

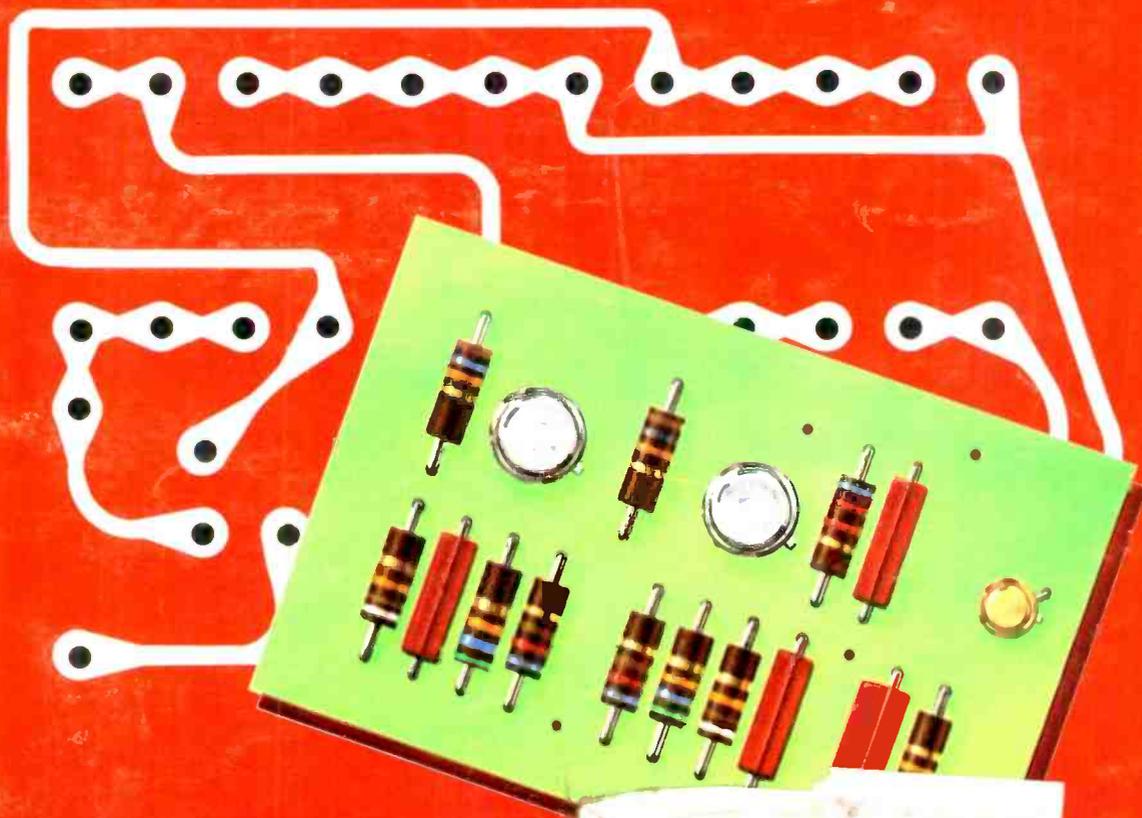
EASILY BUILT FM-STEREO INDICATORS

POPULAR ELECTRONICS

NOVEMBER 1963

35
CENTS

FEATURE PROJECTS: Meterless VTVM • Capacitance Checker • Headphone Amplifier • New-Design FM Antenna • VHF Receiver



**Super Crystal Calibrator
for Ham-SWL-CB**

122E244 48064
L DARKNELL JR
406 UPTON ST
REDWOOD CITY CAL



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

nri

3939 Wisconsin Avenue
Washington, D.C. 20016

**PICK YOUR
CAREER**

**in the wonderful
field of Electronics.**

**TRAIN
AT
HOME
WITH THE LEADER**





"Everything I now have in the way of better living conditions is due to my success through NRI training. Any one who is interested can absorb the material the way NRI presents it. Each subject is completely covered." Wallace G. Baptist, owner of a large wholesale radio electronics business, 419 South Mauvaisterre, Jacksonville, Ill.



