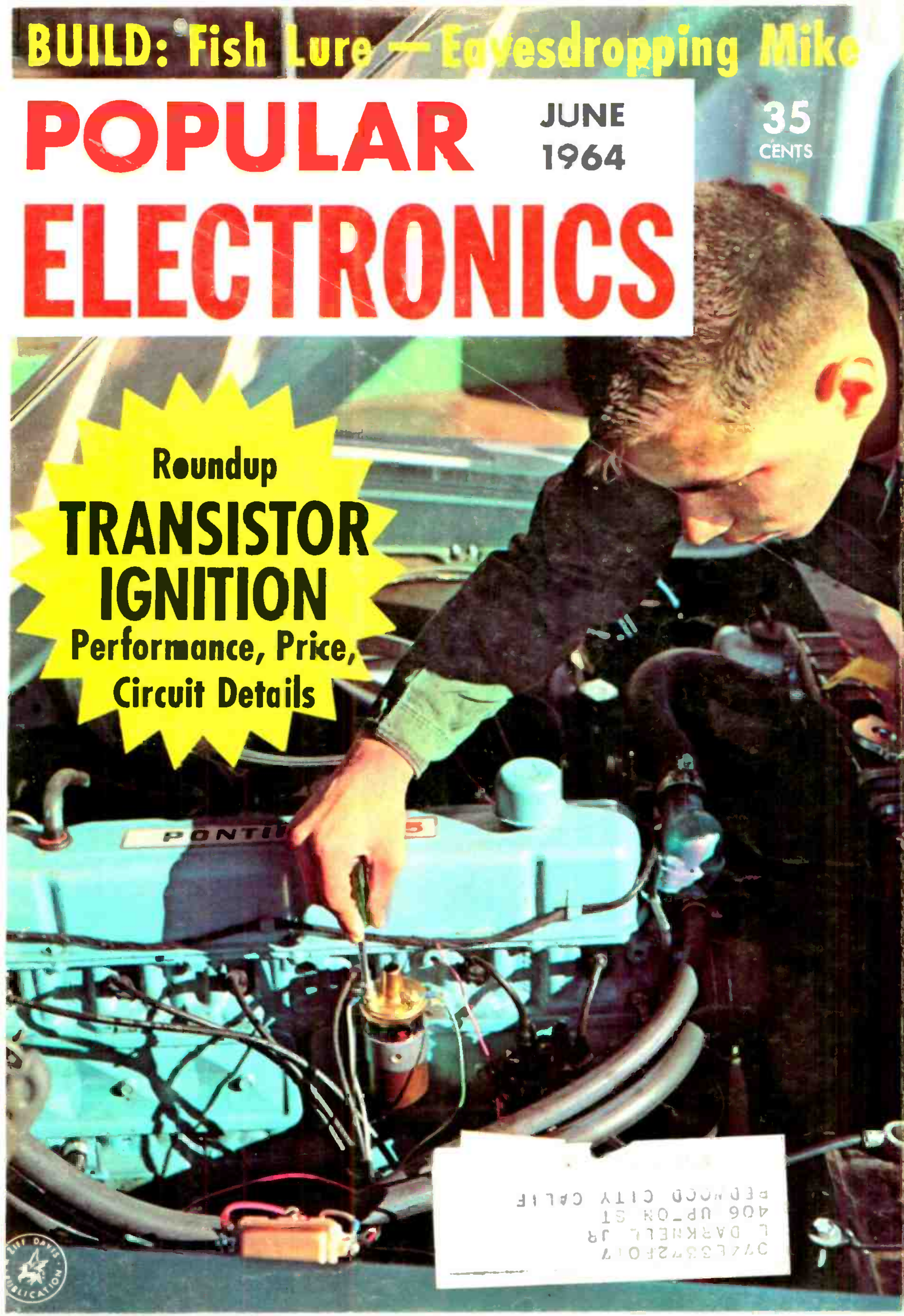


DISCOVER THE EXCITEMENT OF LEARNING ELECTRONICS WITH NRI TRAINING KITS.

BUILD ACTUAL TRANSMITTER
Complete your Communications course by building an actual phone-CW transmitter with components NRI sends. Complies with FCC regulations. Can be put on the air.

BUILD COMPUTER CIRCUITS
In NRI's Electronics course you solve mathematical problems with analog computer circuits you build yourself. One of 10 training kits you get.

BUILD YOUR OWN TV SET
As part of NRI's Servicing course you get everything to build this complete attractive set from "the ground up." What better way to learn, than to do it?

MAIL POSTAGE-FREE CARD NOW

FIRST CLASS
PERMIT
NO. 20-R
(Sec. 34.9, P.L.&R.)
Washington, D.C.

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY

NATIONAL RADIO INSTITUTE
3939 Wisconsin Avenue
Washington, D.C. 20016

NOW 10 WAYS PICK YOUR FIELD FROM NRI's 10 SPECIALIZED INSTRUCTION PLANS AND BEGIN AN ABSORBING ADVENTURE IN HOME-STUDY ELECTRONICS TRAINING.

1 TELEVISION-RADIO SERVICING—Learn to fix black-and-white and color sets, radios, stereo hi-fi, etc. A profitable field part or full-time.

2 INDUSTRIAL-MILITARY ELECTRONICS—Covers computers, servos, telemetry, multiplexing, other subjects.

3 COMPLETE COMMUNICATIONS—Broadcasting, mobile, marine, aviation. Prepares for FCC License.

4 FCC LICENSE—Prepares you quickly for First Class License exams.

5 MATH FOR ELECTRONICS—From basic arithmetic to electronics formulas. Quick, complete, low cost.

6 BASIC ELECTRONICS — Automation-Electronics, TV-Radio language, components, principles.

7 ELECTRONICS FOR AUTOMATION—Process control, ultrasonics, telemetering and remote control, electromechanical measurement, other subjects.

8 AVIATION COMMUNICATIONS—Covers direction finders, ranges, markers, loran, shoran, radar, landing system transmitters. Prepares for FCC License.

9 MARINE COMMUNICATIONS—Covers transmitters, direction finders, depth indicators, radar, other equipment on commercial and pleasure boats. Prepares for FCC License.

10 MOBILE COMMUNICATIONS—Learn to install, operate, maintain mobile equipment, associated base stations. Prepares for FCC License.

NOTE: You must pass your FCC License exam (Communications courses) or NRI refunds in full the tuition you have paid.

MAIL NOW—NO POSTAGE NEEDED

4FD4

nri

NATIONAL RADIO INSTITUTE, Washington, D.C. 20016

Please send me your catalog. I have checked the field(s) of most interest to me. (No salesman will call.) Please PRINT.

☐ TV-Radio Servicing
☐ Industrial Electronics
☐ Complete Communications
☐ FCC License
☐ Math for Electronics
☐ Basic Electronics
☐ Electronics for Automation
☐ Aviation Communications
☐ Marine Communications
☐ Mobile Communications

Name______________________Age________

Address______________________________

City______________State________Zip Code________

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

Don't cut your training short

NRI PIONEERED "LEARN-BY-DOING" TO MAKE TRAINING FASCINATING, FASTER

To make your home-study diploma a true symbol of knowledge—to have a thorough understanding of electronics—you must learn with your hands as well as your head. You must create, experiment, explore, discover. How? By combining NRI's "bite-size," programmed lesson texts with NRI training equipment that remarkably brings to life the theory and practice you read about. NRI pioneered and perfected this on-the-job technique of training at home and combined it with lesson texts as direct and well-illustrated as 50 years of teaching experience can make them. Together, they make learning Electronics an exciting adventure . . . a fast-moving flight to fulfillment.

Whatever your need . . . whatever your education . . . the best way to train at home is the practical, thorough NRI way. Select the field of most interest to you. Then, step-by-step, absorb new knowledge. Prepare yourself completely for a new career, part-time earnings, a source of retirement income or a new hobby. Before you consider any home-study school, investigate NRI's extensive list of training plans and practical, interesting learning methods. Mail the postage-free card now for the NRI catalog. No salesman will call. NATIONAL RADIO INSTITUTE, Washington, D.C. 20016.

50 YEARS OF LEADERSHIP IN ELECTRONICS TRAINING

any*

Yes, in any CB application...you'll outperform 'em all with a

MESSENGER®

Your own 2-way radio for Business or Personal use!

"PERSONAL MESSENGERS"—Compact, hand-held 100 milliwatt or 1½ watt units! Rugged and reliable—11 transistors, 4 diodes. Twice the sensitivity and 40% more range than similar units with conventional circuitry—more output than similar units with same rated inputs!

Cat. No. 242-101......100 Milliwatts........................**$109.50 Net**
Cat. No. 242-102......1½ Watts...............................**$129.50 Net**

"MESSENGER" AND "MESSENGER TWO"—For mobile or base stations. High efficiency design makes full use of maximum allowable legal power. Excellent receiver sensitivity and selectivity. Automatic "squelch" control. 5 crystal controlled channels on the "Messenger" and 10 crystal controlled channels plus tunable receiver on the "Messenger Two".

"MESSENGER"	"MESSENGER TWO"
Cat. No. 242-127	**Cat. No. 242-162**
115 VAC/6 VDC......**$114.95 Net**	115 VAC/6 VDC......**$169.95 Net**
Cat. No. 242-128	**Cat. No. 242-163**
115 VAC/12 VDC....**$114.95 Net**	115 VAC/12 VDC.....**$169.95 Net**

"MESSENGER III"—Offers everything you ever wanted in a CB transceiver . . . compact size, a husky signal, extreme sensitivity, razor-sharp selectivity—and complete flexibility for base station, mobile, public address, or battery powered portable use! Double conversion receiver—set-and-forget "Volume" and "Squelch" controls—11 channel coverage—"Tone Alert" Selective Calling System available as accessory.

Cat. No. 242-150......12 Volts DC Messenger III...........**$189.95 Net**
Cat. No. 250-823......117 Volt AC Power Supply...........**$ 29.95 Net**

The nation's most popular Citizens Radio equipment line!

*Rated BEST by Distributor Salesmen in National Survey!

WRITE TODAY for full color brochure, or see your Dealer/Distributor and ask for a demonstration!

E. F. JOHNSON COMPANY
2425 TENTH AVE. S.W. • WASECA, MINNESOTA

CIRCLE NO. 12 ON READER SERVICE PAGE

POPULAR ELECTRONICS

ZIFF-DAVIS PUBLISHING COMPANY

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

Cover photo by Jacques Saphier taken at Bender's Service Station, Hillsdale, N. J. The AEC-77 ignition system (center) was especially painted for photographic use

VOLUME 20 JUNE, 1964 NUMBER 6

Special Feature

Construction Projects

Amateur, CB, and SWL

Electronic Features and New Developments

Departments

POPULAR ELECTRONICS

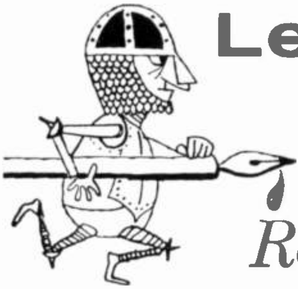
World's Largest-Selling Electronics Magazine

POPULAR ELECTRONICS is published monthly by Ziff-Davis Publishing Company at 434 South Wabash Avenue, Chicago, Illinois, 60605. June, 1964, Volume 20, Number 6. (Ziff-Davis also publishes Popular Photography, Electronics World, HiFi/Stereo Review, Popular Boating, Car and Driver, Flying, Modern Bride, Amazing, and Fantastic.) Subscription Rates: One year United States and possessions, $4.00; Canada and Pan American Union Countries, $4.50; all other foreign countries, $5.00. Second Class postage paid at Chicago, Illinois, and at additional mailing offices. Authorized as second class mail by the Post Office Department, Ottawa, Canada, and for payment of postage in cash.

PAYMENT MAY ALSO BE REMITTED in the following foreign currencies for a one-year subscription: Australian pounds (2/6/10); Belgian francs (260); Danish kroner (36); English pounds (1/17/6); French francs (26); Dutch guilders (19); Indian rupees (26); Italian lire (3300); Japanese yen (1750); Norwegian kroner (38); Philippine pesos (21); South African rands (3.80); Swedish kronor (28); Swiss francs (23); or West German marks (21).

SUBSCRIPTION SERVICE: All subscription correspondence should be addressed to POPULAR ELECTRONICS, Circulation Department, 434 South Wabash Avenue, Chicago 60605, Illinois. Please allow at least six weeks for change of address. Include your old address as well as new—enclosing if possible an address label from a recent issue.

EDITORIAL CONTRIBUTIONS must be accompanied by return postage and will be handled with reasonable care; however, publisher assumes no responsibility for return or safety of art work, photographs or manuscripts.



Letters from our Readers

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

Protecting Receiver Antenna Coils

■ The circuit shown in the "Tips and Techniques" item (March, 1964) on protecting receiver antenna coils from burn-out by high power—even though widely used—needs a detractor. Despite the fact that neon bulbs light better on r.f. than a.c. and will handle high transient powers, they will light only to tell you that your receiver is burned out when used directly across the primary of an antenna coil (50 or 300 ohms). Tests run to develop protective devices have shown that two watts is the maximum most receivers can withstand: the neon bulbs can't handle that. Some protection can be had, however, by connecting a neon bulb across a high-impedance antenna coil secondary where it can fire on transients. One truly safe lightning arrestor is a d.p.d.t. switch—or relay operated by the on/off switch—to open antenna connections to the receiver and short them to ground.

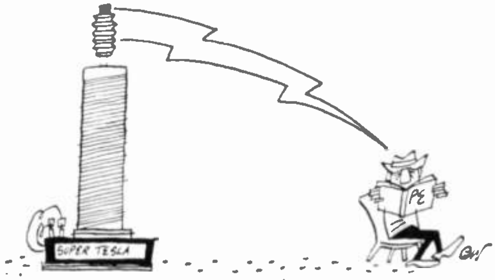
Will Herzog, KØLTH
Cedar Rapids, Iowa

Tesla Coil Spectacular

■ I recently read an interesting letter in an old issue of Popular Electronics about a Tesla coil project published some time ago. I would like to build such a project—although I don't have the issue which contained this article—and would appreciate any suggestions.

Donald Dirks
Burlingame, Calif.

Just one suggestion, Donald. Watch for P.E.'s Tesla coil "spectacular" coming up in the July issue. Two



versions of this favorite experimenter's device will be offered—one the biggest Tesla coil we've ever seen, and the other a modern model which can be built from salvaged TV parts.

(Continued on page 8)

CIRCLE NO. 1 ON READER SERVICE PAGE

Letters

(Continued from page 6)

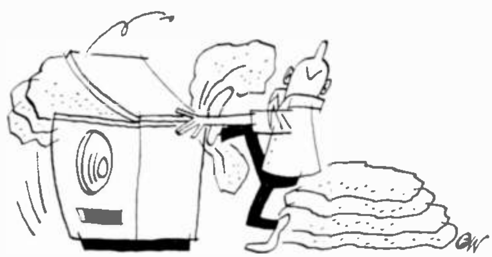
Indoor-Outdoor Temperature Control

■ We noted with interest the letter from reader H.S. Commons (February, 1964) requesting ideas for an anticipating indoor-outdoor temperature control system. Honeywell developed such a system in the mid-1950's called the "Electronic Moduflow." The outside thermostat signals weather changes as they occur, long before any change is noticed by those indoors, and activates a relay which starts the burner. The indoor thermostat shuts off the burner when the desired temperature is reached. The team works constantly, compensating for temperature changes and heat losses as they occur—not afterwards.

RICHARD T. SAUNDERS
Minneapolis-Honeywell
Minneapolis, Minn.

Too Much Speaker Padding, He Says

■ The time has come for hi-fi fans everywhere to stop wasting fiberglass padding on the inside walls of speaker enclosures where it usually has absolutely no effect on the quality of sound reproduction. Padding, when properly located, acts as an acoustic resistor and damps out waves that may tend to bounce around in the speaker enclosure and produce an audible sound signal when there is no corresponding electrical signal across the speaker voice coil. It can do this only when it is located where it can absorb energy from the air—



where the air is forced back and forth through it. The air undergoes its greatest movement right behind the speaker, and right behind the speaker is where the padding belongs.

STEPHEN J. LEBOFF
Boston, Mass.

As a matter of fact, Stephen, we tend to agree with you. The best way to install padding would be to hang it down the center of the cabinet, but practically, putting it on the back wall of the enclosure is just about as good. One mistake that many hi-fi enthusiasts tend to make, however, is to nail or glue the padding securely in place. This renders it completely ineffective—it should hang loosely for best results.

BC Reception On Phono

■ As background, a rather old two-tube record player receives the programs broadcast by a local radio station. Holding the tone arm up and touching the needle brings in the station at almost full volume. I wonder how the r.f. gets changed to a.f.?

RAY SABIN, KØECR
Idaho Springs, Colo.

Such cases are not at all uncommon, Ray; a strong r.f. signal can be rectified by the cartridge, by a poor connection at the amplifier, or by the amplifier itself. When you touch the needle, your body acts as an an-

Letters

(*Continued from page 8*)

tenna. The cure is tight connections, shielding, and a filter consisting of an r.f. choke and a 50- to 500-pf. bypass capacitor in the grid of the first amplifier stage.

She's Still Waiting!

■ Dave Harbaugh's cartoon captioned ". . . Honey, don't wait dinner . . . I'll be a few light years late" ("There's a Laser In Your Future," April, 1964) implies that a light year is a measure of *time* rather than the *distance* a beam of light travels in a year (about 6,000,000,000,000 miles).

RANDOLPH B. GOLD
JIM DENBY
Shaker Heights, Ohio

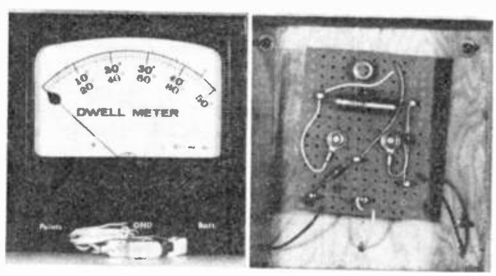
■ Harbaugh shouldn't be so "laser" when it comes to his measurements!

DAN FRANKLIN
Columbus, Ohio

In spite of all criticisms, Dave Harbaugh remains unrepentant, and insists on giving us his own personal views of science and the state of the electronics art. Although we tried to reason with him, our arguments were to no avail; his latest efforts appear on page 69 of this issue.

Simplex Dwell Meter Praised

■ Many thanks for the dwell meter plans ("Build SIMPLEX Transistorized Ignition") that were published in the February, 1964, issue. I used a 6" 0-1.0 ma. d.c. meter in my version to keep the 75° dwell reading closer to midscale. A 100-ohm fixed resistor was used for *R4*, and *R5* was changed to a 5000-ohm, type AB, locking pot. A new meter face was made and the calibration point calculated to correspond to the new meter scales. The calibration current was found



to be 900 μa. Momentarily connecting the cathode of *D3* to the anode of *D2* is all that is required for the calibration of *M1*. Included on the meter face for my own personal use is a 31° and 75° tic mark—all 4-cylinder Tempest owners will find the latter a necessity. My dwell meter has yielded excellent accuracy on 4-, 6-, and 8-cylinder engines.

RICHARD V. LOVETT
Dothan, Ala.

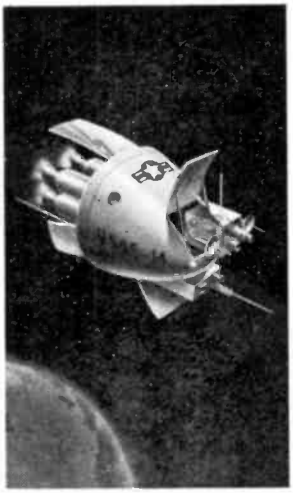
Thanks for the letter and the photos, Dick. Other readers will be interested in your adaptation of this popular project.

Musical Four-Way Oscillator?

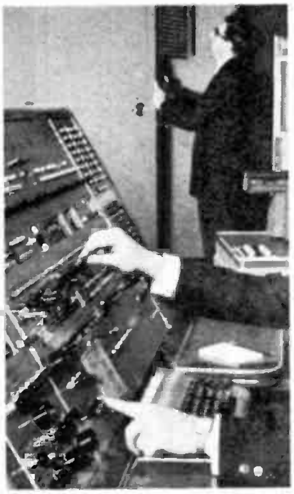
■ I found the "Four-Way Oscillator" (February, 1964) very interesting. While experimenting with it, I removed *R3* (binding posts were used for all connections) and found that by connecting the headphones to

A NEW WORLD OF OPPORTUNITY AWAITS YOU WITH N.T.S. ALL-PHASE HOME TRAINING IN ELECTRONICS

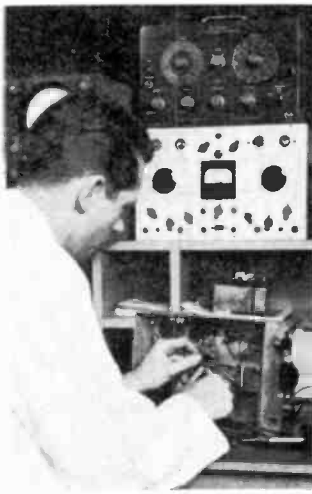
You can install and maintain electronic circuitry in missiles and rockets ... specialize in micro-waves, radar and sonar.



You can succeed in TV-Radio Communications ... prepare for F.C.C. License, service advanced satellites for industry and defense.



You can service and repair the electronic "brains" of industry — computers, data processing, and other automation equipment.



You can become a highly-paid TV-Radio Technician, an electronics field engineer, or succeed in your own sales & service business.

The N.T.S. Master Course enables you to do more, earn more in ELECTRONICS•TELEVISION•RADIO

Yet N.T.S. Training costs no more than other courses far less complete

There's a good reason why N.T.S. Master-Training opens a wide new world of opportunity for you in Electronics, Television, Radio.

Everything you learn, from start to finish, can be applied directly to all phases of the Electronics Industry.

As a result, the N.T.S.-Trained Technician can move ahead faster, in any direction — from TV-Servicing to Radio Communications to Space-Missile Electronics and Automation for industry and defense. You can go wherever pay is highest and opportunity unlimited.

Electronic circuitry, for example, is one of science's miracles that is basic to the entire field of Electronics. It is used in satellites, computers and space capsules as well as in today's television sets and high fidelity equipment. N.T.S. shows you how to service and repair electronic circuitry for all electronic applications.

YOU WORK ON MANY PRACTICAL JOB PROJECTS. You build a short-wave, long-wave superhet receiver, plus a large-screen television set from the ground up. N.T.S. training kits contain all the parts you need, at no extra cost. (See box at right.) You also receive a professional Multitester to use during training and on the job.

ONE LOW TUITION. You need training related to all phases of Electronics. Industry demands it. Only N.T.S. provides it ... in ONE Master Course at ONE low tuition.

RESIDENT TRAINING AT LOS ANGELES

If you wish to take your Electronics-TV-Radio training in our famous Resident School in Los Angeles — the oldest and largest school of its kind in the world — write for special Resident School catalog and information, or check coupon.

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905
4000 So. Figueroa St., Los Angeles 37, Calif.

Accredited Member N.H.S.C.

YOU ENROLL BY MAIL AND SAVE MONEY. No salesmen means lower costs for us, lower tuition for you.

START NOW. A whole new world of opportunity awaits the man with Electronic Home-Training from National Technical Schools — a recognized leader in technical training for 58 years.

MAIL COUPON NOW FOR FREE BOOK AND ACTUAL LESSON!

NO OBLIGATION.
NO SALESMAN WILL CALL.

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905

National Technical Schools, Dept. R2G-64
4000 S. Figueroa St., Los Angeles 37, Calif.

Please Rush FREE Electronics-TV-Radio "Opportunity" Book and Actual Lesson. No Salesman Will Call.

Name ____________________ Age ______

Address ____________________

City ____________ Zone ______ State ________

☐ Check if interested ONLY in Resident Training at L.A.

High school home study courses also offered. Check for free catalog. ☐

Letters

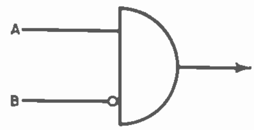
(*Continued from page* 10)

output #1 and the collector of *Q2*, I got a standard frequency which could be changed by connecting the collector of *Q2* to one or more of the other binding posts. I have gotten more than 25 different frequencies, and with a little effort I can play tunes.

PHILIP TROUPE
Oakland, Neb.

"If Only" Equals Inhibited "And"

■ I'm sorry to disappoint Mr. Apperson, but his "IF ONLY" gate ("Car Battery Saver," April, 1964) is really a combination of the "AND" and "NOT" gates commonly called an "INHIBIT" gate. The small circle in the diagram represents the "NOT." When a signal



is applied to *A* (the lights), there is an output unless there is also a signal at *B* (the ignition), which inhibits the output.

BRUCE A. BLACK, WA8DXN
Cleveland, Ohio

E Over R Times I

■ I believe I've found an error in the March, 1964, issue. On page 69 in the article on "Understanding Burn-Out" you state that "When hot, its resistance (by Ohm's law) is R=E÷R . . ." The answer arrived at is correct, but the formula should read R=E÷I.

JOHN W. AUGHEY
Hobart, Ind.

You're absolutely right, John. Somehow this one escaped the sharp eyes of our proofreaders. Our thanks to you and other readers who spotted the mistake. —30—

A MESSAGE TO OUR READERS

We would like to draw the attention of all readers—particularly those scanning our pages for the first time—to the fact that POPULAR ELECTRONICS cannot answer individual requests for information on how to modify published circuitry, or attempt to design new projects through the mails. We are also unable to service construction projects, or to make recommendations for substitutions in published plans. Blueprints, enlarged drawings, and special photographs of construction projects other than those published in POPULAR ELECTRONICS are not available.

While it would be a pleasure to be able to offer these services to our half-million readers, the volume of mail received (thousands of letters per month) makes such services impossible. However, letters pertaining strictly to short-wave listening, transistor experimentation, ham radio, and CB are forwarded to the Contributing Editors handling those topics in POPULAR ELECTRONICS. Possible errors in our construction plans, or improvements, appear in subsequent issues as soon as the information becomes available.

POPULAR ELECTRONICS
PRODUCT SERVICE PAGE

You can get additional information promptly concerning products advertised or mentioned editorially in this issue

1 Circle the number on the coupon below which corresponds to the key number at the bottom of the advertisement or is incorporated in the editorial mention that interests you.

2 Add up your total number of requests and fill in the box in the upper right-hand corner of the coupon.

3 Mail the coupon to the address indicated below.

4 Please use this address only for Product Service requests.

POPULAR ELECTRONICS
P. O. BOX 8391
PHILADELPHIA 1, PA.

NUMBER OF REQUESTS ☐

Please send me additional information about the products whose code numbers I have circled

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

NAME *(Print clearly)* ______________________________

ADDRESS ______________________________

CITY ______________ STATE ______________ ZIP CODE ________

VOID AFTER JUNE 30, 1964 6

Tips and Techniques

IMPROVE THE QUALITY OF YOUR TRANSISTOR RADIO

You can hear sounds from your transistor radio that you didn't know could come out of it, especially if it's of the FM variety. The trick is to use a pair of headphones with reasonably good frequency response. To make an adapter, obtain a plug to fit your transistor radio earphone jack. Using shielded cable, connect this plug to a standard phone jack or other connector which will accommodate your headphones. The wider range of frequencies afforded when listening through the phones will come as a pleasant surprise. —*Jon H. Larimore*

SEALING BATTERY CRACKS

Due to extremes of heat and cold, wet cell storage batteries may tend to develop tiny hairline cracks around cell openings and terminals. Fumes and acids emerging from these cracks can cause corrosion on the connections and an abnormally low liquid level in the cells. To prevent such effects, and prolong battery life, you can seal these small fissures with ordinary aquarium cement, available at most dime stores and pet shops. —*Robert K. Dye*

REEL BOON FOR TAPE RECORDERS

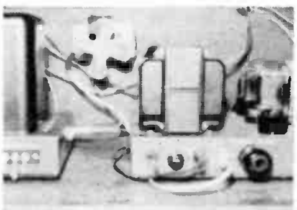
Ever start taping a musical program on your tape recorder, only to find yourself interrupting it to record a speech or some other type of material? · Hang a piece of peg board near the tape recorder with sev-

(*Continued from page* 16)

eral pairs of side-by-side pegs on it. When such an interruption occurs, simply remove *both* reels from the recorder and hang them on a pair of pegs, substituting another pair of reels. After the second recording is completed, you can replace the original reels on the machine, and complete the first recording. —*Glen F. Stillwell*

HEAT-PROOF YOUR STEREO

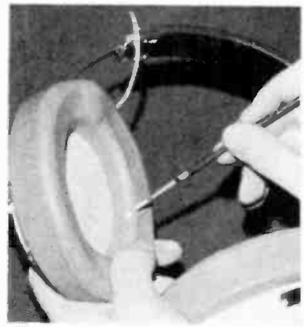
Heat plays hob with electronic equipment. Capacitors may melt and tube life may be curtailed. While most electronics gear is over-rated to allow for the effects of heat, the less your equipment is subjected to, the better off you are. You can solve the heat problem by installing a small fan inside your hi-fi cabinet. Modern cooling fans are quiet and efficient, and take up little space. Your amplifier probably has an a.c. accessory socket that you can plug the fan into.



—*Clyde C. Cook*

EAR-MARK YOUR STEREO PHONES

Do you often hear the strings where the horns should be and vice versa? All it takes to tell left from right is a dab of paint or nail polish. With the phones on, rotate the balance control on your amplifier to the full left channel. The sound will come entirely from one earphone, and this should be identified as the left channel. In the future, put this marked phone over the left ear, and you will never again find yourself at the rear of the orchestra.



—*Kent A. Mitchell, W3WTO*

POP'tronics Bookshelf

INSIDE ELECTRONICS

by Monroe Upton

For several years book sellers around the country have been recommending Upton's *Electronics for Everyone* as a good starting place for someone with absolutely no prior electrical or electronics experience. This second book is not a supplement, but rather an attack on the same subject from a different angle—more up to date and somewhat more practical. It is impossible to compare the two (the earlier version is in its third reprinting) without finding this book—*Inside Electronics*—far superior. Highly recommended.

Published by Devin-Adair Co., 23 E. 26th St., New York 10, N.Y. Hard cover. 272 pages. $5.95.

PRACTICAL HAM RADIO PROJECTS

by Charles Caringella, W6NJV

Apparently Chuck Caringella—a frequent contributor to POPULAR ELECTRONICS—is not convinced that most of his fellow hams are simply "plug-in appliance operators." This is Chuck's second book aimed at getting more hams to build their own gear, and includes such diversified pieces of equipment as a 500-watt linear amplifier, electronic keyer, monitor scope, and several transistorized 6- and 2-meter projects. All of the projects are simple to construct, and more than adequate details are given.

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

BASIC TELEVISION: PRINCIPLES AND SERVICING

by Bernard Grob

This is the third edition of author Grob's very thorough text on television. It has

Bookshelf

(*Continued from page* 20)

been expanded to include up-to-the-minute detailed information on transistorized TV receivers, color reception, UHF converters, and original-equipment UHF tuners. Although not primarily designed as a classroom text, each chapter (there are 25) has a "self-examination" question and answer section, and there is a particularly useful appendix. Your reviewer was impressed by the fast pace of the book and the author's "let's get down to business" attitude.

Published by McGraw-Hill Book Co., 330 West 42 St., New York, N.Y. 10036. Hard cover. 654 pages. $11.95.

THE TRANSISTOR RADIO HANDBOOK

by Donald L. Stoner and L. A. Earnshaw

The valuable handbooks published by Editors and Engineers, Ltd. are always a pleasure to review. Not only are the authors very knowledgeable and aware of their readers' interests, but the handbooks are jam-packed with new and unique ideas. After reviewing several dozen books on transistors, it's refreshing to see a pair of hams (W6TNS and VE7QL) produce a book that no transistor experimenter should be without. Theory is relegated to less than 20 per cent of this book—the remainder being brand-new, previously unpublished construction plans for innumerable amplifiers, receivers, power supplies, and transmitters.

Published by Editors and Engineers, Ltd., Summerland, Calif. 93067. Hard cover. 178 pages. $5.00.

Free Literature

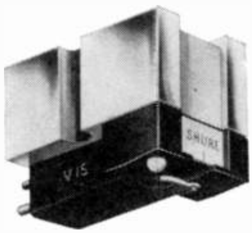
The full line of Bell Sound's stereo components is described and illustrated in a new 16-page catalog. Complete specifications are given for the equipment, which includes stereo tuners, amplifiers, receivers, tape decks, and tape recorders. For your free copy of Catalog CL-643, write to the TRW Columbus Division, 6325 Huntley Rd., Columbus, Ohio . . . A 16-page, 2-color catalog (No. 1090) is available from the Jensen Manufacturing Company, 6601 South Laramie Ave., Chicago, Ill. 60638. This one thoroughly covers the many items in Jensen's "Concert," "Viking" and "Weather Master" series of general-purpose and replacement loudspeakers. Easy-to-read specification tables are included. —30—

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.

ELLIPTICAL-STYLUS CARTRIDGE

Are you a hi-fi perfectionist? *Shure Brothers, Inc.* has a new stereo dynetic cartridge, the V-15, which incorporates a unique "Bi-Radial" elliptical-shaped stylus. Because the shape of the stylus closely conforms to the wedge shape of standard record cutting styli, it moves almost the same way. The distortion level of the V-15 is claimed to be *below* the inherent noise level of test records and of test instruments.



Circle No. 75 on Reader Service Page 15

Frequency response of the cartridge is 20 to 20,000 cycles; output, 6 mv.; separation, over 25 db; compliance, 25 x 10^{-6} cm. per dyne; impedance, 47,000 ohms. It's priced at $62.50.

CB BASE STATION

Browning Laboratories, Inc., has introduced the "Eagle" 23-channel CB base station

Circle No. 76 on Reader Service Page 15

which consists of an R-27 receiver and an S-23 transmitter. The receiver features an r.f. gain control, a selectivity switch giving a choice of either broad or narrow selectivity, a cascode nuvistor front end, and 12 tuned i.f. coils. The transmitter employs a compression amplifier and a clipper-filter stage for high modulation; an SWR meter is built in. Price, $359.

MINIATURE OSCILLATOR

Measuring only 2¼" x 2¼" x 5", the Model TC-3 "alignment generator" announced by the *Texas Crystals Division* of Whitehall Electronics takes up very little space on a workbench. It is intended for use in aligning i.f. strips and discriminators, as a frequency standard, a marker generator, or as a signal source for marine band operation. Battery-operated, the TC-3 has a frequency range of 200 kc. to 3 mc. It comes complete with battery and three standard frequency crystals (your choice). Additional factory-calibrated crystals are available. Price, $29.95.

Circle No. 77 on Reader Service Page 15

CORDLESS "RADIO-MIKE"

Having trouble with dangling mike cords or cables? The *Bergen* Model WMT "Radio-Mike" is a miniature wireless microphone radio transmitter that you hold in your hand, put in your pocket, or attach to an instrument. All voice or instrumental sounds are transmitted to any standard FM receiver within range, resulting in noise-free hi-fi reception. The transistorized battery-operated unit weighs only 10 ounces, measures 4" x 3" x 1", and has a range of up to a quarter of a mile. No license is required to use it. A matching transistorized receiver (Model WMR) is also available.

Circle No. 78 on Reader Service Page 15

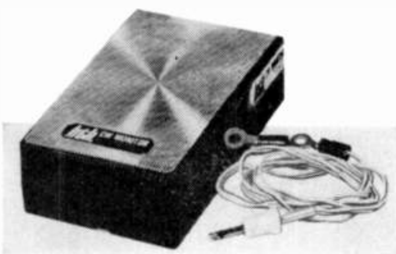
TV/FM SWEEP MARKER GENERATOR

A TV/FM sweep and post injection marker generator, the EICO 369 demodulates the output signal from the TV or FM set under test and feeds it to a mixer in the generator where the markers are added before the composite signal is fed to a scope. Thus, the set under test is not affected by marker signals, and does not reduce or eliminate them. A product of *Eico Electronic Instrument Co., Inc.*, the 369 has a controllable inductor sweep circuit with no mechanical parts which might wear. The sweep generator has five ranges, all fundamentals, from 3.5 to 216 mc.; tuning to the desired center frequency is simplified by a 6:1 vernier dial and 330° scale. The marker generator has four ranges covering 2-225 mc.; a 4.5-mc. crystal is supplied for rapid checking of marker alignment. Prices: $89.95 in kit form; $139.95 factory-wired.

Circle No. 79 on Reader Service Page 15

C.W. MONITOR/CPO

No modification to existing equipment is required to use the transistorized c.w. monitor and code practice oscillator introduced by *Herman Electronics*. The unit includes



Circle No. 80 on Reader Service Page 15

a built-in speaker, 9-volt battery, tone control, and patch cord for connecting it to a key. With the transmitter off, the unit will operate as a code practice oscillator without adjustment. Price, $7.95.

CB BASE STATION ANTENNA

The "Mark V" collinear-gain omnidirectional CB base station antenna has been developed by the *B & K/Mark Division* of Dynascan Corporation. This antenna has two in-phase elements, with the feed point located internally at the center. A symmetrical-feed system and mid-point excitation provide an unusually low angle of radiation, beamed toward the horizon, for extra efficiency and extended range. The SWR approaches a maximum of 1.2:1 at the edges of the Citizens Band (290 kc. wide), and reaches 1.5:1 across 800 kc. and 2.0:1 across 1200 kc. for efficient operation in other low-power radio services adjoining the Citizens Band. The Mark V can be mounted on any pipe with an O.D. from 1" to 1¾".

