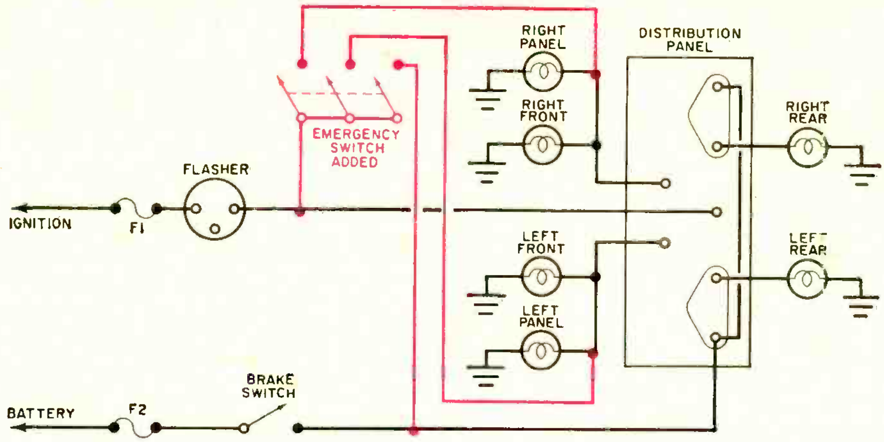


Fig. 2. Connected as indicated, a 3-p.s.t. switch provides four-light front and back flashing.

usual turn-signal switch has six leads; one from the flasher, one from the brake switch, and four leads to the various exterior lights. When the turn signal switch is in the center—or neutral—position, there is continuity between the brake-switch lead and the two leads which go to the rear lights of the car. If a path is provided from the flasher lead to the brake-switch lead, the rear lights will receive power through the flasher and will blink on and off in the same manner as the turn-signal lights, making an attention-getting device.

Figure 1, on page 75, shows a typical wiring layout and the necessary modification. The switch used is a s.p.s.t. type, and may be a toggle, rotary, or push-pull device rated to carry 3-5 amperes. Since most cars normally use two lights for signaling, one in the front and one in the back, the flasher will be operating under its normal load when flashing the two back lights.

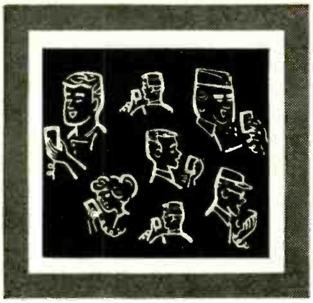
One exception is some General Motors cars which normally flash two lights on either side in the back, and one on either side in the front. If the flasher is connected to the four back lights, it will be operating with an overload and will run fast. To overcome this deficiency, one of the heavy-duty, variable-load flashers, designed for truck service or for vehicles towing a trailer, can be substituted for the original flasher. These variable-load units, which are manufactured by Ideal and Tung-Sol, will operate from one to eight lights of 21 or 32 candle power while maintaining a constant flashing rate. Replace a 6-volt flasher having three terminals with a Type 535 or 2535, a 12-volt unit having two terminals with a Type 536 or 2536, and a 12-volt unit having three terminals with a Type 550 or 2550.

Most cars made since 1949, as well as some earlier models, have a flasher socket under the instrument panel on the driver's side. It is only necessary to remove the original flasher and plug in the heavy-duty unit. Chrysler products from 1949 to 1954 have the flasher mounted on the engine side of the firewall. For those cars which do not use a flasher socket, remove the leads from the original unit and wire them to the corresponding terminals of the replacement unit.

Four-Light Flasher. While the simple hookup illustrated in Fig. 1 can be used in most states, California requires that any warning-light setup include "four or more approved turn-signal lamps . . . at least two of which must be toward the front and at least two toward the rear of the vehicle." Your local motor vehicle department can tell you the rules that apply in your area.

The added wiring needed to connect the flasher to all four light leads is not very involved. A three-pole, single-throw switch, either rotary or toggle, will do the job. An advantage of this method is that the panel indicator lights, which are usually paralleled with the corresponding front light on late-model cars, will also be energized. This keeps you from

(*Continued on page* 96)



On the Citizens Band

with MATT P. SPINELLO, KHC2060, CB Editor

PLANS are already under way for the Corn Belt Citizens Banders, Inc., fourth annual banquet to be held this coming November. "Early-bird" planning is probably one of the big reasons for the success of this annual event, *plus* the well-coordinated efforts of six different planning committees who, in turn, enlist the help of the rest of the CBCB membership.

For the record (and for those who have asked for hints on planning large "indoor" fests), the CBCB organizes its annual hoopla under the direction of two dinner cochairman, prize committee (5 members), tickets and registration committee (4), display (3), entertainment (4) and publicity (2) committees.

Last year's banquet was held on November 23 near Bloomington, Ill., home of the CBCB. Publicity chairman Jim Brook, KHA4158, informed us long before the "zero" date that 525 tickets had been sold (the limit) forcing them to refuse additional requests. Publicity for the event drew CB'ers from 75 different communities representing the states of Illinois, Kentucky, Texas, Wisconsin, Indiana, South Carolina and our northern neighbors, in this case from Traffordsville, Ontario, Canada.

Your CB editor was booked to speak before this assembly of CB enthusiasts, and we spoke, although we were not present at the event. In clarification of the last statement, circumstances beyond our control found us traveling several hundred miles (almost in the opposite direction) from the event at the time it took place. However, a recording session with audio engineer Bill Nicholls, KHD4706, placed our apologies and our speech on a reel of audio tape the day before the banquet. Thus, while we physically were being propelled at 20,000 feet and 500 miles an hour, our voice delivered a message to several hundred CB'ers, "technically reproduced!"

To produce a successful banquet of your own, you might follow a few well-chosen tips from the CBCB'ers. They (1) plan early, (2) delegate responsibilities, and (3) work hard at it. "A lot of work but well worth the effort" were the feelings left with CBCB club members after the 1963 event.

Publicity chairman Jim Brook gained a new title for his efforts at this gathering. With six hours sleep in a 48-hour period which caught Jim up in the hurry-scurry of last-minute details to be ironed out, he decided to lose his voice—most of it at least. At any rate, club officers dubbed him with

These two photos were taken at the very successful third annual banquet of the Corn Belt Citizens Banders, Inc., Bloomington, Ill. The group above is listening to a prerecorded talk made by your CB Editor for the occasion. At the right is a display of identification badges, decals, cards, etc., prepared by the well-known K9TVA Enterprises.

Members of the Nineteeners Citizens Radio Service of Akron, Ohio, assisted in the running of the recent 26th All-American Soap Box Derby races. Two of the Nineteeners who took part were Jim Harko (left) and John Mickel (below). In all, four CB base stations and 16 walkie-talkies were utilized.

the moniker "Bullfrog Brook!" That's gratitude for you, Bullfrog!

Walkie-Talk. Twenty members of the Nineteeners Citizens Radio Service of Akron, Ohio, manned the official communications network for the 26th All-American Soap Box Derby. Sponsored by Chevrolet, newspapers, radio, TV and nonprofit organizations, the event required the use of four CB base stations and 16 walkie-talkies. Derby Week kept the Nineteeners busy relaying Soap Box Derby Champions' names and home towns as they arrived from all over the world. The relays were received by a booth announcer in front of the Sheraton Mayflower Hotel where the champs were officially welcomed by the city.

On the Friday preceding the main event, Akron residents watched as some 1500 Soap Box Derby marchers paraded down Main Street, also known as All-American Boulevard. Parade marshal George Brittain was able to keep an eye—rather an ear—on the entire parade movement through a walkie-equipped Nineteener member stationed at his side. Several other club members were perched atop two of Akron's largest department stores to coordinate the shower of confetti poured down upon the marchers, while several other Nineteeners positioned at strategic points aided in controlling the crowd of some 65,000 onlookers.

When Derby Day came, Burt Woodring, 19A8358, activities chairman for the Nineteeners, supervised network communications operations from a topside command post using base stations on channels 10 and 18. Traffic handled on these two network channels included coordination of a two-hour pre-race parade, assistance in ushering 80,000 spectators to their seats, distribution of programs for the big event and supplying transportation of "chow" for the other Derby workers. The Jam Handy Organization, which filmed the event for General Motors, also used the CB walkie-talkie net to keep informed of pertinent information regarding the Soap Box Derby.

All Nineteener club participants were experienced in handling the communications needed, having operated the radio net for the *Akron Beacon Journal*'s local Soap Box Derby race the past two years. Club president Harold Baringer, 19Q1972, stated that the Nineteeners expect to set up communications for several other local sporting events this year, including collegiate football, cross-country races, swimming competition, and Akron's Junior Olympics. Plans for this year's Soap Box Derby are already being made, and the operation is expected to expand to four networks, including a 465-mc. CB net.

Club Chatter. The latest CB addition to the state of Texas has ridden (on a hoss, I guess) its way into being with the title of "White Rock Two-Way Radio Club of Dallas." The group has already assisted officials by manning the state fair Citizens Band network. This club monitors channel 11 twenty-four hours a day; meetings and coffee breaks are on Friday evenings. Those interested in saddling up with the group should contact Bob Schumann, KEH1135, 9929 Bethany Drive, Dallas, Texas.

The Arkansas Citizens Band Radio Club has published a 92-page CB directory of members and area clubs throughout the state. The state-wide organization conceived the idea back in 1961, and the culmination of their efforts appears in this descriptively detailed directory of information. Arkansas groups mentioned in the directory include Blytheville CB Club, U. S. Coast Guard Flotilla No. 87, Central Arkansas CB Radio Club, Dixieland CB Club, Grand Prairie

(*Continued on page* 105)

Predicted Radio Receiving Conditions

How the short-wave bands will sound for the next few months

By **STANLEY LEINWOLL,** Radio Propagation Editor

EDITOR'S NOTE: Five years ago, most of the countries engaged in international broadcasting agreed to make major schedule changes four times a year. Schedule changes (frequencies and times) are necessitated by seasonal trends in radio wave propagation conditions.
For the past year, Stanley Leinwoll has been preparing month-to-month predictions of radio receiving conditions. To enhance the use of his material, the editors of POPULAR ELECTRONICS have decided to delete the monthly tabular listing and in its place publish a quarterly report. This report will conform with the practices established by the Geneva Radio Regulations and will appear in our March, May, September, and November issues.

MOST of the international broadcasting stations scattered throughout the world will make schedule changes on Sunday, March 1. These changes will be in effect during the months of March and April and will be revised on May 3. Frequency and broadcasting time schedules set up in May will continue throughout the summer season of May, June, July, and August. Changes will also be made on September 6 and November 1.

Utilizing the latest computer techniques to predict radio transmitting conditions, we have analyzed the international broadcasting bands and prepared the following summary for the spring of 1964.