"It would be very hard for me to describe how much your course has done toward securing my position. As far as I am concerned, it is responsible for my whole future." Thomas R. Favaloro, Box 133, Sherburne, N. Y., Superintendent of Defense and Industrial Divisions, Technical Appliance Corp.



"After graduating from NRI, I entered the U. S. Air Force. Because of my training, I worked on Lark missiles at the Missile Test Center, Cocoa, Fla. Now I teach electronics for the National Industrial Electronic Research Co. I feel strongly that there is a great future for NRI graduates." Donald A. Smith, Box 45, Hagerstown, Md.

CUT OUT AND MAIL FREE 2 NEW BOOKS

NO STAMP NECESSARY—NRI PAYS POSTAGE

National Radio Institute, Washington, D.C. 3MD4

Please send me your two new books "The Story of NRI" and "Technical Instruction and Equipment." (Please Print—No Salesman Will Call)

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL

FROM STATEMENT OF NRI OBJECTIVES:

"... prepare each person enrolling with NRI to become an employable technician."

Any training, if it is to be effective (and worth your time and money), must give you knowledge and skills wanted by employers. In this age of automation, rockets, guided missiles, space travel, ELECTRONICS is a key word with employers. That's why NRI, the largest, oldest school of its kind, puts emphasis on providing a choice of self instruction plans designed to turn you into a trained technician in the field of your choice as quickly as is practical and at the lowest possible tuition cost. Regardless of your age, status or profession, you can meet the challenge of today's job market by training with NRI for a career in Electronics.



Special Custom Designed Training Equipment

NRI originated the use of Training Kits to provide actual on-the-job experience while training at home. NRI Kits are designed *only for training*, to bring to life the things you read in illustrated, easy-to-understand training manuals. You demonstrate theories, circuit action, defects; get experience in operation, maintenance, trouble shooting practices. Even a beginner can approach a prospective employer after his instruction with practical know-how as well as knowledge. All NRI equipment is yours to keep.

NATIONAL RADIO INSTITUTE

Oldest, largest school of its kind



Choose from NRI's Specialized Instruction Plans

1 TELEVISION-RADIO SERVICING

Learn to service AM-FM Radios, black and white and color TV sets, Stereo Hi-Fi, PA systems, etc. A profitable, interesting field for part-time or full-time business of your own.

2 INDUSTRIAL-MILITARY ELECTRONICS

Learn Principles, Practices, Maintenance of Electronic equipment used today in business, industry, defense. Covers Electronic controls and measurement, computers, servos, telemetry, multiplexing, many other subjects.

3 COMPLETE COMMUNICATIONS

A comprehensive training program for men seeking careers operating and maintaining transmitting equipment in Radio-TV Broadcasting or mobile, marine, aviation communications. Prepares you for your First Class FCC license.

4 FCC LICENSE

Prepares you quickly for First Class License exams. Every communications station must have one or more FCC-licensed operators. Also valuable for Service Technicians.

5 BASIC ELECTRONICS

An abbreviated, 26-lesson course covering Automation-Electronics, Radio-Television language, components and principles. Ideal for salesmen, hobbyists and others who find it valuable to be familiar with the fundamentals of this fast-growing industry.

6 MATH FOR ELECTRONICS

A short course package of carefully prepared texts that take you from basic arithmetic review through graphs and Electronic formulas. Quick, complete and low in cost.

7 AVIATION COMMUNICATIONS

For men who want careers working with and around planes. Covers direction finders, ranges, markers, loran, shoran, radar, landing systems, transmitters. Prepares you for FCC license.

8 MARINE COMMUNICATIONS

Shipboard transmitting equipment, direction finders, depth indicators, radar are all covered in this course. You prepare for your First Class Radiotelephone license with Radar Endorsement.

9 MOBILE COMMUNICATIONS

Training in installation and maintenance of mobile equipment and associated base stations like those used by fire and police, taxi companies, etc. Prepares you for First Class FCC license.