Circle No. 81 on Reader Service Page 15

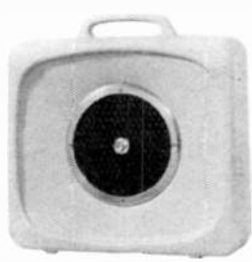
TRANSISTORIZED RECITAL ORGAN KIT

A screwdriver, wire cutter, pliers, solder and soldering pencil are all that is needed to assemble the new transistorized *Schober* Recital Organ. Detailed instructions with each kit provide the buyer with step-by-step procedures. The instrument is said to offer realistic pipe tones combined with complete adaptability to any kind of music one may wish to play. It is a full-size organ comparable in physical and musical qualities to some of the best two-manual pipe installations. Estimated assembly time ranges from 100 to 200 man-hours. Complete kits may be purchased or portions bought and assembled separately. Cost of complete organ, about $1500.

Circle No. 82 on Reader Service Page 15

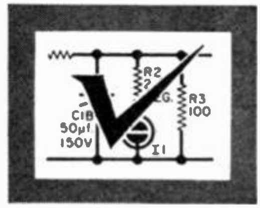
PORTABLE LOUDSPEAKER

Weighing only eight pounds, the new *Electro-Voice* "Sonocaster" outdoor/indoor portable hi-fi loudspeaker can be placed anywhere. The 8" coaxial driver unit in the Sonocaster features a rigid die-cast frame, ceramic magnet assembly, and a double-wound voice coil for wide-range frequency response and high efficiency. It's housed in a durable plastic material similar to that found in air travel luggage. The Sonocaster can be used with even low-powered amplifiers and tiny transistor radios or phonographs to produce greatly increased volume and tone quality. —30—



Circle No. 83 on Reader Service Page 15

Operation Assist



THROUGH THIS COLUMN we try to make it possible for readers needing information on out-dated, obscure, and unusual radio-electronics gear to get help from *other* readers. Here's how it works: Check over the list below. If you can help anyone with a schematic or other information, *write him directly*—he'll appreciate it. If *you* need help, send a post card direct to OPERATION ASSIST, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. Give the maker's name, the model number, year of manufacture, bands covered, tubes used, etc. Be sure to print or type everything legibly, including your name and address, and be sure to state specifically what you want, i.e., schematic, source for parts, etc. Remember, *use a post card;* we can handle them much faster than letters. 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

Fada Model 6A(?), broadcast and 6-18 mc., 6 tubes, chassis 6 650114. (Alan P. McGuiness, 4744 Cape May Ave., San Diego, Calif. 92107)

Pilot Radio Model T-135. Manufactured after 1941, covers three bands. Has input for phono. (Alvan P. Eddy, Box 111, Hampton, S.C.)

Wilcox-Gay Recordio Model 8T-11 tape recorder. (Don Wamsley, R.R. 1, Greensburg, Ind.)

RCA Model 8K1 console, 3-band receiver, circa 1937. (Daniel Eisenberg, Box 2270, Johns Hopkins University, Baltimore, Md. 21218)

Fairbanks, Morse & Co. Model 10LS-3 (about 1945). 110-volt power plant. Diagram for automatic start wanted. (Eugene Merrithew, Box 461, Woodland, Me.)

Firestone Airchief receiver. 13 tubes, with 78-rpm changer and 15" speaker. Covers broadcast, 2 s.w. bands. (Jeff Klientz, 6010 McKnight, Houston, Texas 77035)

RCA Radiola-18. Power supply is VX-280, cabinet made by Stout-Smith. (E. Mandich, 304 Chicora St., E. McKeesport, Pa.)

Echophone Model EC-1B 3-band short-wave receiver. 6 tubes. (Scott Maynard, 1304 Wells St., Philadelphia, Pa. 19111)

Mills Novelty Co. Model MCP2429 dual hi-fi amplifier, taken from juke box. (Lee Eddy, 20592 Drake Rd., Strongsville 36, Ohio)

RCA Model RC-351C receiver. Tunes 5 bands, has 12 tubes. Part of p.a. system, circa 1936-7. (Joseph L. Tolbert, Jr., Box 96, Ninety-Six, S.C. 29666)

Motorola Model 62T1 6-tube superhet. Covers BC plus s.w. (Clifton Andressen, 741½ Voisin St., New Orleans 24, La.)

NRI Model 88 signal generator. Covers 150 kc.—140 mc. (David Lee Pinson, Box 26, Powers, Ore.)

(Continued on page 28)

Operation Assist

(*Continued from page* 26)

American Bosch receiver (Model 460R). Has 7 tubes, tunes .54—9 mc. Circa 1935. (John Bober, 42 Warren Ave., Milton, Mass. 02187)

McMurdo Silver "15-17" receiver. 15-tuber, built for Davega City Radio. Covers 550 kc.—32 mc. in four bands. About 1937. (F. Dannenberg, 266 Riverdale Ave., Brooklyn, N.Y. 11212)

E. H. Scott custom-built receiver with 33 tubes, chromed chassis. Has five AM bands to 25 mc., old FM band. (J. Ryberg, Box 428, Fairview, Pa.)

Sentinel Model 9-1047A FM tuner. Covers old FM band. Chassis 1047A. (Byrd J. Raby, Rte. 1, Box 183B, Indian Head, Md.)

Atwater-Kent Model 92. Circa 1933. Chassis 7230443. Covers broadcast bands with type 47 final. (Jean A. Delancy, K1ZAT, RFD 3, Bear-Hill, New Milford, Conn. 06776)

Stewart-Warner Series 900. Uses 7 tubes plus rectifier. Pre-1940. (R. L. Young, Woodmont, Conn.)

Link Model 11UFDC. 30-40 mc. FM receiver. (Alfred Boatman, 738 N. Chestnut Ave., Cookeville, Tenn.)

Zenith Model A-356625, chassis 10 B 1. Tunes 540 kc. through 18 mc. (Paul E. Stevenson, 4300 Upper Val. Pk., Springfield, Ohio)

Triumph analyzer, Model 333S, Army BC1052 E. (Francis Hillibush, R.D. 1, Ringtown, Pa.)

Emerson Model 103B 20-tube TV set, circa 1949. (Gary Olin, 150 East Parkway, Rochester 17, N.Y.)

Grebe Model CR-9. Tunes 100-3000 meters, has 3 #201A tubes. Manufactured in Richmond Hills, N.Y., about 1922. (H. C. Havlik, 1022 N. Harlem Ave., River Forest, Ill.)

RCA 7-tube a.c.-operated table radio. Tunes .5 to 19 mc. in three bands. Chassis number may be 027435. (T.Sgt. W. J. Wayland, Box 142, FPO 510, New York, N.Y.)

Midwest Radio Corp. radio. Ser. 1622661. 15 tubes, 5 bands. (Vaughn N. Kimball, WPE1DYG, Box 229, N. Uxbridge, Mass. 01538)

Firestone Airchief receiver, S-7400-3, code F-C-114. (S. A. Colburn, 328 Hayes Ave., McDonald, Ohio 44437)

Grunow Model 1191 (type 11-G) all-wave superhet. (W. J. Wiley, Box 1807, Physics Dept., Vanderbilt University, Nashville, Tenn. 37203)

Supreme Model 599 tube tester. (Joe Penner, Box 555, Chouteau, Okla.)

Stromberg-Carlson Model 68 10-tube all-wave receiver, 3 bands. Serials 24420 & 24318. (Benet R. Freund, 213 N.E. Ave., Faribault, Minn.)

Simpson Model 320 "Giant Set Tester." Serial 1573. (M. D. Shapiro, 135 Southview Drive, Marion, Iowa)

Special Data or Parts

APR-5/R111. Antenna, cable and manual needed. (Gale O'Dell, Box 486, Craigsville, W. Va. 26665)

Superior Instrument Co. Mite Meter Model PB-100. Schematic, operating and calibrating instructions needed. (Robert J. Grill, 24 Woodhollow Lane, Huntington, N.Y. 11743)

AN/URC-4 (RT-159) Survival transceiver. Source for the original battery pack needed. (A2C Randall M. Keils, 1936 Comm., Box 373, APO 406, New York, N.Y.)

LM-13 frequency meter made for U.S. Navy by Bendix Radio. Operating and service manual needed. (George Erwig, 154 Reservoir St., Needham Heights 94, Mass.)

RA-20 power supply for BC-314 receiver. (George Gunther, 381 Bob-O-Link Dr., Lexington, Ky.)

TCS-8 receiver (CWS-46159). Schematic and operating manual needed. (Michael A. Stark, WPE4AEK/3, Rte. 2, Box 259-K, Brandywine, Md. 20613)

BC-659 surplus tranceiver. Technical data needed, plus info on conversion to AM for CB use. (Russell Ottney, Rte. 2, Sciotoville, Ohio)

National HFS receiver, about 1948. Two plug-in coils for band "B" needed. (H. M. Yotti, 203 Lenox Ave., Pittsburgh 21, Pa.)

(*Continued on page* 30)

Operation Assist

(*Continued from page 28*)

AFSCO Amplimeter (Model M-10). Tube data needed. (J. J. Hinkleman, 4708 Hillside Rd., Harrisburg, Pa.)

Echophone TRF receiver, made by Gilfillan Bros., ser. 55732. Technical data needed, also transformer and speaker. (Barry Zimmerman, 1215 Bridge St., New Cumberland, Pa.)

Sears Roebuck Model E (ser. S-5349) 6-tube TRF receiver, circa ear y 20's. Tubes, tube substitutes, and technical data needed. (James Cook, Rte. 2, Box 74, Imperial, Calif.)

Stewart-Warner Model EZ-777 Army surplus receiver, part of PRA-3. Service manual and diagram needed. (Edgar Vassallo, 718 Durie St., Toronto 9, Ontario, Canada)

RCA Model ACR-136 communications receiver. Tubes and schematic needed. Tubes are 6A7, 6B7, 6D6 (3 needed) 41 and 80. (Chris Kilpert, 146-20 New York Blvd., Jamaica 34, N.Y.)

T. R. McElroy Co. Model 6S13 automatic photo tube transmitter. Code practice tapes needed. (Bruce Hardy, 512 S. Baldwin St., Whitehall, Mich.)

Telefunken Bajazzo Model 56 AM-FM-s.w. portable made in Germany. Manual and/or technical data in English needed. (Melvin Granick, 220-42 137th Rd., Laurelton, Queens, N.Y. 11413)

Hallicrafters Model S20R Sky Champ receiver, about 1939. Schematic and technical data needed. (Manuel Lopez, 522 E. 138 St., New York, N.Y.)

Airline Model 326W, 5 tubes, made about 1925. Z-80 tube needed plus data. (David Barnes, R.D. 1, Greene, N.Y. 13778)

RCA Radiola Type R1. Two UV-199 tubes, three WD-11 tubes needed. (Frank J. Krov, Linwood, Neb. 68036)

Philco Model 42-400 superhet receiver, about 1942. Schematics, alignment data, antenna info needed. (Denis Hanson, 716 S. Norwood Ave., Green Bay, Wis.)

Technical Radio Co. Model LRR-6, 15 tubes, BC and two s.w. bands. Alignment data, i.f. value, and schematic needed. (Harvey J. Larkin, 2275 Altadena Ave., San Diego, Calif. 92105)

DuMont Model 208 5" oscilloscope, about 1945. Diagram and manual needed. (Herschel Weintraub, 1012 Denox Pl., Cincinnati, Ohio 45229)

Detrola console, 10-tube superhet, about 1930. Info on r.f. coil pin connections wanted. (Rudy Schleinkofer, 1630 Second Ave., York, Pa.)

Mars Mfg. Co. Satellite World Wide Radio kit, one tube, printed circuit covers BC and s.w. Parts list and schematic needed. (Chester Konopka, 6849 Ottawa Rd., Cleveland 5, Ohio)

Emerson RBZ 5-tube battery-operated portable receiver, type CEX-46203, circa 1940-45. Schematic and alignment info needed. (Bill Buoy, 540 W. 28, Houston, Texas)

Midwest Radio Corp. all-wave receiver, many inputs, ser. 1713343. Tube locating diagram and schematic needed. (Gary E. Shartle, R.D. #1, Wayland Rd., Meadville, Pa.)

Atwater Kent Model 20 5-tube receiver with 6-wire cable, ser. 358197. Parts list and schematic needed. (Herbert Powell, 602 W. Washington St., Suffolk Radio & TV, Suffolk, Va.)

Philco 15-tube BC and s.w. receiver, chassis 37-3115, code 122. Tube diagram wanted. (Walter Rehm, 505 11th Ave. South, Port Alberni, B.C., Canada)

Corsair III marine transceiver, made by Hudson-American Corp., about 1957. Operating manual and schematic wanted. (Taylor W. Hubble, 306 Swarthmore Rd., Glassboro, N.J.)

Webster Electric 6-tube, 8-transformer amplifier-modulator, ser. 3926, war surplus. Operating manual and power info needed. (W. J. Fitzpatrick, 620 S. Kensington Ave., La Grange, Ill.)

Zenith Model R-315595 all-wave receiver, circa 1938. Tone control rotary switch 85-101 needed. (Charles H. Eiffert, 2301 Maiden Lane S.W., Roanoke, Va.)

TV set, make unknown, ser. A12AC-B17C. Coils and capacitors for channels 2, 4, 7, 9, needed. (John Manney, 162 Wood St., Rutherford, N.J.)

COMING NEXT MONTH

YOU ASKED FOR IT...

TESLA COILS

Ranked among the top three most-frequently requested electronics construction projects—TESLA COILS—continues year after year to fascinate both young and old experimenters alike.

Developed about 60 years ago by Nikola Tesla, these ultra-high voltage generators can be used as Science Fair projects, physics laboratory demonstrators, or just curiosity projects.

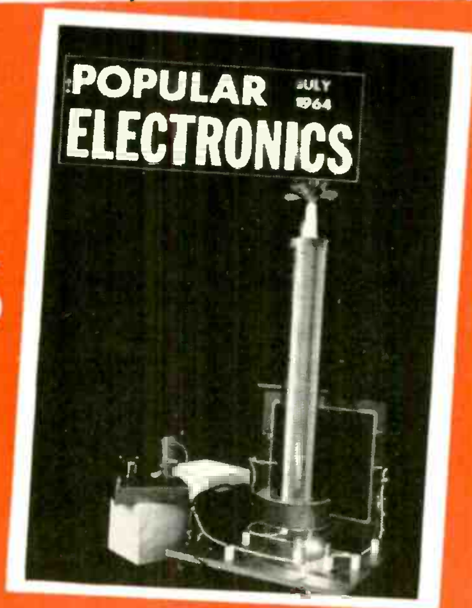
Two distinctly different approaches are shown in our July issue. The smaller coil—generating about 30,000 volts—is built from electronics parts salvaged from a TV receiver. The larger coil—generating nearly 200,000 volts—uses a minimum of parts and can be driven by the r.f. signal from a spark gap.

Complete construction details are given in the July issue for both TESLA COILS. This is an issue you'll want to keep in your files for years and years.

JULY POPULAR ELECTRONICS

on sale June 18th

only 35c



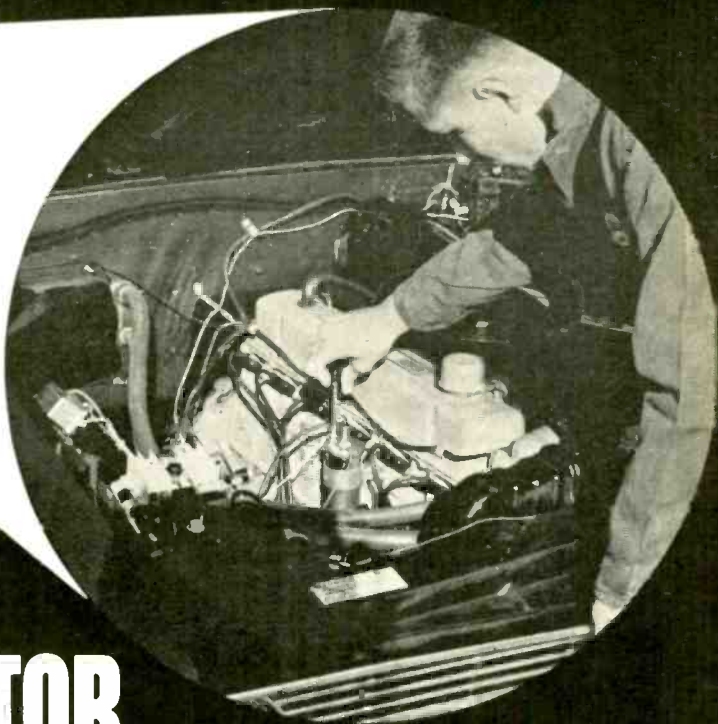
DON'T MISS OUR

4TH ANNUAL CB EQUIPMENT DIRECTORY

appearing in August **POPULAR ELECTRONICS**

Listen to the EICO Hour, WABC-FM, N. Y. 95.5 MC, Mon.-Fri., 7:15-8 P.M.

CIRCLE NO. 5 ON READER SERVICE PAGE



COVER STORY

TRANSISTOR IGNITION

First Complete Review of All Systems

By BRICE WARD

Author of "Transistor Ignition Systems Handbook" published by Howard W. Sams & Co., Inc.

better engine performance

eliminate misfiring

never replace points

more power at high speeds

insure quicker starting

no maintenance costs

ARE YOU CONFUSED by the claims and counterclaims of the various manufacturers of transistor ignition systems? If you are, you're among the vast majority of the motoring public. Only three years ago—when transistor ignition was just being proven possible—you could number the manufacturers on one hand. Today, as this is written, there are more than 40 manufacturers (and/or distributors) selling — at recent count — 65 different systems!

Earlier this year, POPULAR ELECTRONICS commissioned the author to attempt to lift the "epoxy veil" surrounding transistor ignition systems that you or your neighbor might buy either by

TRANSISTOR IGNITION

mail order or over a store counter. There were many questions that needed answers. Why do some systems use only one transistor while others have two, three, or even four? How important is coil-turns ratio? Has the breakdown-in-use problem been overcome? Should you buy now, or wait for something better to come—maybe tomorrow?

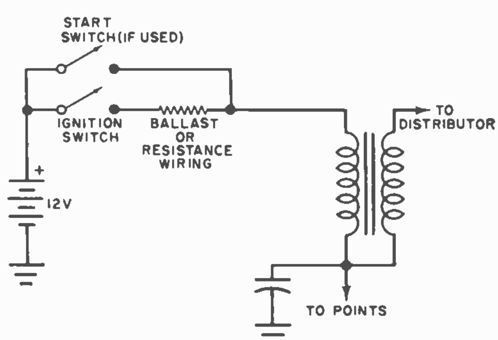
Those Selling Prices. What the man says on TV, "You get what you pay for," requires some modification when it comes to transistor ignition. In preparing this article, the author found systems selling (remarkably well) for under $12; several systems selling near $100; and one manufacturer who publicizes a good circuit, but builds another into his manufactured product. And if you're not careful, you can pay a 100 per cent markup for the identical system from two different suppliers.

There are a few manufacturers taking a whopping markup between cost and selling price. A few manufacturers (fortunately very few) have started to reduce component quality to reduce selling price. A majority of manufacturers have improved products, showing that lessons learned in actual usage have been absorbed and acted upon. With the exceptions in the list on pages 41-43, you should expect to pay at least an average of between $25 and $40 for a good-quality "install-it-yourself" system. A top-quality system installed by a reputable automotive dealer can cost as much as $75-$100. Original equipment (installed on new cars only) is presently averaging about $70.

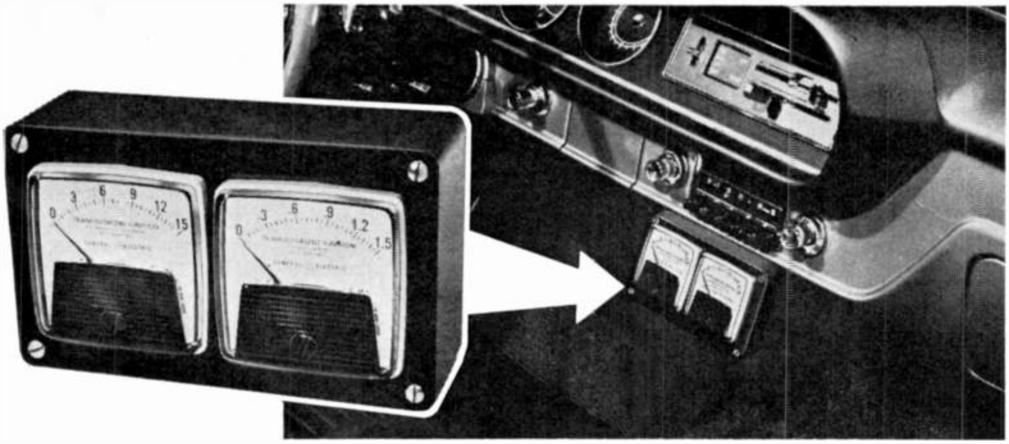
Electronically oriented readers have an advantage over those not "in the know" when it comes to pricing systems such as the Leece-Neville 11EA. The suggested list price is $59.00—and this is the price you would pay an automotive parts dealer. The identical system is sold by Allied Radio Corp. as catalog number 51N421 for only $29.95, plus shipping charges. House-branding by electronics mail order concerns is not uncommon and observant buyers will frequently spot bargains. The listing on pages 41 through 43 contains several mail order houses and, when possible, identifies the original manufacturer of the transistor system being sold.

Transistor Ignition Fundamentals. It is not the purpose of this article to recite the theory of automotive ignition. Nevertheless, some of the terminology peculiar to the automobile must be identified.

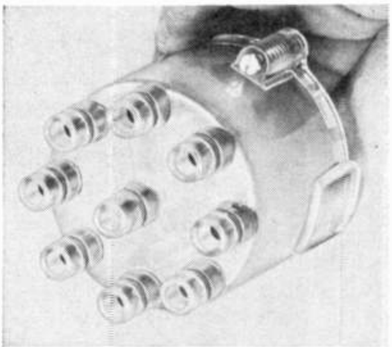
One of the first—and most common—terms is *ballast resistor*. This high-wattage, low-ohm resistor (generally 1.0-1.5 ohms) is simply a current limiting device in series with the primary of the original equipment ignition coil. In many recent cars, this ballast resistor (as a physical element) has been replaced by *ballast wiring* somewhat similar to a resistance line cord. It is frequently omitted in cars with 6-volt batteries, but in one form or another is a *must* in 12-



This basic ignition system developed by Kettering has not changed significantly in the past 40 years although automotive engines have made tremendous advances. The simplicity of this system is remarkable. As the points close, current flows through the ignition coil, building up a magnetic field. As the points open, the field collapses, producing a surge of counter-EMF in the coil secondary on the order of nearly 20,000 volts. The capacitor across the points attempts to suppress the arcing as the points open and close thousands of times per minute. As the text indicates, this system has outlived its usefulness and will undoubtedly be replaced by some form of transistor ignition in all cars by 1966.



General Electric is offering these two meters to check on the performance of transistor ignition systems. One meter reads the primary current (up to 15 amperes), the other the point current (up to 1.5 amperes). They are available from G.E. outlets, or directly from J.G. Bowman & Co., 221 West 79 St., Chicago, Ill. 60620 as Models BOW-47 and BOW-48 at $13.60 each, net plus postage.



Some distributor caps will not withstand the extra high voltages generated by the high turns-ratio coils. This transparent distributor cap was designed for ignition systems where voltage leakage is a problem. Called the "Transpark," it is sold by Estes Engineering Co., 1639 W. 135 St., Gardena, Calif., for only $6.95.

volt automobiles. The ballast is occasionally bypassed or shorted out of the circuit when starting the car engine. This is done to insure maximum current flow to the ignition coil during cold weather when battery capacity is at its lowest value.

Instructions supplied by the manufacturers of transistor systems almost always explain what must be done about ballast wiring or the ballast resistor. A suitable method of overcoming the problem of ballast wiring is discussed further on in this story.

Positive and *negative grounding* are two more terms found in the auto mechanic's vocabulary. As any electronics enthusiast knows, the type of grounding simply means which pole of the car battery is electrically attached to the automobile frame. While the basic idea of such a grounding method is excellent, it has complicated the life of the transistor ignition installer. Quite "thoughtlessly," the auto manufacturers also grounded the stationary distributor breaker point. Had this not been so, positive ground transistor systems would be cheaper and the circuits of many other systems much simpler.

When the mechanic speaks of the *spark*, he may be using the term in any number of ways. Rather than explain all possibilities, let's look at the spark from the modern-day, high compression engine's point of view.

The basic purpose of any ignition system is to deliver a periodic high voltage to four, six, or eight spark plugs. This high voltage can be considered a pulse and must have sufficient energy to cause an electrical spark to jump between two electrodes at the base of the plug spaced between 0.025 and 0.040 inch apart. It must also overcome the resistance at the gap induced by the high gas pressure (up to 200 pounds-per-square-inch) and varying fuel-air mixtures. These conditions require voltages up to 25,000 volts. Voltages supplied to the spark plug beyond this level do not necessarily improve engine performance.

Ignition Coil Specifications

80 to 100:1 TURNS-RATIO

Primary resistance	1.5 ohms
Primary inductance	6.0 millihenrys
Secondary resistance	15,000 ohms
Secondary inductance	100.0 henrys
Reflected primary voltage*	250 volts
Peak primary current**	3.3 amperes

250:1 TURNS-RATIO

Primary resistance	0.33 ohm
Primary inductance	1.0 millihenry
Secondary resistance	8200 ohms
Secondary inductance	64.0 henrys
Reflected primary voltage*	100 volts
Peak primary current**	7.7 amperes

400:1 TURNS-RATIO

Primary resistance	0.34 ohm
Primary inductance	1.3 millihenrys
Secondary resistance	15,000 ohms
Secondary inductance	130.0 henrys
Reflected primary voltage*	62.5 volts
Peak primary current**	6.8 amperes

**Based on a secondary output voltage of 25,000 volts*
***Based on an optimum energy storage of 30 millijoules or 30 milliwatt-seconds to develop a secondary output of 25,000 volts*

There are other somewhat critical factors involving *RC* time constants and ignition coil secondary resonant frequencies that will not be discussed here. However, it can be shown that the system must store roughly 30 millijoules of energy in the primary of an induction ignition coil. This applies to all engine speeds and to transistor coils with special turns-ratios.

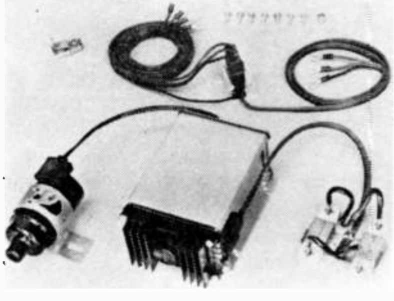
The table on this page details the three basic types of ignition coils in use with transistor and conventional systems. Specifications are given for the other parameters that affect ignition systems, such as: approximate reflected voltages returned by the secondary to the primary; d.c. resistances; peak primary current.

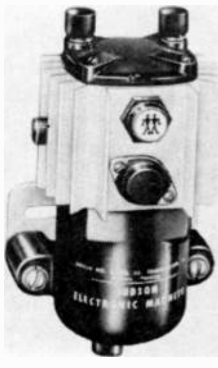
Desired Advantages. Let's briefly review what we hope to gain or accomplish by switching from the proven-in-practice Kettering ignition system to some form of transistorized switching.

The Kettering system was plagued by two problems—one a direct result of the other—plus an inherently weak component. The initial problem was generated by the acceptance of a compromise between reasonable breaker point life and the maximum current these points could handle. It is known that reasonable point life can only be expected when the maximum current is maintained under 4 amperes. Since automotive engine theory establishes that 30 millijoules must be ideally stored in the ignition coil primary, we can see how the Kettering compromise was resolved.

Obviously, millijoule storage is related to inductance in such a manner that with 4-amp. maximum primary current flow the turns-ratio of the coil cannot exceed 100:1. This was fine, except that the inductance of the primary of a 100:1 turns-ratio coil prohibited the development of 30 millijoules of energy when the engine was speeded up. In fact, the available voltage at the secondary of a standard ignition coil drops to about 37 per cent of the desired level when a 6-cylinder engine is turning over

Somewhere among these three approaches to transistor ignition is the answer to the problem of getting peak performance from high compression engines. At left is the Motion EI-4, a capacitive discharge system. In the center is the new Judson magneto with zener diode and transistorized regulation. At right is an example of the popular inductive system (based on Kettering coil idea) as represented by a Mallory Electric unit.





TRANSISTOR IGNITION

at 4000 rpm. This is so simply because the high primary inductance of the standard coil does not have enough time to store up 30 millijoules of energy.

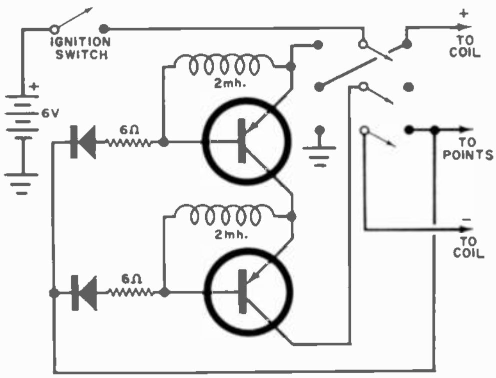
When the Kettering system was invented, engines ran slower and compression ratios were substantially under those in the modern automobile. Thus, the Kettering system has outlived its usefulness, for to keep point current down and still store 30 millijoules of energy, the ignition coil primary inductance must be increased. Now that engines run faster and have more compression, we need those 30 millijoules of energy at all speeds.

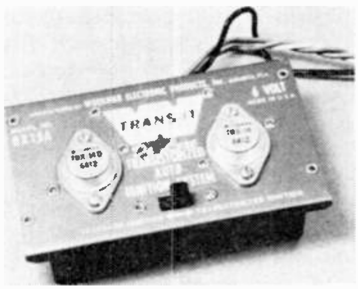
The desired method of accomplishing that end would be to maintain, or lower, the breaker point current and increase the inductance of the coil primary. But since this would not be possible, an alternative had to be proposed—first find a device to switch higher currents. Here is where transistors came into the picture.

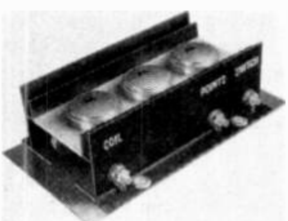
Fortunately, with transistors you can make and break more current than the 4 amperes "reasonably" handled by the distributor breaker points. By inserting a transistor circuit in the ignition system, you can turn on and off between 10 and 12 amperes while the breaker points are handling less than 750 ma.!

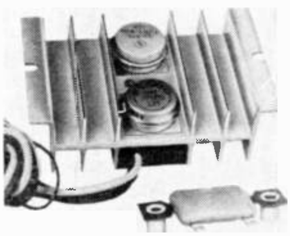
Since we now have more current available for the coil—meaning that the d.c.

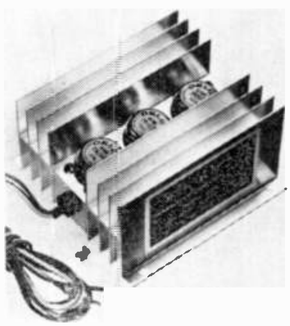
One of the most popular transistor ignition circuits was derived from the "Operation PICKUP" article in the June 1963 issue of POPULAR ELECTRONICS. Below are four slightly different versions of that circuit. At bottom, left, is the Delta Electronic "Trigger." At bottom, center, is the Gavin A-4 which has the third transistor inverted below the heat sink. At bottom, right, is the newest model on the market, the Ignition Engineering N120. The circuit diagram and photo at top, right, are of the Workman "Trans-it"—the cheapest transistor system found in our survey. Note that the "Trans-it" uses only two transistors and incorporates a switching arrangement to revert back to original-equipment ignition—should the system fail in operation!

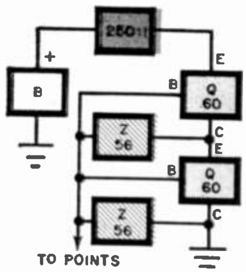




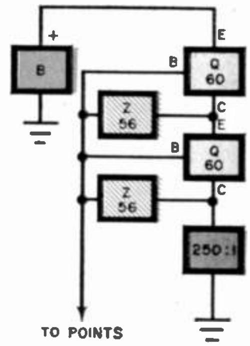




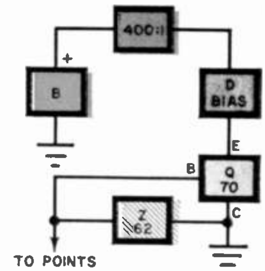




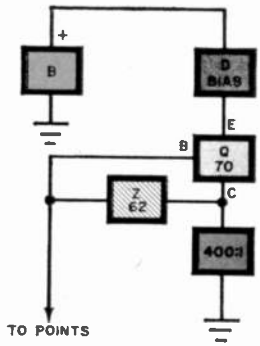
Circuit 1.



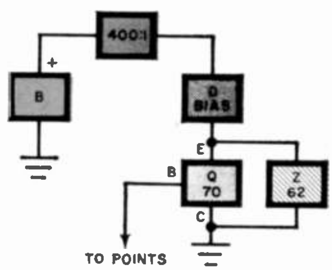
Circuit 2.



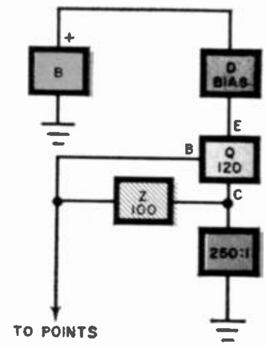
Circuit 3.



Circuit 4.



Circuit 5.



Circuit 6.

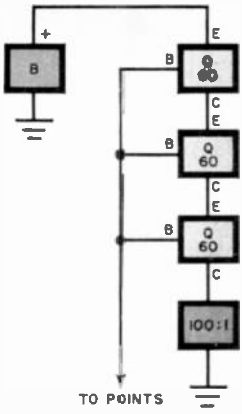
resistance must be dropped and inductance reduced—a coil redesign was necessary. Much of the credit for this redesign should go to the people at Motorola. They started with the assumption that they would have unlimited primary current available and worked from the coil secondary backwards—establishing the "worst possible case" of fouled spark plugs, high compression, rich fuel mixture, etc. The result was a 250:1 turns-ratio coil with the specifications outlined on page 36.

Contrary to advertising claims, higher turns-ratio coils *do not always* mean better engine performance—except at very high speeds which on the modern car would be out beyond 80 m.p.h. The higher turns-ratio does have the advantage that the transistor circuit can be made simpler and—in the case of marginal systems—somewhat safer to use and keep going. Between a well-made system using either a 250:1 or 400:1 ratio ignition coil there is little choice.

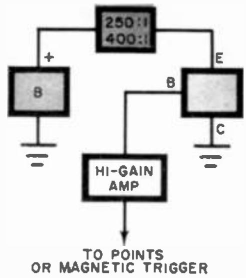
Actual Advantages. With a transistor system, there is negligible breaker point wear since the current has been drastically reduced. Point life exceeding 25,000 to 40,000 miles is not uncommon. Just what the ideal point current should be has not been established. Some manufacturers believe that 100 ma. is about ideal, although several transistor systems on the market operate satisfactorily with a point current around 1.0 ma.! Apparently anything under 750 ma. assures positive operation, no overheating or bluing, and no contact-to-contact metal transfer.

A lower primary inductance coincident with a higher ignition coil turns-ratio results in much improved high speed engine operation and no rpm miss with its consequent fuel loss.

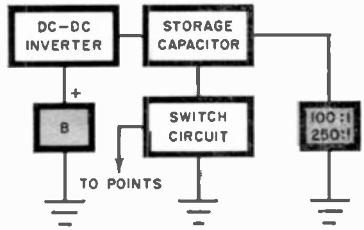
Removing the capacitor across the breaker points eliminates a possible trouble spot. A capacitor across the points when a transistor system is installed would be "gilding the lily" since the voltage seldom exceeds 15 volts and the energy previously absorbed by the capacitor is now safely controlled by other components in the transistorized system.



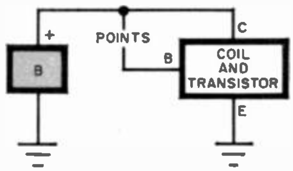
Circuit 7.



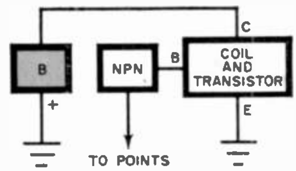
Circuit 8.



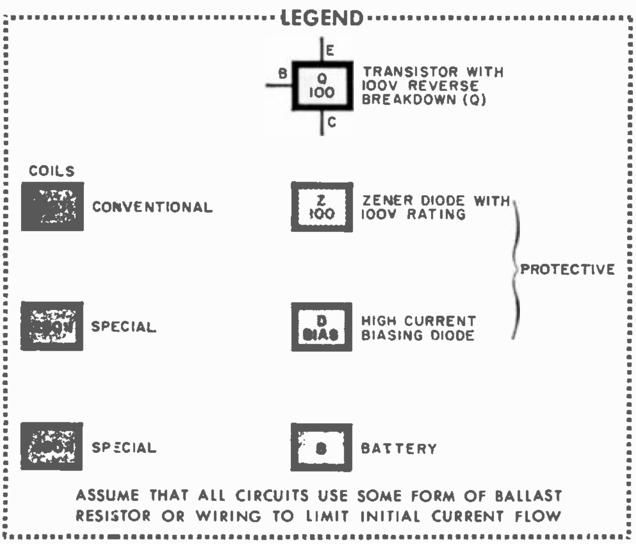
Circuit 9.



Circuit 10.



Circuit 11.



The evolution of transistor ignition can be seen in the 11 block diagrams above. Circuit 1 is the original Motorola "hot coil" design, followed by the "cold coil" and the three subsequent single-transistor circuits permissible because of the lower kickback voltage from higher turns-ratio coils. Better transistors resulted in Circuit 6, which is now considered to be an ideal compromise. POPULAR ELECTRONICS' design, "Operation PICKUP," introduced a new approach, as seen in Circuit 7. The last four circuits indicate trends under development, including magnetic pulse triggering and capacitive discharge systems permitting faster spark plug firing times. Circuit 11 shows that positive grounding is possible by simply adding a large npn transistor. These diagrams are cross-referenced to the list of commercially available units appearing on pages 41 to 43.