11 Meters (25.60-26.10 mc). This international broadcasting band has been useless for the past few years. Since we are at the minimum of our sunspot cycle, very poor conditions will persist for another two or three years. No DX stations should be heard in this band.

13 Meters (21.45-21.75 mc). If you tuned to this band during the winter of 1963-64, you may have heard a few weak DX stations. These should have been audible only during the daylight hours. There may be some DX openings in the spring, but these will be confined to the reception of a few South American stations. For the most part, however, this band will be dead.

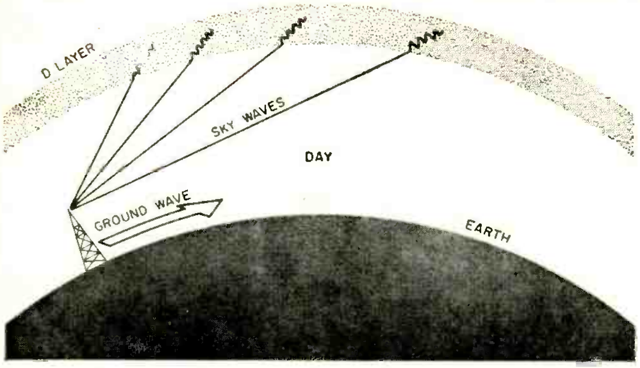
16 Meters (17.70-17.90 mc). There is considerably more international broadcasting activity in this band than in either the 11- or the 13-meter bands. In general, some DX can be expected during the daylight hours. Best results should be observed from stations transmitting in austral Asia, South America, Latin America, and Africa.

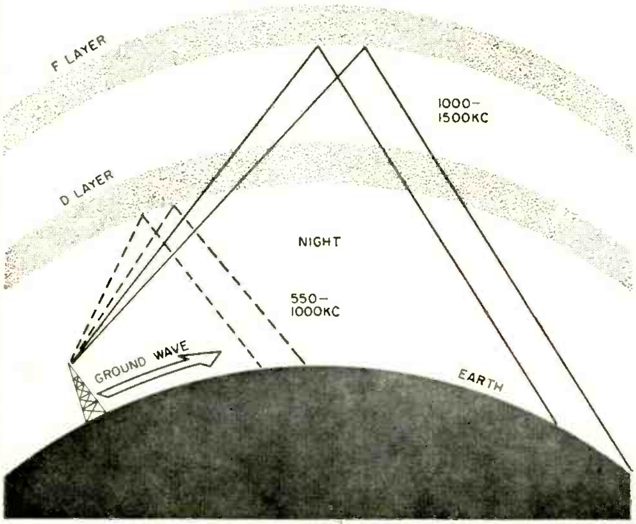
19 Meters (15.10-15.45 mc). This will be the best DX band during the daylight hours in March and April. Considerable DX should be heard from stations in the southern hemisphere and from transatlantic or transpacific DX stations from early morning to late afternoon.

25 Meters (11.70-11.97 mc). Expect to see less and less DX audible on this band during the spring. Signal strengths will be low and, during the daylight hours, the atmospheric noise will be high. Some DX may be heard from Latin America around sunset and in the early evening hours. Close-in stations (800-2000 miles) will be heard in the United States and Canada throughout the daylight hours.

31 Meters (9.50-9.77 mc). During local daylight hours, this band will be useful for short distances (500-2000 miles). At sunset and in the early evening hours reception will vary from very good to barely marginal. Expect to hear stations from the southern hemisphere and occasionally high-power broadcasters in Europe.

41 and 49 Meters (7.1-7.3 mc and 5.95-6.20 mc). In the hours of local darkness, these two bands will be very active. At sunset the best DX will be from the east—since the path of the radio signal is entirely in darkness. Around dawn, with darkness to the west, most DX heard on these bands will come from that direction. In the daylight hours, reception will be restricted to a range of 500-750 miles. All listeners can expect extremely severe interference levels due to the channel crowding on both bands. This is the same condition that persisted throughout the past winter.





HOW AND WHY OF BROADCAST-BAND DX

During the past winter, DX'ing for stations in the standard AM broadcast band was especially good. Listeners east of the Mississippi reported that numerous European stations could be heard shortly after sunset. On the West Coast, broadcast-band stations in Japan, the Philippines, and Australasia could be intercepted.

Broadcast-band DX is possible only during the periods when most—or all—of the path between the transmitter and receiver is in total darkness. During the daylight hours, the ionosphere absorbs all of the sky-wave signal radiated by AM broadcasting stations. Around sunset, the D layer changes character; instead of absorbing radio waves, it reflects signals below about 1000 kc. Signals on the high-frequency end of the AM broadcast band pass unhindered through the D layer (during the nighttime hours) and are reflected by that part of the ionosphere called the F layer.

The maximum distance of D layer reflected signals is about 1200 miles. Signals reflected by the F layer will occasionally cover 2500 miles in a single hop. DX from more distant stations involves multiple reflections between the ionosphere and the earth.

60 and 90 Meters (47-5.0 mc and 3.2-3.4 mc). Conditions on both of these bands during the nighttime hours have been the best observed in the past decade. With the coming of spring, there will be an increase in atmospheric noise levels and a slow deterioration of conditions. On quiet nights when noise levels are down, excellent DX should still be heard. Listen for stations to the east after sunset and stations to the west just before dawn.

Standard Broadcasts. Scores of listeners had an opportunity in December, January, and February to hear their first transatlantic regular AM broadcast-band DX. Some stations from Europe may still be heard during the first few weeks of March. Atmospheric noise levels will be increasing, and by April practically all European DX stations will no longer be audible. Listen occasionally for AM broadcasting stations from Latin America and the countries bordering the Caribbean along the South American coast.

Wrap Up. Summaries of radio receiving conditions will now appear in the March, May, September, and November issues of POPULAR ELECTRONICS. In addition to these summaries, a short discussion of general band conditions to be expected for that particular season will be included in each column. Our topics will range from sunspots, the ionosphere and ionospheric disturbances, to any other material thought to be of interest to the DX listener.

Your comments, questions and suggestions are always welcomed. Address them to the attention of Stanley Leinwoll, Radio Propagation Editor, POPULAR ELECTRONICS, 1 Park Ave., New York, N.Y. 10016. –30–

Monthly Short-Wave Report

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

MEET O. LUND JOHANSEN

IF YOU were to ask nearly any DX'er who he considered to be the best known person in short-wave listening, he most likely would answer: "O. Lund Johansen." Mr. Johansen's annual edition of the *World Radio TV Handbook* (his 1964 issue is the 18th) receives nearly as much use as the equipment in an average listening post. But while his name is synonymous with DX'ing, little is actually known in the U.S.A. about this respected Dane.

O. Lund Johansen

Olaf Johansen is 70 years of age and is a grandfather 16 times over. He has a long history of activity in the field of radio publishing which goes back almost to the birth of radio itself. As early as 1920 he published several technical handbooks on radio and a series of yearbooks on Danish broadcasting. In 1924 he published the first European radio journal, *Radiolyttern*. Later he was an editor with *Brelingske Tidende*, one of Scandinavia's largest newspapers.

The idea for *WRTH* (formerly *World Radio Handbook*) was born about two years before the end of World War II, as a way to promote world peace and understanding. Considering his past efforts, it is not surprising that Mr. Johansen chose broadcasting as the best means to achieve this end. If radio listeners were to come to understand people in other countries and their way of life, through radio broadcasts, he felt that they would have to know what stations were on the air and when and where to tune for them. The natural answer was a book containing schedules, frequencies, and program information about the world's radio stations.

It wasn't that easy, however. It took two years of writing letters, contacting stations, telling them about the idea, and then getting them interested enough to cooperate. The larger broadcasters were immediately enthusiastic; others took more time and effort to convince.

The *WRH* appeared in print initially in 1947 with a small edition, due to its experimental nature. Today, after 17 years of publication, cooperation from most stations is good, although it is still difficult to get information from some of the Latin American stations. Mr. Johansen writes some 15,000 letters each year to insure

Short-wave listener E. J. Payette, Monroe, Mich., is shown with his Hallicrafters SX-42 receiver and RME DB-22 preselector. He has a 75′ antenna.

An active Far Eastern DX'er, Hiroshi Kato of Kuse, Okayama, Japan, is also a radio amateur (JA4AKL). He uses a 6146 transmitter rated at 16 watts, and a 12-tube crystal-controlled double-conversion receiver, both homemade.

that the information in the book is as complete and up-to-date as possible.

News of stations appearing in *WRTH*, which is published yearly, is obtained from broadcast organizations, DX clubs, and listeners, as well as from the stations themselves. The primary responsibility for the accuracy of the information lies with the stations, of course. However, Mr. Johansen has much praise for short-wave listeners because of the help they have given him. (If you are interested in becoming a monitor for *WRTH*, write to Mr. Johansen at Lindorffsalle 1, Hellerup, Denmark).

In the beginning, Mr. Johansen *was WTH*. Now a staff of eight people is kept busy preparing the material for *WRTH* and other World Radio publications. It takes them an entire year to prepare one edition of *WRTH*.

Where does *WRTH* get the most use? Mr.

(*Continued on page* 107)

ENGLISH-LANGUAGE NEWSCASTS TO NORTH AMERICA

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

COUNTRY	STATION	FREQUENCY *(kc.)*	TIMES *(EST)*
Australia	Melbourne	17,840, 15,220	2030, 2130, 2230
		9580	0745
Bulgaria	Sofia	6070 (and/or 9700)	1900, 2000, 2300
Canada	Montreal	11,720, 9625, 5970	1800 (Caribbean)
East Congo	Leopoldville	11,755	1630, 2100, 2230
Czechoslovakia	Prague	9795, 9550, 7345, 6005*, 5930	2030, 2230
Denmark	Copenhagen	9520	2100, 2230
Finland	Helsinki	15,185	1530 (Mon., Fri.)
West Germany	Cologne	15,405, 11,795	1010
		9640, 6160	2035
		9735, 9575, 6145	0000
Hungary	Budapest	11,910, 9833, 7220	1900
		9833, 7220, 5960	2230
Italy	Rome	11,905, 9575	1930, 2205
Lebanon	Beirut	11,890	1630
Netherlands	Hilversum	17,810, 15,445	1030 (Tues., Fri.)
		11,950, 9590	1415 (Tues., Fri.)
		9715, 6085	1630 (exc. Sun.)
		6035, 5985	2030 (exc. Sun.)
Portugal	Lisbon	6185, 6025 (and/or 9740)	2105, 2305
Spain	Madrid	9360, 6130	2215, 2315, 0015
Sweden	Stockholm	17,840	0900
		9660	2045, 2215
Switzerland	Berne	9665, 9535, 6165	2035
		15,315	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

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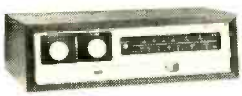

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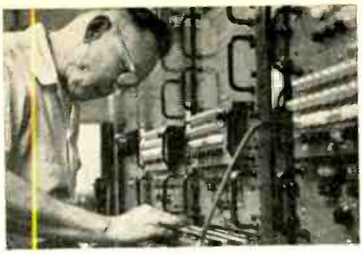

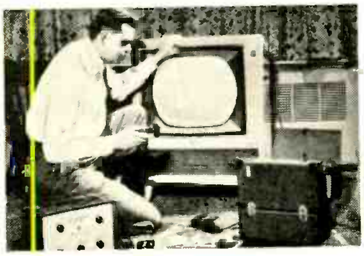

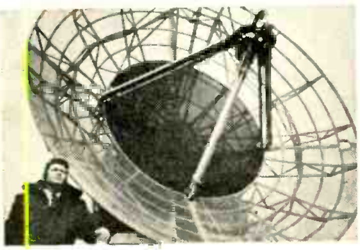

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VHF Listener

(*Continued from page* 56)

The case shown in the photographs was handmade in an effort to give the "Listener" a professional appearance. However, the Minibox specified in the Parts List is quite satisfactory, and saves much work.