***The Oldest and Largest
School of its Kind***



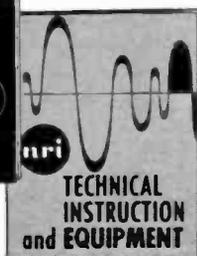
A STATEMENT OF POLICY FROM NRI—

“If the student is not satisfied, or if unexpected situations arise, he may discontinue training at any time with no obligation to pay for further services, materials or privileges”

NRI now makes it possible for you to train at home for a rewarding career in the expanding field of Electronics without risk—without obligating yourself to continue. Are you capable of learning Electronics? Does NRI have the exact instruction plan you seek among its specialized plans? This special "Cancel-At-Any-Time" agreement takes the guesswork out of your choice of training, your choice of school. When you enroll with NRI you sign an agreement—not a contract. If you decide the training is not exactly what you want, or is too difficult—or if you want to stop for any other reason—just notify

NRI and you are not obligated for payments beyond that time. Only a school that can stand upon a half-century record of effectively teaching through home study could dare to establish and live up to such a policy! The proof of the quality of NRI training is in its record of tens of thousands of successful graduates and the reputation NRI holds throughout the Electronics industry. Mail the postage-free form today for complete instruction plans, the story of NRI, information about NRI's exclusive Cancel-At-Any-Time agreement. NATIONAL RADIO INSTITUTE, Washington, D. C. 20016.

**MAIL CARD
FOR 2
NEW BOOKS**



Get the full story of NRI, its history, its philosophy of training, its role in the expanding field of Electronics. Move ahead now in the exciting ever-changing, ever-growing Electronic industry.

POPULAR ELECTRONICS



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

VOLUME 19

NOVEMBER 1963

NUMBER 5

Special Construction Feature

- MPX Meter.....Fred Blechman, K6UGT 41
*An inexpensive stereo indicator that doubles as a tuning
indicator—choose your circuit from three different versions!*

Construction Projects

- Meterless VTVM.....William J. Millard 45
Assemble a Phone-Boost.....Lou Garner 55
VHF ADVENTURER (Part 2).....James G. Lee, W6VAT 57
Handy EP Pack.....E. G. Louis 64
C Bridge.....Frank A. Parker 65
Turnstile for Stereo.....Frederick J. Haines, W2RWJ 69

Amateur, CB, and SWL

- Crystal Super Calibrator.....R. A. Scheidel 51
Across the Ham Bands: ARRL Sweepstakes—1963.....Herb S. Brier, W9EGQ 71
Short-Wave Report: Lightning Strikes HCJB.....Hank Bennett, W2PNA 77
English-Language Newscasts to North America.....78
Short-Wave Broadcast Predictions.....Stanley Leinwoll 79
On the Citizens Band.....Matt P. Spinello, 18W4689 80

Electronic Features and New Developments

- Cover Contest Winners.....30
NEWS.....49
Breakthroughs.....50
Electronic Inventors Quiz.....Robert P. Balin 67
Hobnobbing with Harbaugh: Those Happy Happy Hams.....Dave Harbaugh 70
The Lightning Bug (a Carl and Jerry Adventure).....John T. Frye, W9EGV 73
Transistor Topics.....Lou Garner 74

Departments

- Letters from Our Readers.....6
Out of Tune.....10
Tips and Techniques.....12
Coming Next Month.....20
Operation Assist.....22
New Products.....26
POP'tronics Bookshelf.....32

Copyright © 1963 by ZIFF-DAVIS PUBLISHING COMPANY. All rights reserved.



Men of most All Ages — from many walks of Life have profited by DeVry Electronics Training

Electronics training has given job opportunities to thousands of men of most ages. Many went on for years looking for the "big break," and never even thought they had a chance in electronics. Then, sooner or later, an item in the paper, a coupon in a magazine, a word of advice from a friend — led them to Electronics. It's an ideal field for the lad just graduated, the man just married, the man looking for a "second chance."

Electronics training has done so much for so many men, and DeVry Tech offers practical programs to suit almost anyone 17-55. You can train in one of our modern laboratories, day or evening. Or, you can keep your present job and train at home — even earn while you learn! No previous technical experience is required to get started. Send for our free booklets today and find out how you, too, may prepare for a bright, more profitable tomorrow — in electronics.