Circuit Configurations. In analyzing as many transistor systems as possible for this article, the fact that many of them are distinctly similar was uncovered—even though they may be packaged differently by different manufacturers. To demonstrate the subtle differences in various transistor ignition systems, the block diagrams on these two pages have been prepared. The circuit family identification has also been carried over into the master listing of systems on pages 41 through 43.

Circuit 1 is the design which resulted from the Motorola studies. It it sometimes referred to as the "series-stacked" circuit, meaning that the coil current is passed through two transistors. Although at its inception the idea of two transistors was quite valid—the cost of two medium-voltage transistors was then less than that of a single high-voltage semiconductor—technology has outstripped this design and the new diffused base transistor with high reverse voltage characteristics makes a single-transistor system quite feasible.

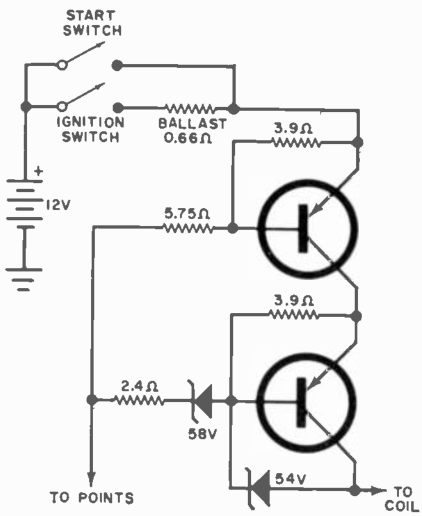
Circuit 2 is almost identical to *Circuit 1* except for the location of the ignition coil. In both of these circuits a 250:1 ratio coil is used with two transistors possessing a breakdown voltage

TRANSISTOR IGNITION

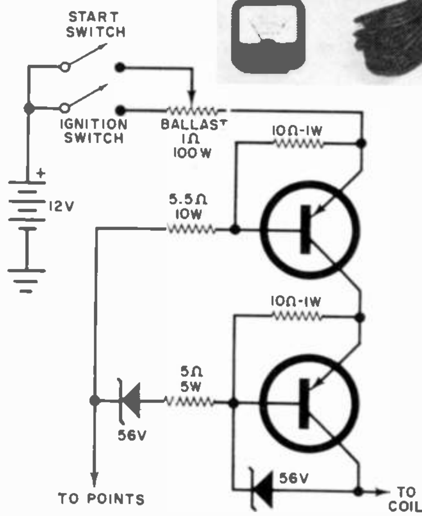
rating of at least 60 volts *(BV_{cbo})*. One-watt zener diodes with 58-volt ratings clamp the base circuits of the transistors and will turn the transistors on if the zener breakdown is exceeded.

An improvement over the series-stacked transistor arrangement is shown in *Circuit 3*. This design includes a mild compromise made by increasing the

Motorola's TR12N is of the "cold coil" configuration known throughout this article as Circuit 2. The parts values are specially selected and the transistors have a breakdown of 100 volts at 10 ma.



This Heathkit GD-212 system differs slightly from the Motorola unit at the bottom of the page so far as parts values are concerned, and uses slightly different transistors. The coil ratio in this circuit is 250:1. Meter is used to establish current in ignition coil.



coil turns-ratio to reduce the reverse or kickback voltage. This measure permits the use of a low-cost, low-voltage transistor; hence the cost to the ultimate consumer is lower. In the circuit we see a new component: the bias diode, which places the transistor in a condition where the collector-to-emitter breakdown can be protected in a safe and reliable fashion. The base operating voltage of the transistor is clamped by a 1-watt zener diode. This circuit is sometimes referred to as the "hot coil" circuit, for obvious reasons.

Moving the coil to the collector side of the single transistor (now a "cold coil") results in the arrangement shown in *Circuit 4*. *Circuit 3* and *Circuit 4* function equally well, although a small amount of energy is lost in *Circuit 4* because the base-emitter current does not flow through the ignition coil.

Another adaptation of the single-transistor system appears in *Circuit 5*.

(*Continued on page* 44)

Manufacturers of Transistor Ignition Systems

COMPANY	MODEL	PRICE	COMMENT
Alco Electronics Products 3 Wolcott Ave. Lawrence, Mass.	Trans-Power TP-3N	$39.95N	Modified version of Circuit 2 without zener diode protection. Uses feedback from ignition coil to reverse-bias the two transistors. Not tested.
Allied Radio Corp. 100 N. Western Ave. Chicago 80, Ill.	51N421	$29.95N	Identical to Leece-Neville top-quality 11EA system. Tested favorably.
Alma Engineering 3135 Engineer Rd. San Diego 11, Calif.	Mk VII Mk VI Mk V-C	$39.50N $64.95N $79.95N	Circuit not revealed by manufacturer. Top price model designed for dragging and competition according to manufacturer. Not tested.
Automotive Electronics Co. 387 Park Ave. South New York, N.Y. 10016	AEC-77 AEC-7E7 (PNIP kit) AEC-77 (pos. gnd.) AEC-7M7 (marine)	$39.95N $29.95N $39.95N $49.95N	Straightforward design using Circuit 5. Sturdy, well-built of consistently good quality components. Sold with 3-year guarantee. Tested favorably.
Autronics, Inc. 2410 Airline Way Phoenix, Ariz.	A-15	$60.00N	Well-built model using "hot coil" system shown as Circuit 1. Tested favorably.
Delta Electronic Co. 1021 North 22nd Ave. Phoenix, Ariz.	Trigger	$16.50N	Slightly modified version of Circuit 7 derived from "Operation PICKUP." Not tested.
Delta Products 221 North 5th St. Grand Junction, Colo.	Transnitor Mk 5	$39.95N	Slightly modified version of Circuit 8. Tested favorably. All products from this manufacturer have a 50,000-mile guarantee.
"	Thunderbolt Mk-10	$99.95N	Very modern version of Circuit 9 permitting continued use of original ignition coil. Tested favorably.
"	Thunderbolt Mk-15	$129.95N	Same Circuit 9, but triggered by simple attachment to distributor.
e.c.i. 325 N. MacQuesten Parkway Mt. Vernon, N.Y.	Spitfire	$24.95N	Unknown circuit. Not tested.
Electrotone Laboratories, Inc. 128-138 South Paulina St. Chicago 12, Ill.	SS-1 SS-1P (pos. gnd.) SS-2 SS-2P (pos. gnd.)	$29.95N $34.95N $39.95N $49.95N	All are versions of Circuit 5 with positive ground adaptations as indicated. SS-2 models include load relay and quick changeover switch. Tested favorably.
Gavin Instruments, Inc. Depot Square & Division St. Somerville, N.J.	A-4	$34.95N	Assembled version of Circuit 7 derived from "Operation PICKUP." Very well made. Tested favorably.
Heath Company Benton Harbor, Mich.	GD-212	$17.95N	Kit to build Circuit 2 based on the "cold coil" system. Tested favorably.
"	EI-4	$95.00N	Same model as Motion EI-4.
Holley Carburetor Co. 11955 E. Nine Mile Rd. Warren, Mich.	TPI	$99.95L	Two-transistor system based on Circuit 8. Using magnetic triggering from special distributor attachment to pulse ignition coil. Not tested.
Ignition Engineering Co. 501 S. Arroyo Parkway Pasadena, Calif.	N120 P120 (pos. gnd.)	$22.95N $26.95N	Kit to build well-made copy of Circuit 7 derived from "Operation PICKUP." Not tested, but should operate as claimed.

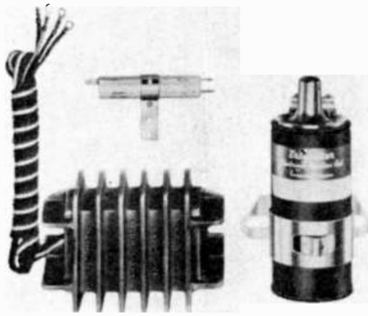
Manufacturers of Transistor Ignition Systems

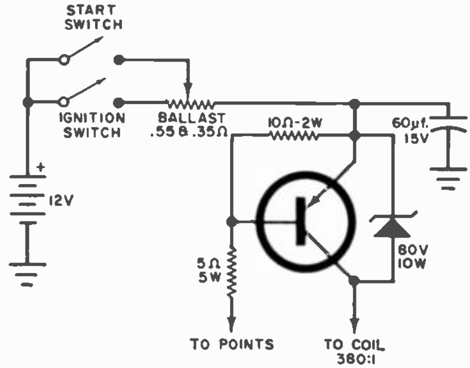
COMPANY	MODEL	PRICE	COMMENT
Judson Research and Mfg. Co. Conshohocken, Pa.	Electronic Magneto	n.a.	Replaces original ignition coil with magneto-type generator. Transistorized with zener protection. Very fast rise time at spark plug. Not tested, but sold with 3-year warranty.
Lafayette Radio Electronics 111 Jericho Turnpike Syosset, L.I., N.Y.	AA-180	$19.95N	Identical to system manufactured by e.c.i. Not tested.
"	AA-226	$29.95N	Identical to system manufactured by N.E.L.I. as the "Trans-Spark." Tested favorably.
The Leece-Neville Co. 1374 East 51st St. Cleveland 3, Ohio	11EA	$59.00L	Slightly modified version of Circuit 6. Well-made. Tested favorably.
Mallory Electric Corp. 12416 Cloverdale Ave. Detroit 4, Mich.	All-in-One	n.a.	New system announced at press time. Single-unit design permits 5-minute mounting. Manufacturer states unit was designed to withstand high under-the-engine-hood temperatures.
"	Transistor Ignition	$78.50L	Circuit not revealed by manufacturer, but appears to be either Circuit 1 or 6. Tested favorably.
Motion, Inc., Div. of Tung-Sol 630 W. Mt. Pleasant Ave. Livingston, N.J.	EI-4	$95.00N	Cold-cathode tube version of Circuit 9. Spark has very fast rise time. Tested favorably. System may be replaced by SCR version when this is in print.
Motorola, Inc. Automotive Division 9401 West Grand Ave. Franklin Park, Ill.	TR6N TR6P (pos. gnd.) TR12N TR12P (pos. gnd.)	$65.00L $70.00L $60.00L $70.00L	Up-to-date version of original "cold coil" Circuit 2. Excellent construction. Tested favorably.
Nuclear Electronic Laboratories, Inc. 1370 Ygnacio Valley Rd. Walnut Creek, Calif.	Trans-Tune	$29.95L	Economy two-transistor system similar to Circuit 2 with minimum protection. Coil not supplied. Not tested.
"	Trans-Spark	$49.95L	Similar to Circuit 2 with 260:1 turns-ratio coil. Tested favorably.
"	Trans-nition	$69.95L	Modified version of Circuit 8 using four transistors (pos. gnd.) or three transistors (neg. gnd.). Well-made. Tested favorably.
Olson Electronics, Inc. 260 S. Forge St. Akron, Ohio 44308	AM-243	$17.99N	Simplified version of Circuit 4 without bias diode. Not tested.
"	AM-244	$24.98N	Circuit identical to that in manufacturer's Model AM-243, but also includes primary load relay. Not tested.
W. F. Palmer Electronics Labs. Carlisle, Mass.	Transfire T	$54.95L	Single-transistor variation of Circuit 3 without biasing diode. Not tested.
"	Transfire TX2	$64.95L	Two-transistor version of Circuit 2 with option of 250:1 or 400:1 turns-ratio coil. Not tested.

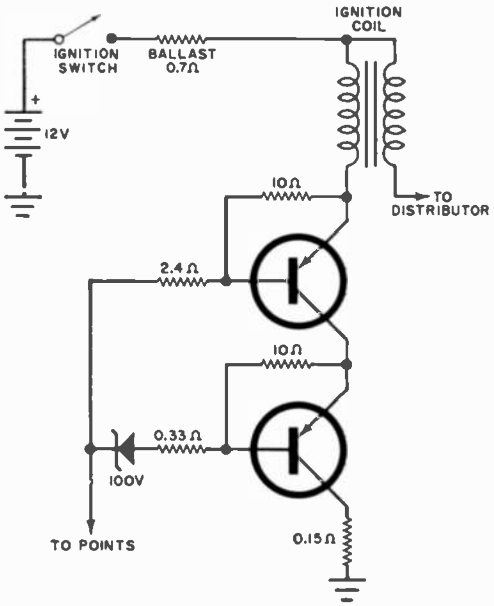
COMPANY	MODEL	PRICE	COMMENT
Prestolite Division of Eltra Corp. P.O. Box 931 Toleco, Ohio	Transigniter 201	\$75.00L	Adaptation of "hot coil" system shown as Circuit 3. Includes "load relay" to circumvent ignition wiring problems. Sold with 30,000-mile or 3-year guarantee. Tested favorably.
"	Transigniter 250	\$63.35L	Adaptation of "cold coil" system shown as Circuit 4, No "load relay." Sold with 30,000-mile or 3-year guarantee. Tested favorably.
Radatron, Inc. 232 Zimmerman St. N. Tonawanda, N.Y.	Mk IV	\$49.95N	Exact circuit not revealed, but probably identical to Circuit 4. Sold with plug-in connector to convert back to standard ignition, and with 3-year guarantee. Not tested.
Radio Shack Corp. 730 Commonwealth Ave. Boston 17, Mass.	121244	\$19.88N	Similar to the e.c.i. model. Not tested.
"	121248	\$19.95N	Similar to the Radatron model. Not tested.
Slep Electronics Co. Box 178, 301 Highway Ellenton, Fla.	TS-30 Banshee F-250T TS-30 Banshee F-400T TS-30 Banshee F-500T TS-30 (pos. gnd.)	\$39.95N \$44.95N \$49.95N \$59.95N	Version of Circuit 3. Available with different turns-ratio coils. Model received has no diode protection or biasing. Two transistors in parallel.
Workman Electronic Products, Inc. Sarasota, Fla.	Trans-it	\$11.75N	Two-transistor version of Circuit 7 based on "Operation PICKUP" design. Has switch to permit user to revert to original system. Not tested.
World Radio Laboratories, Inc. 3415 West Broadway Council Bluffs, Iowa	55N074	\$39.95N	Identical to N.E.L.I. "Trans-nition."
"	59N002	\$10.77N	Identical to Workman "Trans-it," but without changeover switch (60¢ extra).

Notes: L—List price (usually the price payable when system is purchased from an automotive parts supplier)
N—Net price (price commonly available to electronics experimenters from radio parts jobbers and via mail order)
n.a.—Price not available at publication time

EDITOR'S NOTE: In preparing this article, the author solicited information from all known manufacturers of transistor ignition systems. Twelve manufacturers ignored his requests for information as well as letters and telegrams from the editorial staff of POPULAR ELECTRONICS. As far as our combined "intelligence" resources could determine, the products of the missing manufacturers have either been discontinued or are of such a quality as to make inclusion of circuitry details embarrassing. Also not included in the above list is Delco-Remy, whose transistor system (magnetically triggered) is offered as optional equipment on Pontiac and Tempest 1964 model cars; this system is somewhat expensive (about \$75.00) and is available only as original equipment or as installed by a GM dealer. Several European systems can be obtained in the U.S.A., including those of Simes Sas di V. Norzi (Milano, Italy), Joseph Lucas, Ltd. (Birmingham, England), and Ducellier et Cie (Paris, France), but insufficient information was available on these three European systems to include them in the above list. Several new companies were coming into the market while this story was being prepared, and one that might be worth contacting for information is Micro-Kits Co., Box 494, Paramount, Calif.



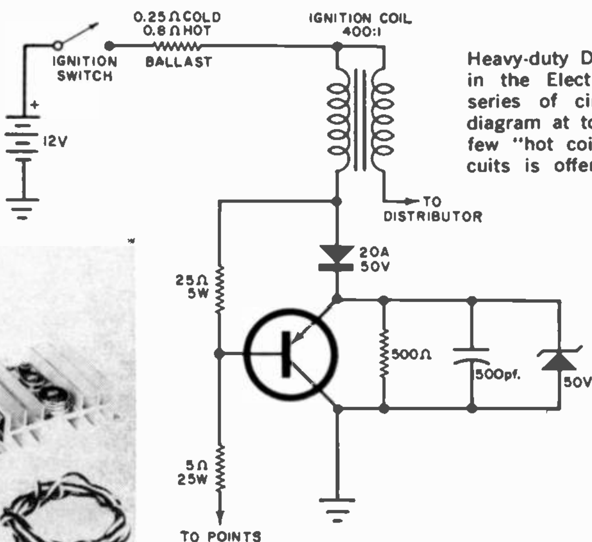




Technically an emitter-follower circuit, the zener diode is made larger and is now placed across the collector-emitter. This placement of the zener diode effectively protects the transistor should voltage transients or "spikes" be induced in the circuit. In most manufactured systems employing this circuit, the zener diode is paralleled with a 500-pf. silver mica capacitor which affords extra protection by effectively storing or integrating extremely fast transients and allowing them to be more readily handled by the zener.

The introduction of low-cost germanium transistors manufactured by the diffused base process raises the breakdown voltage to 120-160 volts. These transistors can then be used in the manner

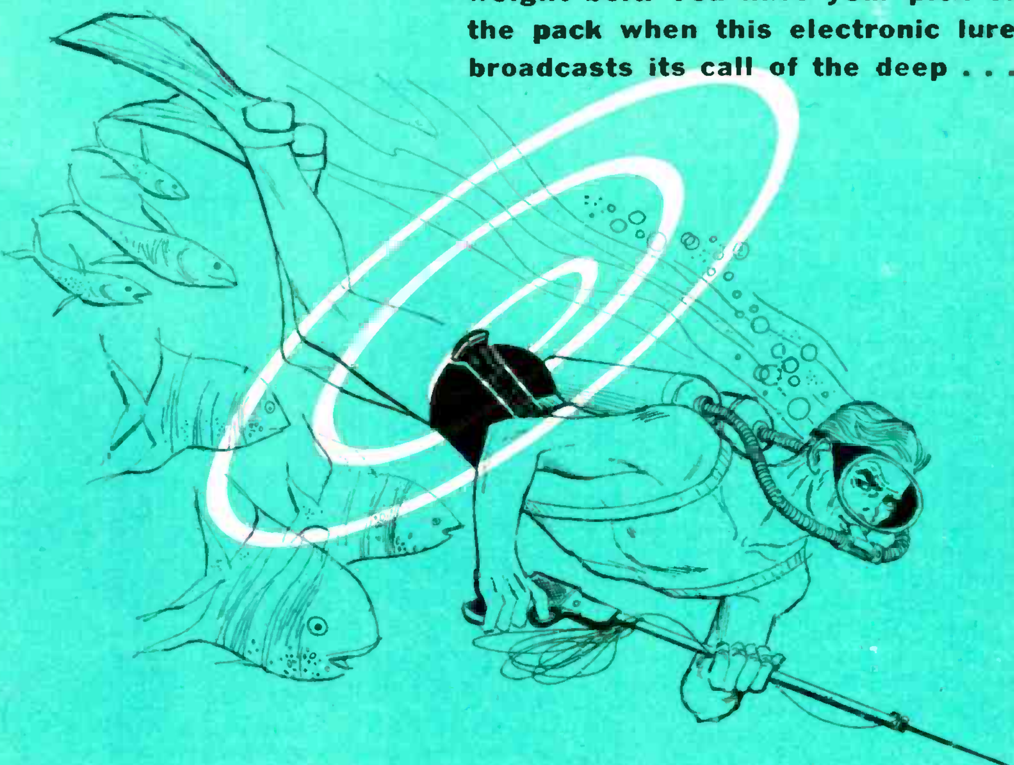
(*Continued on page* 85)



Heavy-duty DAP transistors are used in the Electrotone Laboratories SS series of circuits (see photo and diagram at top of page). One of the few "hot coil" Motorola-derived circuits is offered by Autronics in its Model A-15; this circuit is shown at left, center. Directly at left is the AEC-77, a version of Circuit 5 (page 38) using top-rated components. The AEC-77 is sold with optional load relay.

"CQ FISH"

Fish can't resist this CQ from a weight belt. You have your pick of the pack when this electronic lure broadcasts its call of the deep . . .



By BILL BILLICK

ELECTRONIC FISH LURES have been used for years by "stick" fishermen. Such lures depend on the low intelligence level of the fish, and have actually worked well. While it is dubious that anybody ever psychoanalyzed a fish, the great attraction would seem to be that the noise emanating from the lure sounds like food. Another theory is that all fish do not dine in the same fashion, and what might sound like food to one would just arouse the curiosity of another. In either case, the fish is lured to his ultimate destruction!

Double-Duty Lure. The fish lure described here can be employed with a fishing rod or by a skin diver. The housing of a pressure-proof skin-diving flashlight permits its use at depths up to 200 feet. To use the lure with a rod, you lower it into the water after turning it on and replacing the end-cap. A skin diver should turn the unit on before entering the water. The flashlight housing can be attached conveniently to a spear gun, weight belt, or a line.

The transistor circuit is a simple Hartley oscillator whose tone or repe-

"CQ FISH"

Completed unit fits into watertight flashlight case after works come out.

tition rate is determined by R/C circuit *R1*, *R2* and *C1*. By varying potentiometer *R2*, you can create any sound from that of a bee to a grasshopper through the high-impedance dynamic earphone.

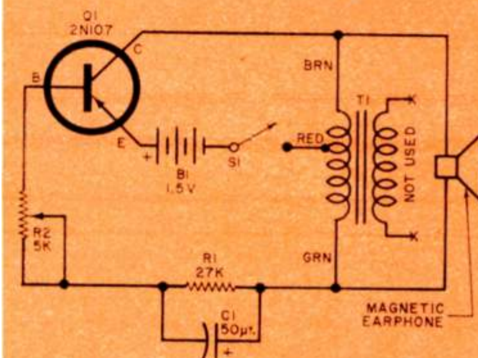
Construction. To build the unit, start by stripping the skin-diving flashlight down to its shell. Remove all switches, springs and hardware. Next, fill all holes with cement, using epoxy or household cement. Make sure the rubber gaskets (included with the original flashlight) seal all the openings when the basic flashlight is reassembled. You can test for leaks by submerging the unit in water and watching for air bubbles.

Cut a perforated mounting board into two pieces. One piece should be 4½" x 1¾"; the other is formed into a circle of about 1½", or to fit the lens area of your flashlight. Cement the circle to the end of the rectangular board as shown in the illustrations. The bracket for switch *S1* is formed from scrap aluminum.

After you assemble the major components on the board, paying careful attention to the polarity of *Q1*, *C1* and *B1*, cement the back of the earphone to the center of the circular piece.

Testing. When the wiring is completed, turn the unit on and listen for the tone at the earphone. Varying the setting of *R2* should change the tone. If the unit works, coat all wiring with polystyrene "Q"-dope to minimize corrosion damage.

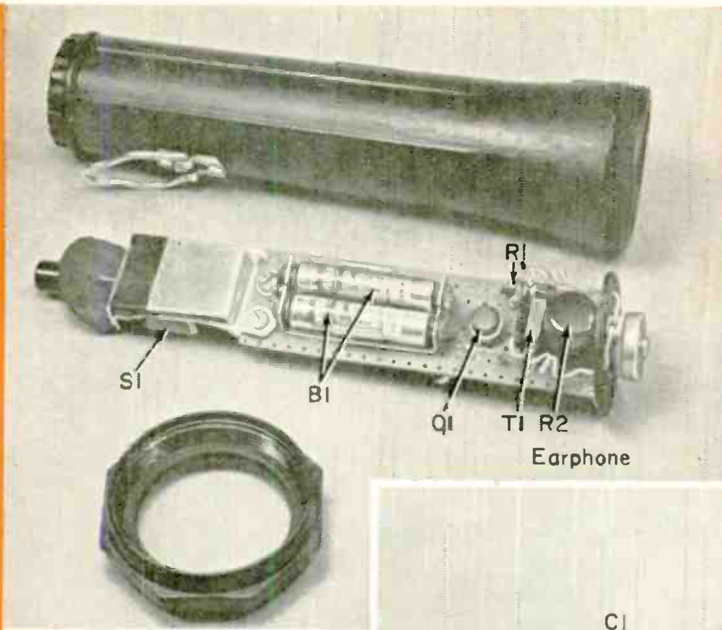
Now assemble the circuit into the flashlight housing and, once again, submerge the unit to make sure that it is watertight. If all is well, watch those fish sit up and QRZ! —30—



Switch S1 is a push-on/push-off type, and R1, R2, C1 determine frequency varied by potentiometer R2.

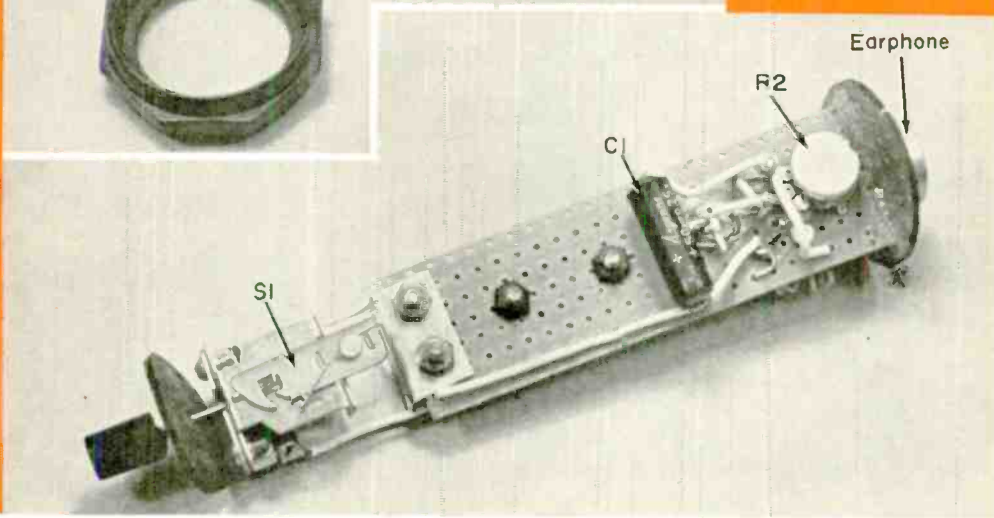
PARTS LIST

B1—1.5-volt battery (two Eveready #912's in parallel)
C1—50-µf., 25-volt miniature electrolytic capacitor
Q1—2N107 transistor or equivalent
R1—27,000-ohm, ½-watt resistor
R2—5000-ohm miniature potentiometer
S1—S.p.s.t. locking push-button switch
T1—Subminiature output transformer; 500-ohm, center-tapped primary, 8-ohm secondary (Lafayette TR-116)
1—Pressure-proof skin-diving flashlight (U.S. Divers, Voit, Sportsways, or equivalent—available at most sporting goods stores)
1—Battery holder, two-cell type
1—High-impedance earphone, 7000-ohm dynamic (Lafayette MS-260)
Misc.—Knob, transistor socket, switch bracket, perforated mounting board, wire, solder

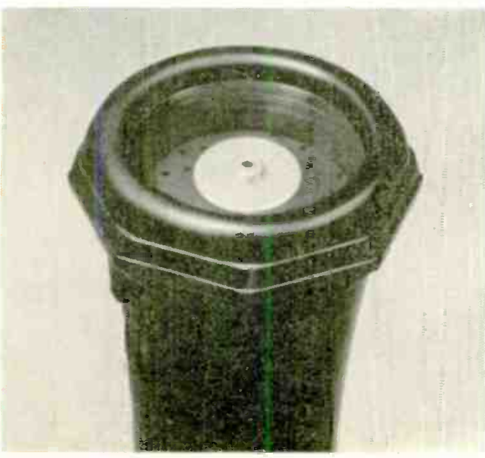


Earphone is mounted with cement on a disc cut from the perforated board.

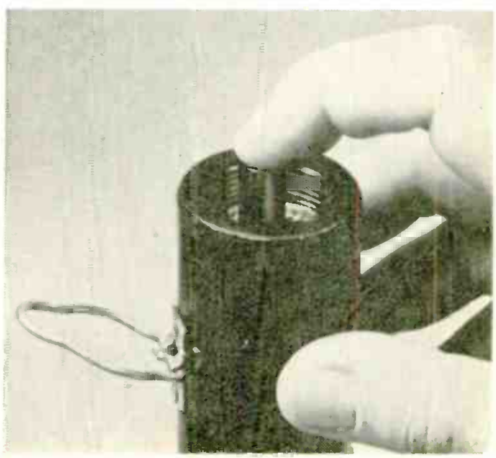
Switch is mounted on an aluminum bracket, bracket is attached to board.



Looking at front end, earphone which is used as a small speaker is protected by flashlight glass disc.

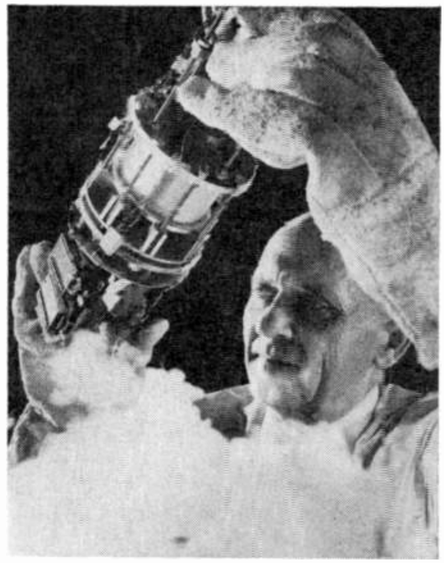


Turn unit on by removing end-cap and pressing S1. Set R2 to desired frequency, then replace end-cap.

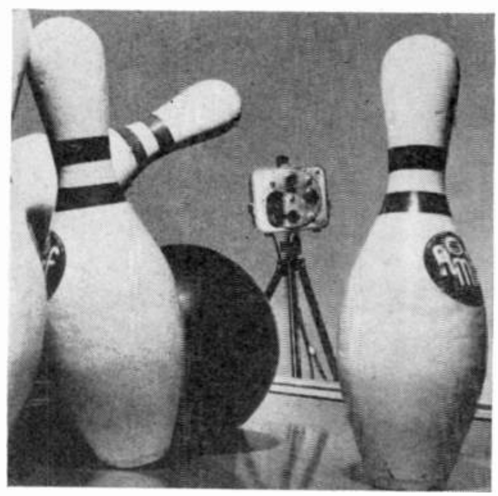


POPULAR ELECTRONICS news

COLD POWER—"Electric flux pump" converts 1 amp a.c. to 500 amps d.c. at temperature of −452° F. This GE device promises to make practical very powerful superconducting magnets.



CHEERS!—Champagne glass contains $10,000 in Hughes Microglass diodes. Heart of each one is junction as small as the period at the end of this sentence. Double glass seals protect unit, which is now in quantity production.



STRIKE!—A "TV training lane" at a Florida bowling alley permits bowlers to study the action of the pins as the ball hits. Installed by General Telephone, the system incorporates a camera and 23" television monitor.

FRIENDLY ROBOT—Goro is life-size radio-controlled robot developed by Jiro Aizawa, director of Tokyo toy research institute. Goro bows, shakes his head, talks, even winks at girls.

BUILD THE TUNE-TABLE

Double your pleasure, double your fun, listen to two sounds instead of just one!

By HOMER L. DAVIDSON

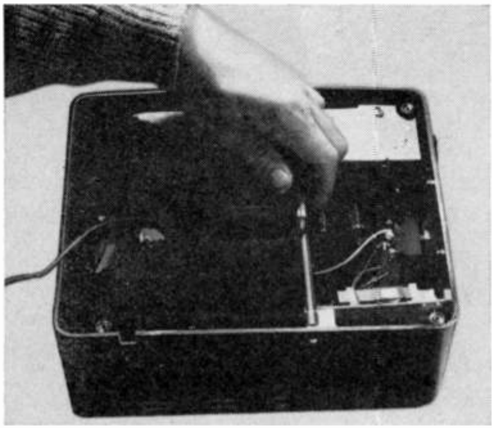
IF YOU HAVE A PHONOGRAPH and a little ingenuity, you can convert that turntable into a radio-phono combination—and very inexpensively. The tuner used in the conversion shown here is a Lafayette Radio Model PK-633 transistorized AM unit which costs less than eight dollars.

Circuit Description. The broadcast tuner is very small and should fit any phonograph. A complete information sheet, including a schematic diagram, is supplied with it. To make the "Tune-Table," you simply mount the tuner conveniently under the phono base and wire it to d.p.d.t. toggle switch *S1* (see drawing on next page).

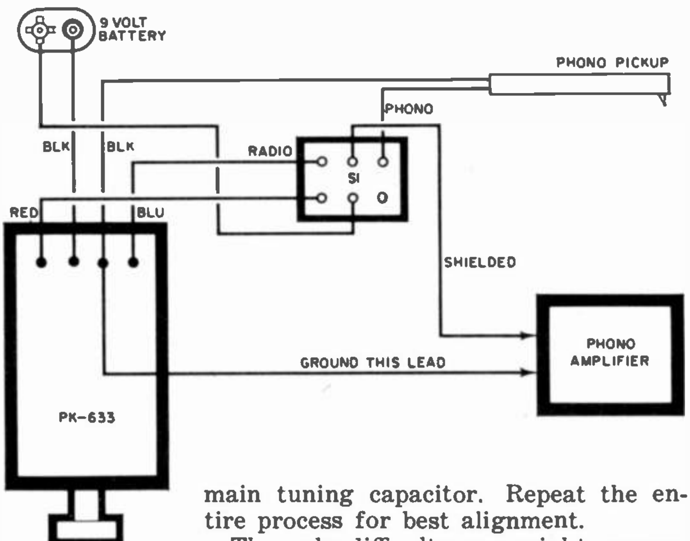
Switch *S1* has its center, or arm, contact on one side connected to the amplifier input, and the two outer poles connected so that the switch chooses either radio or phono. The arm contact on the other side of the switch is used to apply battery voltage to the tuner in the radio position, and remove the battery voltage from the tuner when the switch is thrown to the phono position.

Mounting the Tuner. Lock the phono arm so it won't bounce around, and invert the turntable. You'll probably find more than ample space to locate the tuner. Having done so, prepare the necessary mounting holes. For the tuning capacitor shaft, you will need a 3/8" hole, and you will also require a 1/2" hole for the toggle switch. A 1/8" hole to attach the mounting bracket will complete the mechanical work.

After wiring the unit, align the tuner. The easiest way to do this is to place the unit near a fluorescent light fixture and turn the volume control wide open.



Locate a convenient spot under the turntable, and mount the tuner on brackets; add switch.



Toggle switch S1 supplies the signal from the phonograph arm or the tuner to the amplifier.

Consulting the diagram that comes with the tuner, adjust *T2* and *T3* for maximum noise. Now turn off the fluorescent light and tune in a radio station near 540 kc. Adjust *T1* for best volume, then tune to a station near 1200 kc. and adjust *C2a* for maximum volume. Repeat the adjustment on *T1*, *T2* and *T3*.

A more critical alignment can be made with a signal generator. Take a piece of hookup wire and form two or three turns around the antenna coil. Hook the generator output to the ends of the wire loop. With the volume control on the phono-amplifier at maximum, set the generator to 455 kc. Short-circuit oscillator capacitor *C2* to ground, rendering the oscillator section inoperative. Adjust *T1*, *T2* and *T3* for maximum loudness in the small speaker. The tuning capacitor plates should be unmeshed at this point.

Remove the short from across *C2* and set the tuning capacitor to 5.4 on the dial. With the signal generator adjusted to 540 kc., tune *T4* for maximum volume. Keep the output of the signal generator at low levels during the whole alignment procedure. As volume increases in the receiver, reduce the output from the generator still further. *T4* is adjusted at the top of the oscillator shielded transformer. Now, with the tuner dial at 16, set the signal generator for 1600 kc., and adjust *C2a* and *C2d* which are the trimmer capacitors on the main tuning capacitor. Repeat the entire process for best alignment.

The only difficulty you might encounter is that your turntable may revolve while you listen to the radio. If you have a neutral position, you can use this to stop the turntable. Lacking this position, determine that your motor is operated directly from the line voltage, and add a switch to open the circuit. Some units use the phono motor as dropping resistor for the tube filament circuit. Obviously, shutting off the motor will also cut off the tube, eliminating any possibility of amplification.