The dial is a 2" aluminum disc cut from sheet material, but heavy artist's board or stiff sheet plastic is equally good. If you use metal, sand the surface with very fine sandpaper and put the calibration marks on with India ink. A light priming coat of clear krylon spray will make the ink flow on perfectly. After the ink has dried, spray several coats on the dial to protect the markings.

Testing and Calibration. Temporarily connect a 0.1-μf. capacitor between point 1 and 2 on the schematic. This will bypass the squelch circuit while the detector is being tested. Connect a 10,000-ohm resistor in series with a 100,000-ohm potentiometer and temporarily substitute this combination for bias resistor *R5*. Attach the fixed resistor end of the combination to the base of *Q2*. Turn *C6* to minimum capacitance and connect the antenna. With the audio volume turned up full, vary the 100,000-ohm test bias potentiometer. At some point a loud hiss will indicate correct detector operation.

With the temporary bias potentiometer still in place, calibrate the dial. If a grid dip meter is used, keep the signal weak by keeping dipper and Listener well separated. With a generator, a short antenna plugged into the output may be needed. When the signal source is tuned to the detector frequency, the audio hiss will drop noticeably in volume. The frequency range tuned by the detector may be adjusted by squeezing or stretching *L4* slightly to change its inductance. You may also need to readjust the bias on *Q2* with the temporary bias potentiometer. For the Citizens Band version, set the frequency range covered by adjusting *L4* and *C6a* in alternate steps.

Tune near the center of the band, and adjust antenna capacitor *C1* for loudest volume (or lowest hiss level if your signal source is not modulated). It will not be necessary to change this setting when tuning other parts of the band.

Now measure the total resistance of the temporary resistor-potentiometer bias combination, and install a fixed resistor (*R5*) of the nearest standard value. The optimum value for *R5* depends slightly on the voltage of battery *B1*, and the detector may fail to operate near the high end of the band when the voltage of an aging battery begins to drop.

If this happens with a relatively fresh battery, lower the value of *R5* slightly. The current drain on both batteries is only about 5 ma., so they will give many hours of service. A manganese-alkaline battery such as the Burgess 2MN6 is ideal for *B1* since it holds an almost constant voltage until the end of its long life.

When the detector is working satisfactorily, remove the temporary capacitor between points 1 and 2. With squelch control *R11* fully counterclockwise, the detector hiss should be heard. When fully clockwise, the audio output should be silent. Check squelch operation over the entire tuning range. If it does not operate properly over the full range, a slight adjustment in the value of *R12* may be necessary.

For most sensitive receiver operation, the squelch control should be set as close as possible to the turn-on point. If the receiver is left on for extended periods of time, check the squelch setting periodically.

Thanks to the relatively broad tuned circuits of the Listener, tuning to a given channel is not critical. Also, the broad tuning and very low warm-up drift make the set stay "put" on a selected channel without constant retuning.

If you have built the unit for the aircraft band, here's a word of caution. Even though the r.f. stage cuts detector radiation to a relatively low value, very sensitive aircraft receivers may still pick it up and experience troublesome interference when they are very close. For this reason you should never operate the VHF Listener while in a commercial airliner, or closer than several hundred feet to a control tower or airport. If you are interested in listening at this close range, refer to "Airline Eavesdropper," POPULAR ELECTRONICS, April, 1963, for a suitable circuit. —30—

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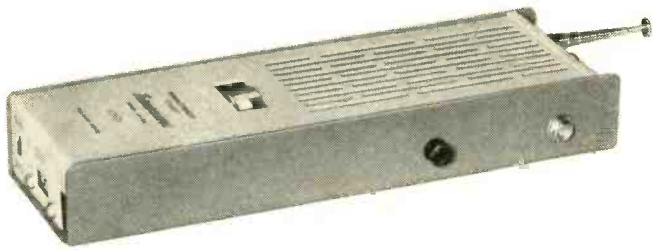

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GX-124R

CIRCLE NO. 12 ON READER SERVICE PAGE

The Hot Hot Meter

(*Continued from page* 71)

enough neutrons emitted by random fission to prevent any chain reaction. However, when the rods are pulled far enough out of the core, a mixture of plutonium and beryllium contained in that other long guide tube furnishes sufficient neutrons to start a chain reaction, and the reactor becomes critical. Once started, this chain reaction is self-sustaining, and its energy level is controlled by how far the rods are pulled from the core.

"While the reactor is rated at ten kw.," Professor Dailey continued, "we are only licensed for one kw., so that's the maximum amount of nuclear energy we generate. Four neutron detectors near the core constantly monitor the rate at which the uranium is fissioning. This information is displayed on meters and also operates recording devices in that cabinet next to the control console to keep a detailed record of the core's activity."

"Is the thing pretty safe?" Carl asked a little nervously from where he stood near the console.

"Three scintillation detectors—over the pool, under the console, and there by the water processing system—monitor radiation continuously, and the radiation level in this room is always about equal to that from a luminous-dial wrist watch. Many cities at high elevations receive far more radiation from space. All air entering and leaving this room is filtered. Water in the pool is continually filtered by a process that removes all dirt particles which might eventually interfere with a clear view of the core, become irradiated, or corrode the aluminum parts. A de-mineralizer also removes salts. You could fall into the pool without receiving a lethal dose of radiation. Actually, you're safer standing here than you are crossing the street."

"Then how come this big red button on the console says SCRAM?"

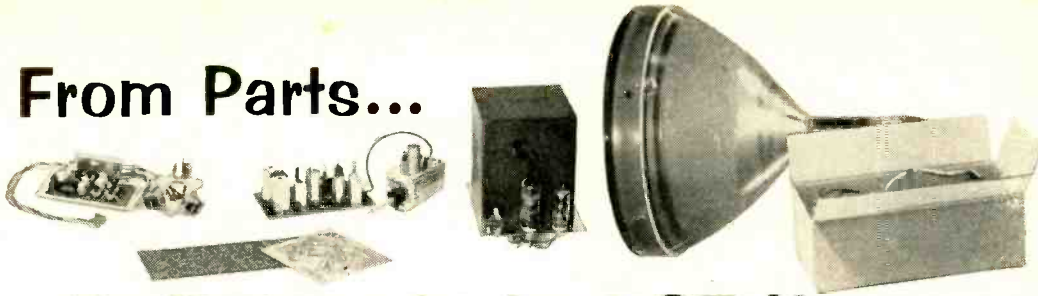
"It's not what you think," Professor Dailey said, grinning. "It doesn't mean 'Head for the hills, the dam's busted!' Automatic controls hold the radiation energy at any desired, preset level; but if the operator, for any reason, wants to stop the reactor quickly, he can do so by pushing that button. It drops the two boron rods into the core and stops the chain reaction immediately."

"Well, we'd better get on with our little project," the professor declared. "I decided we should irradiate about a tenth of a gram of indium powder and mix it with paint used on the meter cases. We often use indium foil for measuring neutron flux. It has a half-life of sixty-four minutes, which is to say, its induced radioactivity is halved every sixty-four minutes. I estimate that with the reactor running at one kw. the indium powder will be saturated in eight to ten hours. It should remain sufficiently radioactive for your purposes for at least five hours.

"So we'll start the reactor now. Then, at about three p.m. we'll mix the radioactive indium powder into a small amount of the quick-drying lacquer used on the meter cases. You'll rush this to the factory. The meter painter has been stalling so as to have a good batch of painted meters in his booth. He'll brush some of the blending radioactive paint on the back of each meter case and start the specially painted meters down the line before four o'clock. If one is stolen, it should be from this batch; and when it's carried through the gate shortly after five, it will still be sufficiently radioactive to register strongly on a scintillator."

While speaking, the professor picked up a powder-filled medicine capsule and placed it in a watertight aluminum container. As the rest watched, he used a long handling tool to lower the container to the reactor and place it in one of the

From Parts...



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CL-166R

CIRCLE NO. 12 ON READER SERVICE PAGE

cylindrical tubes surrounding the core. Then he sat down at the console and began to throw switches and turn knobs while his assistants called out meter readings. Motors inched the control rods from the core until suddenly jumping meter pointers indicated that the reactor was critical. Carefully, the energy level was raised to the one-kw. maximum.

"Now," Professor Dailey said, "I'm going to get breakfast, and I presume you two want to do the same. Johnson and Selden will keep things cooking here until we come back at three."

Carl continued to stare down into the pool for a few seconds before turning toward the door. "You can't tell that a thing's going on down there," he said. "It seems like there ought to be a loud humming sound, metal glowing red hot, lights flashing, or something. This thing's spooky!"

THE BOYS were back at the reactor promptly at three with a quarter-pint of paint from the factory. The reactor was shut down, and Professor Dailey removed the aluminum container from the isotope cylinder, took out the powder-filled capsule, and dropped it into the paint.

"The capsule will dissolve quickly and release the radioactive powder beneath the surface of the paint," he explained. "That way there's no danger of radioactive particles getting into the air and possibly being inhaled. Now you better take off; but let us know what happens."

Carl and Jerry drove along the speedy highway bypass to the Tuncan Meter plant and delivered the paint to the plant manager. They waited around until nearly five and then took up positions near the exit gate, each with his own theatrical "props." Jerry, wearing dark sunglasses, stood to the right of the gate cradling what was ostensibly a bag of groceries in his arms—at least, a stalk of celery was sticking out of the top. In the bottom, though, where he could easily see its meter, was a sensitive radiation detector borrowed from the nuclear engineering department. Carl idly dribbled a basketball about the parking lot close by.