DeVRY TECH STANDS BACK OF EVERY DeVRY MAN — EVEN AFTER HIS TRAINING!

Thorough, practical training has made DeVry outstanding for 32 years. Equally important is DeVry Employment Service, which is always available to our trained men. In addition, DeVry Consultation Service helps our men with any technical problem they may face at any time,



DeVry Technical Institute

Chicago • Toronto

Accredited Member of National Home Study Council



SEND FOR FREE BOOKLETS

DeVRY TECHNICAL INSTITUTE

4141 Belmont Ave., Chicago 41, Ill., Dept. PE-11-T

Please give me your two free booklets, "Pocket Guide to Real Earnings" and "Electronics in Space Travel"; also include details on how to prepare for fields (check one or more):

a career in Electronics. I am interested in the following opportunity

- | | |
|--|---|
| <input type="checkbox"/> Space & Missile Electronics | <input type="checkbox"/> Communications |
| <input type="checkbox"/> Television and Radio | <input type="checkbox"/> Computers |
| <input type="checkbox"/> Microwaves | <input type="checkbox"/> Broadcasting |
| <input type="checkbox"/> Radar | <input type="checkbox"/> Industrial Electronics |
| <input type="checkbox"/> Automation Electronics | <input type="checkbox"/> Electronic Control |

Name _____ Age _____

Address _____ Apt. _____

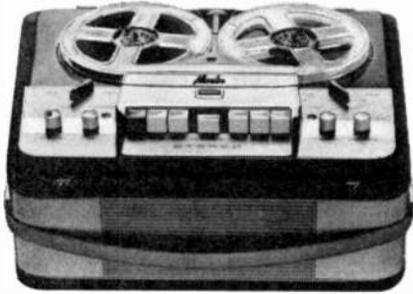
City _____ Zone _____ State _____

Check here if you are under 16 years of age.

Canadian residents: Write DeVry Tech of Canada, Ltd.
970 Lawrence Avenue West, Toronto 19, Ontario

2086

all signal no noise



The most noise-free recordings you have ever heard are to be made on the new all-transistorized Norelco Continental '401' Stereo Tape Recorder, the only recorder using the newly developed AC 107 transistors in its two preamplifiers. The only transistor specifically designed for magnetic tape head preamplifiers, the AC 107 utilizes specially purified germanium to achieve the extraordinary low noise figure of 3 db, measured over the entire audio band (rather than the usual single frequency). This noise figure remains stable over large collector-emitter voltage swings and despite large variations in source resistance.

FEATURES: 4-track stereo/mono record and playback • 4 speeds: 7½, 3¾, 1½ and the new 15/16 ips which provides 32 hours of recording on a single 7" reel • fully self-contained with dynamic stereo microphone, two speakers, dual preamps and dual recording and playback amplifiers • self-contained PA system • mixing facilities • can also play through external hi-fi system • multiply facilities.

SPECIFICATIONS: Frequency response: 60-16,000 cps at 7½ ips. Head gap: 0.00012". Signal-to-noise ratio: better than -48 db. Wow and flutter: less than 0.14% at 7½ ips. Recording level indicator: one-meter type. Program indicator: built-in, 4-digit adjustable. Inputs: for stereo microphone (1 two-channel); for phono, radio or tuner (2). Foot pedal facilities (1). Outputs: for external speakers (2); for external amplifiers (1 two-channel); headphone (1). Recording standby. Transistor complement: AC 107 (4), OC 75 (6), OC 74 (2), OC 44 (2), 2N1314 (2), OC 79 (1). Line voltage: 117 V. Power consumption: 65 watts. Dimensions: 18½" x 15" x 10". Weight: 38 lbs. Accessories: Monitoring headset and dual microphone adapter.

Write for Brochure E-11 North American Philips Co., Inc., High Fidelity Products Division, 100 East 42nd Street, New York 17, New York.

Norelco

SUBSCRIPTION SERVICE: All subscription correspondence should be addressed to POPULAR ELECTRONICS, Circulation Department, 434 South Wabash Avenue, Chicago 5, 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.