Making this addition to your phonograph is an easy way to upgrade your listening pleasure. It will not take more than an evening's work to do the job, as the printed-circuit board tuner is completely wired, needing only installation and alignment to bring the stations in loud and clear. –30–

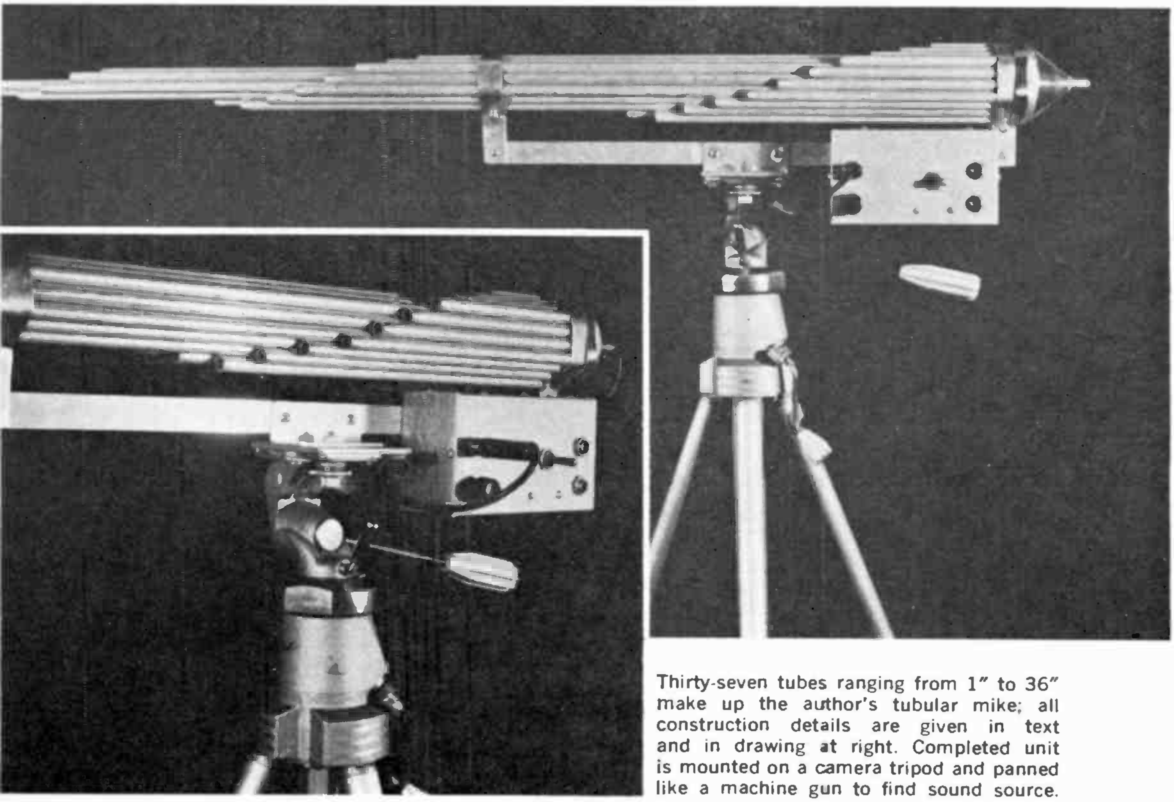
Build the SHOTGUN SOUND SNOOPER

Operating on "organ pipe" principles, this amazing tubular microphone amplifies distant sounds

By JAMES R. HOLLINGER and JOHN. E. MULLIGAN, K3TIB

ONE WINDY DAY last fall, the authors hustled a skeptical friend out into a field bordering on a wooded area to test a homemade long-range tubular microphone. Waiting until the friend had crossed the field and disappeared completely, we panned the mike toward the spot where he had last been seen. At first only the sounds of birds were heard; then, on the last swing, came the sound of crashing brush and a voice mumbling "Mary had a little lamb." When we told him later that we had enjoyed his nursery rhyme, he looked at us incredulously. At a range of 250 yards under adverse wind conditions, we had picked his voice out of the woods!

The tubular microphone, one of the less publicized but one of the most spectacular long-range listening devices, might be described as a bundle of open-end tubes designed to pick up and amplify sounds of different frequencies by virtue of different tube lengths. The principles involved are familiar: In re-



Thirty-seven tubes ranging from 1" to 36" make up the author's tubular mike; all construction details are given in text and in drawing at right. Completed unit is mounted on a camera tripod and panned like a machine gun to find sound source.

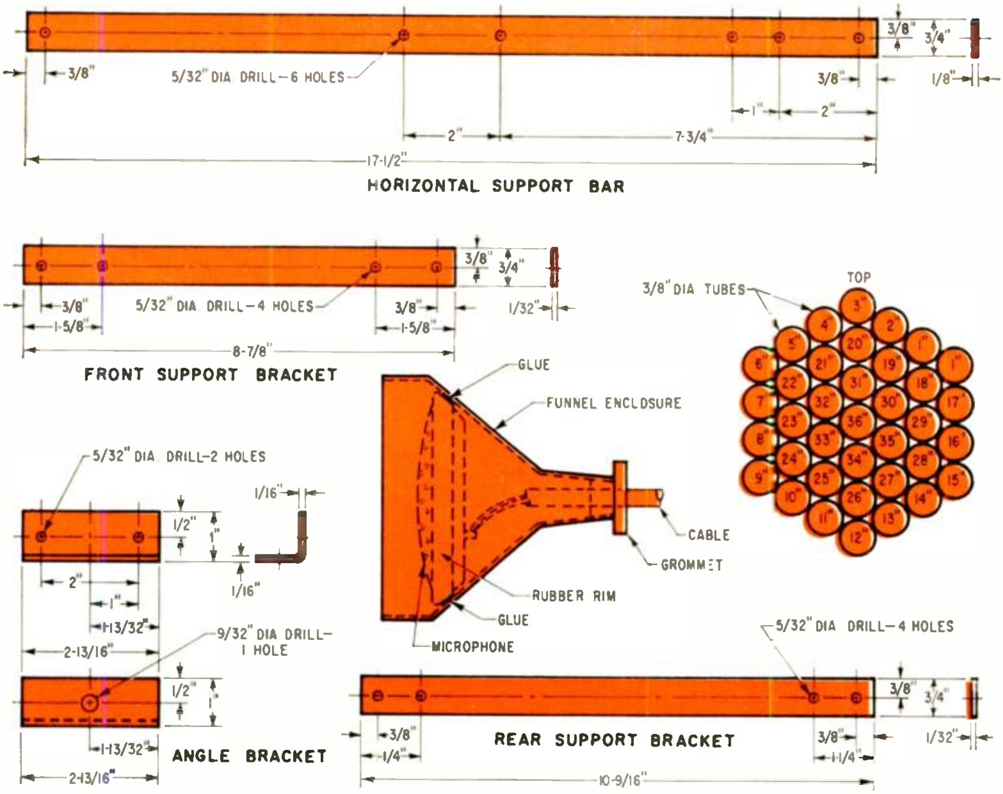
sponse to sounds of various frequencies, the air columns within each tube vibrate and, in doing so, amplify the original sounds.

Applications of the tubular mike, which has far greater sensitivity, better frequency response, and superior directional characteristics than parabolic types, are many. Bird and animal watchers are delighted with the added dimension of sound when it is applied to nature studies. Small boat operators may find the unit of value as a navigational aid, especially in fog or conditions of poor visibility. The tubular mike can pick up conversations from busy streets, and under the right conditions, can actually pick up conversation through closed windows 40 or more yards away. The mike described in this article works well with tape recorders, and has even been used with a 100-mw. CB walkie-talkie.

Design and Construction. As you might assume, tubes are cut to resonate over a specific range of frequencies. To calculate tube length, first find wavelength by dividing the speed of sound (1100 feet per second for practical purposes) by the frequency. For example, the wavelength of 256 cycles equals 1100 ÷ 256, or 4.296 feet. *Tube length,* however, is half this, or 2.14 feet, since tubes open at both ends resonate at a wavelength twice as long as their length.

In designing a tubular mike, it is necessary only to assemble enough tubes to cover the frequency range of sounds you want to hear. The exact number of tubes is not critical, but should be the greatest number that can be efficiently covered by the microphone element. The graduated lengths should be stepped evenly from the shortest to the longest so frequency nulls are avoided.

The "Shotgun Sound Snooper" is built with 37 aluminum tubes, 3/8" O.D., ranging from 1" to 36" in length, and graduated in 1" steps. The 37th tube is an extra 1" length added to complete the hexagonal symmetry of the pickup. The tubes can be conveniently cut from ten 6' lengths, using a tubing cutter or fine-tooth hacksaw. Dress the edges with a fine file to remove burrs. Assemble the



Easily worked aluminum is used for fabricating the pickup. The tubes can be conveniently cut from ten 6′ lengths of 3/8″ diameter stock, the support brackets from a sheet or strip of 1/32″ aluminum. The horizontal support bar is made from heavier stock. Angle bracket mounts to standard camera tripod.

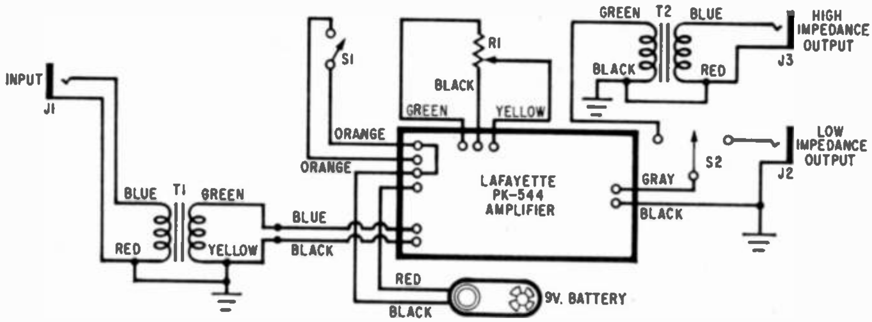
BILL OF MATERIALS FOR MICROPHONE

1—56′ length of 3/8″-O.D. aluminum tubing (ten 6′ lengths preferable)
1—Crystal microphone cartridge, approx. 2 1/8″-diameter (Lafayette PA-27 or equivalent)
1—Household funnel, 2 3/4″-diameter
1—3/4″-wide, 1/32″-thick aluminum stripping for support brackets, battery bracket (approx. 2′ required)
1—3/4″-wide, 1/8″-thick aluminum strip for horizontal support bar (approximately 1 1/2′ length required)
1—Standard camera tripod
Misc.—Glue (fast-drying rubber base contact cement or epoxy glue), 8-32 machine screws and nuts, rubber grommet, microphone cable, solder, etc.

tubes as shown in the drawing above, starting with the 36″ length and gluing the 35″ tube to it at at least three spots. The authors used fast-drying rubber base cement, but epoxy glue can be used for greater strength. In any case, be sure the tubes are flush at one end by checking each one against the others as you glue them in place.

Cut and drill the front and back support brackets from easily worked 1/32″-thick aluminum as shown in the drawings. The brackets are shaped around the tubes to form a tight fit; it will help if you bend each one at the exact center to form a slight V before you shape it. Make the horizontal support bar from 1/8″ aluminum as shown, and cut off a piece of aluminum angle to form the angle bracket.

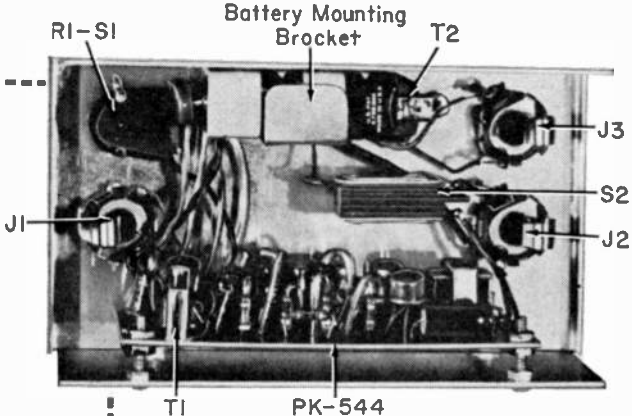
Cartridge Mounting. The microphone cartridge enclosure is made from a 2 3/4″-diameter household funnel. Hold the wide end to the tube cluster and mark the sides to indicate the corners of the hexagon shape. Place the funnel on a smooth, solid surface, and make dents at each of the six corners of the hexagon with a small ball peen hammer. With the flat head of the hammer, flatten the areas



Wire amplifier and other components as above; T2, S2, J3 are optional.

AMPLIFIER PARTS LIST

J1, J2, J3—Standard open-circuit phone jack
R1—10,000-ohm miniature potentiometer with s.p.s.t. switch S1 (Lafayette VC-28 or equivalent)
S1—Part of R1
S2—S.p.d.t. toggle switch
T1—Transistor input transformer; 200,000-ohm primary, 1000-ohm secondary (Lafayette TR-120 or equivalent)
T2—Transistor output transformer; 2500-ohm primary, 11-ohm secondary (Argonne AR-114 or equivalent)
1—Lafayette PK-544 5-transistor audio amplifier or other high-gain amplifier
1—9-volt transistor battery (Burgess 2U6 or equivalent)
1—Aluminum box, approximately 2 1/8" x 3" x 5 1/4" (LMB #136 or equivalent)
1—Miniature knob (Lafayette MS-185)
1—18" length of single-conductor shielded microphone cable
1—Set of headphones, high or low impedance
Misc.—4-40 x 5/8" machine screws and extra nuts, scrap aluminum, contact cement or epoxy glue, wire, solder, etc.



Follow parts placement indicated (unit is inverted in this photo) to avoid possible feedback problems.

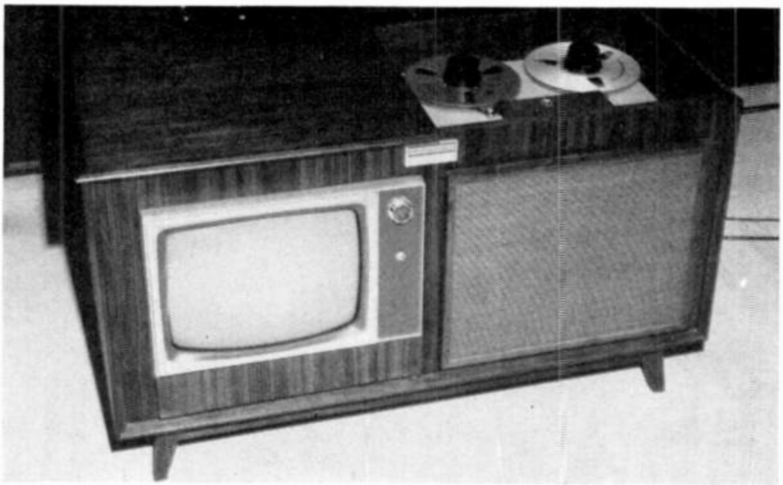
between the indentations for about 1/4" in from the edge of the funnel. Place it over the end of the tube cluster and peen again if necessary. A tight sliding fit is desirable, but a loose fit can be remedied with tape.

As shown in the drawing on page 53, the microphone cartridge is mounted in the funnel with glue. First connect a length of mike cable and install a rubber grommet in the small end of the funnel; apply glue to the rubber rim of the mike cartridge and to the funnel. Press the cartridge into the funnel, truing it up and clamping it into position until the glue is dry.

Final Assembly. Place the rear support bracket over the tube cluster 1/4" forward of the flush end and tighten it onto the cluster with a 6-32 x 3/8" machine screw and bolt. Install the front bracket the same way, and slide the horizontal support bar between the brackets, aligning the holes in the bar with the lower ones in the brackets. Bolt the horizontal bar in place along with the angle bracket for mounting the microphone to the pan head of a camera tripod. Now fit the microphone enclosure over the tubes; it can be taped on if necessary with a strip of masking or metalized Mylar tape around the enclosure and the rear support bracket. The Mylar tape is not necessary, but looks better.

The Amplifier. Weak or distant sounds naturally require a high-gain amplifier. For this purpose, the five-transistor Lafayette PK-544 is ideal, and the cost is low. The high-impedance microphone cartridge is matched to the low-impedance amplifier input with a transformer. The high-impedance output shown in the

(*Continued on page* 84)



TV tape recorder, shown installed in cabinet with set, will also be made as a separate unit. It requires three connections to TV: pickups for audio, video, and horizontal sync. Audio is recorded through a multiplex arrangement in which it is added to video to form a composite signal that is impressed on the tape. Separate record and playback heads are used.

U.S. Firm Announces Under $500 Video Recorder

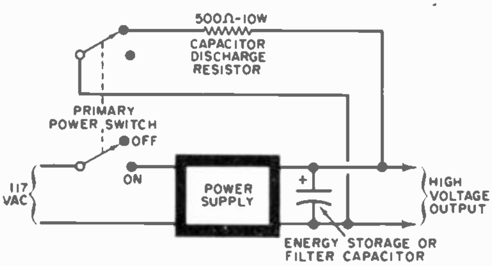
ANOTHER ENTRY in the race to perfect a low-cost sound-and-picture TV tape recorder for the home market was announced recently by Fairchild Camera and Instrument Company, which demonstrated a prototype machine capable of recording and playing back high-quality pictures, and carrying a price tag "somewhat under $500."

Using highly polished half-mil, quarter-inch instrumentation tape on an 11" reel—a reel would sell for $30 when mass-produced—the machine records for one hour on four tracks the same width as stereo tape tracks. Signals are impressed on each 15-minute track at a tape speed of 120 inches per second; the machine then slows and reverses automatically to begin on the next track. Total reversal time is 7 seconds.

The greatest innovations involved in building the recorder are in the wide-band electronic circuitry, according to Wayne R. Johnson, vice president and technical director of Fairchild's Winston Research Corp., and the man largely responsible for developing the machine. Approximately 50 silicon transistors are used in a record-playback amplifier that is "essentially flat to 2 mc. and only 6 db down at 2.25 mc." Evidence of the machine's startlingly wide bandwidth is that it can reproduce very complex TV pictures—dancers on a mammoth black and white checker board for example—with results as good as off-the-air reception. The recording head is a standard stationary instrumentation head with a gap of less than one micron.

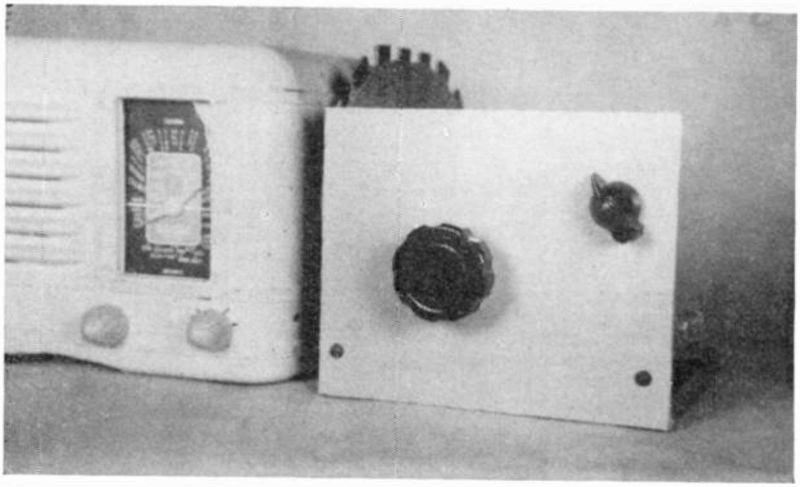
Although there are some similarities between the Fairchild and Telcan recorders (P.E., Sept., 1963, and Feb., 1964), they may be more apparent than real. The recording capabilities of the Fairchild machine are superior to those of Telcan as demonstrated. However, Johnson credited the British machine with "shaking us up and getting us going." Only time will tell who wins the home video recorder race. -30-

Shock-Proof Your Power Supply



SUPPOSEDLY dead power supplies can give you quite a jolt—filter capacitors will store a lethal charge for days, and high-capacity electrolytics such as those used in electronic flash units can give you a painful shock even months later. A simple safety device that will act as a bleeder even if the regular bleeder resistor fails is diagrammed at left. Simply add a resistor and use a d.p.d.t. on/off switch. -30-

SOUP UP THAT AM BROADCAST RECEIVER



By F. J. BAUER, Jr., W6FPO

Want to improve the sensitivity of your small receiver? Here are several ideas that really work

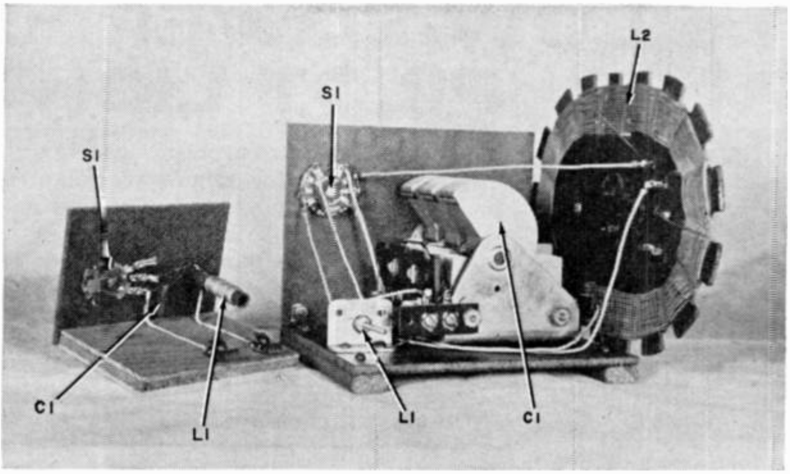
IF BROADCAST BAND DX'ing is your cup of tea, you are aware of the shortcomings of the "All-American 5" and the built-in loop antenna. As the loop is not just a signal catcher but also a part of the first tuned circuit of the receiver, you can't tamper with it without altering receiver alignment.

Simple Coupler. Will a coupler and long-wire antenna improve your reception? They certainly will, and here's a quick-and-dirty test to prove the point. String up a good antenna, the longer (at least 50 to 100 feet) and higher the better. Connect one end of this wire to a four- or five-turn coil of wire that you wind around your hand. The other end of the coil goes to a good water-pipe ground (Fig. 1). Now tune in a weak station and bring the coil of wire closer to the loop antenna on the receiver. See? The signal strength increases, and the weak station comes in strong. The next step is to build something permanent.

A Better Coupler. A better antenna coupler tunes the antenna to the frequency of the station you want to hear. It consists of an adjustable ferrite coil with a series capacitor that can be switched in or out of the circuit (Fig. 2). With the capacitor in the circuit, the upper half of the broadcast band is covered, and with the capacitor out of the circuit, the lower half is covered. You can adjust the ferrite coil to obtain optimum results.

Still Better. A more elaborate, more flexible coupler will work with any antenna length (Fig. 3). The author utilized parts available in the junk box, using coil *L2* for maximum coupling to the receiver. This coil was salvaged from an old receiver as was capacitor *C1*, made by paralleling the three sections of an old tuning capacitor.

Adjusting the Couplers. The first thing to do is determine the amount of "coupling" that will best suit your own



Looking at the backs of the two couplers diagrammed in Figs. 2 and 3, it's obvious that there isn't any complex wiring to be done. Use point-to-point wiring throughout, build panels of Masonite, wood scrap.

Fig. 1. Simple coupler consists of four or five turns of wire connected to a long (50'-100') antenna and good ground. To use, place coil near receiver's antenna.

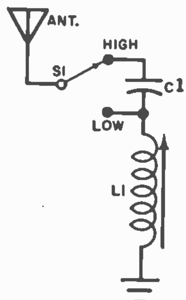


Fig. 2. Better coupler has s.p.d.t. switch to insert or remove 100-pf. capacitor C1. Ferrite antenna coil L1 fine-tunes antenna.

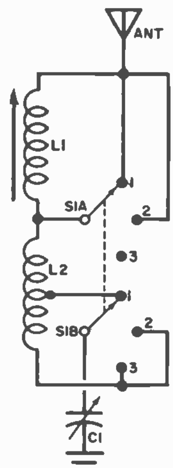


Fig. 3. This coupler is more flexible. A double-pole, 3-position switch selects portion of band to be heard, .001-μf. capacitor C1 fine-tunes.

system. ("Coupling" refers to the placement of your antenna coupler with relation to your receiver antenna coil.) There are two ways to do this. If you have a VTVM, connect it to the a.v.c. bus in your receiver. Now move the coupler closer to your antenna coil as you observe the meter. The voltage will increase—to a point—and then start to fall off. The best location for the coupler is where it was at that highest voltage point.

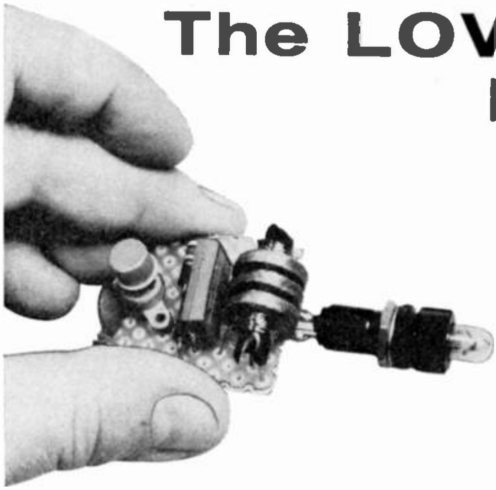
A simpler way to achieve maximum coupling efficiency is to place the antenna wire near a fluorescent fixture and couple for maximum noise in the receiver loudspeaker. In either case, do not increase the coupling beyond the optimum point, for over-coupling serves only to introduce interference with no increase in gain.

Using the Couplers. To use the coupler shown in Fig. 2, first select the switch position (capacitor *C1*—a 100-pf. unit in this coupler—in or out) that corresponds with the frequency you want to hear, and then adjust the slug in *L1* for best reception. Coil *L1* in Figs. 2 and 3 is an Olson Radio No. L-75.

To use the coupler shown in Fig. 3, tune in a station near 540 kc., with the plates of capacitor *C1* (.001 μf.) fully meshed, and adjust the slug in coil *L1* for maximum volume. Then you can use switch *S1* to rough-tune the coupler, and capacitor *C1* to fine-tune. The switch positions and frequency ranges are as follows:

Switch Position	*Frequency*
1	540- 870 kc.
2	740-1200 kc.
3	1100-1650 kc.

An outdoor antenna will improve any "All-American 5." An antenna coupler will permit you to use an outdoor antenna with your receiver. -30-

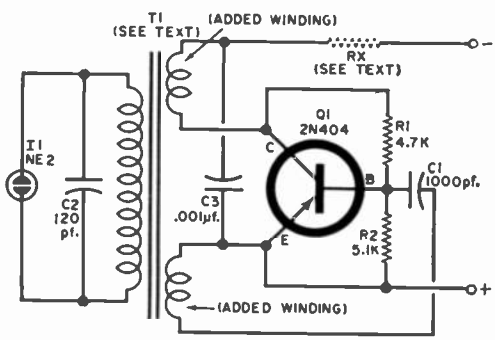


The LOW-POWERED PILOT LIGHT

EVER have a problem providing a pilot light for a new transistorized battery-operated gizmo? The first solution that comes to mind is the old standby, a #47 pilot lamp. However, when you realize that a #47 draws 900 mw., the unit shown here, with a drain of only 30 mw., begins to "shine" by comparison.

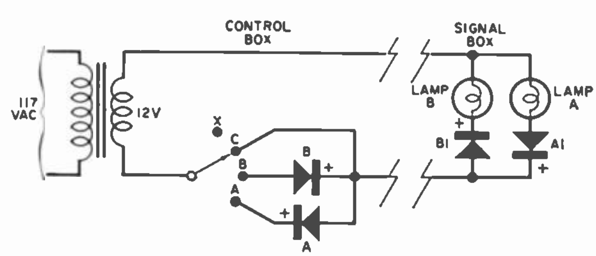
Transformer *T1* is a National R-50-1 10-mh. r.f. choke. Place a layer of electrical tape over each end of the core, and wind a 25-turn coil of #30 enameled wire over each end. Try the unit with a 6-volt battery. If it does not work, phase the coils by reversing the coil wires to *C1* and the emitter of *Q1*. Capacitor *C1* is a mica type, *C2* is a 300-volt mica and *C3* a disc capacitor. All the resistors are half-watt units. Resistor *Rx* is used at the rate of 100 ohms for every volt over six volts. If a 9-volt battery is used, for example, *Rx* would be a 300-ohm resistor.

With this low-cost, low-drain pilot light, you can have visual indication without spending all of your battery power on light.—*A. E. Donkin, W2EMF*

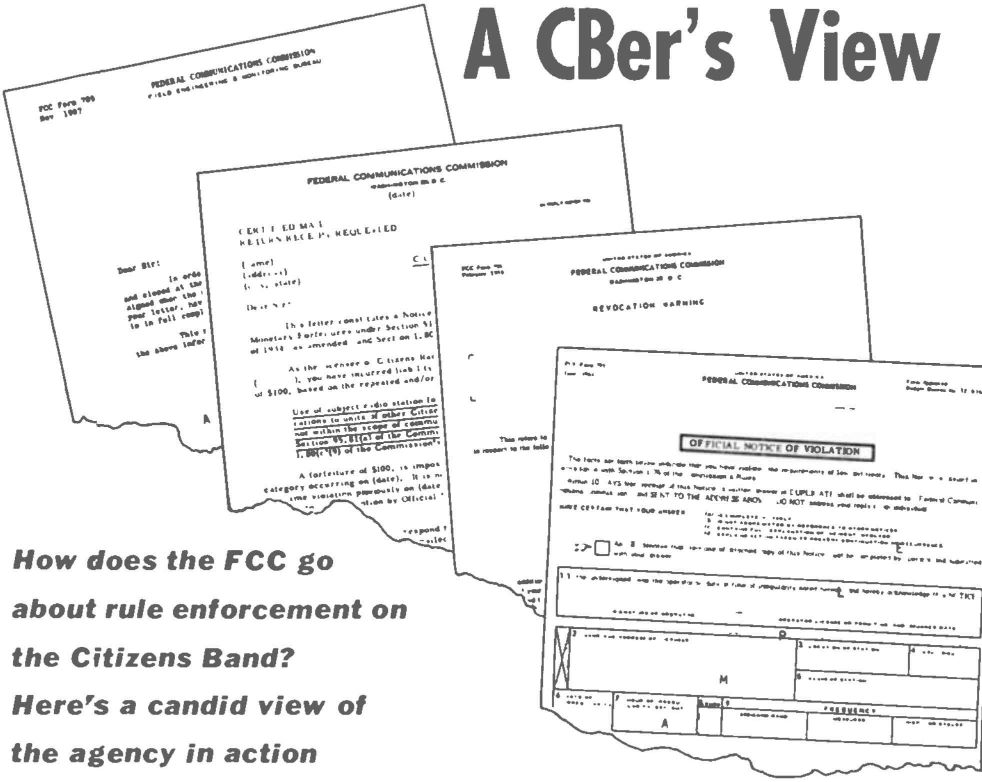


2 CONDUCTORS CONTROLS

THIS signal box was designed to provide a means of silently relaying such commands as "lights off" or "tape recorder on" to a remote location for home movie use. The two 6-volt lamps are separately controlled, and provide up to four signal combinations. The transformer is a step-down type to reduce the 117 volts to 12, and the four diodes are ordinary silicon types with a PIV of 100. Looking at the single-pole, four-position switch, "X" is the off position. In position A, diode *A* and *B1* are back-to-back, so only lamp *A* will light. In position B, diodes *B* and *B1* will conduct, lighting lamp *B*. In position C, both the lamps will light. If you replace the lamps with 6-volt d.c. relays, you can control appliances remotely and eliminate the wiring maze. —*Errol J. Queen*



The FCC and 11 Meters: A CBer's View



How does the FCC go about rule enforcement on the Citizens Band? Here's a candid view of the agency in action

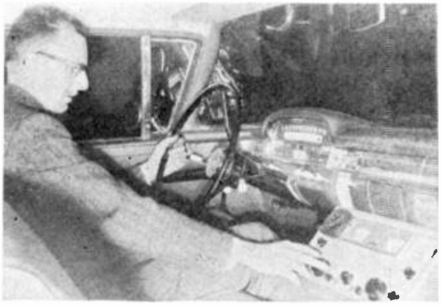
By DAVID T. GEISER, 20W2456

The following article has not been reviewed by the FCC and does not necessarily carry its endorsement. The events described, however, were witnessed by the author or by others involved.

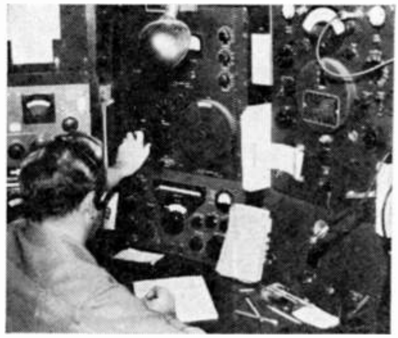
CAN YOU violate the Rules and Regulations by which the Federal Communications Commission governs the Citizens Band and get away with it? To the author and other CB'ers living in a New York State community, it seemed for a time as if the answer to this question might be "yes." What led to this shocking conclusion? Intentional jamming, profanity, obscenity, bootlegging —a list that is all too familiar to those seriously concerned with the future of the Citizens Band. Finally, an investigation was begun by the author: What, if anything, did the FCC intend to do about CB rule enforcement?

A number of area CB'ers wrote the FCC, but nothing seemed to happen. Several even submitted witnessed statements, but there still seemed to be no action. Finally, a letter containing two important questions was sent to the U.S. Attorney General who referred it to the FCC. Stated simply, the questions were "Is there a proper place for the submittal of affidavits concerning violations observed by a citizen of either the basic Communications Act or the Rules and Regulations of the FCC?" and "Will an action be taken by any agency of the Federal Government on the basis of such a legal document?"

The FCC In Action. The engineer-in-charge of the area FCC engineering



Typical FCC monitoring installations are shown in the photos at left and below, in one case a mobile setup and in the other a fixed position. Precision is the watchword in all monitoring—an FCC citation is difficult to argue with.



and monitoring station dropped in to see the author, bringing with him each and every complaint received from local CB'ers. In talking with this official, it became obvious to the author that the FCC cannot immediately investigate all complaints because of the large territory each office must cover—in some cases literally hundreds of thousands of square miles.

Soon after the visit of the engineer-in-charge, and in response to the author's offer of help, a phone call was received from an FCC engineer. Permission to use the author's home as a temporary monitoring location was quickly given. Shortly thereafter, a rusty car pulled into the author's driveway, notable *only* for the fact that there were *no* FCC signs on the sides and that the license plates were local—there was nothing to show that it was an FCC vehicle. Yet, the car was fitted for direction-finding and all other FCC monitoring, and soon a new Browning receiver, frequency meter, power meter, and other pieces of equipment were unloaded and brought into the house.

While the gear was warming up, the author learned from the engineer who had brought it that many CB'ers invite the attention of a monitor through the careless use of "10" signals; "10-7" and "10-8" result in automatic citations except under exceptional circumstances. They are general announcements not directed to a specific addressee.

A common practice of FCC monitors is to make frequency measurements whenever a CB'er attracts FCC attention by improper transmissions. If a CB'er flits from channel to channel, odds go up that one channel will be off frequency. Does the FCC try to trap CB'ers by (as rumor has it) "getting them on the air and making them do something wrong?" "Emphatically not," according to FCC personnel. Any such actions would be ruled "entrapment" by the courts and would be thrown out.

In this particular case, the monitoring engineer commented that he had seen every common fault on his visit to the author's home town except bootlegging. Soon a station came on asking for signal reports, however, and attracted his attention. Shortly after the operator, who announced his call as "unit three," identified himself as a bootlegger by mentioning on the air that a friend said he could borrow the call he was using.

It was then that the mental picture many CB'ers have of the FCC cruising up and down the streets with direction finders on their cars proved to be in error. The engineer stayed where he was in front of the receiver, and refused the author's offer of an accurate loop antenna to get a "fix" on the offender. Events proved that he knew what he was doing.

As the bootlegger was asking all the stations he raised what their location was, it was only natural that they would ask him the same question. After a bit, he said he lived on "X" street, and was trying out a new brand "Y" antenna. The engineer had just pulled out a city map and was looking for "X" street when the bootlegger decided it would be fun to start collecting QSL's, and passed out his name and address. The engineer

(*Continued on page* 88)

STANDING WAVES: Do They?

Sure they do! But don't go and blame high VSWR for your troubles—there are other factors involved

By **FRED BLECHMAN**, K6UGT

IF YOU have been involved with ham, CB or business radio, you may have heard of and wondered about standing wave ratio. There's a profusion of fact and fancy, theory and practice, discussion and argument over this subject. The purpose of this article is to break it down for you and see if we can clear up some of the problems that cause confusion. We'll also analyze a "typical" situation and find out if SWR (or VSWR for Voltage Standing Wave Ratio) is as important as some folks seem to think it is.

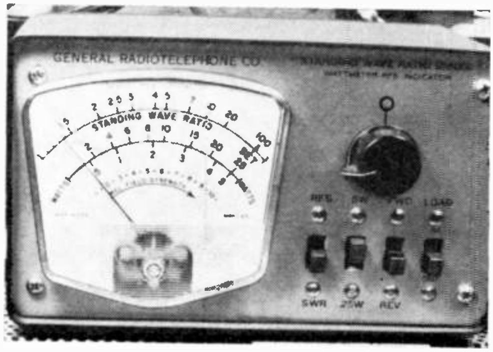
What Is SWR? Unless you use a handheld transceiver, you have a transmission line to carry the signal from the transmitter to the antenna. The physical construction of the transmission line results in its having a certain impedance at radio frequencies. This characteristic impedance is a fixed value that does not vary with frequency and is one of the two factors that determine SWR. The other factor is the terminating impedance which is produced by the antenna. The antenna also has a characteristic impedance, but this is determined by the type of antenna, method of connection, and frequency of operation as well as other factors. If your antenna impedance is the same as the transmission line impedance, you have what would be a perfect match and your only losses would be due to inherent transmission line losses.

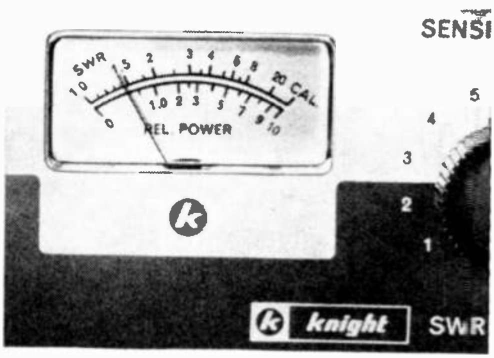
More often, a mismatch occurs between the antenna and the transmission line. Now only part of the energy from the transmitter is absorbed and radiated by the antenna. Some of the energy is reflected, or bounced back toward the transmitter. The transmitter continues to push energy toward the antenna, so we have energy going in both directions. The "forward" and "reflected" voltages will combine to produce waves whose crests and valleys do not move along the line, but remain stationary; hence, they are called "standing waves." Standing wave ratio is the ratio of maximum to minimum voltage or current of the standing wave. This is also the ratio of the load impedance (Z_L, the antenna) to the characteristic line impedance (Z_0).

Effects of SWR. Every transmission line attenuates the signal it carries, due to its ohmic resistance and dielectric losses. As frequency increases, these losses can become quite high. Unfortunately, standing waves increase the attenuation due to the increased current flowing through the transmission line, and the higher-than-normal voltages that can cause more leakage loss. Another sad effect of standing waves is that they reduce the power handling capacity of the line. The allowable power, compared to the rated power, is the reciprocal of the SWR.

The most important effect of standing waves, however, is that they indicate a mismatch. Instead of your transmitter pumping all of its power into the antenna, some of this power is reflected back and does no useful work. In other words, reflected power is wasted power.