While the men filed past, Jerry kept his eyes, hidden behind the dark lenses, glued to the meter of the scintillator, but almost all the workers passed through and the line began to thin out without the meter giving any indication, and he began to fear that something had gone wrong. Then a sallow-complexioned man wearing a heavy Mackinaw and a pair of ill-fitting large white cotton gloves came through carrying a dinner bucket in his left hand, and the meter pointer swung over sharply.

Thinking that the meter was probably in the dinner bucket, Jerry casually lowered his meter to waist level and walked to the left side of the man. The meter reading was much lower. When he moved back to the right side, the original reading was restored; and when the man raised his hand to settle his hat on his head, the meter pointer dipped sharply.

"He must have the meter in the palm of his hand inside that oversize glove!" Jerry thought to himself. Carl, who had been dribbling the basketball along in front of the man to distract his attention from Jerry's maneuvering, was watching out of the corner of his eye. When he saw Jerry staring pointedly at the big glove on the man's right hand, he began to dribble, feint, and wheel madly. Suddenly he lurched backwards and crashed into the sallow-complexioned man, knocking him to the asphalt-covered parking lot.

"Oh, I'm sorry!" Carl exclaimed, reaching down to help the man up. The latter instinctively reached for Carl's outstretched hand, but Carl managed to clutch only the tips of the glove fingers and give them a jerk. The glove slid off the man's hand, and a dove-colored running-time meter fell from the empty cuff and went bouncing across the lot. As if by magic, but actually through careful planning, a plain-clothes detective appeared out of the crowd and placed the man under arrest.

"Well," Carl remarked as they watched the detective hustling his prisoner into a waiting squad car, "the man knew that meter he stole was hot, but he didn't know how hot! You know I kind of go for this nuclear engineering jazz. It seems to fit in mighty well with electronics. We can't work around the reactor until we're at least seniors, but let's go see if Professor Dailey won't suggest some books we can be reading to sort of bone up on it!" —30—

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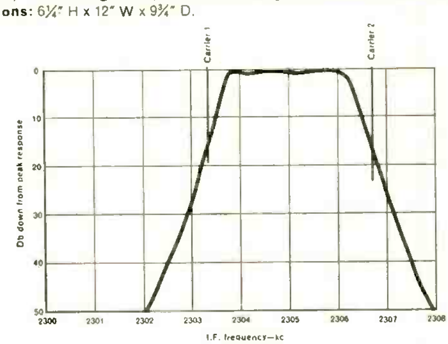
It's easy to see why the new Heathkit SSB Single Band Transceivers are heard so often on the air today—in both fixed and mobile operation! They are compact (less than ½ cubic foot), lightweight (only 12 lbs.), loaded with versatile features and pack more input power-per-ounce than any other comparable unit (200 watts PEP). And best of all you save two thirds the cost of three band units by buying only the band you need. Assembly is a marvel of simplicity (only 15 hours) with over 90% of the components mounted on a heavy-duty circuit board. The rugged one-piece steel chassis is welded and braced to withstand plenty of abuse . . . dependable operation with maximum stability. Choose 80, 40, or 20 meter models, or all three, now and enjoy versatile, power-packed performance at lowest cost!

Check These Features!

• True Transceiver for one-band, one sideband operation • 200 watts PEP RF input • Crystal filter type SSB generation • Automatic level control • PTT and VOX circuits built-in • Low frequency VFO (1.5-1.7 mv) for greater stability • 2 kc dial calibration • 6" of band-spread • Vernier tuning • Provision for operation with Linear Amplifier • Fast, easy, circuit board assembly • Complete with one-piece steel cabinet and "gimbal" mounting bracket.

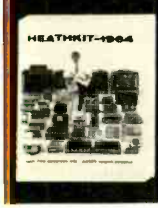
Kit HW-12, 80-meter (LSB)...15 lbs..........$119.95
Kit HW-22, 40-meter (LSB)...15 lbs..........$119.95
Kit HW-32, 20-meter (USB)...15 lbs..........$119.95
Kit HW-42 (all 3 models) 45 lbs...Save $39.85..$320.00
Kit HP-13, DC power supply...7 lbs...........$59.95
Kit HP-23, AC power supply...18 lbs..........$39.95
GH-12: Push-to-talk microphone...2 lbs........$6.95
Kit HR-10A: Plug-in 100 kc crystal calibrator. 1 lb. $8.95

SPECIFICATIONS—RF input: 200 watts PEP. **Sideband generation:** Crystal lattice bandpass filter method. **Stability:** 200 cps per hour after warm-up. **Carrier & unwanted sideband suppression:** 45 db. **Frequency coverage:** HW-12, 3.8-4.0 mc; HW-22, 7.2-7.3 mc; HW-32, 14.2-24.35 mc. **Receiver sensitivity:** 1 uv for 15 db S+N/N ratio. **Receiver selectivity:** 2.7 kc @ 6 db, 6.0 kc @ 50 db. **Output:** 50 ohm fixed (unbalanced). **Operation:** HW-12 & HW-22, LSB; HW-32, USB. **Audio output:** 1 watt @ 8 ohms. **Mike input:** Hi-Z. **Panel controls:** Frequency, final tune, function (OFF-PTT-VOX-TUNE), RF gain, AF gain, (pull for crystal calibrator), VOX gain, meter. Front panel screwdriver adjust for S-meter and VOX delay. **Rear panel controls:** Mike gain, tune level, final bias. **Tube complement:** Fourteen tube heterodyne circuit; (3) 6EA8's mic. amp., VOX relay amp., IF amp., RF amp., Rcvr. mixer; (5) 6AU6's, VFO, VOX amp., IF amp., Xmtr. mixer; (1) 6BE6, VFO isolator (HW-12), Het., Osc. and mixer (HW-22 & HW-32); (1) 12BY7, Driver; (1) 12AU7, Xtal osc. product det.; (1) 6EB8, Audio amp. and output; (2) 6GE5 RF output. **Power requirements:** 800 VDC @ 250 MA peak, 250 VDC @ 100 MA, —125 VDC @ 5 MA, 12 VAC or VDC @ 3.75 amperes. **Cabinet dimensions:** 6¼" H x 12" W x 9¾" D.



A "pre-designed" full lattice crystal filter provides selectivity and unwanted sideband suppression comparable to the most expensive transceivers. Note the narrow bandpass (2.7 kc at 6 db), steep skirts (6.0 kc at 50 db), and low passband ripple (less than 1 db).

HEATHKIT by Daystrom



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CIRCLE NO. 12 ON READER SERVICE PAGE

Transistor Topics

(*Continued from page* 74)

vice and the point where the soldering iron is applied. Once the soldering operation is completed, the temporary heat sink is removed.

A variety of heat sink assemblies designed for permanent installation are available commercially. Unfortunately, the hobbyist doesn't always have access to these devices and must seek substitutes. Several useful techniques are illustrated in Fig. 5.

The use of a fuse clip, metal cable clamp and coil spring as heat sinks for small transistors is shown in Figs. 5(a), 5(b) and 5(c), respectively. In each case, the heat sink is attached to a metal chassis to aid heat dissipation.

Use of a small "U" chassis and a drawn

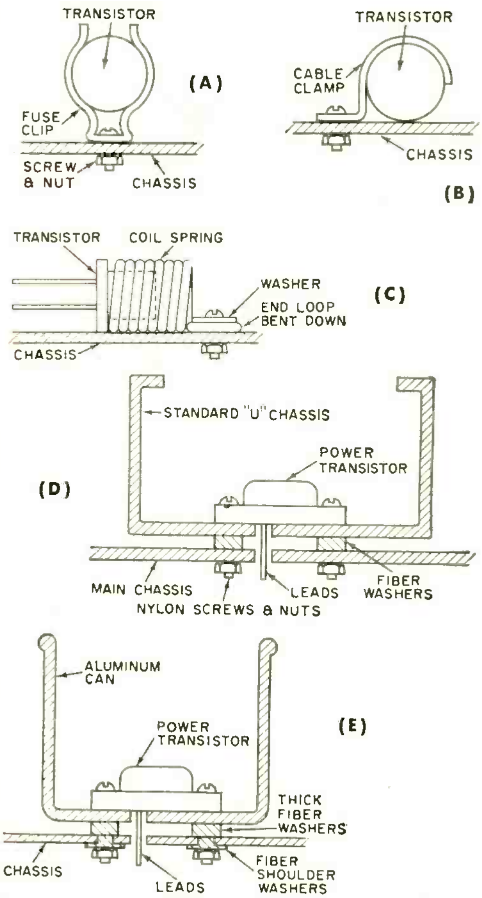
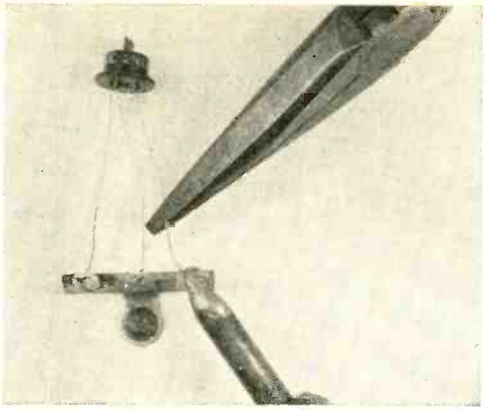


Fig. 5. You can make a heat sink using any of these methods: (A) fuse clip; (B) cable clamp; (C) coil spring; (D) small chassis; (E) aluminum can.



This is the proper way to use long-nose pliers to conduct heat away from the leads while soldering.

aluminum can as power transistor heat sinks is illustrated in Figs. 5(d) and 5(e). Small chassis suitable for use as heat sinks are available commercially, or may be bent from scraps of aluminum from the junk box. The kitchen is a good source of drawn aluminum cans for several types of foodstuffs are now packed in such containers.

In some cases, the heat sink must be electrically insulated from the equipment's main chassis. This can be accomplished by using Nylon screws and nuts and flat fiber washers, as in Fig. 5(d), or flat and shoulder washers, as in Fig. 5(e). In other cases, the semiconductor device itself is insulated with respect to the heat sink, generally by means of a flat mica washer and suitable insulating washers for the mounting screws. Heat-conductive silicone grease can be spread on the heat sink and device mating surfaces to improve heat transfer.

New Literature. A number of major manufacturers have published good-sized books covering semiconductor circuit design and applications. As a general rule, these are "best buys," for they contain an exceptional amount of practical information. Several recent offerings are listed below.

Switching Transistor Handbook—Published by Motorola Semiconductor Products, Inc. (5005 East McDowell Rd., Phoenix 8, Ariz.), this 365-page book covers switching transistor circuit design and characteristics. It sells for $2.50 through franchised Motorola distributors.