POPULAR ELECTRONICS

World's Largest-Selling Electronics Magazine

Publisher **PHILLIP T. HEFFERNAN**

Editor **OLIVER P. FERRELL**

Feature Editor **W. STEVE BACON, W2CJR**

Technical Editor **L. JEROME STANTON, W2WHM**

Art Editor **JAMES A. ROTH**

Associate Editor **MARGARET MAGNA**

Technical Illustrator **ANDRE DUZANT**

Amateur Radio Editor **H. S. BRIER, W9EGQ**

CB Editor **M. P. SPINELLO, 18W4689**

Semiconductor Editor **L. E. GARNER, JR.**

Short-Wave Editor **M. BENNETT, W2PNA**

Contributing Editor **J. T. FRYE, W9EGV**

Radio Propagation Editor **STANLEY LEINWOLL**

Editorial Consultant **OLIVER READ, W4TWV**

Advertising Manager **WILLIAM G. MCROY, 2W4144**

Advertising Service Manager **ARDYS C. MORAN**

ZIFF-DAVIS PUBLISHING COMPANY

Editorial and Executive Offices (212 ORegon 9-7200)
One Park Avenue, New York, New York 10016

William B. Ziff, Chairman of the Board (1946-1953)
William Ziff, President

W. Bradford Briggs, Executive Vice President
Hershel B. Sarbin, Vice President and General Manager
M. T. Birmingham, Jr., Vice President and Treasurer
Robert P. Breeding, Circulation Director
Stanley R. Greenfield, Vice President
Phillip T. Heffernan, Vice President

Midwestern and Circulation Office (312 WAbash 2-4911)
434 South Wabash Avenue, Chicago, Illinois 60605
Midwestern Advertising Manager **JAMES WEAKLEY**
Western Office (213 CRestview 4-0265)
9025 Wilshire Boulevard, Beverly Hills, California 90211
Western Advertising Manager, **WILLIAM J. RYAN, 11Q3002**
Foreign Advertising Representative
D. A. Goodall Ltd., London, England



Member
Audit Bureau of
Circulations



POPULAR ELECTRONICS is published monthly by Ziff-Davis Publishing Company at 434 South Wabash Avenue, Chicago 5, Illinois, November, 1963. Volume 19, Number 5. (Ziff-Davis also publishes Popular Photography, Electronics World, HiFi/Stereo Review, Popular Boating, Car and Driver, Flying, Modern Bride, Amazing and Fantastic.) Subscription Rates: One year United States and possessions, \$1.00; 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 (23); Swiss francs (23); or West German marks (21).

this is the Poly-Comm® B
the first low-cost FM
business band transceiver
*with two-way selective calling**



299⁹⁵ AC/DC model

Rugged, dependable, yet priced considerably less than competitive systems. With Capture effect reception, the Poly-Comm B overcomes interference and gets your call through. Immunity to ignition noise as compared to AM units and ease of operation make the "B" the ideal communications system for the serious user. There are other Poly-Comm built-in bonuses, too . . . the FM

mode of transmission results in a greater range than AM units . . . guaranteed mobile to mobile range of 20 miles on flat terrain and 30 miles for base to mobile transmission . . . even greater ranges can be acquired as needed with a Poly-Booster. Selective listening is available by adding a plug-in Poly-Call Selective Ringer. No examination necessary to acquire a business band license.

*optional at extra cost

There's extra value in every Poly-Comm



FREE! "How to Get a Business Band License." Fill in and mail today!