A Typical Example. Let's take a hypothetical case, where you have a transmitter with an output impedance of 52 ohms delivering 100 watts to a 150-foot length of RG-8/U at 30 mc. Assume that the antenna impedance at this frequency is 104 ohms. We can look up the characteristic impedance of RG-8/U and find it to be 52 ohms. The SWR is the ratio of the two, with the higher number always the numerator. Here, the SWR is 104/52 or 2:1. The RG-8/U cable also has an attenuation of 1.0 db per 100 feet at 30 mc. at an SWR of 1:1. As you have 150 feet of line, the attenuation is

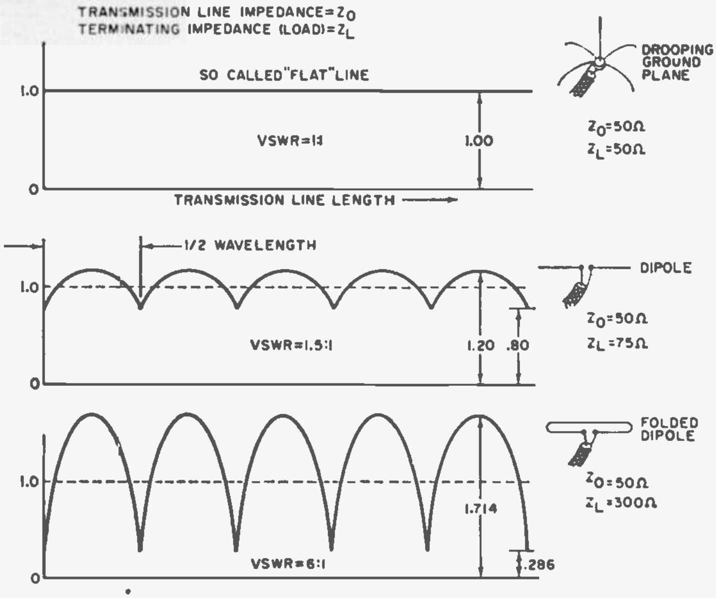




Three different SWR meters were inserted in the same line one at a time. Notice the close similarity in readings that was obtained. The Heathkit AM-2 (top) and the General Radiotelephone Co. 615 are one-piece types in which the transmitter connects to the input, and the transmission line to the output. The Knight-Kit P-2 SWR/power meter has a separate unit that connects into the transmission line; unit shown contains meter and controls.

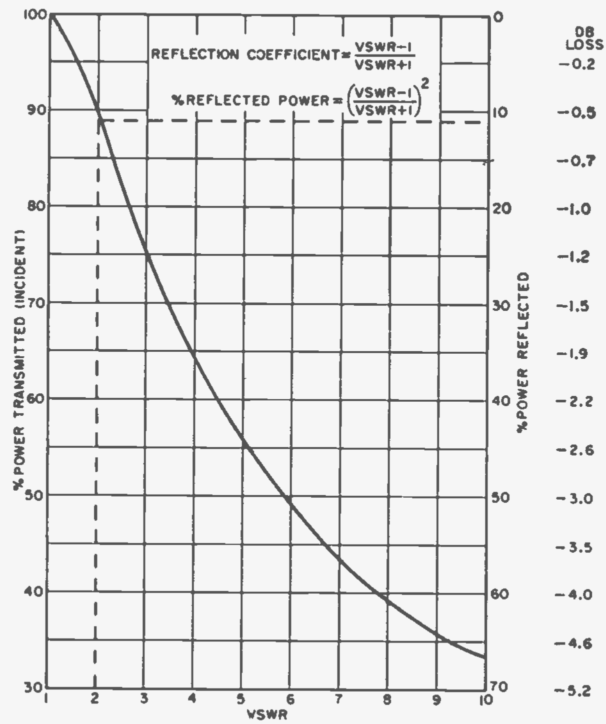
150/100 times one. This equals 1.5 db. Now add the effect of SWR on line loss by looking at the chart on page 64.

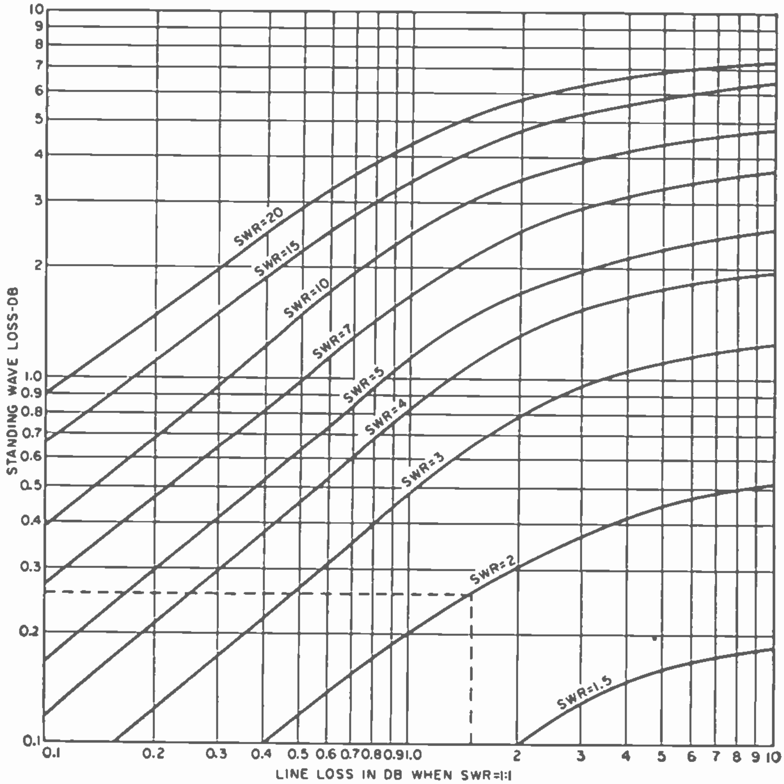
Locate 1.5 db at the bottom of the chart, go straight up to SWR 2 (actually 2:1), and then to the left to read 0.26 db. This 0.26-db loss is added to



The VSWR is determined by the impedance of the line termination and the impedance of the transmission line as in several examples at left. To simplify things, line losses are not included in figures.

When a transmission line is terminated with a load of larger or smaller impedance than the characteristic impedance of the transmission line, some of the transmitted energy will bounce back from the load to form standing waves. This chart shows VSWR versus power and db loss in transmission line.





Transmission line power loss is increased with an increase in standing waves. Note that the loss can be more than doubled if high standing wave ratios are on the line.

the transmission line loss which is now 1.76 db. At an SWR of 2:1, the power loss at the antenna is 0.51 db.

The total loss then is 1.76 db in the transmission line, plus 0.51 db at the antenna, or 2.27 db. This means that 59% of your input power is radiated by the antenna.

As for the allowable power, RG-8/U is rated for 1720 watts at 30 mc. at an SWR of 1:1. At an SWR of 2:1, this is reduced by 50%, allowing you 860 watts (50% of 1720) which is well in excess of the 100 watts you are putting into the line.

What Does it All Mean? How much do these losses hurt your operating effectiveness? A 1.0-db change in signal power at the receiver is considered to be the minimum discernible change. The commonly used industry standard for calibrating S-meters is 6.0 db per S-unit. Receiver sensitivity is usually based on a reference of 10 db signal above the noise level. Actually, a few db of signal is hardly worth getting excited about unless you have some particularly critical requirement. In our previous example, the received signal would be 2.27 db "down," or less than one-half an S-unit, as compared to having a perfect antenna with a lossless line (which doesn't exist). Looking closely, the standing waves contributed 0.77 db (0.26 db plus 0.51 db) loss to the total 2.27 db, and this loss is not even discernible at the receiving end.

Are you getting the idea that SWR (if it is reasonably low) is not as much of a villain as you thought? In most practical cases, the majority of loss is caused by the real villain, transmission line loss! However, when your transmission line loss is high to begin with and your SWR is also high, your radiated signal may be really down in the mud.

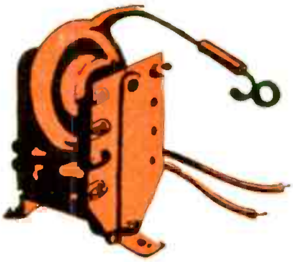
Cure the Cause. What to do about SWR? Use the shortest, lowest-loss transmission line you can get, and match this to an antenna whose nominal impedance at the operating frequency is from one-half to two times the line impedance. This will limit your SWR to 2:1. If you can get an antenna with gain, such as a

(*Continued on page* 88)

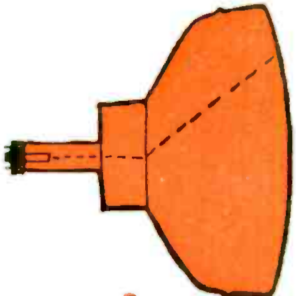
ELECTROMAGNETIC FUNCTION QUIZ

By ROBERT P. BALIN

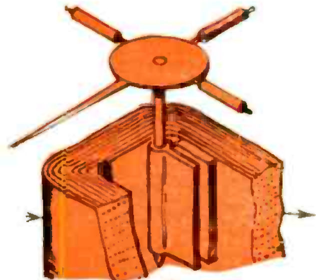
Since 1820, when Oersted discovered the magnetic field around a current-carrying conductor, electromagnetism has found many uses in electronics. Can you match the functions of electromagnetism listed below (1-10) with the drawings of the corresponding devices (A-J)?



A



B



C

1 Attraction ____

2 Repulsion ____

3 Magnetizing ____

4 Degaussing ____

5 Generating e.m.f. ____

6 Generating back e.m.f. ____

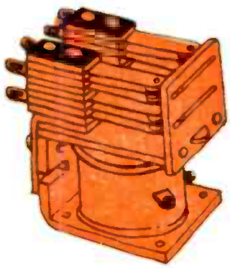
7 Heating ____

8 Deflection ____

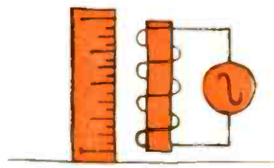
9 Radiation ____

10 Magnetostriction ____

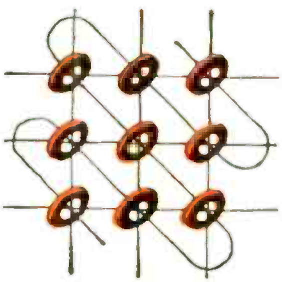
(*Answers on page* 106)

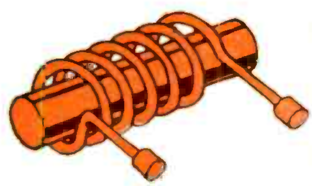


J

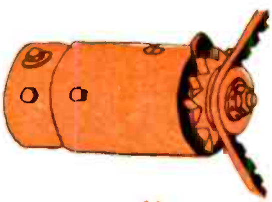


D

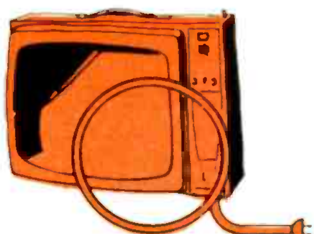




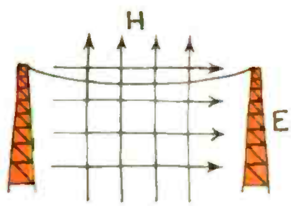
E



H

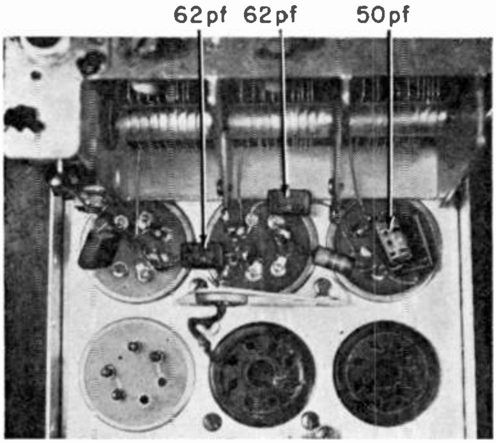


G



F

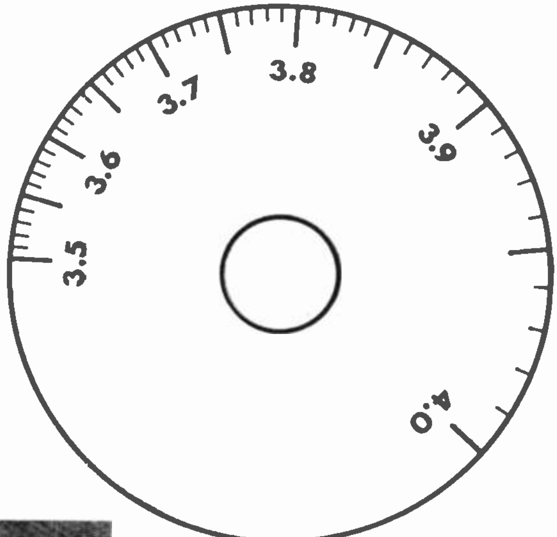
Bandspreading the ARC-5



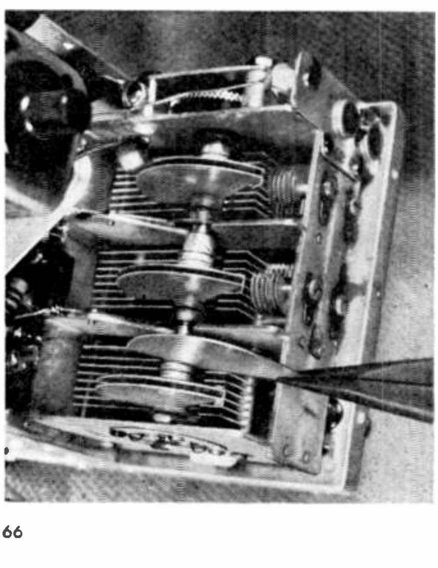
Three capacitors are soldered from the stator plates to the chassis ground. Placement isn't critical; author grounded capacitors to convenient terminals.

IF YOU have converted a 3-6 mc. Command set for use in the 80-meter amateur band, there's one more step you can take to improve its performance. A simple modification will make the 3.5-4 mc. ham band cover a much larger part of the dial than was originally intended and will, consequently, make signals much easier to tune.

Modifying the Unit. First pull out the 12K8 and 12SK7 tubes and the i.f. transformer can next to them. Remove the cover over the tuning capacitor by removing the screws at the sides and back. Rotate the tuning capacitor so the plates are fully unmeshed. You will notice that all the rotor plates, except the one at the left, are tied together at the tip with a support. Using a wire cutter, clip the support between them except for the last two on the left in each section.



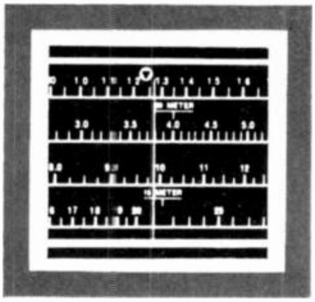
The full-size dial (right) can be cut out of the magazine and cemented to original dial plate to calibrate modified receiver.



Carefully remove stator plates following instructions in text. Hold the rotor plates firmly to avoid breaking the bearing spring supporting the shaft.

Grasp the plates one at a time with a pair of long-nose pliers, and wiggle the plate back and forth about 50 times. This will break the solder connection so that a little downward pressure will cause the plate to roll out. Remove the

(*Continued on page* 91)



Across the Ham Bands

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

HIGH POWER VS. LOW POWER

"IF I only had a little more power," is the universal plea of most low-power operators when they fail to raise a new state or a DX station they have called, or if another station gets a better report than they do. But there are two sides to the story.

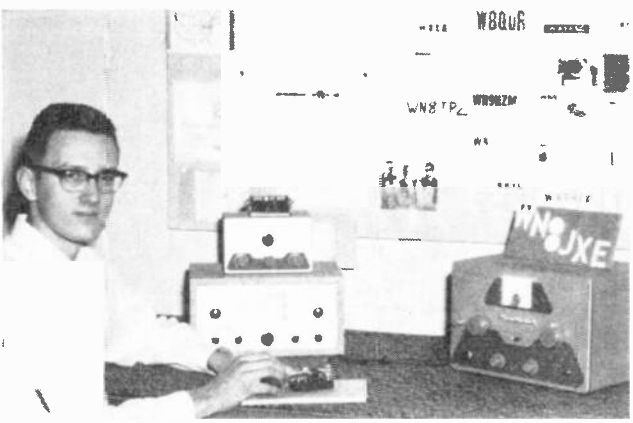
Not long ago I was working a West Coast station, and (for the umpteenth time) the operator told me about his rig, his wonderful location, and his super antenna system. At that precise moment, another West Coast station opened up on the frequency and covered him up. After getting him to shift a few kc., I put my tongue far in my cheek and asked, "Say, Bill, if you have such a fine setup, why is W........'s signal so much stronger than yours?" Without a moment's hesitation, he replied, "Because I'm running only 1000 watts!"

Another time I called VQ2AB in Northern Rhodesia on 20-meter SSB when he signed off with another VQ2. Buggy came back with the amazed question, "You're not really hearing me, are you, Herb?" I replied, "Of course, I'm hearing you, Buggy. You're S8—three S-units stronger than my power leak." Buggy's amazement stemmed from the fact that he had reduced his transmitter power to a few watts to work his buddy across town, and he didn't expect to be heard 9000 miles away.

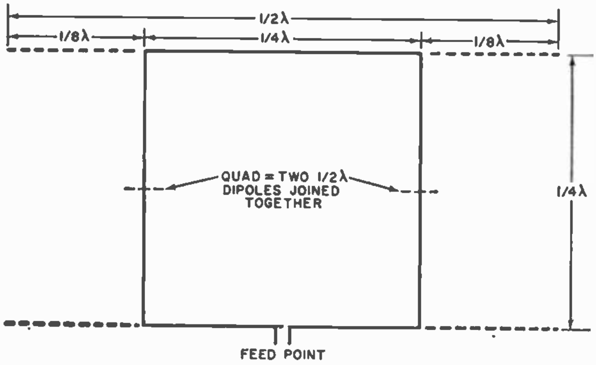
The first ham implied that he was at a power disadvantage with a 1000-watt transmitter, yet the second one covered thousands of miles per watt. Obviously, it should be easier to make contacts with a high-power transmitter than with a 10-watter, but is there any reliable yardstick for measuring the rate of improvement? Actually, there are two.

They are the annual ARRL Field Day (June 27-28) and "Sweepstakes" (SS) in November. During Field Day, competitors using a transmitter power of less than 30 watts may multiply their scores by three; competitors using a power between 30 and 150 watts multiply their scores by two, and competitors using over 150 watts earn no multiplier. Similarly, in the SS, c.w. competitors using less than 150 watts earn a

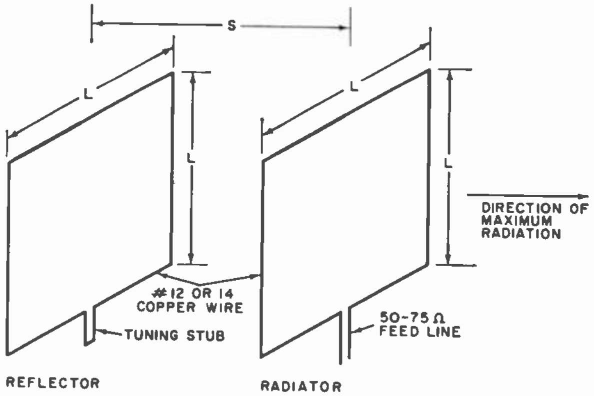
Novice Station of the Month



The winning station in the Novice Station of the Month contest for June is that of Phil Schmitt, Benton Harbor, Mich. As WN8JXE, Phil uses a Heathkit DX-40 transmitter running 75 watts to feed an 80-meter dipole antenna and a Heathkit AR-3, plus a Q-multiplier—in the 80-meter Novice band, of course. Although WN8JXE operates only on Friday nights and Saturday mornings, he has worked 33 states and Canada. Phil will receive a one-year subscription to POPULAR ELECTRONICS for his photo. If you would like to enter the contest, send us a clear picture of your station—preferably showing you at the controls—along with some information about yourself, your equipment, and operating achievements. All contest entries should go to Herb S. Brier, Amateur Radio Editor, POPULAR ELECTRONICS, P. O. Box 678, Gary, Indiana 46401.



The end ⅛-wavelengths (shown by the dashed lines) of two ½-wave dipoles are bent towards each other and joined to form a quad antenna element. Gain: 0.9 db.



Basic layout of two-element cubical quad antenna. In drawing, L (ft.) equals 248 divided by frequency (mc.), while S (ft.) equals 120 divided by frequency (mc.). Effective forward gain: 5.5 to 6.5 db.

power multiplier of 1.25, and phone competitors using less than 150 watts earn a multiplier of 1.5.

Are these realistic multipliers? Well, experienced competitors in these affairs almost always choose to compete in the lower power brackets, because they have found that the multipliers, combined with a good antenna and sharp operating, are worth more than high power in running up a big score.

Take a tip from the experts. Run high power if you like (and can afford it), but don't skimp on your receiver or antenna system to do so.

CLASSIC HAM CIRCUITS

The cubical quad antenna is truly the answer to a ham's prayers. Originally, Ecuador's famous missionary radio station HCJB was located in Quito, Ecuador, at a height of 10,000 feet above sea level. (It is now at Pifo, Ecuador.) Its antenna was a huge, four-element, parasitic array.

Something very dramatic occurred to the HCJB antenna when the tropical sun went down: the extremely high r.f. voltages at the ends of the antenna elements combined with the thin, moist, night air to produce huge blue corona discharges, like giant Fourth-of-July sparklers, at the ends of the elements. These discharges could be seen and heard a quarter mile away. Worse, their intense heat was slowly melting the antenna away.

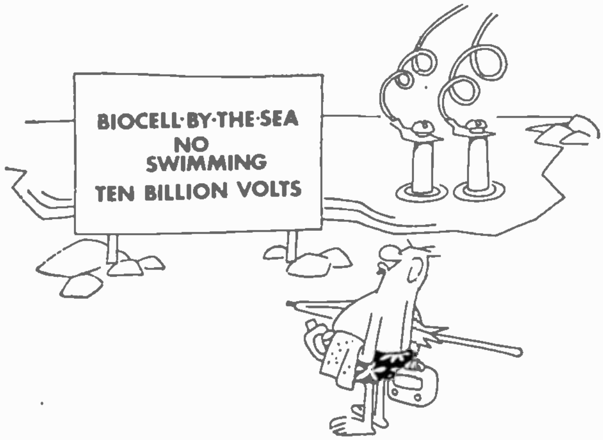
By 1942 the situation had become critical, and Clarence C. Moore, W9LZX, one of the station engineers, vowed "with the help of God" to solve the problem. Surrounding himself with reference books, Clarence spent countless hours studying basic antenna theory. Then, as W9LZX reports it, "Our prayers must have been answered, for gradually, as we worked, the vision of a quad-shaped antenna grew from the idea of a pulled-open folded dipole antenna." (Folded dipoles have lower voltages at their ends and higher center voltages than conventional dipoles.)

A quad antenna with a quad reflector was quickly installed at HCJB. Not once did it flare into destructive corona discharge. Equally important, floods of listener reports brought the welcome news that the new antenna was a good radiator of HCJB's signals to the world.

Evolution of the Cubical Quad. Amateurs first became aware of the cubical quad antenna when Clarence Moore installed one at HC1JB in Quito. HC1JB's fine 20-meter signal quickly influenced other hams to try the new antenna.

(*Continued on page* 93)

Hobnobbing with Harbaugh

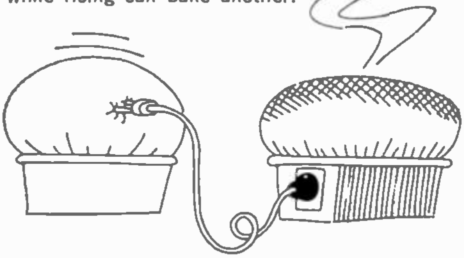


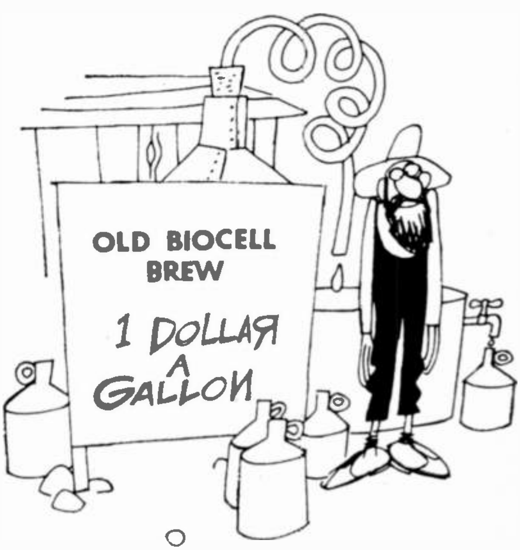
Bodies of water may become giant biocell batteries.

Future of the Biocell

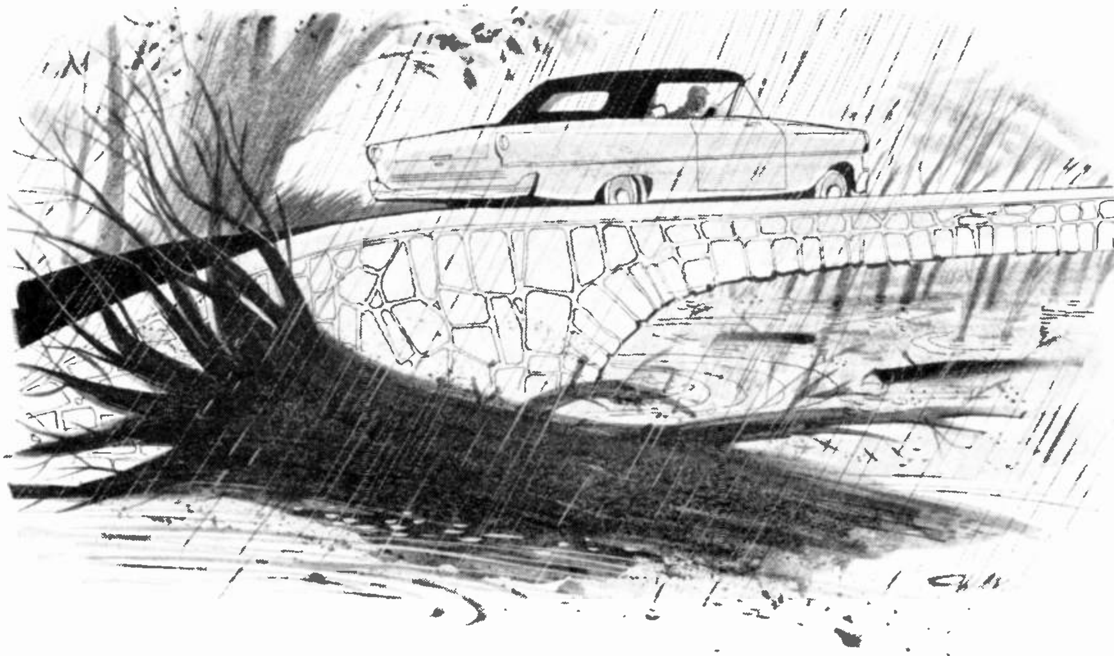
Sewage-powered automobiles: here's the sewage-matic custom V-8 hardtop.

Since yeast is a popular biocell fuel, one loaf of bread while rising can bake another.





Moonshiners will have a field day. Stills will run on electricity generated by fermentation.



SCHOOL WAS OUT for the summer, and Carl and Jerry were hurrying home from Parvoo University through a torrential downpour. It had been raining heavily for almost a week, and the previous night a series of terrific thunderstorms accompanied by tornado-like winds had marched across the state leaving heavy damage in their wake. Unable to call home because the telephone lines were out, the boys were understandably worried about their parents.

"Wonder if we'll be able to get across the river," Jerry muttered, gripping the steering wheel and peering through the rain-drenched windshield. "I've seen the old Wabash flood with less rain than this, and the low approaches to the bridges are covered even before the water gets into town. Well, we'll soon know. We've just got about four miles to go."

"We'll know sooner than you think," Carl said. "Pull over on the side at the top of that next knoll and cut the motor."

While talking, he opened the glove compartment and lifted out a device enclosed in a hand-sized two-toned gray plastic case. From one end he stretched out a telescoping antenna.

"What's that?" Jerry demanded, eyeing the object suspiciously as he pulled off the road.

"You're probably going to have a fit, but it's a Cadre Model C-75 hand-held CB transceiver," Carl said in a small voice.

Jerry recoiled as though Carl had pulled a live cobra from its basket.

"I never thought I'd see the day when you, a self-respecting ham, would touch chicken-band equipment," he said bitterly. "You don't have a license to use that thing—I hope."

"But I have," Carl confessed. "You see, when the folks and I go up north fishing, we need something to enable those out in the boat to keep in touch with camp. Since Dad and Mom can't—or won't—get ham licenses, CB seemed like a good idea. I got the license, and Dad bought the equipment. We have a five-watt unit that can operate either in the car or from house current and this little transistorized gem. Right now the 'big job' is set up at home on a ground plane antenna. I brought this little thing along to school to show it to you, but I never got up enough nerve to do it."

"You'd probably do a better job of get-

A Carl and Jerry Adventure in Electronics

Togetherness!

By
JOHN T. FRYE
W9EGV

ting out with a megaphone than with that toy," Jerry sneered.

"That's what you think!" Carl retorted. "Don't get the idea that this eleven-transistor-and-two-diode unit is the same as those little hundred-milliwatt jobs or like the typical home-brew ham transceiver. The plug-in modular boards inside this case give you a very sophisticated little rig. An r.f. stage and two i.f. stages with a ceramic filter account for the receiver's sensitivity and selectivity. Only one microvolt of signal will produce ten db or better signal-to-noise ratio and a full half-watt of power from the speaker. The receiver has variable volume control, a.g.c., adjustable squelch, and an automatic noise limiter."

"How about transmitter output?" Jerry asked, sounding intrigued in spite of himself.

"The transmitter input is a watt and a half, and the output to the antenna is about nine-tenths of a watt. That's only about six db, or one S-unit less than a Class D CB transmitter puts out. It has speech clipping and TVI suppression. There are jacks for external speaker, antenna, and microphone. Right now the transceiver is being powered by nine mercury penlight cells which are supposed to give about fifty hours of service, but ordinary penlight cells or two miniature six-volt rechargeable nickle cadmium batteries can be used instead. I can select either of two crystal-controlled transmit and receive channels."

"Sounds like an awful lot in such a small case," Jerry said doubtingly. "Is Cadre the only outfit producing high-powered hand-held transceivers?"

"Not at all. Heath, Allied Radio, E. F. Johnson, Telcon, and Lafayette Radio produce transceivers with at least one watt input. Each type has different features. The beauty of all of these jobs is that they will work in a car or boat, on foot, on horseback, or as a base station at home. Well, let's give it a try."

CARL ROLLED down his window, which fortunately was on the downwind side, and thrust the short whip antenna outside. When he turned up the volume control with his thumb, only a faint rushing sound could be heard. Jerry smiled mockingly.

Carl's strong fingers tightened around the case, pushing in the push-to-talk lever on the left side. He spoke in a normal voice directly into the speaker louvre in the upper part of the case: "KHD4167 base, this is mobile Unit 1 calling."

Even as his fingers relaxed, the voice of his mother could be heard coming clearly and with surprising volume from the speaker: "Ten-two, Carl. This is KHD4167 base. Let's move off calling channel eight to channel eleven."

Carl flipped a little slide switch on top of the transceiver, and there was his mother's voice asking: "What's your ten-twenty, Carl?"

"We're on highway twenty-five about a mile west of the state hospital."

"Ten-four. The only way you can get home is to cross on the new bypass bridge west of town and circle around and come in from the north. The town is in bad shape, but we're fine and so are Jerry's folks. The storm knocked out almost everybody's telephones, and many houses have no power. We still have both, thank goodness. The river is already flooding many parts of the town and is rising fast. The CD director wants you boys to put your ham station on the air just as quickly as you can. I'll stay

(*Continued on page* 89)

Transistor Topics

By **LOU GARNER**, Semiconductor Editor

AMONG FOREIGN NATIONS, Japan probably leads the world in the production of semiconductor devices and transistorized equipment, and even rivals the U.S. as far as transistorized consumer products are concerned. This is a trend which has been growing steadily over the past few years. In 1957, for example, Japan exported only 11,000 transistors as compared to 3,762,000 vacuum tubes. By 1960, the ratio had grown to 12,325,000 transistors versus 26,108,000 tubes. Then, in 1962, transistor exports exceeded those of tubes, with figures of 36,819,000 and 35,356,000, respectively. In all, Japan produced 231,710,000 transistors and 196,180,000 vacuum tubes in 1962.

As far as transistorized consumer products are concerned, a recent English-language edition of *Japan Electronics* included the following: a 16-inch transistorized TV receiver; a 5-inch transistorized TV set; a 6-transistor table-model AM receiver; a 17-transistor, 8-band radio; a 10-transistor FM/AM receiver; an 8-transistor, 2-band set; an 11-transistor, 4-band portable receiver; a 9-transistor, 2-band radio; a 9-transistor FM/AM set; a 10-transistor, 5-band receiver; a 14-transistor, 4-band radio; a 16-transistor AM/FM radio/stereo phonograph; a transistorized power megaphone; a transistorized 0.5-watt CB transceiver; an "eye-glass" type transistorized hearing aid; and a transistorized all-band FM booster.

Several factors have contributed to Japan's expansion in semiconductor device and equipment production, not the least of which is her low labor costs. Other contributing factors, however, are a high degree of technical competence (a Japanese scientist, Esaki, invented the famous tunnel diode), and a willingness to adapt and modify products developed by foreign engineers.

Recognizing the serious competition offered by Japan, American manufacturers are turning towards automation and the use of integrated circuits. Texas Instruments, for example, recently developed a 6-transistor, 16-resistor integrated high-gain amplifier for Zenith. Only one-tenth the size of a match head, the new amplifier module is being used in the first consumer-type product to employ integrated circuits, a premium-priced subminiature hearing aid.

Reader's Circuit. The "rain alarm" circuit shown in Fig. 1 was submitted by Eugene Richardson (Alexandria, Va.), a reader who has made several contributions to this column in the past. Suitable for use in a science fair exhibition or by home owners and amateur gardeners, the unit sounds an audible alarm whenever moisture accumulates on its sensor plate. Eugene's circuit is uniqu in that he uses a transistorized audio oscillator as a signaling de-

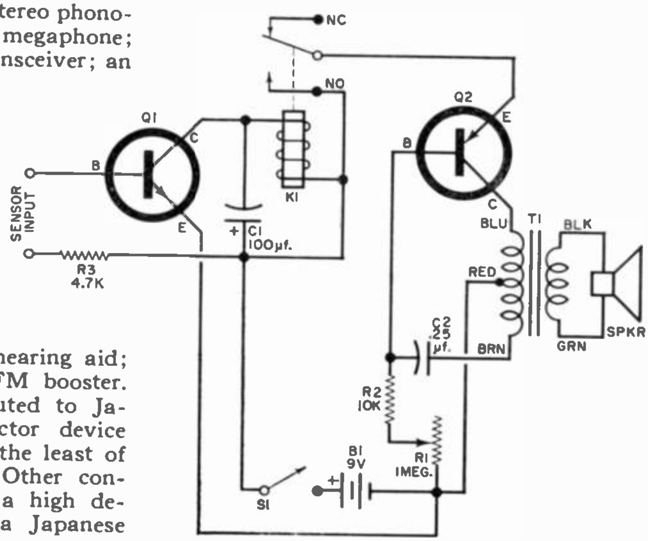
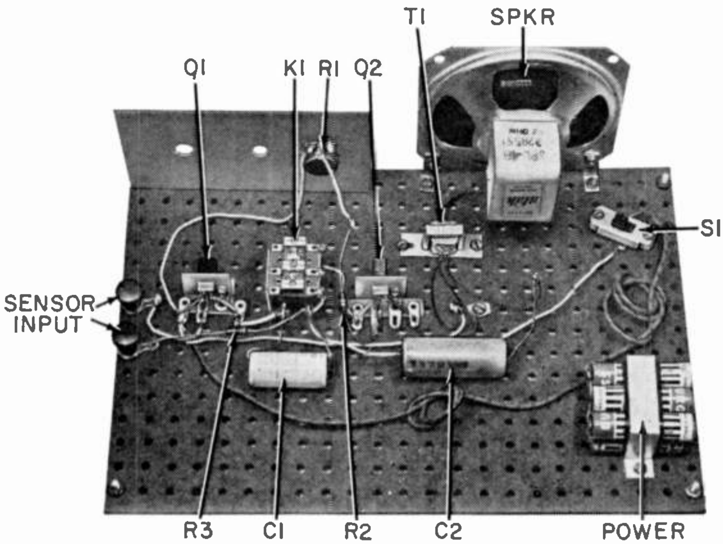
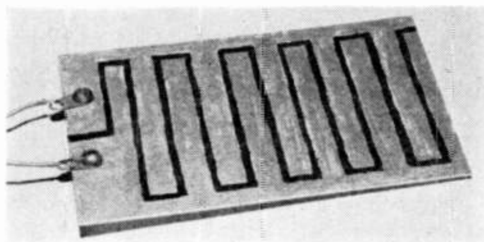


Fig. 1. Transistorized "rain alarm" circuit submitted by Eugene Richardson. Unit sounds audible alarm whenever moisture accumulates on its sensor plate.



Transistor Q2 is employed as an audio oscillator in the rain alarm, with the primary of T1 serving as its collector load.



The sensor used by reader Richardson was painted on a piece of Bakelite with conductive paint.

vice rather than the usual buzzer or bell. The oscillator requires less current for operation than an electromagnetic device and thus permits longer battery life.