Silicon Controlled Rectifier Designer's Handbook—Selling for $2 per copy, this book covers the SCR and its application in considerable detail, with data on SCR operation and construction, design techniques, characteristics, test methods, and—of particular value to the hobbyist—a considerable number of practical circuits, with parts values given. It's published by the Semiconductor Division of Westinghouse Electric Corporation, (Youngwood, Pa).

Tunnel Diodes—Identified as Technical Manual TD-30, this $1.50 book is published by RCA's Semiconductor and Materials Division (Somerville, N.J.). It contains 160 pages of valuable technical information and circuit data.

As a famous film cartoon character is wont to say . . . "That's all, folks!" Back next month.

—Lou

For Greater Safety

(*Continued from page* 76)

inadvertently leaving the emergency switch on. Figure 2, page 76, shows the necessary changes for a four-light flashing switch.

The most convenient way to connect the leads from the emergency switch to the turn-signal switch leads is to strip the free ends about 3/8", fan out the strands, and insert the lead into the socket half of the proper bullet connector. Then reassemble the connector, making sure no bare wire is left exposed.

To keep from distorting the connectors, light gauge wire (#22 or #24) should be used on the emergency switch. Since these leads will probably be less than a foot long, no appreciable voltage drop will be introduced. To make the job even easier, it's a good idea to prewire the switch with the proper length leads for the mounting location chosen, then mount the switch.

The author's car, a 1962 Ford, already had cutouts in the lower face of the instrument panel for mounting accessory controls. These were concealed by an aluminum trim panel, making it easy to bore a hole for a three-pole rotary switch. To give the installation more of a built-in look, a matching replacement knob was purchased and the switch shaft turned down to fit into it.

No matter how simple or elaborate your installation, the important thing is the large amount of safety that can be bought with a light-flashing switch costing literally pennies. —30—

Across the Ham Bands

(*Continued from page* 67)

capacitance across the oscillator tube terminals. These two features help give the Clapp oscillator good dynamic frequency stability.

Modern VFO's. Most modern, commercial VFO's use the Clapp circuit with modifications dictated by the ideas of the individual engineer. For example, some de luxe VFO's use precision-type fixed capacitors in the tuned circuit, and the dial drives a ferrite slug in and out of the coil by means of an accurate lead screw to vary the oscillator frequency, instead of using a fixed inductance and a variable capacitor as in conventional circuits. Although costly to make, this system provides an extremely linear dial calibration.

Minor circuit variations in a VFO are not too important. The difference between a mediocre VFO and a superb one depends almost entirely on the quality of the components, the mechanical rigidity of the tuned circuit assembly, and the auxiliary circuits—such as voltage regulation, temperature compensation, and isolation amplifiers—employed to protect the oscillator from factors that will degrade its performance. These facts explain why a good VFO cannot be acquired for pennies.

WORLD UNDERSTANDING WEEK

In cooperation with the Radio Club Peruano, "El Rimac," the Rotary Club of Lima, Peru, is sponsoring a "World Understanding Week" from March 15 to 19, 1964. During this period, the club's stations OA4A and OA4O will be on the 40-, 20-, and 15-meter bands to work participating amateurs. If you want to take part, contact your local Rotary Club, obtain its name and Rotary district number, and send this information to either OA4A or OA4O. In return, you will receive a number. After you QSO one of the stations, write the assigned number and your local Rotary Club's name and district number on your QSL card. Mail the card to: Radio Club Peruano, P.O. Box 538, Lima, Peru. They will send you a special commemorative QSL card, and your local Rotary Club will receive a colorful display banner and an informative pamphlet.

Stations OA4A and OA4O will operate on the following schedule during the activity. OA4A (SSB): March 15—0001-0600 GMT and 2000-2400 GMT, transmitting on 14,110 kc., receiving on 14,245 kc., and 1400-2400 GMT, 21,410-21,440 kc.; March 16, 17, 18—0100-0500 GMT, 14,110-14,345 kc.; March 19, 1400-1800 GMT, 21,410-21,440 kc., and 2000-2400 GMT, 14,110-14,345 kc. OA4O (AM): March 15—0001-0600 GMT and 2000-2400 GMT, 14,180-14,210 kc., and 1400-2400 GMT, 7050-7100 kc.; March 16, 17, 18—0200-0500 GMT, 14,180-14,210 kc. and 7050-7100 kc.; March 19—1400-1800 GMT, 21,150-21,350 kc., and 2000-2400 GMT, 14,180-14,210 kc.

News and Views

Robert Soto, WN6GKG, 315 E. Grove Pl., Fullerton, Calif., transmits on a Johnson Adventurer, feeding either a 15-meter ground-plane antenna or a 40-meter dipole, and receives on a Hallicrafters SX-71. Both the 15-meter antenna and his electronic transmit-receive switch were built from specs in past *Across the Ham Bands*. Thirty-two states (including Hawaii), Canada, and Mexico appear in Bob's log book . . . **Bill Nason, WN5HYT,** 261 East Drive, Baton Rouge, La., really made time his first month on the air—35 states and seven countries worked, including Guatemala, Mexico, Venezuela, Canada, Puerto Rico, and the Canal Zone. A Johnson Ranger transmitter feeding a 40-meter "inverted V" antenna and a Hallicrafters SX-111 receiver occupy the honor spots on Bill's operating table.

Rich, K1ZXS, 29 Evergreen Ave., Somerville, Mass., samples all bands within the range of his Heathkit DX-40 transmitter and Gonset 211 receiver, but he likes 15 meters the best. Rich is working for a WAS (Worked All States) certificate to go with his Ragchewers' Club certificate and has 14 states to go. . . . To **John, VE5SZ,** Ken Barton, and the other Canadian hams who pointed out that there are 10 provinces in Canada—not seven, as I stated last November, my thanks and apologies. I confused the number of ARRL "sections" (7) in Canada with the number of provinces (10).

Vito Colantuono, WA2PJF, 79 Boston Ave., Massapequa, L. I., N. Y., works 20 and 40 meters with an EICO 720 transmitter and 730 modulator exciting 40- and 20-meter dipole antennas; he receives on a "surplus" Hammarlund SP-200 receiver. He has 30 states and three countries worked, although college chores at Southern Tech limit his time on the air. An active member of the QRP (low-power) Club, Vito will schedule anyone working for one of the QRP Club awards. He is WA2PJF/4 during the school year, when his address is P.O. Box 8667, Southern Tech, Marietta, Ga. . . . **Greg Greenwood, WN6FZH,** 260 Tiburon Blvd., San Rafael, Calif., should have the "N" knocked out of his call by the time you read this. As a Novice, Greg ran up a record of 44 states and 12 countries. And if his Johnson Ranger transmitter seems to glow with pride, it may be because of all the RST-599 reports it earns. A Hallicrafters SX-110 receiver and three antennas—an 80-meter "long wire" and dipoles for 40 and 15 meters—complete Greg's equipment. Would-be Novices and Technicians are invited to contact Greg for help, and he'll sked anyone needing a California QSL card.

A radio amateur made a technical breakthrough! At the October, 1963, meeting of the Aeronautical Center Amateur Radio Club in Oklahoma City, Okla., **L. J. Weissenberger, W5RRN,** demonstrated a coaxial cable tester he developed. The device gives a visual indication of the condition of coaxial cable connected to it, and it is used to test all coaxial cable purchased by the Federal Aviation Agency. Commercial firms who have attempted to design such a device are reported to have declared it impossible to do. Thanks to *Collector and Emitter*, the ACARC's club bulletin, for this item.

Bob Farley, WB6CGP, 831 Coronado Ave., Coronado, Calif., really had a hectic first year as a ham. He was originally licensed as WNØDSW, which was quickly changed to

KG4BB, Guantanamo Bay, Cuba, where his father was stationed. A month later, Bob was evacuated from the base during the Cuban crisis to Los Angeles, where he received the call of WN6CGP. Next, he went to Norfolk, Va., where he signed WN6CGP/4 until he obtained the call of WN4MUI, which was changed to WA4MUI when he earned his General Class ticket. Soon after that, Bob's dad was transferred to California, where Bob operated as WA4MUI/6 until the FCC issued his present call of WB6CGP, which Bob hopes to keep for a few years. Bob's well-traveled station consists of a Drake 2B receiver and a Hallicrafters HT-40 transmitter. . . . **Bill Shecket, WA8IHX,** 16620 Aldersyde Dr., Cleveland 20, Ohio, worked 31 states and six countries as a Novice. Most of his DX was on 15 meters, of course, and Bill learned that the way to work DX was by good, hard listening, not by endless CQ's.

That's all for now. Until next month, remember, send your "News and Views" and pictures to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Ind., 46401. 73,

Herb, W9EGQ

Amplifier Quiz Answers

(*Quiz on page* 64)

1 - D In the COMPOUND-CONNECTED amplifier, over-all current gain remains relatively constant in spite of changes of emitter current with signal voltage.

2 - C In the REFLEX AMPLIFIER, the r.f. amplifier stage preceding the diode detector is also made to amplify the audio signal output of the diode and drive a following audio stage via the iron-core transformer.

3 - F The BRIDGE AMPLIFIER is driven by two input signals of opposite phase (or one signal balanced to ground) and due to the bridge configuration does not cause any d.c. to flow through the loudspeaker voice coil.

4 - B The PUSH-PULL amplifier is symmetrical, and has less even-harmonic distortion than a single-ended amplifier of equal power.

5 - A In a COMPLEMENTARY SYMMETRY amplifier, pnp and npn transistors are connected so as to give a push-pull output when driven by a single input signal without phase inversion.

6 - E A PARAPHASE AMPLIFIER is one that receives a single-ended input signal and develops two single-ended output signals of opposite polarity.

Resonance Engine

(*Continued from page 45*)

43). Although the weight of the flywheel should not be too critical, some experimenting may be in order. The author's was made of aluminum and weighed one pound. Drill and tap one end of the flywheel shaft for a 6-32 machine screw and thread the opposite end with a ¼"-20 die.

The flywheel shaft bearing—a 1½" brass rod ½" in diameter with a ¼" hole drilled through the center—is mounted in the bracket shown in Fig. 7 and in the assembly drawing. The bracket is made with a stiffening buttress so that it will stand up under the vibration of the engine. In the author's unit, the bracket was mounted to the coil platform by tapping three small pieces of brass rod and cementing them into holes drilled into the bottom of the bracket. Wing bolts thread into the holes from the bottom of the coil platform, making it easy to disassemble the engine for other experiments. In any case, drill a ½" hole in the bracket at the height shown in Fig. 7, and cement the bearing in it with epoxy glue.