NAME _____

ADDRESS _____

CITY, STATE _____

88 CLINTON ROAD, WEST CALDWELL, NEW JERSEY 07007 TEL: (Area 201) 228-2400

NEW **WEN** Model 75 SOLDERING PISTOL

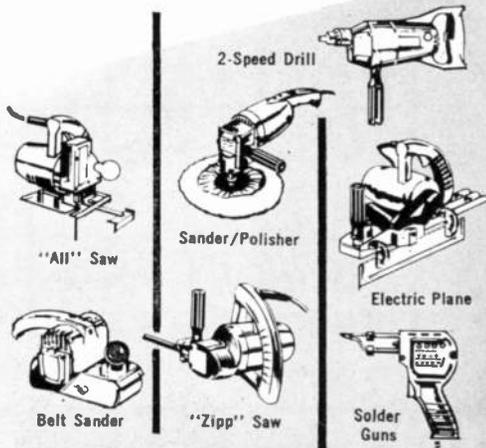
with ATR*

Only \$495

"Pencil" Delicacy
with BIG-JOB
CAPABILITY



A new space-age metal wire heats a heavy tapered copper tip so efficiently this lightweight beautifully balanced pistol delivers heat normally available only from heavier devices with twice its low rating of 50 watts. *NEW ATR REGULATES TEMPERATURE FOR HIGHEST EFFICIENCY—A surge of 50 watts brings tip to working temperature in seconds . . . then only 30 watts are needed under normal soldering conditions. When the tip is placed against an unusually large cold mass, ATR automatically triggers more watts until the mass is properly heated . . . then regulates back to its amazing 30 watt efficiency. No double triggers or tricky switches with ATR—exclusively in the new WEN Model 75 Soldering Pistol.



WEN

PRODUCTS, INC.
5810 Northwest Highway
Chicago 31, Illinois



Letters from our Readers

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

Ham Equipment Directory?

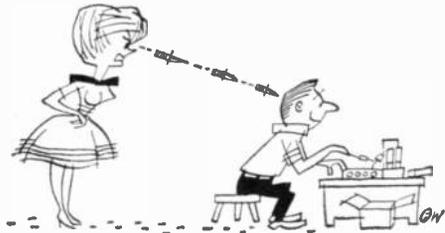
■ The August issue of POPULAR ELECTRONICS featured a very complete directory of CB equipment, but I have never seen a listing of ham gear. How about a directory of amateur equipment?

GEORGE LINDSEY, WA4MVA
Memphis, Tenn.

Thanks for the letter, George. Although the idea of running such a directory has been considered, it has not been done due to the fact that there is a tremendous amount of ham equipment which falls into many different categories. There is a possibility, however, that we may run short directories from time to time covering, for example, low-power transmitters, medium-price receivers, etc.

"Electronics Widow" Wants Help

■ My husband knew little or nothing about electronics when we married five years ago. Two children later, he knows quite a lot—largely due to POPULAR ELECTRONICS, which he studies from cover to cover. I feel like a complete dunce when he talks about tubes and transformers, but I've come to



the conclusion that he's not joking when he refers to a bunch of plugs as "male" and "female." How can I find out what it's all about? Go ahead and laugh, but I didn't even know how to change a fuse until recently.

MRS. JANET RIZZI
Monterey Park, Calif.

P.S. I bet there are a lot of wives in my shoes—is there anyone at POPULAR ELECTRONICS brave enough to do a column for US?

Thank you for the letter, Mrs. Rizzi. In answer to your last question, no, but perhaps the following

Always say you saw it in—POPULAR ELECTRONICS

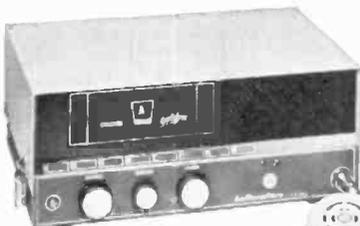


Terry
W9DIA
18W3516

CB'ers SAVE!
Buy this Hallicrafters
CB-3A for \$159.95 —
pay cash, or as little
as 10% and \$7.20
per mo. (2 years)

and
for

\$1.00
just extra
you can have any
one of these deluxe
Hy-Gain antennas!



CB-3A
supplied on
channel 11,
extra channels
\$5.90 ea.