Transistor *Q1* is a general-purpose *npn* transistor, such as a 2N35, 2N170 or 2N229, while *Q2* is a *pnp* type, such as a CK722 or 2N107. A sensitive-type relay (*K1*) is employed—typically, an Advance SO/1C/1000D or Sigma 4F-1000-S/SIL. Capacitor *C1* is a 100-μf., 12-volt electrolytic and *C2* a 0.25-μf. tubular paper unit. Potentiometer *R1* is a 1-megohm unit, and *R2* and *R3* half-watt resistors. The output transformer, *T1*, has a 500-ohm center-tapped primary and a 3.2-ohm secondary (Argonne AR-119). A 4- to 6-inch loudspeaker with a 3-4 ohm voice coil is used. The power supply, made up of six penlight cells connected in series to supply 9 volts, is controlled by s.p.s.t. slide switch *S1*.

In operation, *Q1* is used as a d.c. amplifier, with the relay's coil, shunted by *C1*, serving as its collector load. Under normal conditions, *Q1* is operated without base bias. Collector current is close to zero and the relay remains open. When moisture accumulates on the sensor connected to the instrument's *input* terminals, base bias is supplied to *Q1* through current limiting resistor *R3*. This permits a corresponding, but amplified, flow of collector current, closing the relay and supplying power to *Q2*.

The *pnp* transistor, *Q2*, is used as a conventional audio oscillator, with *T1*'s primary serving as its collector load. The transformer, in turn, plays a dual role, serving not only to match *Q2*'s moderate output impedance to the loudspeaker's low-impedance voice coil, but also to provide the feedback needed to start and sustain oscillation. Obtained from *T1*, the feedback signal is coupled to *Q2*'s base through d.c. blocking capacitor *C2*. Transistor *Q2*'s adjustable base bias is furnished through *R1* and *R2*. Finally, operating power for the entire circuit is supplied by *B1*.

The rain alarm can be assembled on a small chassis, on a printed-circuit board, in a wooden or metal cabinet, or "breadboard" fashion, as preferred. Eugene chose the latter type of construction, as shown in the photograph of his unit. He used a piece of perforated Masonite as a base, mounting major parts with small machine screws and nuts. Neither layout nor wiring is critical, although all d.c. polarities must be observed. Naturally, care must be taken to avoid heat damage if the transistors are soldered in place.

Consisting of two conductor areas separated by a narrow insulated space, the *sensor* can be assembled using any of several techniques. The sensor shown in the photo was produced by painting the conductors on a piece of Bakelite with standard conductive silver paint. A suitable unit can also be made from a piece of copper-clad phenolic board by using etched circuit methods. Or a quite satisfactory sensor can

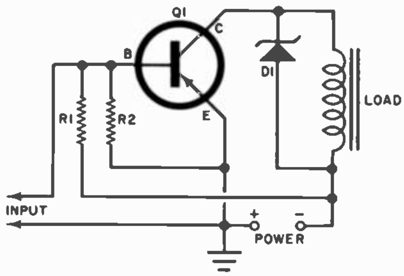


Fig. 2. Typical circuit for damping out excessive transient voltages uses zener diode (D1) to shunt the inductive load.

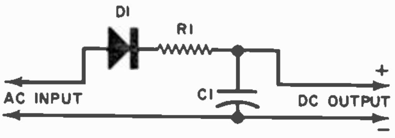


Fig. 3. Resistor R1 is connected between half-wave rectifier D1 and filter capacitor C1 to limit current surges.

be assembled by cementing a piece of aluminum foil to a small plastic board, cutting away a narrow strip with an Xacto knife or razor blade to form two insulated sections. Neither the conductor pattern nor board size is critical. Finally, holes are drilled through the board, and terminal lugs are attached by means of small machine screws and nuts.

In use, the control assembly is placed where the alarm signal can be heard easily. The sensor is placed on a window sill or wherever the user wishes to detect rain or moisture, and is connected to the unit's input terminals using two pieces of hookup wire or a length of ordinary lamp cord.

The last step is the adjustment of *R1*. The input terminals are shunted with a 1000-ohm half-watt resistor. With *S1* closed, *R1* is adjusted for the desired audio output. Afterwards, the 1000-ohm resistor is removed and the unit is ready for operation.

Transitips. Transistors, diodes, and other semiconductor devices can be damaged quite easily by excessive transient voltages or heavy current surges. Care must be taken to avoid both conditions, not only in equipment design, but also during experimental tests of breadboarded circuits. In general, both transients and surges are caused by reactive components.

Sometimes called "spikes" because of their wave shapes, *transient voltages* may be generated whenever power is applied to (or removed from) circuits in which inductive elements are present. The peak amplitudes of such transients can be many times greater than the d.c. supply voltages. When applied across a semiconductor device, these voltage spikes may punch through and destroy the *p-n* junction.

In practical circuits, transient voltages can be damped out by using zener diodes across the inductive components. A typical arrangement is illustrated in Fig. 2. Here, transistor *Q1* controls the current through a solenoid coil which serves as its collector load. The base bias of *Q1* is supplied through voltage-divider *R1-R2*, and a zener diode, *D1*, shunts the inductive load. If *D1* were not present, sudden changes in the load's current could cause high transient voltages, destroying *Q1*. In operation, however, *D1* conducts whenever the voltage across the solenoid coil exceeds its breakdown voltage, thus acting as a low-resistance load and preventing a build-up of high voltage peaks. If an oscillatory wave-train is developed, as may occur with some loads, the zener diode acts to damp both positive- and negative-going peaks, for it conducts as a normal diode in its forward direction.

In practice, the zener diode should have a voltage rating *greater* than the normal operating voltages across the load but *less* than the maximum ratings of the device (such as a transistor) to be protected. Its power rating is determined by the nature and size of the load and, in general, will be comparable with the power rating of the protected device.

Current surges, in contrast to voltage transients, generally are caused by capacitive elements. A discharged capacitor acts as an effective short circuit until it builds up its charge and thus can permit extremely large momentary currents. These currents may be sufficient, in some cases, to literally "melt" a semiconductor junction.

A simple, but effective, technique for limiting surge currents is illustrated in Fig. 3. Here, a small resistor, *R1*, is connected in series between a half-wave rectifier, *D1*, and a filter capacitor, *C1*. In operation, *R1* limits the maximum current that can flow as *C1* charges.

The series limiting resistor's value is not critical. Typically, it may range from 22 to 56 ohms in medium-current, high-voltage power supplies . . . or down to a fraction of an ohm in high-current, low-voltage circuits. Its wattage rating is determined by the currents handled but, in general, is relatively small. In a common B voltage power supply circuit for an audio amplifier, *R1* might be a half-watt resistor.

Military Developments. The Naval Research Laboratory (Washington, D. C.) has developed a compact radio transmitter de-

(*Continued on page* 92)

Monthly Short-Wave Report

By HANK BENNETT, W2PNA/WPE2FT
Short-Wave Editor

HOW TO GET GOOD RETURNS ON YOUR RECEPTION REPORTS

REGULAR READERS of this column will recall that several times in the past we have stressed the importance of sending correct and reliable reports to the stations when requesting verifications. We feel sure that the large majority of DX'ers are doing so, and finding that their returns are in proportion to the value of their reports. On the other hand, if you're having trouble getting veries, it may be that you are neglecting to include an essential bit of information.

Your report *must* contain enough information to prove to a station that you actually heard it. You fool no one but yourself if you attempt to obtain a verification under what might be termed false pretenses. Your Short-Wave Editor has received two letters from stations which illustrate what can happen when a report is inadequate or incorrect.

One of these letters was from KXEL in Waterloo, Iowa, a 50,000-watt medium-wave station, over the signature of Jerry Dee, WPEØSB. Mr. Dee handles some of the station's mail, and we think a portion of his letter is worth quoting here.

". . . I never even bother to answer a letter that fails to give the time, what was heard, and the date. That eliminates about 20 per cent of the DX mail. It's not that I'm lazy but I think that a person ought to be truthful—and accurate—in a report. I can tell when someone is merely fishing for a verification and has, in fact, never heard the station.

"The National Radio Club, and others, urge their members to include return postage. In my experience with VHF DX'ing, I've always sent along a self-addressed and stamped envelope with my report, and I can boast a 100 per cent return on all requests."

The other letter, received some time ago from a station in the Far East, was an indignant one. The writer had just received

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

Lavoyd Kuney (WPE8AD), Detroit, Mich.

One Hundred Countries

Jonah F. Heffler (WPE2GPN), Bronx, N. Y.
Michael Mandrick (WPE2GVF), Rochester, N. Y.

Seventy-Five Countries

W. C. Klontz (WPE6EYO), Culver City, Calif.
Frank Gregory (VE3PE1VQ), Brampton, Ont., Canada
Norman C. Elser (WPE8CSI), Evansport, Ohio

Fifty Countries

Mark Levy (WPE2FZG), Brooklyn, N. Y.
Charles J. Matterer (WPE6DGA), San Leandro, Calif.

Twenty-Five Countries

Ian Roberts (VK2PE2E), Newport Beach, Australia
David Bock (WPE2GXV), Newfield, N. Y.
Billy W. Akin (WPE4EUW), Columbia, Tenn.
Allan Cameron (WPE6CDO), Los Angeles, Calif.
Harry T. Stout (WPE4CXE), Elizabethton, Tenn.
Jim Skatoff (WPEØCHB), St. Louis, Mo.
Raymond N. Rouillard (WPE1AVG), Chicopee, Mass.
Russell Peterman (WPE5CSA), Austin, Texas
James Eudaily, Jr. (WPE4GLQ), Millers Creek, N. C.
Dennis Kuzak (WPE8EOH), Seven Hills, Ohio
Karl Drake (WPE9DHZ), Palo Alto, Calif.
Patrick McGuire (WPE8FZJ), Drayton Plains, Mich.
Tom E. Brannan (WPEØCLV), St. Louis, Mo.
Richard F. Little (WPE5CBD), Fort Worth, Texas

Gary Clark, WPE2JBR, Flushing, N.Y., does his DX'ing with a Lafayette HE-30 receiver, a Lafayette TE-27 crystal calibrator, tape recorder, and 40' antenna. So far he has 29 countries verified.

a reception report from a listener in the United States. This listener had evidently copied some of the program details for the station that we had listed in this column. But while the listener knew that the station operated on a 24-hour basis, he didn't know that it had a short silent period once a month for maintenance. His report was for reception at the very time that the station was off the air.

Fortunately, this type of false reporting is not very common, and DX'ers caught in the act find themselves outcasts of the hobby.

Check the important points as mentioned by Mr. Dee: the time, program details, the date, and return postage. Add to this some indication of signal and readability characteristics, a brief resume of your receiving equipment and antenna, and state whether

(*Continued on page* 98)

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	15,190, 11,760, 9585	1800 (Caribbean) 0215, 0300 (W. Coast)
East Congo	Leopoldville	11,755	1630, 2100, 2230
Czechoslovakia	Prague	11,905, 9795, 9550, 7345, 5930	2030, 2330
Denmark	Copenhagen	15,165	0700
		9520	2100
Finland	Helsinki	15,185	1530 (Mon., Fri.)
West Germany	Cologne	11,945, 11,795, 9735	1010
		9545, 6075	2035
		9735, 9575, 6145, 6075	0000
Hungary	Budapest	9833, 7215, 6234	1930, 2030, 2200, 2330
Italy	Rome	11,905, 9575	1930, 2205
Japan	Tokyo	15,205, 15,175, 11,780	1830
Lebanon	Beirut	11,890	1630
Netherlands	Hilversum	17,810, 15,445	1030 (Tues., Fri.)
		11,950, 9590	1415 (Tues., Fri.)
		7125, 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	15,240	0900
		9660	2215
		5990	2045
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

On the Citizens Band

with MATT P. SPINELLO, KHC2060, CB Editor

CB GOES TO COLLEGE

MOBILE summer classrooms for the course "Field Geography of the United States" have been conducted for the past 15 years under the direction of Dr. Benjamin Moulton, Indiana State College associate professor of geography. Each summer the ISC entourage wends its way to different parts of the United States and occasionally into Canada and even Alaska. And during the summer of 1962, when Dr. Moulton's class traveled 7500 miles in the northwestern states, CB radio joined the group.

The usual form of travel for these field trips is a caravan of sedans and station wagons with as few as three mobiles and as many as eight. The CB units serve a two-fold purpose: They are used in question-answer periods, lectures, and discussions as the caravan travels through cities, villages, and over countrysides; and they help to keep the various vehicles close together and alerted for possible hazards ahead.

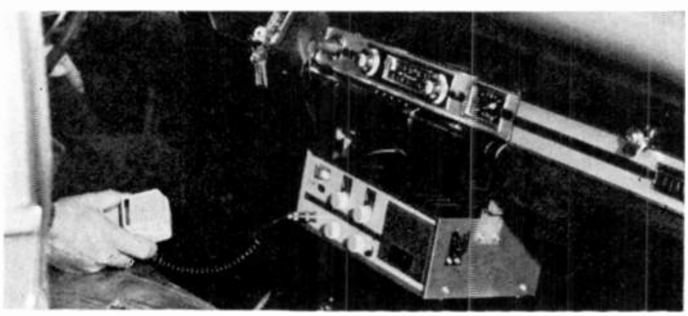
Before departure each travel unit is equipped with an Olson "Spotter" transceiver, rain-gutter-type antenna, and power cord that plugs into the cigarette lighter receptacle on the dashboard. Since most of the vehicles are leased, the equipment cannot be permanently installed; the three pieces are therefore chosen on the basis of the facilities they afford and the speed with which they can be installed or switched from one vehicle to another. The quick installation procedures are important to the group since the CB units are used quite often on short trips, two or three times a week.

During the actual excursions, the CB gear is in operation as long as the caravan is in motion. Of primary value to the students in each vehicle, of course, is Dr. Moulton's voice transmitted from a lead unit describing the features to be seen in the valley below, for example, or the rock ledges on the right, or on the slope of the mountain directly ahead. Incidentally, the travelers have found local CB operators exceedingly helpful in supplying information or informing them of local interest items.

The ISC group uses six different frequencies to prevent jamming of the channels. Depending upon local conditions, they choose between channels 2, 7, 9, 11, 14, and 19. They don't have much trouble in the west, but in large cities and the east, they say, "It's difficult to find a channel that isn't used!"

"We're sold on CB," one of the students remarked. "Besides being guided through unfamiliar cities, over unmarked roads, and warned of road hazards and traffic problems ahead, we feel as though we're in a theater watching a film with sound. We have a real use for Citizens Radio. I guess you could call us a *classroom on wheels,* thanks to Citizens Band radio!"

The official call-sign issued the college for such travels is KHA7046. If you re-



This is a typical installation of one of the Olson "Spotters" used by Indiana State College students in their mobile summer geography sessions.

1964 OTCB JAMBOREE CALENDAR

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

Fresno, Calif. June 6-7
Location: Wildwood Beach Country Club on Highway #41. Sponsor: Fresno CB Radio Club, 231 Dennett Ave., Fresno.

Spruce Pine, N. C. June 12-14
Event: Grandfather Mountain CB Jamboree. Contact: CB Jamboree Headquarters, Box 362, Spruce Pine.

Bad Axe, Mich. June 14
Location: Bad Axe Fairgrounds. Sponsor: Northeastern Michigan CB Club, Inc. Contact: Les Evans, Cass City, Mich.

Williamsport, Pa. June 20-21
Sponsor: Susque CB Radio Club, Box 644, Williamsport, Pa.

Springfield, Ill. June 21
Location: New Berlin County Fairgrounds, New Berlin, Ill. Sponsor: Springfield CB Club, P. O. Box 1825, Springfield.

York, Pa. June 27-28
Location: Fishing Creek Community Grounds. Sponsor: York CB Assistance Club.

Sioux Falls, S. D. June 27-28
Event: Annual Great Plains CB Radio Convention. Sponsor: Sioux Empire Citizens Communication Association, 1100 Sunset Drive, Sioux Falls.

Peoria, Ill. June 28
Location: Exposition Gardens, University Ave. at Northmore Rd., Peoria. Sponsor: Illinois Valley Citizens Banders Club, P. O. Box 141, Peoria.

Bridgeport, W. Va. July 12
Event: CB picnic and roundup. Location: Stuart Park on U. S. Route 33. Sponsor: Tri-County Citizens "D" Banders, Inc., Rt. #3, Box 173, Bridgeport.

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

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

Plaistow, N. H. August 8-9
Event: First Interstate Jamboree. Location: Legion Farm, State Line Route #121, Haverhill, Mass. Sponsor: CB Socialites, Box 336, Plaistow.

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

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

ceive a plea from this call at any time, lend a hand! The class is either passing through your area, or having a look-see at what your part of the country has to offer in the way of geographic interests.

Many thanks go to Willis Wolf, merchandising vice president of Olson Electronics, for enabling us to add another extremely useful application of CB radio to our bulging file of unusual and successful activities on 11 meters.

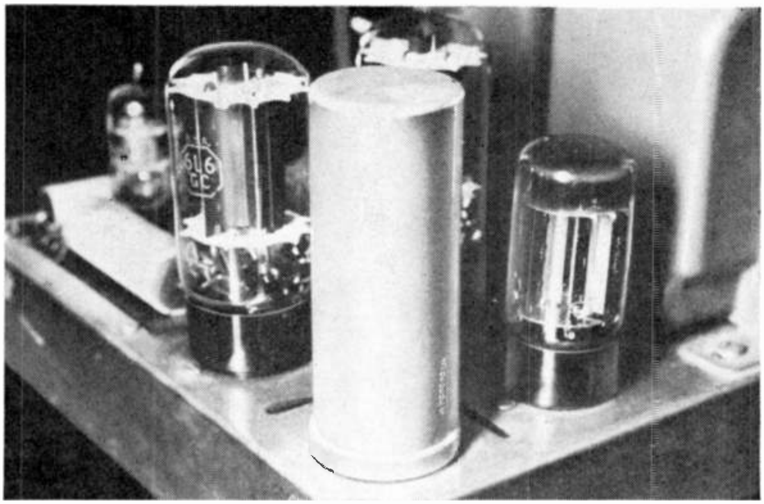
Electronic License Processing. If he never hits the headlines again, David W. Berry, Caratunk, Maine, can at least have the distinction of announcing that he received the first CB license ground out by the FCC's new Univac III electronic computer. David's call is KKA0001, issued February 12, 1964, and has started the ball rolling toward the processing of nearly 1,300,000 radio station licenses over the next few years.

Other electronic processing is also scheduled to begin this spring. An important phase will be the processing of antenna data from all types of radio station applications to determine quickly if proposed towers will create a safety hazard to air navigation. In addition, the computer will be used to make broadcast station and ownership data available for quick reference, as well as engineering computations for AM, FM and TV broadcast facilities—such as radiation and service contour patterns and channel studies.

Club Chatter. The Aurora (Illinois) 5 Watters have been in existance for less than a year. With only three months under

(*Continued on page* 96)

"I'd sure like to find the guy who swiped my walkie-talkie."



Filter Capacitor Replacement —Think Ahead

A few words of advice to keep in mind the next time you have to replace an electrolytic

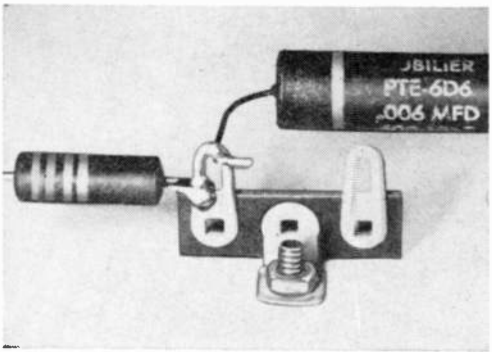
By LEWIS A. HARLOW

THE electrolytic filter capacitor is a wonderful device combining high capacity, low cost, and modest size. Unfortunately, like all components, it occasionally fails, and replacing one of these units is far from simple. There are soldered connections to its three or four working lugs, and often, additional soldered connections to the mounting lugs which are twisted in a slotted metal plate to hold the capacitor firmly. Removing an old capacitor involves unsoldering all of the connections, and cleaning up the mounting lugs which must then be straightened. During this process, some of the small components connected to the capacitor may be damaged.

If you are assembling a kit or building a project from scratch, remember that the filter capacitor you are installing now may have to be replaced. Here are some ways to save headaches and costs of additional components in the future.

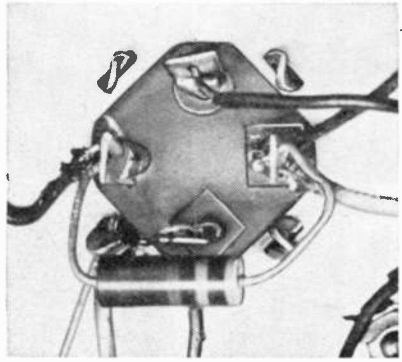
Use Long Leads. Forget the old fetish about using short leads. This may be necessary in higher frequency circuits, but in power sections where the filters usually are, a little extra lead length will do no harm. If you allow this extra length, connections to capacitor terminals can be snipped instead of unsoldered, and sufficient lead will remain for connection to the replacement capacitor. Greater lead length will also permit you to push the components aside so you can get your tools into the crucial areas.

Don't Crimp. While you're at it, drop the old habit of running a lead through a terminal, bending it back on itself, and crimping it in a death-like grip to the terminal. A simple hook-type connection properly soldered will do just as well electrically, and is easy to remove with a bit of heat. If you have to depend on a vise-like mechanical connection, there's



Crimped resistor (left, above) is on its last assignment. Lead is too short for a salvage operation, mechanical connection too tight. Compare with capacitor (above, right).

Capacitor installation pictured in a do-it-yourself manual. All lugs are accessible, components can be easily removed.



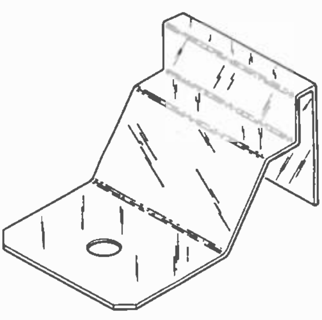
something wrong—either with your soldering tool or your soldering technique!

Incidentally, when removing excess solder from the twist-prongs, a brush made of aluminum wire, and a bulb-type solder-sucker can save you a lot of time and trouble.

Think Ahead. When you become aware of the fact that capacitor replacement is required, take a close look under the chassis, and try to estimate exactly what else will have to be replaced at the same time. If you have short-lead components, chances are that they will be sacrificed in the process of removing that bad capacitor. Pick up replacements for these components at the same time that you go for the new capacitor, and save yourself a trip. While you might get away without having to replace additional small parts, it won't hurt to be prepared.

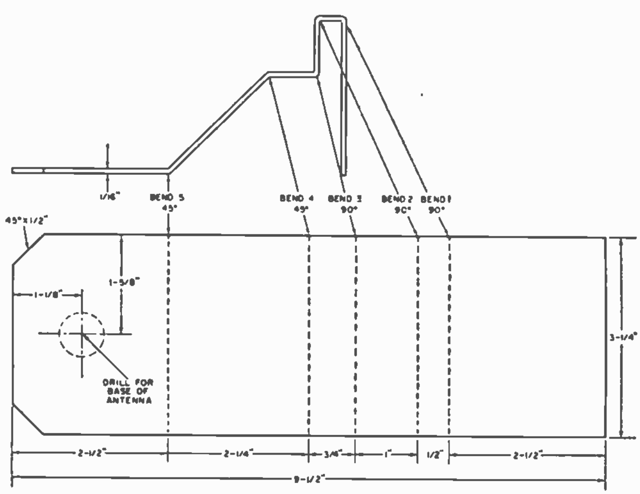
If you allow sufficient extra lead length when you install components and leads in the vicinity of filter capacitors, the operation of your unit will not be adversely affected, and replacement, if and when it becomes necessary, will be a breeze. —30—

Stick It Where?

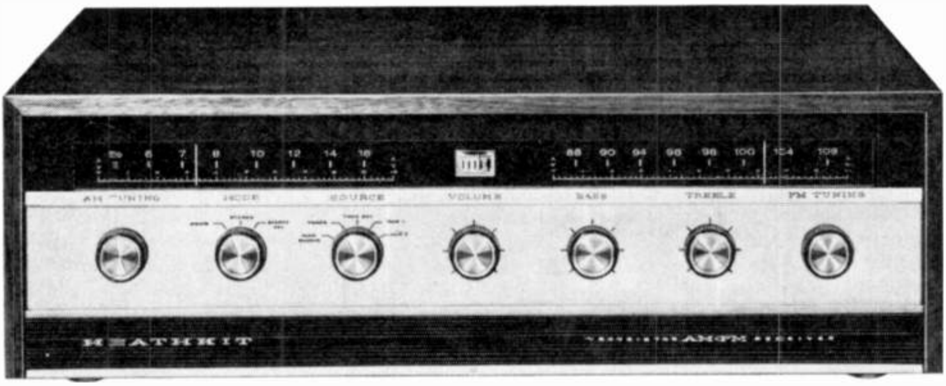


. . . on the car window, if you build this bracket from sheet aluminum. It will hold a small antenna rigidly, and won't mar the car. For complete isolation from the car body, simply roll the window down a few inches. The entire assembly can be detached or re-installed on the window in a few seconds.

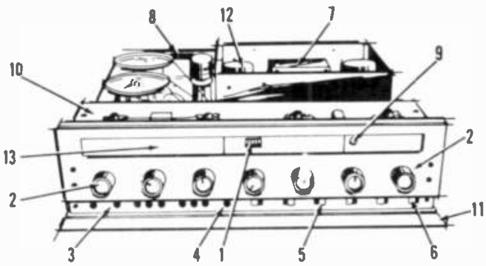
—Bob Sargent, WN0GGI



first all-transistor stereo receiver kit!



New! Cool-Operating Heathkit Receiver Combines All-Mode Tuner & 40-Watt Amplifier Into One Compact Walnut Cabinet . . . Only $195.00



1. Tuning meter 2. Individual AM and FM tuning 3. Input level controls 4. Level balance control 5. Local-distance switch 6. Speaker phase switch 7. Transformer operated power supply 8. AM rod antenna 9. Stereo indicator light 10. Preassembled FM "front-end" 11. Hinged lower front panel (conceals secondary controls) 12. Regulated and electronic filtered power supply 13. Illuminated slide-rule dial • 43 transistor, 16 diode circuitry • Dimensions: 17" L x 5⅜" H x 14¾" D.

Two 20-watt power amplifiers...two separate preamplifiers . . . plus wide-band AM, FM and FM Stereo...all beautifully housed in one compact, "low-silhouette" walnut cabinet. Add to this, cooler, faster operation with no fading, no faltering, just clean, pure, unmodified sound, and you have the exciting new Heathkit Stereo Receiver. The first all-transistor receiver in kit form! And it's so easy to own...just $195.00!

Advanced features in addition to those shown at the left include: automatic switching to stereo; inputs for magnetic phono and two other sources; filtered tape recorder outputs; high-gain RF stages, squelch control; AFC; effortless flywheel tuning; external antenna terminals; and preassembled FM "front-end" and 3-stage AM-FM I.F. strip. Just add two speakers and a phonograph or tape recorder, and you have a complete music system. "Transistor sound," designer styling, advanced features, plus big savings...more than enough good reasons to move up to the "better listening" of the New Heathkit Stereo Receiver!

Kit AR-13, 30 lbs. $195.00

HEATHKIT® by Daystrom

10-6-1

FREE 1964 HEATHKIT CATALOG
See the latest products in Heathkit's wide, wonderful line. Over 250 do-it-yourself kits for stereo/hi-fi, marine, TV, electronic organ, amateur radio, test instruments, educational and home and hobby items that will save you up to 50%. Send for your free copy today!

HEATH COMPANY · Benton Harbor, Michigan 49023
In Canada: Daystrom, Ltd., Cooksville, Ont.

Name____________________

Address____________________

City__________State________Zip No.______

Prices & specifications subject to change without notice.

☐ Enclosed is $195.00 plus postage, please send Kit AR-13 Stereo Receiver.

☐ Please send complete detail and specification sheet on the AR-13 Stereo Receiver.

☐ Please send Free copy of 1964 Heathkit Catalog.

HF-165

CIRCLE NO. 10 ON READER SERVICE PAGE

Some plain talk from Eastman Kodak about:

oxide needles and sound brilliance

What makes good tape good? How we push needles around has a lot to do with it.

As exotic as the many performance parameters of sound tape might be, it all still depends upon gamma oxide particles dispersed throughout a resin binder. Many of the tape's magnetic characteristics depend largely on the size, shape and orientation of these particles. Frequency response, signal-to-noise ratio and general sensitivity are all interrelated, not just to one another, but to how close to optimum these needles of gamma oxide are handled.

Let's see just what's involved.

Visualize a basket filled with a few million needles.

They have all been magnetized so they are clinging together in disoriented clumps. The problem? Just take them all apart, lay them along parallel lines so they are all similarly oriented and their magnetic fields all reinforce one another. Oh, one more detail. These needles measure 1 micron by .2 microns so, of course, they are somewhat delicate. One more point. Don't break any. The lengths are critical. For every broken or disoriented needle, H.F. response and signal-to-noise ratio will be affected. Every time one needle touches another, making electrical contact, sensitivity suffers.

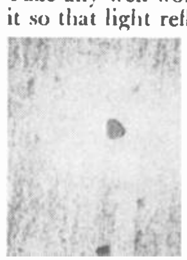
Fortunately, we've been solving problems that are kissin' cousins to this one in the coating of photographic emulsions. And we've been doing it for more than 85 years. Photographic emulsions are generally considered to be far more critical than sound tape in terms of physical characteristics. But we think that tape made to the gnat's-hair specifications of a photographic film is a better tape. And we proceed on just this basis.

We separate the needles in a big-shouldered machine called a ball mill, a massive stainless steel drum that contains two million ball bearings. When the drum turns, the bearings tumble. Into the drum goes the binder which will act as a suspension for the oxide. Now add the oxide. Now the mill starts turning, and the ball bearings tumble. As they tumble, they actually shear the honey-like suspension separating the individual needles, coating them with suspension so they can't make electrical contact with each other. This process really takes horsepower—and lots of it! It's like the world's biggest taffy-pull.

Now comes the critical part. If you stop milling too soon, you'll have clumps of needles. If you mill too long, you'll start breaking up the individual needles. There is a tendency among many nonscientific personnel to fall in love with the idea that the shorter you mill, the higher the production, since that's one way to make tape cheaper. But we don't play that sort of music around here.

We never cut milling time. And we can prove it.

Take any well-worn tape. Look at it so that light reflects off the surface. See those glossy spots surrounded by a dull ring? These are nodules—high spots produced by clumping of the oxides. They were caused by too short a milling time, obviously.

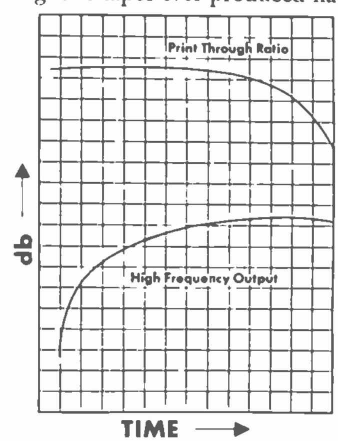


Nodules show up as polished "high points" on tape surface

In actual practice they cause accelerated head wear and degrade high-frequency response as well as show up on the tape as noise. Now check a well-worn Eastman tape. If you can't find a clumping immediately, check the entire roll. There must be one there, someplace. Or must there?

Milling too long is equally bad. Here's why. Best performance is to some extent dependent on the dimensions of the needles. That is the ratio of length to width. If you break the needles into smaller particles by milling too long, you'll get forms that are more cube-like than needle-like.

Cubes have pretty awful characteristics in terms of their magnetic parameters. Some of the very first magnetic tapes ever produced had



Notice how severely high frequencies suffer if milling time is too short; how print-through is degraded with prolonged milling.

cubes. Remember? You had to operate at a speed of 30 inches to get anything approaching good sound, and even at that, it didn't approach it very closely.

In addition, these cubes do all

sorts of other distressing things such as change the bias requirements of the tape, and elongate the hysteresis curve, cutting sensitivity, and give pretty awful print-through characteristics.

Milling time is critical to about one percent. Temperature and humidity a lot more critical than that.

Once the milling operation is complete, the suspension is filtered to remove any clumps that might have remained. Then the real tough problem starts. Coating. All you have to do is to take this honey-like mass and lay it along a base nice and evenly. Problem is, the needles

try to reclump after filtering. To prevent this, we developed our new "R-type" binder. It never reclumps. And it always stays where it's put. No sagging, ever. And this means it can be handled with precision.

At Eastman Kodak, coating is uniform to within a few millionths of an inch. No, that's not a typographical error—we mean it. Six decimal places. This may be a new standard of precision for sound tape. But remember, we've been doing this sort of coating for years on film. While it's not exactly as easy as falling out of bed, it is a technique which we have down cold. And it makes dramatically significant difference in performance. Sound brilliance is what you get when you do everything right. And the righter you do it, the better the sound. As one Eastman physicist puts it, "making tape is like being married to a redhead. But luckily, we know how to handle her." Next time, let's chat about base and surface characteristics.

EASTMAN KODAK COMPANY
Rochester, N.Y.

Circle No. 6 on Reader Service Page

Shotgun Sound Snooper

(*Continued from page* 54)

schematic on page 54 is optional; *T2*, *S2*, and *J3* may be omitted if low-impedance output will suffice.

The PK-544, *R1*, *S1* (part of *R1*) *T2*, *S2*, and *J1*, *J2*, and *J3* are mounted in half of a 2⅛" x 3" x 5¼" aluminum box (LMB #136). As a matter of convenience, the authors first mounted input transformer *T1* to the board of the PK-544 amplifier. To do this, you bend off the mounting tabs of the transformer. Then apply quick-drying cement to the bottom of *T1* and to an open area on the amplifier board near the input leads. Mount transformer *T1* in this area.

When the cement is dry, remove the PK-544 input leads where they fasten to the board. Referring to the schematic, trim the low-impedance leads of *T1* and solder them to the board where the original input leads were attached. The high-impedance primary of *T1* is later connected to *J1*.

As shown in the photo on page 54, the PK-544 is mounted with four *4-40* x ⅝" machine screws and extra nuts to the top of the box. Tighten the screws with nuts, then use eight more nuts, four above and four below, to mount the board so it is well away from the metal box. Mounting holes are already drilled in the PK-544; disregard the mounting hardware that comes with it.

Drill holes in the front of the box for mounting the three jacks, controls *R1-S1*, and transformer *T2*. Drill a hole in the bottom of the box for the battery mounting bracket which is made of a piece of scrap aluminum. Referring again to the photo and schematic on page 54, mount and wire the remaining components, cutting any excess leads. In general, it's a good idea to follow the arrangement shown to avoid possible feedback problems.

The bottom section of the box is fastened to the horizontal support bar of the tubular pickup unit by means of two *6-32* ⅜" screws and macthing nuts. Place the top section of the box with the mounted amplifier components onto the bottom section, fasten with the screws provided, and the completed unit is ready to use.

Operation. Operation of the "Shotgun Sound Snooper" is simple—just connect a pair of headphones and turn on the amplifier, adjusting the volume control carefully to avoid painful sound volume. The tubular mike must be aimed toward the location from which sound pickup is desired—sight along the tops of the tubes and turn the volume up gradually. Wind has the effect of carrying sound, so straight-on reception is not always possible.

Under windy conditions, the unit should be panned until the best reception is achieved as determined by ear. Noisy winds can spoil listening—especially if the tube ends cannot be sheltered a bit—but moderate wind noise can be cut down by draping the mike with a cloth. Annoying sounds of consistent frequency can often be partially blocked by simply plugging the tubes which are carrying them.

If you enjoy experimenting, you'll find the "Shotgun Sound Snooper" a unique, fascinating project. Endless variations are possible, of course—in tube length and diameter, in the microphone cartridge, the amplifier, etc. Just as endless are the applications you'll find for the microphone. Construction is easy, and the cost is reasonable. Don't delay! -30-

"Now what would banana peels be doing in your set?"

Transistor Ignition

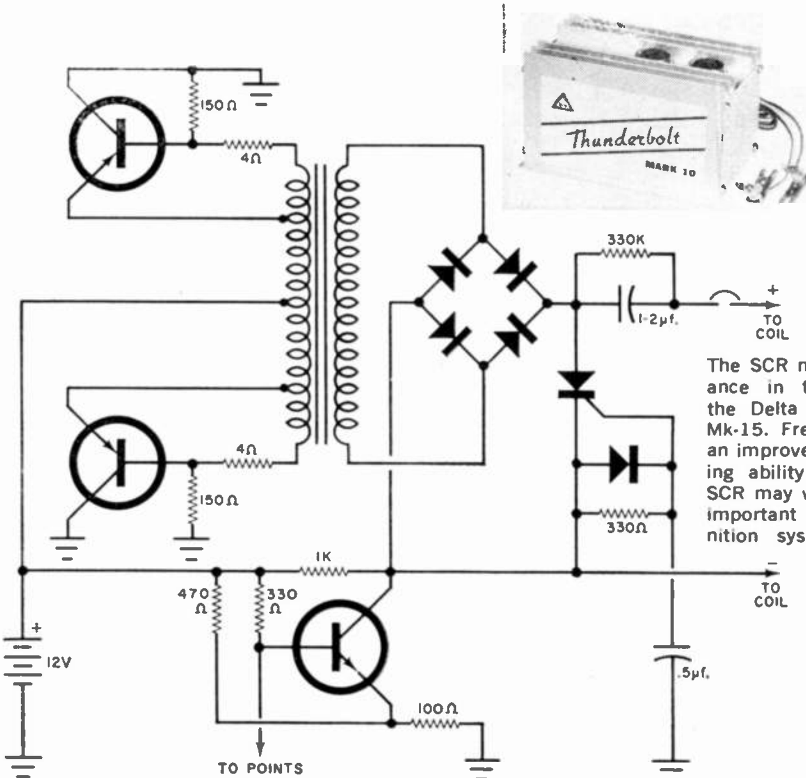
(*Continued from page* 44)

shown in *Circuit 6*. Various manufacturing techniques produce the same approximate results and the Bendix DAP, Delco Nu-Base and Motorola PNIP transistors are commonly seen in this circuit. The transistors are moderately priced, and it is not unusual for a system with this circuit to sell for around $30. As in the circuits mentioned above, a zener diode is used to clamp the base of the transistor.