Mounting Stand. Make a double-deck stand as shown in the photos and secure the capacitors, *C1*, *C2*, *C3*, to the lower section. Mount the d.p.d.t. toggle switch, *S1*, and four pin jacks, *J1*, *J2*, *J3*, *J4*, on the upper deck of the stand in front of the coil position. Drill holes in the upper deck for coil leads, coil mounting screws, bracket mounting screws, and for the engine piston. The piston hole should be large enough to provide ample clearance.

Mount all of the parts on the stand as shown in the assembly view on page 45. Solder the end of the flywheel shaft to the end of the crankshaft where the two join together. To hold the long 12" core in place for repulsion coil experiments, drill and tap the top disc for a setscrew that extends from the outer rim into the center hole.

Connect the parts as shown in the schematic diagram on page 45. You will note that the diagram shows a "discharge" position for *S1*. This is a safety device to discharge the capacitors after the unit has been in use. Label *S1*'s positions (*S1* is a center-off type) "On," "Off," and "Discharge."

Testing the Engine. When the assembly and wiring are done, spin the flywheel by hand to make certain there is no undue friction. Use light oil on all bearings and piston surface. With everything ready to go, plug the unit in, turn the switch on, and give the flywheel a turn in either direction. The flywheel will pick up speed and be on its way. Like most single-cylinder reciprocating engines, your engine will require an initial start, unless the crank is turned to its upper position and slightly off center.

Theory. How does the resonant engine operate? One of the laws governing a series-resonant circuit is that when the reactance of the capacitor equals the reactance of the coil, the maximum amount of current will flow in the circuit. The reactance of the capacitors is fixed; the reactance of the coil depends on the piston core's position.

When the piston core is slightly above its lowest point of travel, or the same distance below its upper point of travel, the reactance of the coil equals that of the capacitor, and the circuit is resonant. In operation, the piston is drawn toward one of the resonant positions, but the flywheel carries it beyond that point and the circuit drops sharply out of resonance. From there on, the piston is carried by the momentum of the flywheel to the next resonant position.

The value of the capacitance needed for the resonant engine is 10.6 μf. As shown in the schematic, the author got this value by connecting 1- and 2-μf. units in series, and then connecting them in parallel with a 10-μf. unit. Other combinations can, of course, be used to arrive at 10.6 μf.

Other Experiments. Want to make a step-down transformer? Wind a 40-turn coil of wire and connect it to a flashlight bulb. Position the long core in the engine coil, tighten the setscrew, and slowly bring the flashlight bulb and coil down over the core. An interesting variation is to try the same thing with the capacitor shorted out by means of a jumper across the two capacitor pin jacks. The increased brilliancy of the bulb with the capacitor in the circuit shows how much more efficiently a.c. circuits operate at resonance.

Another intriguing experiment using the transformer principle is the repulsion coil. Secure a piece of 5/8"-i.d. aluminum tubing 2" long. Place the tubing over the long core, turn the switch on, and it will shoot skyward. Adjust the center core to get maximum upward thrust if necessary.

The transformer principle involved here is that of mutual induction where a varying current flowing in a coil induces a current in another coil placed in the same magnetic field, such as the primary and secondary of a transformer. The induced current is always in an opposite direction to the original current; thus, the magnetic fields set up by the two currents will be in opposition. The aluminum tubing acts like the secondary of a transformer, and, since it is free to move, opposing magnetic fields send it flying.

A similar piece of aluminum tubing

3″ long can be made to oscillate up and down the center core for approximately 8″ by adjusting the core to proper height. The height is critical—1/16″ either way may prevent the tubing from oscillating.

If you have an a.c. voltmeter with a maximum range of at least 500 volts, it can reveal some startling facts about series resonant circuits. Connect the meter to *J3-J4* across the coil and adjust the long center core until the meter gives a maximum reading. Change the voltmeter to the capacitor jacks *J1-J2* and note the reading. Readjust the center core until the coil and capacitor voltmeter readings are the same. The circuit is now at resonance, and the voltage indicated across each unit should be about 400 volts.

In a series resonant circuit such as this, the maximum current will flow at resonance. At 60 cycles, the reactance of the capacitor bank comes to about 250 ohms; and at resonance, the reactance of the coil will also be 250 ohms. However, at resonance, these reactances cancel one another—the current flow is limited only by the small resistance in the circuit. It is this current flow in combination with the reactances of the coil and capacitor—which may be said to build up the voltage by "handing it back and forth"—that accounts for the exceptionally high counter electromotive voltages.

The experiments and demonstrations suggested above are just a few of those that can be performed with the unit. As you become familiar with it, many more will suggest themselves to provide further exploration of this intriguing phase of electronics. —30—

The Secret Tube

(Continued from page 59)

The first twenty-five production units—followed by many more—were built by Zenith Radio Corporation, and went to England and then to the beaches of Normandy.

A part of the Normandy radar-support operation ended in tragedy—and it was feared that the set and its tube had fallen into enemy hands—when four radar-carrying gliders crashed during the ill-fated Arnhem expedition. Fortunately for the Allies, the destruction of the sets was so complete that there was little left for the Germans to study.

THE SUCCESS of the "Tipsy Three," as it was known to its operators, was due to the secret tube invented by Major Zahl. Essentially four triode tubes connected in parallel, the tube envelope also contained tuned plate and grid lines which made it an oscillator. As much as 250,000 watts peak power could be extracted from the tube during a radar pulse. Because of the plate dissipation and cathode emission required to produce the 250-kilowatt pulse, the anode elements of the secret Zahl tube ran red hot.

Once the tube had been proven, Major Zahl brought a hand-made version of his invention to Eitel-McCullough, Inc., a pioneer manufacturer of high-frequency transmitting tubes located near San Francisco. He asked the engineers of the company if the tube could be mass-produced on a crash basis. The entire resources and ingenuity of the company were thrown into a program of producing Zahl tubes in quantity, and in secrecy. The production tube—also produced in appreciable quantities by Machlett Laboratories—was designated the VT-158.

The exact number of VT-158's produced during the war is no longer known, but it is said that at one time the entire output of the Tantalum Defense Corporation was being used to make the heat-resisting elements of the secret tube. Many problems were encountered in mass-producing the revolutionary

VT-158, but the tube was soon given the unconditional Joint Army-Navy (JAN) approval and placed on the "Preferred List."

Doctor Zahl, now the Director of Research at the Army's Electronics Research and Development Laboratories, Ft. Monmouth, N.J., wrote recently, "Within my recollection, this tube passed through its entire life cycle of usage without ever having been the subject of an unsatisfactory report from the field. Eitel-McCullough did a superb job in the production-design of this tube. Even now, I wonder how they did it."

THE TUBES, still unknown to the public and the enemy, saw action in the Pacific Theatre as well as Europe. In Doctor Zahl's article, "One Hundred Years of Research," published in the October, 1960, *IRE Transactions on Military Electronics*, he said, "But with all the assistance total mobilization brought (to the development of new electronic systems) there were many problem areas where the most learned hesitated to travel, lest the war be over before the problem could be solved—if it could be solved at all. Riding high in this category was the location of enemy mortars, the deadly devices which caused the majority of our ground casualties.

"The problem was one of finding metal objects the size of a small tomato can, loaded with explosives and fired at our troops in bursts of hundreds, with nothing more complicated than a large shotgun shell at the bottom of a piece of iron pipe. Finding these clouds of deadly torpedo raindrops coming unannounced from miles away was the first part of the problem; the next was to establish definitive trajectories, trace the various shell paths back to their points of origin and by coincidence methods, to saturate these coordinates with overwhelming counterfire so that peace and quiet would prevail in these particular areas—and many thousands like them!"

With Major General R. B. Colton challenging his scientists and engineers, and with Captain John Marchetti leading the design group as he had previously done with the AN/TPS-3, Signal Corps Research took on the mortar locating problem when much talented advice said there was no solution. Within six months the problem was solved. Under the personal urging of General Stilwell to hurry the equipment into emergency overseas freight, Captain Marchetti's task force of twenty Signal Research scientists worked for an unbroken stretch of ninety-six hours—to the verge of collapse—on the first prototype radar unit. The deadly problem of enemy mortars had a solution—the Zahl tube used in the AN/TPQ-3 mortar radar set.

During the Korean conflict, the Army again called on the aging Zahl tube and the semi-obsolete AN/TPQ-3 mortar radar—both resurrected from World War II.

THE ZAHL TUBE is no longer manufactured, but the concept has not been forgotten. While the once-secret, revolutionary VT-158 may now be found in dusty surplus bins, work is still being done on powerful new ultra-high frequency radio tubes that contain the resonant circuitry within the tube.

One, the new X-841D giant klystron tube, designed for multi-megawatt, frequency-agile radar, is a modern descendant of the secret Zahl tube. Using six integral cavities resonant in the 400-megacycle region, this eleven-foot, 1000-pound giant is the latest development in the long, continuing search for more power at higher frequencies that started in Panama so many years ago. —30—

On the Citizens Band

(*Continued from page* 78)

Radio Club, Harrison CB Club, Hot Springs CB Radio Club, Jefferson County CB Radio Club, Ozark Five Watters, Riceland CB Club, Saline County CB Radio Club, Two-State CB Club, West Memphis CB Club, and White River Radio Club. State CB clubs or individual organizations interested in compiling similar directories might be able to procure a copy of the ACBRC's 1963 directory for reference by sending $1 to the Arkansas CB Radio Club, Box 534, Little Rock, Ark.

The Holiday Citizens Banders of Maryland, Inc. has been added to the OTCB roster this month. The official news voice of the Cumberland, Md. group is the *Holiday*

Gazette, issued monthly. Recently installed officers of the organization include: Al Kamosa, 4W0856, president; Lou Hoster, KCF0691, vice president; Estelle Smith, KCG0535, secretary; and Rita Mamolito, 4W2094, treasurer. The group also has a sergeant-at-arms and executive committee of three.

The *Groundplane,* a bimonthly publication of the Virginia State Citizens Band Radio Association, Inc., reports an assist by Virginia area CB'ers when the town of Crozet was left drought-stricken. It appears that the town's only supply of drinking water was supplied without interruption due largely to the efforts of CB'ers who kept a 'round-the-clock watch on an emergency substitute source. In order to assure an uninterrupted supply of water through a 6" pipeline running to a pond, each of three pumping stations maintained constant communications with one another. CB'ers voluntarily operated their equipment at the stations for periods of eight hours after working full-time day jobs, and many of the volunteers traveled 50 or more miles to take over their shifts.

A member of the Surburban Mobile Radio Association, Royal Oaks, Mich., recently hinted within the columns of the club's newspaper that it might not be a bad idea for CB'ers to adopt a self-policing committee program similar to the American Radio Relay League's Official Observer program. The ham group has a committee which selects applicants for Official Observers (licensed amateurs) who monitor other amateurs for possible FCC violations. Different classes of observers check such specifics as signal quality, operational procedures, and out-of-band operation.