**GOT SOMETHING TO
TRADE? GET OUR DEAL!**



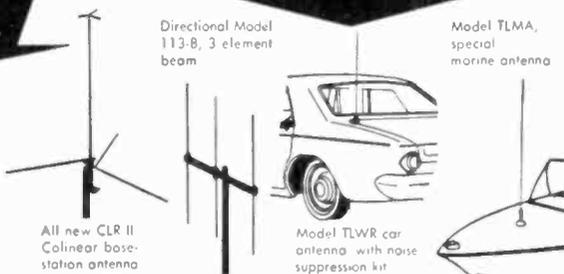
NEW! For the serious
short-wave listener, Hallicrafters
SX-122, now in
stock for XMAS delivery.
Yours for \$5.00 down,
\$10.47 per mo. (3 yr.)

**IDEAL
XMAS GIFT:**

Famous Hallicrafters S-120.
Only \$69.95. Just \$5.00
down, \$6.03 per month
(1 yr.)



Xmas Special: For \$1.00 extra, with purchase of any receiver listed at right, we'll send you a deluxe headset and appropriate outdoor antenna. What a deal!



All new CLR II
Colinear base-
station antenna

Directional Model
113-B, 3 element
beam

Model TLMA,
special
marine antenna

Model TLWR car
antenna with noise
suppression kit

SHORT WAVE LISTENERS . . .
look at these low payments
on new Hallicrafters receivers
after just \$5.00 down!

	Price	Per Month
FOR GENERAL COVERAGE LISTENING		
S-120, 4 tubes	\$ 69.95	\$ 2.34
S-118, 5 tubes	99.95	3.42
S-108, 7 tubes	139.95	4.87
*SX-110, 7 tubes	169.95	5.95
*SX-122, 11 tubes	295.00	10.47
*SX-62A, 14 tubes	430.00	15.34
FOR POLICE, FIRE, TAXI, COMMERCIAL		
CRX-1, 30-50 mc FM	\$ 99.95	\$ 3.42
CRX-2, 151-174 mc FM	109.95	3.78
FOR AIRCRAFT		
CRX-3, 108-135 mc	\$ 94.95	\$ 3.24

*These models do not have built-in speakers. Order R-48A speaker, \$19.95.

NOTE: Payments shown are on three year plan. Minimum order that can be financed for one year is \$60.00; two years — \$120.00; three years — \$180.00.



**AMATEUR
ELECTRONIC
SUPPLY**



Steve W9EAN

MILWAUKEE 8, WIS.
3832 West Lisbon Ave. • Phone We. 3-3262
Hours: Monday and Friday, 9 A.M. to 9 P.M.
Tuesday, Wednesday & Thursday, 9 A.M. to 5:30 P.M.
Saturday, 9 A.M. to 3 P.M.



Doc W9HJS

CHICAGO 31, ILL.
6450 Milwaukee Ave. • Phone: Ro. 3-1030
Hours: Monday, Wednesday & Thurs., 12 P.M. to 9 P.M.
Tuesday & Friday, 12 P.M. to 5:30 P.M.
Saturday, 9 A.M. to 3 P.M.



Phil W9QVM/4

ORLANDO, FLA.
23 Azalea Pk. Shop. Ctr. • Phone 277-8231
Hours: Monday, Tues., Thurs. & Friday, 1 P.M. to 9 P.M.
Wednesday, 1 P.M. to 5:30 P.M.
Saturday, 9 A.M. to 5:00 P.M.

IMPORTANT: Send all mail orders and inquiries to Terry, at our Milwaukee store.

Terry: Ship me _____

I enclose \$_____ and will pay balance (if any)

C.O.D. 1 year 2 years 3 years
(10% deposit required on C.O.D. orders)

I enclose \$1.00 extra for antenna model _____
with CB-3A purchase.

I enclose \$1.00 extra for headset and antenna
with short-wave receiver purchase.

TERRY: I want to buy _____

and I want to trade _____
(describe trade-in fully on separate sheet)

NAME _____

ADDRESS _____

CITY _____ STATE _____

SEND LATEST RECONDITIONED
EQUIPMENT BULLETIN

etters

(Continued from page 6)

suggestions will help. First, get a copy of an electronics dictionary (Allied Radio publishes a small one that costs just 50 cents; you might also secure copies of Basic Electronics and Electronics Data Handbook from the same source). Next, read all of the literature you can find in your husband's interest area—POPULAR ELECTRONICS, hi-fi magazines, etc. When you come to a term you don't understand, look it up; and don't be satisfied until you know exactly what it means. Since you've indicated that your husband is mainly interested in hi-fi, you might also read ABC's of Hi-Fi & Stereo published by Howard W. Sams.