In *Circuit* 7 we see the "Operation PICKUP" designed by C. E. Rouff and first published in POPULAR ELECTRONICS (June and October, 1963). It represents a somewhat novel approach although the advantages that might accrue from the use of a higher turns-ratio coil are forsaken. This circuit does permit the user to take full advantage of his original-equipment coil without worrying about burning out the breaker points. Literally thousands of units using this circuit have been built from the magazine articles, and four different manufacturers sell units incorporating this circuit or slightly modified versions of it.

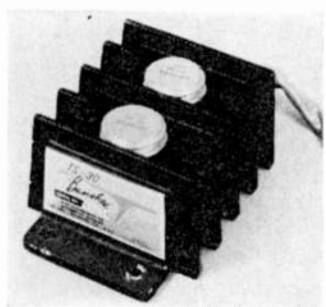
Starting with *Circuit 8,* we encounter the more complex and frequently more expensive transistor systems. In general, the manufacturers working with *Circuit 8* are newcomers to the field of transistor ignition, but the designs are sound and the products have proven out in actual operation. The unusual part of *Circuit 8* is the high-gain transistorized amplifier used to turn the high-amperage switching transistor on and off. This amplifier permits a further reduction of the current flowing through the breaker points. In fact, in the NELI "Transnition" system the manufacturer claims a point current of under 12 ma.!

The most expensive transistor systems are those that use some form of *Circuit 9*. This is the capacitive discharge system as opposed to the inductive systems outlined in the previous eight circuits. Practically all automotive engineers believe that the capacitive system will

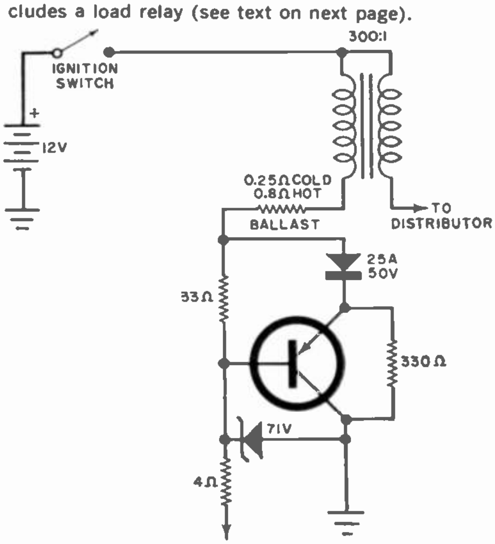


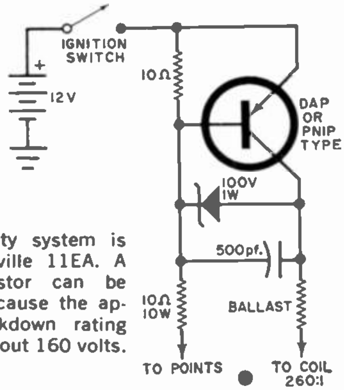
The SCR makes its first appearance in transistor ignition in the Delta Products Mk-10 and Mk-15. Frequently suggested as an improvement over the switching ability of a transistor, the SCR may well become the most important component in ignition systems of the future.

In this Slep TS-30 system, two transistors were tied in parallel. This company offers a variety of systems up to and including a 500:1 model.

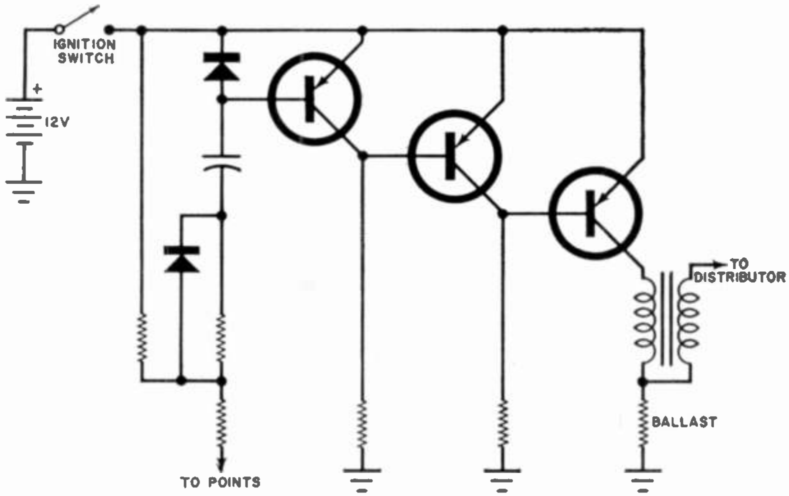


The circuit of the Prestolite 201, one of the better quality systems now marketed, doesn't show that the installation kit includes a load relay (see text on next page).





Another quality system is the Leece-Neville 11EA. A single transistor can be used here because the applicable breakdown rating is probably about 160 volts.



TRANSISTOR IGNITION

Nuclear Electronic Laboratories Inc. (N.E.L.I.) developed its "Trans-nition" circuit using three transistors cascaded (four in positive ground version). Point current is reduced to under 12 ma. and special 260:1 coil must be used.

eventually be acknowledged as the best system for internal combustion engines. Its advantages are two-fold: faster rise time or quicker firing of the spark plugs and more precise engine timing.

The two manufacturers offering capacitive discharge systems approached the circuitry problems from different directions. Motion, Inc. uses cold-cathode tubes while Delta Products uses transistors and a silicon-controlled rectifier. From rumors in the automotive field, Motion will soon switch to the use of an SCR, as will a well-known kit manufacturer who is about to offer a system incorporating an entirely new capacitive discharge concept to the market. By making the ignition coil part of the electronic circuitry, a low ratio (original equipment) can be used without sacrificing performance at high engine speeds.

Where To From Here? There is an obvious trend towards the thinning out of the ranks of transistor ignition equipment manufacturers. Two manufacturers whose products are not listed here (at their request) are definitely discontinuing the sale of transistor ignition systems. Both companies tell of encountering insurmountable stumbling blocks when trying to explain to the general public—with their minimal electronics knowledge—how to install a transistor system in an automobile—about which the average citizen seems to know less than anything else he owns!

Simplification of installation is the objective of several manufacturers (Judson, Delta Products, etc.). Simultaneously, other manufacturers are realizing that many ordinary installation problems can be overcome through the use of a load relay. This relay operates from the ignition switch and the contacts are made to activate the transistor system. The problems of ballast wiring are eliminated and the current delivered to the ignition coil becomes the optimum figure for which the manufacturer's product was designed.

Many of the better grade systems are now sold with this load relay. If you have a system lacking this feature, you can easily remedy the situation by inserting a Prestolite P-9-62 load relay—obtainable at many automotive supply stores.

It is a foregone conclusion that transistors or SCR's will be used in one fashion or another in the ignition systems of 1965-66 cars. Just how they are used remains to be seen. But you can take advantage of transistorized ignition systems now, and gain valuable experience by installing your own. —30—

The FCC and 11 Meters

(*Continued from page* 60)

turned to the author with a tired smile and said, "Now you see why I thought direction-finding wouldn't be necessary."

The Law On 11. One conclusion the author arrived at after witnessing this period of intensive monitoring is that the FCC is indeed serious about CB rule enforcement. The FCC does not like to send citations, and they do it for just one purpose: to prevent recurrence of the offense. Once an offending CB operator has made immediate response to the FCC office issuing the citation *showing that he understands the offense and will prevent its recurrence*, no further action is necessary.

Many CB'ers neglect to answer citations. In the eyes of the FCC, such inaction demands further action, and may result in the revocation of licenses or a fine. Citations must be answered within ten days; answers should be complete in themselves, contain a full explanation of the incident, and detail completely action taken to prevent recurrence of the offense.

Should the violation be repeated and there is any indication that the repetition is willful, the station licensee may receive his next notice of violation in the form of one or more $100 fines.

More Self-Enforcement? What was the eventual answer to the letter sent to the Attorney General? In reply, the secretary of the FCC, Mr. Ben Waple, wrote in part that "Reports of violations . . . may be submitted direct to the Commission in Washington or to any field office" and "except where formal procedures are required . . . , requests for action may be submitted informally. Requests should set forth clearly and concisely the facts relied on, the relief sought, the statutory and/or regulatory provisions (if any) pursuant to which the request is filed and under which relief is sought, and the interest of the person submitting the request."

Mr. Waple went on to point out that there were several factors that affected what action could be taken on the basis of a citizen's report. The most important seems to be whether the report would be admissible as evidence, with a second important criterion, being the effect of the action on safety and the public. Though it wasn't stated in so many words, apparently many of the complaints the FCC receives are actually violations of the "secrecy" part of the Communications Act, Section 605. This prohibits their use as evidence in most cases.

What actions can CB'ers take to improve 11-meter operating practices? A CB'er may avoid violation of the secrecy provisions of the Communications Act by writing direct to licensees noting violations. As long as a letter is marked to the *personal attention* of a CB'er and the contents are not divulged to anyone else, there is no violation of secrecy. Similarly, clubs or groups may agree to remind members when a violation is observed, and the agreement will thus authorize any member to advise the licensee of the questionable practice.

The FCC encourages the formation of CB groups to help members. But they emphasize that they only encourage and do not request or direct such action. Obviously, no one can act for the FCC. They do, however, urge CB'ers to keep their own house clean. -30-

Standing Waves: Do They?

(*Continued from page* 64)

beam—you can more than compensate for both line and SWR losses—since many of these antennas have gains in excess of 8 db. You would have to increase your transmitter power by 6.3 times to get this much gain with a no-gain antenna!

The SWR meters are helpful, but don't rush to quote their readings without reservation! The SWR you read at the transmitter is always less than the actual SWR at the antenna. Power reflected from the antenna is attenuated on its way by line loss. By the time it gets to the meter, the reading is always lower than the power actually is.

Now you can re-evaluate the importance of SWR. -30-

Togetherness!

(*Continued from page* 71)

here on channel eleven instead of returning to eight until you get home. Ten-four?"

"Ten-four, Mom. KHD4167 mobile out," Carl answered, grinning broadly as he placed the little transceiver on the dash against the windshield. "She sounds like a veteran, doesn't she?" he asked Jerry.

"Just like Broderick Crawford in *Highway Patrol*," Jerry agreed, grinning back. "Say, that's darned good performance for that short little whip. It must be better than four miles to your house."

"I've talked slightly better than five miles with it, and I've copied stations twenty miles away," Carl replied. "We better get going. We'll pick up plenty of ignition noise with this ungrounded transceiver, but I'll leave it on anyway. We'll still be able to copy strong stations."

Crossing the bypass bridge high above the swirling water, the boys realized from inundated landmarks that the flood threatened to outdo even the 1913 disaster the old-timers still talked about. From the speaker of the little transceiver came a steady chatter of CB stations working base to base, mobile to base, and mobile to mobile.

"Hey, I thought CB stations weren't supposed to work anyone except their own units," Jerry remarked.

"That's their primary purpose under ordinary circumstances, but they *can* communicate with units of other stations when necessary to exchange messages related to the business or personal activities of the individuals concerned. And in an emergency like this one, many of the restrictions are temporarily lifted."

Following the directions Carl's mother had given them, the boys were soon home, and they immediately put Carl's ham station on the air. When they checked into the state emergency net, already in full swing, they quickly discovered their own city was not the only one in trouble. Towns all up and down the river were being flooded, and important emergency traffic relating to the availability of boats and power supplies and shelter equipment was being passed quickly and efficiently by hams who had drilled day after day, year in and year out, for just such a situation.

THEIR FIRST assignment from the local CD director was to gather information about weather and river conditions upstream. A single request on the net frequency was all that was needed. One by one affected stations called in with river-stage and rainfall data. Other stations filled in with weather conditions over a three-hundred-mile radius. A station in the capital city obtained a river forecast from the state weather bureau. Armed with this information, the local officials realized they must brace themselves for much worse flooding.

The mayor called and asked if the boys could contact the governor for him. A call to the capital city station brought an immediate response, and in a matter of minutes the mayor was talking to the governor over phone-patch facilities at both ham stations. Informed of the seriousness of the situation, the governor promised to send national guard units equipped with amphibious jeeps and ducks.

By means of the little transceiver perched on a corner of their operating desk, the boys could hear the CB stations operating. The CB'ers had at least forty mobile units in the field, and they were doing yeoman work in guiding trucks to families needing evacuation, in patrolling flooded areas, in keeping sight-seers out of the city, and in furnishing communications between disaster units without telephone facilities.

Carl and Jerry soon realized that there should be some sort of liaison between the CB stations and the hams, so they called a strong nearby CB station that seemed to be more or less directing activities on that band and made the suggestion. The CB operator quickly agreed, and the details were worked out: each group was to continue to operate independently, but Carl and the CB operator would both monitor channel eleven. When something came up that needed cooperation, a call would be made on this channel.

This arrangement worked out beautifully. By now anxious inquiries were beginning to pour in on the ham bands concerning the safety of relatives and friends in the flooded city. When the people in question could not be reached by telephone, the receiving ham station relayed the message to Carl and he called the CB station and asked to have a mobile unit check on the addressee. In a matter of minutes a reassuring reply could usually be sent to the inquiring party. And when the word got around, the CB people were quick to avail themselves of the hams' ability to send reassuring messages hundreds and thousands of miles to friends and relatives.

Both groups kept at their stations around the clock, and a mutual respect was quickly established. The hams realized that the CB boys and their large number of mobile units could not be equaled for local coverage and for doing the "footwork" of communications. On their part, the CB fellows respected the way in which the hams, with their greater power, their multiple bands, and their long-established nets, could reach out to great distances to bring in help from areas unaffected by the local disaster.

FINALLY the rains stopped, and after forty-eight hours the river crested and began to subside quickly. The weary CD director and the operator of the CB station with whom the boys had kept in touch during the long vigil dropped in for a cup of coffee and to talk over the operation.

"This has been a rough time," Mr. Shaver, the CD director, said slowly, "but I think we've learned a lot from the experience. I'm sure I have. For one thing, I know that when the chips are down I don't have to worry about either the hams or the CB boys. Both groups have done a wonderful job of providing communications during this entire emergency. And I hope you both realize that working together you have done a much better job than either group could have done separately. Do you read me?" he asked with a twinkle in his eye.

"Roger!" Jerry said promptly.

"A big ten-four!" Mr. Conners, the CB operator, echoed.

"Mr. Conners," Jerry began, "I have a confession to make, and I think I'd better get it off my chest. For no really good reason, I've carried a grudge against you Citizen Banders. Maybe it's because the frequencies you're occupying used to be our eleven-meter band. Perhaps it's because you fellows can get on the air without having to pass the stiff code-theory-and-laws examination we hams have to take. Anyway, in the past I have fallen into the habit of referring to you disparagingly as 'chicken-banders.' I'm stopping that here and now."

"Good!" Mr. Conners exclaimed. "You do that and we CB'ers will stop telling each other that H-A-M stands for the 'High And Mighty' opinions some radio amateurs have of themselves!"

Grinning broadly, the two clasped hands. In the background the amateur calls on Carl's SSB receiver blended with the CB chatter from the little transceiver which was still going strong. -30-

Bandspreading the ARC-5

(*Continued from page 66*)

single unattached plate on the extreme left, and all the others except for the remaining two attached left plates in each section. Since the capacitor shaft floats on a bearing spring, hold the rotor section firmly with one hand during the plate-removing operation so it will not break loose.

Because this plate removal raises the frequency, it is necessary to pad each stator section with a small mica capacitor to bring the tuning range back to the 80-meter band. Placement of these capacitors is not critical, and the author simply soldered them to grounded terminals nearby. A 62-pf. capacitor is used for the oscillator and mixer, and a 50-pf. capacitor for the antenna section.

Using Calibrated Dial. After you replace the capacitor cover, the tubes and the i.f. can, cut out the calibrated dial on page 66 (or make a tracing) and, using rubber cement, paste it to a stiff cardboard backing. Mount the new dial on the front panel of the receiver and, with the tuning capacitor turned all the way in, set it at 3.5 mc. The dial may have to be shifted slightly. If you have a transmitter with a known frequency or a crystal calibrator, this is easy to do. If not, listen during the evening hours to the phone operators who work close to 3.8 mc.

It may be necessary to adjust the oscillator trimmer to less capacity. If the dial will not come quite on calibration, adjust the main oscillator tuning slightly. This will shift the dial calibration into place. It may also help to peak up the mixer tuning.

Bandspreading the tuning of the ARC-5 separates the signals and makes the unit more serviceable.

—*E. H. Marriner, W6BLZ*

Transistor Topics

(*Continued from page 74*)

signed for distress signal transmissions. The new instrument employs a high-current tunnel diode oscillator and is powered by a sea-water activated battery. Although still in the experimental stage, it promises to be of real value in future sea rescue operations.

A hand-carried, self-powered radar system weighing only eight pounds has been developed by General Dynamics/Electronics. Featuring a solid-state FM/c.w. circuit, the unit has an effective range of 1000 meters —approximately two-thirds of a mile. Capable of detecting and tracking many types of moving objects, it is designed for frontline military detection and surveillance. The potential future applications of the instrument are not limited to the military, however, for it also may be used by border patrolmen, industrial security guards, and local police officers.

The armed services, in general, are making a major effort to perfect the use of integrated circuits in military equipment. If integrated circuits were used in the small radar system described above, for example, its weight would be reduced to five pounds. In another case, one firm is developing an integrated circuit guidance system for the advanced "Minuteman" ICBM.

That's the end of the road for now, fellows. Back next month with more circuits, tips and news . . .

—*Lou*

Across the Ham Bands

(*Continued from page* 68)

After its initial popularity, however, many quad users decided that it did not perform up to its promises. But a number of experimenters continued working with the quad and discovered that the originally published quad dimensions were incorrect for peak performance. When the correct dimensions are used, the cubical quad antenna will hold its own in any league.

For example, a two-element cubical quad (the most popular type) has a forward gain of 6 to 7 db (depending on whose figures you use), putting its gain somewhere between the gains of two- and three-element, conventional Yagi beams. Furthermore, many quad users insist that quads are even better DX antennas than the figures indicate.

How It Works. The cubical quad can be analyzed by starting with a half-wave dipole, which has a power gain of unity. If we place another half-wave dipole one-fourth wave below the first one and feed them both in phase, their combined radiation pattern will produce a power gain of 1 db compared to the single dipole. Now, if we bend the ends of the dipoles at right angles towards each other, we can cut the "wing span" of the array in half with a negligible loss in gain (1/10 db), because the center halves of the dipoles do practically all the radiating. Finally, we can connect the ends together (because the currents and voltages match at corresponding points in the two dipoles) and feed the resulting quad in the center of the bottom section.

Next, by placing a similar quad—but 5 or 6 per cent longer per side, and without a feedline—one-eighth wavelength behind the first quad, it will act as a reflector and increase the power radiated in the forward direction by 5 to 5.8 db, making the total forward gain 5.9 to 6.7 db compared to the reference dipole. At the same time, the signal radiated from the back of the array will decrease approximately 20 db.

If desired, the added loop can be made 5 per cent smaller and placed one-eighth wavelength in front of the radiator quad to act as a director, with no essential difference in the performance of the resulting cubical quad. Larger quads use both reflectors and directors.

A feature of quad antennas of particular interest to experimenters is that they fit in well with home-construction techniques. A roll of #12 or #14 wire, four bamboo or fiberglass rods for the supporting "spider," a length of 50- to 75-ohm feedline, and some miscellaneous hardware are the main ingredients of a simple and efficient cubical quad antenna. The various amateur handbooks and antenna manuals give full constructional details for building both single-band and more elaborate multi-band cubical quads.

News and Views

Roy Lincoln, WA4DOU, Moorehead City, N.C., has been operating "portable" near Lexington, N.C., on 6 meters—with an occasional excursion to 10 meters. His Hallicrafters "twins," the HT-40 transmitter and SX-140 receiver, and a DPZ "Vacationeer" portable antenna have racked up over 100 contacts in four states on 6 meters. He and other sharp 6-meter operators are now undoubtedly taking full advantage of the many "short-skip" DX openings that traditionally start each spring about the first of May . . . **Ben Snyder, KN7YDM,** 6317 Nyanza Park Drive, Tacoma, Wash., uses converted Navy ARC-5 units for his transmitter and receiver on 40 meters. As a school project, he is building a new power supply to boost the transmitter power from 35 to 75 watts . . . **Raymond J. Laine, WAØFRQ,** 6729 S. Foresthill, Littleton, Colo., has just graduated from the Novice to General Class license. Ray hops his Heathkit DX-60 transmitter and Hallicrafters S-85 receiver between 80, 40, 20, and 15 meters, but he likes 15 and 20 meters best. He has 43 states worked and confirmed.

Amateur radio station licenses are now being processed electronically! The first one to come out of the Federal Communications Commission's UNIVAC computer was issued to **Victor O. Serviss,** 6460 South Vine, Littleton, Colo., who was assigned the call of **WØANP.** New CB licenses are also being handled electronically, and similar processing of applications in other categories of the Safety and Special Radio Services will be scheduled as soon as possible.

Thirty-five states and a handful of Canadians make up the "brag" list of Richard Leverone, KN1ETP, Norfolk, Mass. Dick runs 27 watts to a home-built 6V6-807 transmitter driving a 56' antenna 20' high. He receives on a war-surplus Hammarlund BC-779.

Dick Van Zandt, Jr., WN9HEU, 704 Main St., Dundee, Ill., works all Novice bands. On the lower frequencies, he uses a Hallicrafters HT-40 transmitter and SX-140 receiver and a Hallicrafters SX-110 receiver with dipole antennas. On 2 meters, a Heathkit "Twoer" feeds a 7-element rotary beam. Dick has made over 400 contacts in 36 states, Canada, Guantánamo Bay, and Puerto Rico, and he has passed the General Class examination . . . **Peter Yankala, WN9ILT,** 9827 Greenwood, Chicago, Ill., has worked 49 states, Canada, and Panama with his Johnson Viking I transmitter and National NC-140 receiver. Forty and 15 meters are his favorites. Pete is now awaiting the arrival of that "big G" license . . . **Frank Koempel, WB2JKU,** 215 Arlington Drive, Fords, N.J., operates on 6 and 2 meters. All his equipment, including his antennas, is located in the attic of his home. On 2 meters, he transmits on a Heathkit "Twoer" feeding a 3-element beam and receives through an Ameco converter ahead of a Hallicrafters S-40A. His best 2-meter DX is 155 miles. On 6, he uses a 2E26 transmitter driving a dipole antenna and receives with a 6CF6 converter ahead of the S-40A.

Ralph, KP4BPH, 17 Onil, Bucare, Rio Piedras, Puerto Rico, who offered free radio parts in the February "News and Views" to anyone who asked for them as long as his supply lasted, received over 100 letters within a few days after the February issue hit the newsstands! Now the parts are all gone, and still the letters roll in. Ralph reports that he QSL's 90% of his contacts via the ARRL QSL Bureaus; so if you have worked WP4BPH or KP4BPH and have not received a QSL card, send a stamped addressed return envelope with your call letters in the upper left-hand corner to your call-area QSL Bureau.

Walt Rhodes, WN5FMV, 5 S.E. 34, Oklahoma City, Okla., says he would rather rattle his "bug" key rag-chewing than DX chasing. Nevertheless, his Heathkit DX-20 transmitter and National NC-173 receiver have helped him "spread the word" in 31 states—27 of them confirmed . . . **John Deegan, WN4QLZ,** 13895 S.W. 72 Court, Miami, Fla., once caught the FCC in an error—they sent him a General call when he applied for a Novice call! John works his Heathkit DX-60 transmitter into a Hy-Gain 14-AVS vertical antenna mounted in solid coral rock. A Gonset GR-91 receiver, plus a Q-multiplier, handles the reception. His record is 25 states and Puerto Rico worked on 40 and 15 meters . . . **Brad Pioveson, WN9KNP,** 104 S. Browning, Benton, Ill., reports that he learned the code in 35 minutes with the code-learning chart featured in our March, 1963, column! In six weeks on the air, Brad has worked 15 states and Canada, using a Heathkit HX-11 transmitter, HR-10 receiver, and a dipole antenna.

Here's hoping you and your radio club run up a good score in the annual ARRL Field Day on the weekend of June 27-28. Will we see your "News and Views" or your picture in this column next month? Write direct to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Indiana 46401. 73,

Herb, W9EGQ

On the Citizens Band

(*Continued from page* 78)

their belts, membership was over 55. The latest tally shows the total nearer to 100. A welfare committee is presently working with agencies in the area and assisting wherever possible, and several social events are planned for 1964. Shown in the photo are the officers and board of directors: (seated) Kathy Turner, treasurer, and Marily Steffes, secretary; (second row) Andy Beilman, sergeant-at-arms, Marrion J. Scott, president, and Jim Cowgill, registered agent; (back row) Fred Dalton,

membership chairman, and Ray Armbrust, parliamentarian. Absent were Bill Jarvis, vice president, and four additional committeemen. If you're interested in joining this group, contact Fred Dalton at 113 Bluff St., Aurora, Ill.

The Twin Ports Mobile Emergency Unit, 230 N. 18th Ave. West, Duluth, Minn., has changed its name to Seaway Seven CB Club. Present officers are: Henry Vandenberghe, 16Q0241, president; Hubert Miller, 16W2366, vice president; and Kurt R. Pietrowski, secretary-treasurer.

We goofed! The Holiday Citizens Banders of Maryland, Inc., were written up in the March issue as being located in Cumberland, Md. They are actually encamped, permanently, in Baltimore, Md. This club has already held a swinging dance this year, and the July and August meets are planned as a beach party, free, with prizes of two walkie-talkies, an AM radio, and an AM-FM radio. Furthermore, their Halloween party is already in the making.

Channel Chatter, monthly publication of the Suburban Mobile Radio Association, Madison Heights, Mich., recently reported four emergencies handled by club members within a two-day period. The first of the 10-33's was handled by S.M.R.A. member Don Seese, KHG5355, while on his way to work early one morning. Spotting a gentleman who had been in an accident with his auto, Don relayed the information to his base station. Three police squads arrived within five minutes. The slightly shaken occupant of the damaged vehicle later presented himself at KHG5355's home to thank him for service rendered.

On another occasion that same day, Bob Rock, KHG5098, while on his way home from work, found that his auto's water pump had expired—kerplunk! Bob put in a call to his base station for help (money), which was soon delivered by friend Harvey Penz, KHI3337, who had been monitoring in the area. A third misfortune seemed to pounce upon another S.M.R.A. member when, on his way home after having his CB unit repaired, it appeared that he (we'll shield his name behind his red face) took better care of his CB gear than his auto. He ran out of gas! Let's just say that friend KHG5355 came to the rescue quickly with some petrol.

In a more serious vein, the next evening club member Carl Stumpf, KHG2962, with his sister as a passenger, was involved in a two-car accident. According to the report in the *Channel Chatter*, it was remarkable that Carl's CB unit worked after the impact. Fortunately it did, and it enabled Carl to call for help via his base station. Then, forcing his way out of his car, Carl found that occupants of the other car involved needed medical assistance. His second CB plea was for ambulances. Again, authorities arrived within five minutes. So, CB radio chalks up additional reasons for its existence; yearly, monthly, weekly, daily, hourly!

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

- REACT of Orange County, P. O. Box 26, Midway City, Calif. Officers: Robert A. Bleakley, 11W8551, president; Harry Sprague, KEF0815, vice president; Betty Sprague, KFA2281. secretary; plus four additional board directors and a public information officer. This group monitors channel 3 24 hours a day.
- Springfield CB Club, P. O. Box 1825. Springfield, Ill. Bill Bowlin, KHA6760, is president.
- Citizens Band Radio Relay League, Inc., 2265 65th St., Brooklyn 4, N. Y. Mr. Angelo Pollicino is chairman.
- Voice of Dundee CB Club, 915 River Acres Drive, Tecumseh, Mich., organized

in late 1963. Officers: Richard Burke, president; Cal Gensler, vice president; Dean Peotter, secretary; and Laurie Kroeger, treasurer.

● Lapeer County CB'ers, 60 Lake Nepessing Rd., Lapeer, Mich. Officers: Gorden R. Shapter, KHG5887, president; Rex L. Bauder, KHG3173, vice president; Roy L. Torr, 19A9892, secretary; Dale Marsh, KHG6102, treasurer and publisher of the interesting club news voice called *The Monitor.*

That about knocks us 10-7 for this month. Be sure to keep us posted on how the jamborees went (we can't make 'em all). Include some pictures if you can. And let's see what some of those "equipped" rescue teams and their vehicles look like!

I'll CB'ing you.

Matt, KHC2060

Short-Wave Report

(*Continued from page* 78)

there was any kind of interference (name the interfering station if you know which one it is). And give the frequency on which you heard the station, of course.

One more point: your report should cover more than just a few moments of listening—a half hour is a good period of time to aim at whenever possible. Or your report might include reception of a station for any given transmission for several days running.

Leaflet G (Verifications) is still available from your Short-Wave Editor. It contains a brief resume of what should be included in a report, and it's yours for return postage.

Club Notes. The National Radio Club has split into two separate organizations as the result of an election held by many members of the original club. If you want to join either of these clubs, write for membership information to: National Radio Club, P. O. Box 63, Kensington Station, Buffalo, N. Y. 14215, or to National Radio Club, Inc., P. O. Box 5181, Terminal Annex, Denver, Colo. 80217. Both organizations publish 34 bulletins yearly, and coverage is on the medium waves only.

"DX'ing Worldwide" with Irwin Belofsky, president of the New York City Chapter of the American Short Wave Listeners Club, is broadcast over WRUL at 1440 on Saturdays. At time of writing, WRUL was operating on 15,440, 11,950, and 9520 kc., but this is subject to change.

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.

Algeria—*Radio-Television Algerienne,* Algiers, is heard to 1700 with all-Arabic programs on 9510 kc.

Angola—*Emissora Oficial de Angola,* Luanda, has this schedule, updated since last month: weekdays at 0100-0400 on 4955, 6025, 6190, and 7235 kc., at 0600-0830 on 4955, 6025, 9560, 9705, and 9765 kc., at 1230-1300 on 3955, 4955, 6025, 6190, and 7235 kc., and at 1300-1800 on all frequencies; Sundays at 0300-0600 on 6025, 9560, and 9705 kc., at 0600-1200 on 4955, 6025, 9560, 9705, and 9765 kc., at 1200-1300 on 3955, 4955, 6025, 6190, and 7235 kc.. and at 1300-1800 on all frequencies.

Ascension—The BBC test xmsns from this island have been completed and the xmtrs dismantled. A permanent station reportedly will be placed in full use before 1966.

Cable and Wireless, Ltd. states categorically that they consider their xmsns private and will not honor requests for confirmation.

Australia—This is the latest available schedule for *R. Australia,* Melbourne: (Eng. only) to India, Malaysia, S. E. Asia, and S. W. Asia at 1714-1815 on 15,330 kc., at 1714-2000 and 0330-0430 on 15,220 kc., at 1745-0430 on 17,870 kc., and at 2000-0300 on 21,540 kc.; to E. Asia at 0329-0500 on 11,810 kc.. at 0600-0712 on 11,810 and 9580 kc., at 1559-1745 and 1845-1915 on 15,240 kc.; to N.A. at 2000-2300 on 17,840 and 15,220 kc., and at 0715-0815 on 9580 kc.; to Africa at 2329-0110 on 17,820 and 15,220 kc.; to United Kingdom and Europe at 0129-0230 on 11,710 and 9570 kc. Additional xmsns for India, Malaysia, and S. E. & S. W. Asia are given at 0330-0945 on 11,880 kc., at 0830-0945 on 11,740 kc., at 0429-1230 on 9570 kc., and at 0830-1230 on 7220 kc.

Austria—Vienna's updated schedule now reads: to Europe at 0000-1700 on 6155 kc., at 0100-1500 on 7245 kc., at 0400-1200 on 9770 and 11,785 kc.; to the Middle East at 0100-0400 on 15,410 kc., at 0600-0900 on 17,840 kc., and on Mondays, Saturdays, and Sundays only at 1200-1500 on 11,870 kc.; to N.A. at 1800-2330 on 6155 kc., at 1900-2300 on 9770 kc., and on Mondays, Wednesdays, and Sundays only at 1700-1800 on 6155 kc.; to South America at 1900-0000 on 9525 kc., and on Mondays, Wednesdays, and Fridays only at 1400-1600 on 15,240 kc. The following broadcasts are on Mondays, Wednesdays, and Fridays only: to Japan at 0000-0200 on 15.435 kc. and at 0200-0400 on 17,855 kc.; to India and Indonesia at 0400-0700 on 17,875 kc.; to Australia and New Zealand at 0700-1000 on 15,115 kc.; and to South Africa at 1000-1200 on 17,750 kc., and at 1200-1400 on 15,325 kc.

The listening post of Joseph Billie, Jr., WPE2GUN, Linden, N.J., is papered with 125 QSL's from some 64 countries. Joe uses a Hallicrafters S-120 (shown) and a 1942 eight-tube Philco receiver.

QSL Cards For You?

The SWL QSL Bureau is currently holding QSL cards for the following WPE Monitors. If your WPE registration is listed here, send a stamped, self-addressed envelope to Mr. LeRoy Waite, 39 Hannum St., Ballston Spa., N. Y. 12020, and your card(s) will be forwarded to you.

WPE1DIA	WPE1EGU
WPE1DKI	WPE1EHJ
WPE1DZL	WPE1EZZ
WPE1EAM	

Belgium—Brussels has been noted on 9600 kc. from 1715 in native language with pop music, some in English.

Brazil—The station listed last month for 2410 kc. is definitely *R. Sirena,* Santo Leopoldina. Broadcasting in Portuguese, it can be tuned evenings.

R. Educadora Rural, Natal, 3285 kc., is heard from 0230 to 0350 and later with rural musical programs, in Portuguese. A newscast is given at 0300.

Other stations reported recently include: *R. Tupi,* 15,370 kc.. and *R. Rural,* 15,105 kc., both in Rio de Janeiro, around 1700-1730 with Latin American music; *R. Timbira,* 15,215 kc., at 1500, and *R. Bandeirantes,* 11,925 kc., at 2030 both in Sao Paulo and both in Portuguese.

Burma—Rangoon uses the following schedule: Burmese Program I at 1945-2100 on 6035 kc., at 2330-0200 on 7120 kc., and at 0600-0915 on 5040 kc.; Burmese Program II at 0600-1000 on 4795 kc.; Hindustani program weekdays only at 2130-2145 on 6035 kc.; Eng. program at 2100-2130 on 6035 kc., at 0200-0230 on 7120 kc., and at 0915-1030 on 5040 kc. The station requires return postage for answering listeners' mail.

Canada—In its second daily xmsn to Europe, the Canadian Broadcasting Corp.

has French at 1500-1545 and Eng. at 1545-1630 on 11,720, 9630, and 15,320 kc. (the latter replacing 5955 kc.). In the Latin American and Caribbean Service, with Eng. to 1800-1830, Portuguese to 1900, and Spanish to 1945, there are two new frequencies: 15,190 kc. (replacing 9625 kc.) and 11,760 kc. (replacing 5990 kc.); plus 9585 kc.

In reply to an item that this column carried recently on a CBC outlet around 4950-4960 kc., Mr. S. B. Duke, Supervisor of Engineering Services for the International Service, states that at no time has CBC ever operated there. He suggests that the station heard could have been a Colombian station that rebroadcasts Montreal's Spanish language xmsn regularly. Other reports indicate it to be HJCW, Bogota, 4945 kc.

Colombia—A new station is HJAM, *R. Buenaventura*, location not yet known, on 4808 kc. It is heard to at least 2300 with musical programs.

Costa Rica—Reported by many, the station on 6205 kc. is *R. Periodico Reloj*, San Jose. Try for it after 1830; there are many ID's, anmts, newscasts, and other items.

Czechoslovakia—Prague continues to be heard well at 2000-2055 and 2230-2325 on 5930, 7345, 9550, 9795, and 11,905 kc. A ham and DX show and a stamp column are given on alternate Thursdays. There is also a special Sunday program at 1000-1055 on 15,285 and 17,830 kc.

Dominican Republic—Station HIBD, *La Voz de La Romana*, 3355 kc., is heard with special musical programs in Spanish some weekends from 0000 to 0200 s/off. *R. Santiago*, HI8Z (?), Santiago de los Caballeros, 3395 kc., is noted to 0052 s/off with music; they may alternate with 3407 kc., and 6060 kc. is used in the mornings.

Ecuador—Comparatively new stations include: HCEF6, *R. Sideral*, Salcedo, 3615 kc., heard to 2353 s/off; and HCOT1, *R. Saracay*, Santo Domingo de los Colorados, 3545 kc., noted weekends and holidays with musical programs and dedications in Spanish to 0200.

Ethiopia—Station ETLF, *Radio Voice of the Gospel*, Addis Ababa, carries this Eng. schedule: at 0900-0955 to India on 15,410 kc., at 1050-1155 to Ethiopia on 4905 kc., at 1330-1425 to W. Africa on 15,265 kc., at 0900-0925 to India on 9765 kc., at 1100-1258 to E. Africa on 9685 kc., at 1300-1400 to S. Africa (Tuesdays, Thursdays, and Saturdays only) and to same areas at 1400-1425 daily on 7200 kc., and at 1430-1500 to W. Africa on 11,825 kc.

Fiji—Station VRH8, Suva, 3230 kc., is heard at times with BBC news at 0200-0210, followed by Fiji news to 0230.