The Official Observer has a supply of postcard forms to be sent to stations which might get in trouble with the FCC. The card (filled out) relates the condition observed, time and date, and the observer's name and address. A printed paragraph informs or reminds the recipient that the card is merely a "friendly notification," not a bawling out or citation. Observers then forward their monthly reports to the program committee. Neither this report or a committee report is sent to the FCC. The program is designed to help amateurs help one another in avoiding FCC citations. Food for thought?

We're Sorry! You asked for it, and we promised it, but it was very late in coming. To those of you who sent us your card many moons ago with a request for us to "Pse QSL"—the war's over. This is directed especially to those of you who threatened to drive a thousand miles to take your cards back if we didn't send ours soon. Now you can de-gas the car, unbundle the kids and sit back to watch the poor mailman (through the window) beating a path to your door through March winds, sleet, snow or sunshine (depending upon the location of your own piece of terra firma) in his (the mailman's) attempt to deliver our meager offering designed to cover up the crack in your shack's wall. We're shipping the cards out today!

If you haven't sent us your card as yet, do it now while we've still got a supply of ours. No telling how long it'll take to get those presses rolling again. And, while you're at it, include a picture of yourself in your shack, as well as pics of club activities or gatherings, and fill us in on the latest functions or planned activities in your area, CB-wise. Send this material to Matt P. Spinello, CB Editor, One Park Avenue, New York 16, N.Y.

I'll CB'ing you.

—Matt, KHC2060

Short-Wave Report

(*Continued from page* 82)

Johansen says that Europe, the United States, Canada, South Africa, Australia, New Zealand, and Japan take the honors. In the U.S., *WRTH* is sold in 25 radio stores and via mail order from Allied Radio, Radio Shack, etc. It may also be ordered directly from Gilfer Associates, P.O. Box 239, Park Ridge, N.J., 07656. It's priced at $3.50 a copy.

Olaf Johansen's other publications (*WRTH Summer Supplement, WRTH Bulletin*, and *How to Listen to the World* came into being six years ago. The *WRTH Bulletin* and the *WRTH Summer Supplement* were added to keep the listener up to date on the latest changes in frequencies, schedules and program information. His newest publication is called *News from Around the World*.

Speaking of the future of short-wave broadcasting, Mr. Johansen believes that stations will be turning more and more to the use of higher powered transmitters in an attempt to increase the size of their audiences. As for short-wave listening, he feels that it is on the increase, since more and more people are becoming interested in foreign affairs and the life, activities, and viewpoints of people in other countries. He wishes he had more time to devote to it himself, but his publications keep him pretty busy.

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.

Afghanistan—Kabul has been noted on 9595 kc. at 0625 with music and some Eng. anmts. An ID was given at 0629 s/off.

Albania—Tirana is being heard fairly well on 7090 kc. at 1400 in Russian, at 1430 in Arabic, at 1500 in Eng. (news around 1520), at 1530 in French, at 1600 in Italian, at 1630 in Eng., and at 1700 in Italian. All xmsns are a few moments short of the 30-minute scheduling.

Austria—*World Radio Handbook* sends this new schedule for *Osterreichischer Rundfunk*: to Europe at 2330-1900 on 6000 kc., and at 0000-1700 on 6155 kc.; to Europe and the Middle East at 0100-1500 on 7245 kc., and at 0400-1200 on 9770 kc.; to N. Africa and the Middle East at 0400-1200 on 11,785 kc.; to N.A. at 1800-2330 on 6155 kc., at 1900-2300 (Saturdays) on 9770 kc., and at 1700-1800 (Mondays and Saturdays) on 6155 kc.; to S. America at 1900-0000 on 9525 kc., and at 1400-1600 (Mondays, Wednesdays, and Fridays) on 11,785 kc.; to the Middle East at 0100-0400 on 15.410 kc., at 0600-0900 on 15,240 kc., and at 1200-1500 (Sundays, Mondays, and Saturdays) on 9545 kc. Other xmsns are broadcast on Mondays, Wednesdays, and Fridays to S. Africa at 1000-1200 on 17,765 kc., and at 1200-1400 on 15,325 kc.; to Japan at 0000-0200 on 11,785 kc., and at 0200-0400 on 15,320 kc.; to India and Indonesia at 0400-0600 and 0800-1000 on 17,735 kc.; and to Australia and New Zealand at 0600-0800 on 17,745 kc.

Cambodia—*R. Cambodge* is planning a European Service around 0100 in the 16-meter band. Further details are not yet available.

Canada—The Northern Service of *R. Canada* is on at 2000-0200 on 11,720 and 9585 kc., with the additional frequency of 5970 kc. now being used only at 2000-2130.

We have been receiving reports of a *R. Canada* xmsn on 4950 or 4960 kc. with s/off at 2300. This xmsn, in Spanish, is unconfirmed; does anyone have definite information on it?

Colombia—Station HJCF, Bogota, 5960 kc., has been noted with an apparently new ID: *El Canal De Color*. It is heard well at 0515-0530.

Cuba—Havana's changeable schedule now reads in part: to Northern Europe at 1520-1640 on 11,865 kc. (replacing 15,230 kc.); to N.A. at 2200-0100 on 6135 kc. (replacing 11,960 kc.); and to S. America at 1600-1700 on 15,340 kc. This is the Eng. schedule.

Czechoslovakia—Prague broadcasts to N.A. daily at 2000-2055 and 2230-2325 on 9795, 9550, 7345, 6005, and 5930 kc. The 6005-kc. channel will be replaced by 11,905 kc. in March. A DX program and a stamp collector's program are aired on alternate Thursdays. There is also a Sunday xmsn at 1000-1055 on 15,285 and 17,830 kc.

Dahomey—The latest schedule from *R. Cotonou* reads: Monday to Friday at 0015-0145, 0615-0730, and 1200-1700; Saturdays at 0015-0145 and 0700-1800; Sundays at 0200-1700; all on 4870 kc.

Dominican Republic—*R. Libertad,* Santiago de los Caballeros, 6080 kc., is noted at 0515-0530 with an anti-Communist program. Other reports, some conflicting, show *R. Santiago,* HI8Z, on 6060 kc. at 0500-0600 with music and to 0630 with news (Spanish) but with QRM from HRUC, Honduras, which, in turn, is reported by others to be operating on 6155 kc.

Ecuador—The "DX Party Line" from HCJB, Quito, is now aired on the first and third Monday of the month at 1630-1730 on 9745, 11,915, and 15,115 kc. "Ecuadorian Echoes" is heard at 2100-2330 and again from 0130 on the same frequencies.

England—Your Short-Wave Editor apparently led many DX'ers astray by our comment last June that the BBC had no intention of operating between 75 and 100 meters. We meant to convey the fact that the BBC was

Medium Waves

Here is a partial list of European stations currently being noted in East Coast areas. Most of the following stations were tuned from one to two hours after local sunset and again from approximately 0100-0400. (We would welcome a similar listing of trans-Pacific stations heard on the West Coast.) The figure in parentheses indicates the power rating in kilowatts. The figure preceding the location is the frequency in kilocycles.

584	Madrid, Spain (200)
647	Daventry, England (150)
665	Lisbon, Portugual (135)
674	Marseillaise, France (150)
684	Madrid (100)
755	Lisbon (135)
764	Sottens, Switzerland (150)
782	Mirimar, Portugual (100)
818	Cairo (300)
845	Rome (150)
863	Paris (150)
935	Sebaa Aioun, Morocco (25)
844	Toulouse, France (100)
1034	Parede, Portugal (25)
1088	Droitwich, England (150)
1196	Munich, Germany (150)
1205	Bordeaux, France (100)
1295	Crowbor, England (150)
1376	Lille, France (150)
1385	Kaunas, U.S.S.R. (150)
1457	Clevedon, England (20)
1466	Monte Carlo, Monaco (200)
1538	Mainflinger, Germany (300)
1554	Nice, France (60)
1578	Porto, Portugal (10)

not planning to resume any operations in the two-megacycle band (such as they once had) although broadcasts would continue on 3952.5 and 3975 kc. These two channels are heard well evenings.

Gabon—*R. Gabon,* 6030 kc., has been noted in Brazil with test xmsns, closing as late as 1900; the language used is French. This station is located in Moanda and is rated at 5000 watts.

Germany (East)—The winter schedule for *R. Berlin International* in Eng. reads: at 1230-1300 and 1515-1545 daily on 6080, 6115, 7300, and 9730 kc., and at 1700-1730 daily on 6080, 6115, and 7300 kc. Xmsns to N.A. are at 2000-2030 and 2130-2200 (East Coast) on 9560 kc., and at 2245-2315 and 2345-0015 (West Coast) on 6080 kc.

Germany (West)—Here are some recent changes from Cologne. To the East Coast at 2035-2115 in Eng. and at 2115-2155 in French daily on 9640 and 6170 kc. (replacing 6175 kc.); in German at 1900-2200 on 9545, 6100, and 6000 kc. (replacing 5955 kc.). To the West Coast in German at 2200-0100 daily on 9640, 6100, and 6000 kc. (replacing 5955 kc.). Spanish to Latin America is now on 6145 and 9545 kc. (replacing 9735 kc.) daily at 0040-0140. Other Eng. xmsn changes: to East Asia, Australia, and New Zealand at 0345-0440 on 11,925, 17,845, and 15,185 kc. (replacing 15,410 kc.); at 1610-1700 on 5980 and 7205 kc. (replacing 7235 kc.). To S. Asia at 1050-1120 on 9735 and 7205 kc. (replacing 7235 kc.). To Africa at 0105-0135 on 11,785 and 9640 kc. (replacing 9685 kc.), and at 1520-1550 on 9735 and 7160 kc. (replacing 7290 kc.).

According to overseas sources, there is a station on 6615 kc. (announced as 6666 kc.) operating from the tower of the *Lufthansa* radio exhibit around 0945. Has anyone heard it?

Iceland—*R. Reykjavik,* 11,780 kc., is tuned at 1530-1600 in Icelandic for Icelanders abroad. This is a daily schedule.

Israel—Station 4XB31, Jerusalem, 9009 kc., is on the air at 1100-1130 with world news and reports from Israel. The Eng. xmsn starting at 1515 has been changed to 1500 but still runs for 30 minutes.

Ivory Coast—Abidjan is the best heard African here (in Illinois); reception is best from 1300 to 1900 on 11,820 kc.

Kuwait—*R. Kuwait* can be heard on 15,150

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

Nathan Rosen (WPE2CY), New York, N. Y.

One Hundred Countries

William S. Sparks (WPE6EXV), San Francisco, Calif.

Seventy-Five Countries

Joe Russo (WPE8HBQ), Trenton, Mich.
William Montague (WPE8FUG), Dayton, Ohio
Bo Yeargan (WPE4DVU), Rome, Ga.