Germany (West)—The most recent schedule includes many changes: to Eastern N.A. at 2035-2115 in Eng. and at 2115-2155 in French on 6075 and 9545 kc. (replacing 6175 and 9640 kc.) and at 1900-2000 in German on 9640, 6175 kc. (replacing 9545 and 6000 kc.), and 6100 kc.; to Western N.A. at 2355-0035 in Eng. on 6075, 6145, 9575, and 9735 kc., at 2200-0100 in German on 9640, 6175, and 6100 kc. (replacing 6000 kc.), and at 1010-1050 in Eng. on 9735, 11,795, and 11,945 kc. Other changes (Eng. only): to E. Asia, Australia, and New Zealand at 0345-0440 on 9640, 11,945, and 15,-

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	kc.—Kilocycles
BBC—British Broadcasting Corporation	N.A.—North American
CBC—Canadian Broadcasting Corporation	kw.—Kilowatts
Eng.—English	R.—Radio
ID—Identification	s/off—Sign-off
	xmsn—Transmission
	xmtr—Transmitter

275 kc. (replacing 11,925, 15,185, and 17,845 kc.) and at 1610-1700 on 7205 and 9545 kc. (replacing 5980 kc.); to S. Asia at 0230-0340 on 11,945, 15,275, and 17,845 kc. (unchanged) and at 1050-1120 on 11,945 and 15,295 kc. (replacing 7205 and 9735 kc.); to Africa at 0105-0135 on 11,785, 15,275, and 17,845 kc. (replacing 9605 kc.), at 1115-1210 on 11,715, 15,275, and 17,845 kc. (replacing 9610 and 11,810 kc.), and at 1520-1550 on 9735 and 11,785 kc. (replacing 7160 kc.).

Guatemala—A new station is *R. Norte*, Puerto Barrios, 11,698 kc., noted to around 1800. Despite conflicting reports, *R. Nacional*, Quezaltenango, has not operated on this channel for nearly six months and, in fact, has moved to 6020 kc. where it is heard at 0700 and to 0100 s/off. Station TGRT, *R. Tikal*, Flores, 6200 kc., now has educational programs including language lessons and historical talks at 2200-2300. Station TGJA, *R. Nuevo Mundo*, Guatemala City, has returned to the air after an absence of some 18 months which was due to technical difficulties.

Honduras—Station HRTK, location not certain, is noted on 4846 kc. at 1730-1830 in Spanish. Station HRUS, *La Voz de Suyapa, R. Catolica*, Tegucigalpa, has moved from 4949 kc. to 4930 kc. and is heard at 2200-2300 with music and religious programs. *R. Luz*, La Ceiba, 4890 kc., is heard well with news at 0700-0800.

India—Delhi is noted on 7180 kc. with the signature tune ("Song of India") at 0725 and Eng. news at 0730. Another outlet on 7105 kc. has been heard from 2030 with a native-language program.

Iran—A Home Service outlet of *R. Iran*, Teheran, is heard on 7130 kc., dual to 9658 kc., at 0830-0930 in Persian.

Iraq—*R. Baghdad* would like to receive tape recordings of their xmsns. Their schedule shows 6030 and 6095 kc. in use, each with 100 kw., at 1530-1600 in French, to 1630 in Eng., and to 1700 in German.

Liberia—Station ELWA, Monrovia, can be heard at 1310-1430 (Saturdays and Sundays) and at 1435-1620 (Fridays) on 15,115 kc. with religious programs to the Near East. The 3225-kc. outlet is noted, although not well, from 0112 to 0230/fade with native-language programs.

Libya—*R. Tripolis* is reportedly on the air on 5965 kc. with 100 kw. at 1100-1600. Has anyone heard it? There may also be a xmsn at 0000-0200.

Mali—*Radiodiffusion du Mali*, Bamako, is fair on 9745 kc. at 1730-1745 with French news; s/off is at 1800. This station has also been noted on 4835 and 3390 kc. mornings from 0100.

Mauritania—*R. Mauritanie*, Nouakchott, 3222 kc., is good at times with Arabic and French news at 0200-0210, then native music to fade-out at 0230.

Mauritius—Mauritius Island B/C Service, 9708 kc., has been heard at 2229-2315 with a newscast and other items in French.

Mexico—Station XETS, Tapachula, is in the clear on 6120 kc. at 2335-0015 with Latin American and South American music. There was only one commercial during the period but an ID was given after each record, all Spanish. Another harmonic has popped up in the form of XELL, Vera Cruz, on 2860 kc. Primarily on 1430 kc., this station is heard from 2210 to 0100 s/off.

Netherlands—Tentative scheduling from Hilversum for the summer months includes the "Happy Station Program" at 1400-1520 (Sundays only) in the 19- and 25-meter bands; Eng. on weekdays at 1600-1650 in the 19- and 25-meter bands, and at 2300-2350 daily in the 31- and/or 49-meter bands.

Nicaragua—Station YNWA, *R. Mundial*, Managua, 5965 kc., is heard from 0000 to 0100 s/off with news, editorials, and commentaries in Spanish. Judging from the signal, they must have increased their power.

Pakistan—Karachi is heard on 11,672 kc. to 0850 s/off with the General Service to the Middle East in Eng., on 9740 kc. to the

SHORT-WAVE CONTRIBUTORS

Francis Welch, Jr. *(WPE1CRV)*, Rochdale, Mass.
Dave Siddall *(WPE1EBN)*, Hyannis, Mass.
Richard Brodeur *(WPE1ECM)*, Chicopee Falls, Mass.
Joseph Trapasso *(WPE1EQI)*, Winthrop, Mass.
Richard Silva *(WPE1FMY)*, New Bedford, Mass.
Stephen Saftler *(WPE1FNV)*, Brockton, Mass.
Irwin Belofsky *(WPE2BYZ)*, Brooklyn, N. Y.
Henry Marbach *(WPE2FHU)*, White Plains, N. Y.
William Hensel *(WPE2FXR)*, Horseheads, N. Y.
Harley Rutstein *(WPE2HKR)*, Englewood, N. J.
Michael Campana *(WPE2JCS)*, W. Hempstead, N. Y.
Ronald Shopinski *(WPE3DKA)*, Mt. Carmel, Pa.
John Feldman *(WPE3EHU)*, Feasterville, Pa.
Warren Fekete *(WPE3EMR)*, Dundalk, Md.
Wayne Blair *(WPE3FAZ)*, Altoona, Pa.
Leroy Herrick *(WPE3FFN)*, North East, Pa.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
Roy Moore *(WPE4FWH)*, Hazard, Ky.
Kenneth Alyta, Jr. *(WPE4FXB)*, Charlotte, N. C.
Tom Palmer *(WPE4GEL)*, Sanford, Fla.
Jack Keene *(WPE5BMP)*, Houston, Texas
Jody Coles *(WPE5CSW)*, Houston, Texas
James Helmke *(WPE5DCV)*, San Antonio, Texas
John Callarman *(WPE5JH)*, Pampa, Texas
Shaler Hanisch *(WPE6BPN)*, Hartford, Conn.
D. W. Day *(WPE6DQW)*, Bakersfield, Calif.
Walter Home, II *(WPE6DZC)*, San Francisco, Calif.
Tim Shaw *(WPE8BUV)*, Bay Village, Ohio
John Forslin *(WPE8FKB)*, Wayne, Mich.
Martin Manges *(WPE8FOR)*, Vermilion, Ohio
Joseph Woravka, Jr. *(WPE8GDC)*, Parma, Ohio
Robert Shankle *(WPE8HJP)*, Youngstown, Ohio
J. P. Arendt *(WPE9DN)*, Aurora, Ill.
John Beaver, Sr. *(WPEØAE)*, Pueblo, Colo.
Jack Perolo *(PY2PE1C)*, Sao Paulo, Brazil
F. R. Cook *(VE3PE1WX)*, Toronto, Ont., Canada
Bernard Brown, Derby, England
S. B. Duke, *Radio Canada*, Montreal, Que., Canada
Joe Esser, New Kensington, Pa.
Bruce Grodner, Brooklyn, N. Y.
Harry Kutcher, Brooklyn, N. Y.
John Mann, Montreal, Que., Canada
Fred Parsons, Welland, Ont., Canada
Everette Payette, Monroe, Mich.
Joe Piechuta, Meriden, Conn.
Joseph Plezia, Cleveland, Ohio
Jim Wedewer, Dyersville, Iowa
Station ETLF, Addis Ababa, Ethiopia
R. Nederland, Hilversum, Netherlands
Sweden Calling DX'ers Bulletin

United Kingdom at 1445-1501 with orchestral music, and on 9672 kc. at 0832 with music and at 0835-0850 with Eng. news.

Peru—Stations logged recently include: OAZ4E, *R. Mineria*, La Oroya, 6205 kc., at 1830-1930; OAX7C, *R. Tahuantisuyo*, 6265 kc., at 2310-2325 s/off; OCX7D, *R. El Sol*, Juliaca, 3230 kc., to past 0200; OAX5U, *R. Huancavelica*, 4816 kc., at 2300-2315 with music and time checks; OAX9D, *R. Tropical*, Tarapoto, 9710 kc., to 2300 close, dual to 4938 kc.; OAX8I, *R. La Hora*, Iquitos, 9601 kc. (moved up from 9541 kc.), at 2150; and OAX5J, *R. Independencia*, Ica, 3350 kc., from 2125 with a listeners' request program. All of these stations broadcast in Spanish. Another new station, not fully identified, on 5035 kc., is *R. Ilo, La Voz . . . Sud;* this one is heard at 2300-2330 but is very difficult to copy.

South Africa—The African Service will be increased both in time and power. Towards the end of 1964 two high-powered xmtrs are to be erected to supplement the present range of the 20-kw. xmtrs in Bloemfontein.

The African Service has been tuned on a new frequency of 15,220 kc. with Eng. news at 1215-1224 and s/off at 1245. A portion of their schedule reads: 0500-1025 on 17,855 and 15,155 kc.; 1025-1150 on 15,155 and 11,900 kc.; 1150-1500 on 11,900 and 9525 kc.; and 2200-2300 and 1500-s/off on 9525 and 7270 kc. An outlet on 2326 kc. is noted in Afrikaans during early morning hours.

Sweden—Stockholm now operates to Eastern N.A. at 0900 in Eng. on 15,240 kc., at 2000 in Swedish and at 2045 in Eng. on 5990 kc.; and to Western N.A. at 2130 in Swedish and at 2215 in Eng. on 9660 kc.

Turkey—Ankara has moved the 1700-1730 Eng.-to-Europe xmsn back to 15,160 kc. (from 7285 kc.). English is also broadcast at 0915-0945 to S. E. Asia on 9515 kc.

U.S.S.R.—Moscow has been found on 4860 kc. at 1900 with an Eng. newscast. *R. Vilnyus*, Lithuanian SSR, is heard well at times on 7120 kc. at 2230-2330, in dual with 7310 and 9530 kc., with a program of news, music, and talks in Lithuanian for Lithuanians living in the United States.

Zambia (formerly Northern Rhodesia)—The National Service is broadcast in Eng. on 3265 kc. at 2255-0130 and 1100-1600 (Saturdays to 1700, Sundays to 1515); on 6170 kc. weekdays at 0130-0700 (Saturdays to 1000) and Sundays at 0055-1000; and on 4911 kc. from 0255 (Sundays from 0055) to 0300 and at 1000-1200.

Clandestine—*Radio Libertad, Your Anti-Communist Voice of America,* now has some Eng. ID's with addresses and is on the 19-, 31-, 39-, 49-, and 60-meter bands as well as on 1400 kc. One address given—2113 Ocean View Drive, Miami Beach, Florida—is actually a public park and beach with no buildings, according to one of our reporters who tried to locate the place.

Radio Liberty, the Voice of the National Socialist Party, has been heard on the West Coast with "local-like" signals at 2245-2300 on 7700 kc. They have also been heard in the 25- and 160-meter bands. In addition they give a frequency of 535 kc., but this broadcast has not been heard. —30—

INDEX TO VOLUME 20

Jan.-June, 1964

AMATEUR RADIO

AUTOMOTIVE ELECTRONICS

CITIZENS BAND RADIO

CONSTRUCTION

DEPARTMENTS

—30—

POPULAR ELECTRONICS June 1964 ADVERTISERS INDEX

Electromagnetic Quiz Answers

(*Quiz on page* 65)

1 - J A relay employs the attractive force of electromagnetism to pull in its armature and thereby change the position of the contacts.

2 - C In a radial-vane meter movement, two iron vanes positioned like the covers of a book are magnetized in the same way by the surrounding coil. The force of repulsion produced between them then causes the pivoted vane carrying the needle to be deflected.

3 - I The toroidal cores in a memory plane are fully magnetized in a clockwise or counterclockwise direction by the coincidence of currents in the wires which are threaded through them.

4 - G A degaussing coil energized by 60-cycle a.c. is used to remove unwanted magnetized areas on a color kinescope. The coil is held momentarily in front of the tube, then slowly backed away.

5 - H An electric generator produces e.m.f. when its rotating armature windings cut the stationary magnetic field produced by the field windings.

6 - A A flyback transformer in a television set creates a large back e.m.f. when the magnetic field around it is permitted to collapse suddenly. The amount of back e.m.f. produced is proportional to the rate of change of magnetic flux.

7 - E An electromagnetic field alternating at r.f. frequencies produces eddy currents which heat up the work piece enclosed by an induction coil.

8 - B The deflection yoke on a kinescope contains horizontal and vertical electromagnetic deflection coils which bend the electron stream on its way to the screen.

9 - F Radio waves consist of electric and magnetic fields, each alternately producing the other as the wave travels through space. The magnetic field is positioned vertically in a horizontally polarized wave.

10 - D When metals such as nickel, iron, or cobalt are magnetized, they undergo a change in length. At ultrasonic frequencies the effect is useful for cleaning and as a transducer for sonar.

CLASSIFIED MARKET PLACE

COMMERCIAL RATE: For firms or individuals offering commercial products or services. 75¢ per word (including name and address). Minimum order $7.50. Payment must accompany copy except when ads are placed by accredited advertising agencies. Frequency discount: 5% for 6 months; 10% for 12 months paid in advance.

READER RATE: For individuals with a personal item to buy or sell. 45¢ per word (including name and address). No Minimum! Payment must accompany copy.

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

FOR SALE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

QSLs—ham or CB. Glossy, two colors, $2.00 per 100 postpaid. Free sample. Hobby Print Shop, Umatilla, Fla.

POLICE Radar Detector plus legal Jammer. Stop before Radar Speed Traps. Build for less than $10; used with Car Radio. Complete construction details, $3.75. C. Carrier Co., 6311 Yucca St., Hollywood 28, Calif.

RECORD TV Programs at home. Easy to construct. Watch your favorite TV Shows whenever you wish. Complete construction details $4.75. DB Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

COLOR TV. Convert your black and white TV to color. Completely Electronic. No mechanical gadgets. Costs about $35. Complete construction details $4.75. DB Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

ANSAPHONE. Automatic Telephone Answering Machine delivers and takes messages. Build under $40. Plans $4.75. Seaway Electronics, 6311 Yucca St., Hollywood 28, Calif.

TAIL Transmitter. Tiny Transistorized Transmitter for the Private Eye. Signals its location for miles. Construction Details $4.75. DB Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

TV Camera. Build for less than $50. Construction details $4.75. DB Enterprises, 7906 Santa Monica Blvd., Hollywood 46, Calif.

TELEPHONE Extension in your car. Answer your home telephone by radio from your car. Complete diagrams and instructions $2.75. C. Carrier Co., 6311 Yucca St., Hollywood 28, Calif.

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

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

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

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

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

ANTENNA Towers—Guyed or self-supporting 75¢ to $1.50 per foot. The Andrews Company, 5290 Hull Rd., Leslie, Michigan.

TWO-BITS for call letter and name plate. Princess, Station F, Box 52, Toledo, Ohio.

BANSHEE TS-30 TRANSISTOR IGNITION SYSTEMS AND COILS. DEALERS WANTED, FREE MONEY MAKER BROCHURE. SLEP ELECTRONICS, DRAWER 178PE, ELLENTON, FLA.

COAXIAL Cable Assemblies: Any type—Any length. Send 25¢ for catalog of stock items and prices. Pamco, Box 16, Bensenville, Ill.

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

CITIZEN Banders! Get base station Performance with your mobile units. No modifications or soldering necessary. Proven performance. Send for free details or send ($15.00) to: T. Francis, 15 Park Row, N.Y. 38, N.Y.

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

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

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

JIFFY-Mast. No Holes, clamps, brackets; just slip into chimney. Ideal for light weight T.V., F.M. antenna. Adjustable, fits openings to prox 11"x11". Send $1.95 plus $.25 postage USA. Van Allan Co., P.O. Box 8246, Cleveland, Ohio 44133

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

CIRCUIT BOARDS, build your "Poptronics" projects the modern space age way. Makes construction simpler, neater. Free catalogue. IRVING ELECTRONICS, BOX 9222, SAN ANTONIO, TEXAS 78204.

$100.00 WEEKLY Spare Time Selling Banshee TS-30 Transistor ignition systems and coils. Big demand. Free money making brochure. Slep Electronics, Drawer 178ZD, Ellenton, Florida 33532.

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

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

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

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

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

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

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

QSL-CB-SWL Letters and Cards. $2.00 and $3.00 per 100. Samples 10¢. Martin, 828-B, Schuylkill Avenue, Reading, Penna.

IGNITION Scope! Earn or save money by analyzing automotive problems. Electronically shows bad points, coil, condenser, plugs, etc. Complete plan $2.00. A. Wanninger, 201 Lanford Lane, Prospect Heights, Ill.

AMPEX 601-2 with accessories. Charles Goodman, 10 Woolson Street, Mattapan, Mass.

DIAGRAMS, service material, Radio, Television, $1.00. Supreme Publications, 1760 Balsam, Highland Park, Ill. 60035.

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

SEMICONDUCTORS — CAPACITORS — MINIATURE ELECTRONIC PARTS, FREE CATALOG. COMPONENTS, P.O. BOX 1432, PLAINFIELD, N.J.

50 JUNGLE Butterflies $2.00. Giant Naturehobbies catalog 25¢. Collectors Wonderland 13, Box 1170, New York 8.

MUST sell everything. Going to school. Send for free list. Electronics; Astronomics; Books. R.L. King, 1027 Yellowstone, Cleveland 21, Ohio.

TWO TUBE NOISE ELIMINATOR, Fits Inside Transceiver. Guaranteed Results. Easily Assembled—Installed. Complete Kit $6.95. Predrilled Circuit Board Only, with Instructions $2.50. Specify Transceiver Model. Glatronics, 4313 Fourth, Phila. 40, Pa.

ELECTROPLATING Kits for Hobbyists. $3.95 Postpaid. Details. Miniplating, Middleboro, Mass.

FIVE Pieces Test Equipment, 115 Sams, $750. tubes. Miscellaneous Components $400.00. Ted Hiles, 502 Riverside, Clare, Mich.

STEREO Tapes, Record Albums At Cost! All Labels Factory Sealed, Guaranteed. Monthly new release bulletin. Holiday Enterprises, Box 1601, Des Moines, Iowa 59306.

HAM EQUIPMENT

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

SELL, Buy, Trade. Details 10¢. Lupi, 1225 Hillside, North Bergen, N.J.

TUBES

BEFORE You Buy Receiving Tubes, Test Equipment, Hifi Components, Kits, Parts, etc. . . . send for your Giant Free Zalytron Current Catalog, featuring Standard Brand Tubes: RCA, GE, etc.—all Brand new Premium Quality Individually Boxed, One Year Guarantee—all at Biggest Discounts in America! We serve professional servicemen, hobbyists, experimenters, engineers, technicians. Why Pay More? Zalytron Tube Corp., 469-E Jericho Turnpike, Mineola, N. Y.

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

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

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

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

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

WANTED

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

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

URGENT! We buy HiFi, Radio, TV, Receiving Tubes—used or new—Write: Electronic Co., 2428 Patton St., Camden 4, N. J.

GONSET tuners wanted. #3012 (152-162 M.C.), (108-128 M.C.), (40-50 M.C.), others. Richard Jacobs, 1015 Glenside, Saint Louis, 63130.

HIGH FIDELITY

"LOW, Low quotes: all components and recorders, HiFi, Roslyn 9, Penna."

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

FM BROADCAST Music without commercials. Schematics, pictorials, instructions. $3.00. Complete receivers and adapters also available. Music Associated, 65 Glenwood Road, Upper Montclair, New Jersey.

PATENTS

INVENTIONS; Ideas developed for Cash/Royalty sales. Raymond Lee, 2104G Bush Building, New York City 36.

ELECTRONICS

BEGINNERS Experimenter kit $7.50, includes Diode Radio, Audio Amplifiers, Transistor Radios, Walky Talky Broadcaster. 25¢ for information, Free Diode. Lectronix, Box 42, Madison Heights, Michigan 48071.

TAPE AND RECORDERS

TAPE Recorders, Hi-Fi, components, Sleep Learning Equipment, tapes. Unusual Values Free Catalog. Dressner, 1523PE, Jericho Turnpike, New Hyde Park 11, N. Y.

SELF-Hypnosis may help you many ways. New Tape or LP-record teaches you quickly, easily! Free literature. McKinley Company, Box 3038, San Bernardino, California.

TAPE Recorder Sale. Latest models $10.00 above cost. Arkay Sales, 22-31 Riverside Ave., Medford 55, Mass.

SAVE 30-60% Stereo music on tape. Free bargain catalog/blank tape/recorders/Norelco speakers. Saxitone, 1776 Columbia Road, Washington, D. C.

RENT Stereo Tapes—over 2,500 different—all major labels—free brochure. Stereo—Parti, 1616-PE Terrace Way, Santa Rosa, California.

TAPEMATES MAKES AVAILABLE TO YOU—ALL 4-TRACK STEREO TAPES—ALL LABELS—POSTPAID TO YOUR DOOR—AT 40% COMBINED SAVINGS. FOR FREE BROCHURE WRITE TAPEMATES CLUB, 5280—P. W. PICO BLVD., LOS ANGELES, CALIF. 90019.

EQUIPMENT

FREE electronics catalog. Tremendous bargains. Electrolabs, Dept. C-619D, Hewlett, N.Y. 11557.

WALKIE-TALKIES—Communicate with friends, business associates, up to 5 miles. Service, construction, business, boating, hunting, Fire Dept., Police. Free Details. Sheirr Electronics Lab, 1490 Jesup Ave., 3M, Bronx, New York 10452.

REPAIRS AND SERVICES

TV Tuners rebuilt and aligned to Specifications. Guaranteed all makes, One Price. $9.50 Complete. Plus Shipping. Valley Tuners, 5641-D Cahuenga, North Hollywood, Calif.

TV Tuners rebuilt and aligned per manufacturers specification. Only $9.50. Any make UHF or VHF. We ship COD. Ninety day written guarantee. Ship complete with tubes or write for free mailing kit and dealer brochure. JW Electronics, Box 51C, Bloomington, Indiana.

TELEFIXIT Alltime Bestseller Nontechnical TV Repair Book with Famous Troubleshooting Charts, 60¢ postpaid 2 for $1.00. Telefixit, Box 714, Manhasset 4, N.Y.

DIAGRAMS: Radio $1.00. Television $1.30: Schematic Collector, 618 4th St., Newark, N.J. 07107.

METERS—Multimeters Repaired and calibrated. Free estimates—catalog. Bigelow Electronics, Box 71-E, Bluffton, Ohio.

CLASSIFIED ADVERTISING ORDER FORM

Please refer to heading on first page of this section for complete data concerning terms, frequency discounts, closing dates, etc.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35

________ Words { @ 45¢ (Reader Rate) / @ 75¢ (Commercial Rate) } = $________

Insert______time(s) Total Enclosed $________

NAME________________

ADDRESS________________

CITY__________ ZONE______ STATE________

Signature________________

WORD COUNT: Include name and address. Name of city (Des Moines) or of state (New York) counts as one word each. Zone or Zip Code numbers not counted. (Publisher reserves right to omit Zip Code if space does not permit.) Count each abbreviation, initial, single figure or group of figures or letters as a word. Symbols such as 35mm, COD, PO, AC, etc., count as one word. Hyphenated words count as two words.

PE-664

INVENTIONS WANTED

INVENTIONS wanted. Patented; unpatented. Global Marketing Service, 2420-P 77th, Oakland 5, Calif.

INVENTORS. We will develop, help sell your idea or invention, patented or unpatented. Our national manufacturer clients are urgently seeking new items for outright cash sale or royalties. Financial assistance available. 10 years proven performance. For free information, write Dept. 41, Wall Street Invention Brokerage, 79 Wall Street, New York 5, N.Y.

ROYALTIES for original toys, games. Tempo, Box 35-PE, Woodbury, New York.

INSTRUCTION

LEARN While Asleep, hypnotize with your recorder, phonograph. Astonishing details, sensational catalog free! Sleep-Learning Association, Box 24-ZD, Olympia, Washington.

FCC License in 6 Weeks, First Class Radio telephone. Results Guaranteed. Elkins Radio School, 2603B Inwood, Dallas, Texas.

HIGHLY-Effective home study review for FCC commercial phone exams. Free literature! Wallace Cook, P. O. Box 10682, Pittsburgh, Pa. 15235.

BUILD Nichrome Wire Styrofoam Cutter. Write for descriptive brochure. Rogers Books—Box 3212, Fresno 6, Calif.

ONE WAY GLASS. Complete formula using simple drug store materials. Only $1.00. Harwyn, Plan P, P.O. Box 8352, Philadelphia, Penna.

DRAFTING, Blueprint reading, schematics. Send $2.00 first lesson. Complete home course $25.00. Prior Inc., 23-09 169 Street, Whitestone 57, New York.

GOVERNMENT SURPLUS

JEEPS $64.50, boats $6.18, typewriters $4.15, airplanes, electronics equipment, thousands more in your area, typically at up to 98% savings. Complete directory plus sample Surplus Marketletter $1.00. Surplus Service, Box 820-J, Holland, Michigan.

"GOVERNMENT SELLS".—Surplus Electronics; Oscilloscopes; Transceivers; Test Equipment; Radar; Walkie-Talkies; Boats; Jeeps; Aircrafts; Misc.—Send For—"U.S. Depot Directory-Procedure"—$1.00—Service, Box 425 (ZE), Nanuet, N.Y.

CONVERT Inexpensive Surplus BC-659 to CB. Step by step plans $2.00. Jay's CB Service, P.O. Box 173, Citrus Heights, Calif. 95610.

FREE "HOW TO BUY GOVERNMENT SURPLUS INFORMATION" with 20 pounds of New Surplus Electronic Equipment. Tubes, Transistors, Motors, Relays and countless other valuable components. $1,000.00 Government Value for $4.95. Send $1.00. Shipped C.O.D. Evergreen Electronics, P.O. Box 2233, Everett, Wash. 98202.

SUPPLIES

PORTABLE REFRIGERATOR—16 pounds, battery operated in car or boat or 110V-AC house current. Office, spare for home. Free details—Sheirr Electronics Lab, 1490 Jesup Avenue, 3Q, Bronx, N.Y. 10452.

REAL ESTATE

FREE! Big illustrated Summer catalog. Top values coast to coast! Farms, Ranches, Homes, Businesses, Waterfront, Recreation, Retirement properties. United Farm Agency, 612-B West 47th St., Kansas City, Mo. 64112, PLaza 3-4212.

BOOKS

AUTHORS! Learn how to have your book published, promoted, distributed. FREE booklet "ZD," Vantage, 120 West 31 St., New York 1.

PRINTING

SIMULATED Engraved Business Cards. $3.99 per 1,000. 2-Color $5.99 per 1,000. High Quality. Fast Delivery. Sanz, Box 296-PE, La Habra, Calif. 90633.

FORMULAS AND PLANS

BUILD Yourself! Fantastic 200 MPG Carburetor! V-8s, sixes, etc. Patent Drawings, Instructions, Complete! $5.00. FraDor, Lakeville, ZD, Ind. 46536.

TV CAMERA under $40.00—Completely transistorized space age flying spot scanner. Schematics, Photographs—Plans for $3.00. Transistorized Shocking Cane—Simple complete schematic—Plans $1.00. Beck, 777 Ruth Drive, Newbury Park, Calif.

ELECTRONIC Continuity Tester. $2.00 for plans. LGL Electronics, Box 3042, Glenstone Station, Springfield, Mo. 65804.

MAGAZINES

ELECTRONIC back issue magazines—sold, . . . bought. A. Landa, Clayton, Georgia 30525.

AMERICANS—Subscribe to Canada's Hobby and Service Magazine—"Electron." Exciting Ads, Stimulating articles $5.00 one year. Box 796, Montreal 3, Canada.

LEATHERCRAFT

FREE "Do-It-Yourself" Leathercraft Catalog. Tandy Leather Company, Box 791-L50, Fort Worth, Texas.

PHOTOGRAPHY—FILM, EQUIPMENT, SERVICES

MEDICAL Film—Adults Only—"Childbirth"—1 reel 8mm. $7.50—16mm $14.95. International-E, Greenvale, L.I., New York.

SCIENCE Bargains—Request Free Giant Catalog "CJ"—148 pages—Astronomical Telescopes, Microscopes, Lenses, Binoculars, Kits, Parts. War surplus bargains. Edmund Scientific Co., Barrington, New Jersey.

AUTOMOTIVE

STEEL Spark Plug Gauge and Gap Chart for all American and Foreign Cars. 25¢ Postpaid. Large Catalog Included. CBS Auto Parts, Tarentum 15, Pennsylvania 15084.

STAMPS

KENNEDY Stamp Free! U.S. Dollar Stamps, Columbus Issue, Pony Express, All Genuine and Free! Send 10¢ for mailing. Empire Stamp Corp., Dept. ZZ, Toronto, Canada.

PERSONALS

"HYPNOTIZE . . One word . . One fingersnap," on stage.

Satisfaction—or refund. $2.00. Hypnomaster, Box 9309-E8, Chicago 90.

EDUCATIONAL OPPORTUNITIES

DETECTIVE Profession. Home Study. Lapel pin, Certificate. Future. 2759AG W. Broadway, Los Angeles 41, Calif.

LEARN While Asleep. Remarkable, Scientific, 92% Effective. Details Free. ASR Foundation, Box 7021, Dept. e.g., Lexington, Kentucky.

ANNOUNCING. Home training. Tape, Monographs. Free details. Fisher, 678 Medford, EG, Patchogue, N.Y. 11772.

BUSINESS OPPORTUNITIES

INVESTIGATE Accidents—Earn $750 to $1,000 monthly. Men urgently needed. Car furnished. Business expenses paid. No selling. No college education necessary. Pick own job location. Investigate full time. Or earn $6.44 hour spare time. Write for Free Literature. No obligation. Universal, CZ-6, 6801 Hillcrest, Dallas 5, Texas.

BUY Direct from factories. Appliances cameras, watches! Free details! Cam Co., 436 PE Bloomfield Ave., Verona, N. J.

VENDING Machines—No Selling. Operate a route of coin machines and earn amazing profits. 32-page catalog free. Parkway Machine Corporation, 715PE Ensor Street, Baltimore 2, Md.

ELECTROPLATING Equipment and supplies. All types for home workshops and industrial. Send $1.00 (refundable) for equipment guide, formulas, operating data, catalog. HBS Equipment Division 90, 3445 Union Pacific Ave., Los Angeles 23, California.

PHOTOGRAPHS and Color Slides Wanted. To $500.00 each. Information write Intraphoto, Box 74607, Hollywood 90004.

I MADE $40,000.00 Year by Mailorder! Helped others make money! Start with $10.00—Free Proof. Torrey, Box 3566-N, Oklahoma City 6, Oklahoma.

EARN $2.50 hour assembling our small Lures and Flies for stores. Write: Lures, Lake Village 14, Arkansas.

SELL HiFi Components—As distributors handling all major brands of HiFi components, we can now offer dealerships to aggressive people who can sell full or part time. Knox Electronic, Dept. 564, Galesburg, Ill. 61401.

NEW! FREE BOOKLET. $8.70 profit per hour. Work from car. All year. Part time. Full time. Free protected territory. Own business. Non-competitive. No experience needed. Easy to learn. Everyone a customer. Vital service. 21 days from today you can be on road to $15,000. yearly income. Get in on ground floor. No selling. Loads of repeat business. Flex-Cote Corporation, 30 W. Sunrise Highway, Valley Stream 13. N.Y.

$75.00 WEEKLY Possible Clipping Newspaper Items for Publishers. Some worth $10.00 each. Details free. Graham's, 1255-N, Englewood, Colorado 80110.

FREE "Franchise Profit Letter" sent to ambitious men who want to operate their own business. Describes wide range of opportunities in expanding franchise field. Write today. National Franchise Reports, PE-528, 333 North Michigan, Chicago 60601.

PIANO Tuning learned quickly at home. Tremendous field! Musical knowledge unnecessary. Information free. Empire School of Piano Tuning. Dept. PE, Box 327, Shenandoah Station, Miami, Florida 33145. (Founded 1935.)

FREE Book "990 Successful, Little-Known Businesses." Work home! Plymouth-717L, Brooklyn 4, New York.

HOW To Make Money. Results Guaranteed rush $1.00 cash prepaid and support under-privileged. PCFS, 616 Gansevoort St., Little Falls, N.Y.

MAIL Order Merchandise that sells repeats. Generous profits. Orders drop shipped. New offer sent each month for one year. Literature imprinted in your name, Details free. General Enterprises, Box 303, Island Park, N.Y.

EMPLOYMENT INFORMATION

FOREIGN Employment. Construction, other work projects. Good paying overseas jobs with extras, travel expenses. Write only: Foreign Service Bureau, Dept. D, Bradenton Beach, Florida.

GOOD jobs require a quality resumé. Receive a Resumé Guide that guarantees your success in writing, including sample resumé, letter, job finding aids, $3.00. K. Johnson, Employment Service, Box 50356E, New Orleans, La.

RESULT-getting combination "Application-Resume" forms! Submit effective employment applications—impress employers—earn more! 25 forms, instructions $1.00. Data Service, Box 175-E, Roselle Park, N.J.

TREMENDOUS Opportunities. USA-Overseas-Choose jobs-locations, Transportation. Free details. Occupations. International Airport, Box 100-V3, Jamaica 30, N. Y.

ELECTRONICS—Current Research Report Lists All Florida Electronics, Aircraft, Missile, Scientific Instrument Industries, Firms, Addresses $1.00 (Airmail $1.25). Resumes—IBM Electric Typed on Bond. Photograph Additional. Free Sample. Bay Research, Box 818, Dept. 25, Palm Bay, Fla.

MISCELLANEOUS

HYPNOTIZE Unnoticed! Patented new hand device makes you a Hypnotist first day or refund! Hypnotist's Handbook included! $2.00. Hypnosis Foundation, Box 487, La Mesa 9, California.

NEW Vortex theory for atoms and elementary particles as a unique and satisfactory structural explanation for the entire Periodic Table. Nuclear theory scrutinized and rejected. 1963 edition. 25¢ postpaid. C. F. Krafft, 4809 Columbia Road, Annandale Virginia, 22003.

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

GUITAR Strings—state type—Set $3.00. Range, Box 41, Bayside, New York 11364.

SPANKEE! New Fashioned Shingle! With old Fashion Results! $1.00 prepaid. Spankee!. Box 466, Salem, Mass.

BUSINESS CARDS $3.95. Rubber Stamps $1.00. List Free. Alco, Box 244-Z, Urbana, Ill.

PORTABLE STILL—Complete plans and instructions. Distill two pints each fill. $2.00. Bande Enterprises, Box 784, Wilmington, Delaware.

HYPNOTIZE right away . . easily . . one glance. Full Instructions only $2.00. Results or refund. Elton's, Box 18223—PE14, Indianapolis, Indiana 46218.

CHAMPAGNE, Beer, Wine formulas $1.00; Emy Rayamel, Box 347, Algonquin, Ill.

BEER, Ale, Liquors, Wines! Strong Formulas! $2.00. (Supplies, Hydrometer, Saccharometer Price List Included.) Research Enterprises, 29-D Samoset Road, Woburn, Mass.

FLOWER, Vegetable Growers, Bigger Better Crops. No Weeds $1.00; Emy Rayamel, Box 347, Algonquin, Ill.

HYDROMETERS—Alcohol Testers. Saccharometers. Free Supplies Catalog. Research Enterprises, 29-MX Samoset Road, Woburn, Mass.

GERMAN Manufacturers 485 Page Directory $4.95. Burke Associates, Manchester, Mass.

STAMMER—Stutter—No More. (Dr. Young.) Write: Gaucho, Box 9309-E8, Chicago 90.

LEARN Radio Announcing! Magazines, Beginners Books: Disk Jockey, Box 620, Pierre, South Dakota, 57501.

GIANT Wholesale Catalogue; 4000 items; Four issues $1.00; Refundable. Rionda, 4321 Atlas, Oakland, Calif. 94619.

This *Weller*®

Heavy Duty Soldering Kit

has a professional
240/325 WATT

Dual Heat Gun

No other soldering set offers you such versatility. The heavy duty Weller gun is the same professional tool used by technicians. Two trigger positions let you switch instantly to either 240 or 325-watt heat. In this single tool you have a choice of heat to suit the job, and tip temperature high enough to handle the tough ones. Instant heat saves time and current.

Kit includes 3 different tips for soldering, cutting, sealing and smoothing; tip-changing wrench and supply of solder. Everything is in a sturdy plastic carrying case. Model D-550PK. Weller Electric Corp., Easton, Pa.

$12.95 LIST

FOR HOBBIES, HOMECRAFT AND MONEY-SAVING REPAIRS

Hi-fi kit building

Electrical work

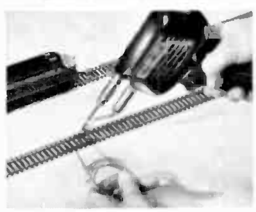
Repairing plastics

Sealing plastic bags

Appliance repairs

Metal work

Model RR connections



Cutting plastic tile

CIRCLE NO. 28 ON READER SERVICE PAGE