Fifty Countries

Donald Scott Pratt (VK6PE1A), Hilton Park, W. Australia
Joseph W. McDaniel, Jr. (WPE3CXY), Hagerstown, Md.
Will White III (WPE4FNR), Lexington, Ky.
James Pierce (WPE9EYQ), Mount Vernon, Ill.
Richard George (WPEØBLM), Wichita, Kan.
William A. Fast (WPE8ETY), Columbus, Ohio
David E. Pope (WPE4DMX), Crescent Beach, S. C.
George Oppegard (WPE3ELI), New Castle, Del.
Gary M. Cooper (VE3PE1MX), St. Catharines, Ont., Canada
Dave Bennett (VE7PE1R), Richmond, B. C., Canada
R. Seager (ZL2PE1A), Wellington, New Zealand
Edward J. Fellows (WPE7BLN), Seattle, Wash.

Twenty-Five Countries

Dominick Viola (WPE8ELG), Philadelphia, Pa.
Hank Lipschitz (WPE2IBZ), New York, N. Y.
Howard Withey, Jr. (WPE2HEM), North Syracuse, N. Y.
Herbert T. Aydlette, Jr. (WPE4GVJ), Virginia Beach, Va.
David A. Hestings (WPE1DSG), Weston, Mass.
James W. Mize (WPE5BO), Merriam, Kan.
Michael Wilder (WPE2HFV), Brooklyn, N. Y.
Kenneth Goetz (WPE2HHJ), Floral Park, N. Y.
Philip Marotta (WPE2JGJ), Solvay, N. Y.
Jim Hrencecin (WPE3ECJ), Wilkes Barre, Pa.
Russell Gorchov (WPE4EIK), Miami, Fla.
John Turgoose (VE2PE1FT), Quebec, Canada
Dennis H. Taylor (WPE3CRJ), Chester, Pa.
Frank L. Wurst (WPE4FFT), Miami, Fla.
Steve Kercel (WPE4FZZ), Chester, Va.
Glenn B. Cortez (WPE8GEM), Garden City, Mich.
Vincent Yucas (WPE1FJA), S. Boston, Mass.
Colin Miller (ZS6PE1A), Discovery, S. Africa
Dennis M. Kitchin (WPE3EKQ), King of Prussia, Pa.
Dan Schonberg (WPE8FWH), Shaker Heights, Ohio
Jack Petree (WPE5CRQ), Houston, Texas
Steven Teleky (WPE2IAR), Brooklyn, N. Y.
Joseph O'Donnell (WPE1FCW), Lawrence, Mass.
Chris Parnell (G3PE1D), Bath, England
Donald Bulgin (VE3PE1IC), Toronto, Ont., Canada
Dean F. McQueen (WPEØCMY), Minneapolis, Minn.
Raymond E. Hebda (WPE2DNP), Trenton, N. J.
Robert Siemion (WPE8GWQ), Detroit, Mich.
James A. Hartford (VE3PE1TB), Waterloo, Ont., Canada
Mark Pilnick (WPE2KXC), Metuchen, N. J.
Reed Khan (HL2PE1H), Seoul, Korea
David Etzel (WPE1FFY), Farmington, Maine
Michael Larcombe (WPE3EAT), Folcroft, Pa.
B. C. Grigsby (WPE4FJV), Bristol, Va.
John Benson (VE3PE1MS/VE4), Winnipeg, Man., Canada
Robert Giordano (WPE2HQO), Buffalo, N. Y.
Robert C. Frostholm Jr. (WPE6EDD), Oakland, Calif.
John Yuss (WPE9EYP), Chicago, Ill.
Stewart MacKenzie, Jr. (WPE6AA), Huntington Beach, Calif.
Sidney Spector (WPE9FHF), Gary, Ind.
Luther L. Knight (WPE3DLV), Baltimore, Md.
Luis R. Mateo (WPE2FJQ), New York, N. Y.

kc. at 1200-1230 in Arabic with African and world news.

Luxembourg—*R. Luxembourg, The Station of the Stars,* according to several overseas readers is the most popular station in Scandinavia among the teen-agers. Their music programs can be tuned from 1330 to 1700 (longer on Saturdays) on 6090 kc. and, for the medium-wave DX'ers, on 1439 kc. The 15,350-kc. outlet has been noted at 1640-1740 with pop music and anmts in French. Some sources claim that this station is located in England; our records indicate it to be at Villa Louvigny, Luxembourg.

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	QRM—Station interference
BBC—British Broadcasting Corporation	QSL—Verification
Eng.—English	R.—Radio
ID—Identification	s/off—Sign-off
kc.—Kilocycles	xmsn—Transmission
N.A.—North American	xmtr—Transmitter

Malaysia—*Suara Malaysia,* Kuala Lumpur, is scheduled in Indonesian at 1830-1900, 0300-0530, and 0930-1130; Eng. at 1900-1930 and 0230-0259; and Mandarin at 1930-2000 and 0200-0230; all broadcasts being on 6105, 7110, 9635, 9750, and 11,900 kc. To date, reports indicate reception in N.A. only on 11,900 kc. Reports go to *Radio Malaysia,* Department of Radio, P. O. Box 1074, Kuala Lumpur, Malaysia.

Mexico—Station XEUDS, operated by the University of Sonora, Hermosillo, has moved from 6140 kc. to 6115 kc. to avoid QRM. It is best heard evenings with classical Mexican and light music and requests for reports in Eng. and Spanish.

Station XESC, Mexico City, is again active on 15,205 kc., and relays medium-wave XEMC.

Station XECMT, Ciudad Mante, 6090 kc., is heard at 1700-1800 with pop and folk music, frequent anmts and musical fanfares. They relay XECM, 1450 kc.

Netherlands—Hilversum now operates to N.A. in Eng., daily except Sunday, at 1625-1720 on 9715 and 6085 kc. (replacing 11,800 kc.). Another outlet, 11,710 kc., carries Dutch at 0700, 0830, and 1130. Dutch lessons are given on Sundays.

Niger—According to a QSL from *Radiodiffusion de Niger,* the latest schedule is: Monday to Friday at 0030-0800 and 1400-1600; Saturdays at 0030-0800 and 1400-1700; Sundays at 0200-1600.

Nigeria—*The Voice of Nigeria,* Lagos, has been testing in Eng. and French at 0800-0900 on both 11,900 and 11,915 kc. Reports are requested. The Overseas Service in French is broadcast at 1400-1500 on 9690 kc.

Kaduna, 6090 kc., was noted from 0000 to 0200 with Eng. news at 0030-0040, BBC news and comment at 0100-0115. This channel has long been inactive.

Enugu is heard on 4855 kc. at 0000-0100 with Eng. music and commercials; a newscast is given at 0045.

Peru—Station OAX8E, *R. Loreto,* Iquitos, has moved from the 9-mc. band to 4735 kc.

and is readable at 2100-2300 with music and Spanish language.

Station OA8Q (call believed actually to be OAX8Q), *R. Pulcallpa,* is heard only when conditions are good, on 9580 kc., from 2135 to 2155 s/off.

R. Del Pacifico, OAZ4L, Lima, is a new station rated at 500 watts. Operating on 9675 kc., their schedule is 1200-2230.

Another new station is *R. Pacasmayo,* Pacasmayo, 4750 kc., noted around 2200, all-Spanish and few commercials.

South Africa—Stations currently being reported are: on 7270 kc. in Afrikaans with Eng. commercials in the African service at 2230-2300 s/off; on 9530 kc. at 0000-0100 and later with news, weather, sports news, no commercials; on 9595 kc. at 0015 in Eng., and on 9720 *(R. Springbok)* around 0000-0115 with mostly local programming.

Switzerland—There are now two xmsns to the United Kingdom and Ireland at 0650-0730 daily on 9665 and 7110 kc., and at 1430-1545 daily on 7110 and 6055 kc. Other changes in the Eng. schedule include: to Australia, New Zealand, and Japan at 0400-0515 on 21,520, 17,720, and 9665 kc. (replacing 17,795, 15,315, and 11,775 kc.); to the Far East at 0745-0900 on 11,865, 15,315, and 17,845 kc. (replacing 17,795 kc.); to the Near and Middle East at 1145-1300 on 9665 and 6055 kc. (replacing 11,865 kc.); to Africa at 0200-0315 on 17,795, 15,305, and 15,315 kc. (replacing 11,715 kc.). There are two new xmsns: to Spain in Spanish at 0600-0635 and to Africa in French at 1345-1415, both on 7110 and 9665 kc.

SHORT-WAVE MONITOR CERTIFICATE APPLICATION

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

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

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Make .... Model ....

Age .... Occupation ....

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

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Signature .... Date ....

(Good only until April 15, 1964)

SHORT-WAVE CONTRIBUTORS

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Ernest Metz, Irwin, Pa.
Ed Payette, Monroe, Mich.
Leon Tallman, Palmer, Alaska
Jim Wedewez, Dyersville, Iowa
Walter Woodside, Arlington, Va.
World Radio Handbook

Vatican City—Here is the Vatican's latest Eng. schedule with a few changes: to the U.S. at 1950 on 6145, 7250, and 9645 kc.; to the British Isles at 1000 on 7250, 9645, and 11,740 kc.; to E. Africa at 0500 and S. Central Africa at 0520 on 17,840 kc. (replacing 17,735 kc.) and 21,490 kc.; to Australia and New Zealand at 0630 on 15,120 and 17,720 kc. (replacing 17,840 kc.) and at 1700 on 9645 and 11,740 kc. The broadcast to India, Pakistan, and Ceylon is now listed as being weekdays (previously Monday, Wednesday, and Saturday) at 1100 on 11,740 and 15,120 kc. The Philippine schedule remains intact.

Venezuela—*La Voz de la Patria*, YVKX, Caracas, is generally strong on 3315 kc. at 2300-2315 with news. The signal is much stronger than the listed 3000 watts would indicate. Station YVLK, *R. Rumbos*, Caracas, is also good on 4970 kc. any time after local sunset.

U.S.S.R.—Moscow is noted in Russian at 0800-1000 on 15,460 kc. with a program believed to be for Russians in the Western Hemisphere.

Clandestine—*R. Americas*, Swan Island, has moved up to 6050 kc., according to late reports.

—30—

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

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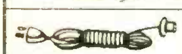

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___4CS6	.61	___6CN7	.70	___11CY7	.75	___12SQ7GT	.91
___4DT6	.55	___6CQ8	.92	___12A4	.60	___12U7	.62
___4GM6	.60	___6CR6	.60	___12AB5	.60	___12V6	.63
___5AM8	.79	___6CS6	.57	___12AC6	.55	___12W6	.71
___5AN8	.90	___6CS7	.69	___12AD6	.57	___12X4	.47

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

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