Hams Out-Gunned, Says CB'er

■ This letter will probably never be printed in "Letters from Our Readers," but I think it expresses the feelings of many CB'ers. After being a CB'er for two years, I recently attended a ham club meeting. Unfortunately, I found that these fellows were wrapped up in themselves, and acted as if CB'ers were in a different social class. They don't encourage ham potentials, but rather ignore them. When it comes to civil defense, I think hams are against CB because they are afraid of being outclassed. While they're busy calling CQ, we can call any mobile or base unit immediately for 10-5 or 10-3.3 info—and there are probably ten times more mobile CB units in use than ham units.

For every argument against CB, I can cite a good reason for it.

ROBERT W. HAMILTON, KHA1984
Decatur, Ill.

Heating Pad QRM

■ I have a problem which I'm sure bothers many other BCB and SW DX'ers. With sensitive communications equipment, I have enough heating pad interference to rip out the speaker cone when the volume is turned up. This r.f. interference is radiated through the air rather than the power



line—it disappears when I disconnect the antenna. How can I get rid of it, short of throwing the heating pad out?

THOMAS R. SUNDSTROM, WPE2AJ
Stockton, N.J.

Your problem is a common one, Tom, and the ultimate answer may be, especially if the heating



The **WONDERSHAFT** mobile whip is, of course, fiberglass (—all Columbia Products antennas are). The Whip — **STYLE 10** series — provides full quarter wave efficiency in antenna lengths approximately 10% shorter than its metal counterpart. The exclusive Columbia Products fiberglass construction loads the conductor dielectrically and reduces the velocity of electromagnetic propagation. This gives a

physical shortening effect similar to that of a coaxial transmission line.

Fiberglass gives **WONDERSHAFTS**, other advantages, too: insulation to reduce operating hazards under live wires . . . a surface that won't rust or corrode . . . light weight . . . high impact and flexural strength. Lengths for frequencies of 25-54 mc. including Citizens Band: **STYLE 10-1**, 54"-60"; **STYLE 10-2**, 61"-102"; **CB STYLE 10-3**, 96".



COLUMBIA PRODUCTS COMPANY
SUBSIDIARY OF SHAKESPEARE CO., COLUMBIA, SOUTH CAROLINA

Get Your First Class Commercial F.C.C. License In a Hurry — Or at Your Own Pace!

Is the Course Proven?

A high percentage of Grantham *resident* students get their 1st class FCC licenses in the short period of 12 or even 8 weeks from the time they start the course. Many others choose *home study*, completing the course and getting their licenses at their own convenience.

Is the Course Complete?

Not only does the Grantham course cover all required subject matter completely; it grows and changes and expands in phase with change and expansion in the electronics field generally. With the Grantham course, you are assured of modern, up-to-the-minute instruction.

Is the Course "Padded"?

The streamlined Grantham course is designed specifically to prepare you to pass FCC examinations and examinations given by electronics firms. What you need to know to achieve these goals, you are taught completely and in detail. The course is not "padded" with information you will not need.

Is It a "Coaching Service"?

The weakness of the "coaching service" or "Q & A" method employed by some schools and individuals is that it presumes the student already has a knowledge of basic electronics.

The Grantham course is presented from the viewpoint that you have no prior knowledge of the subject; nothing is taken for granted where your training is concerned. We "begin at the beginning" and progress in a logical, step-by-step manner from one point to another, with the necessary math taught as an integral part of the course. Every subject is covered simply and in detail; the emphasis is on making the subject easy to understand.

With each lesson you receive an FCC-type test so that you can discover after each lesson just which points you do not understand and clear them up as you go along. In addition to the lesson tests, ten comprehensive Review Exams are given throughout the course.

For further details concerning F. C. C. licenses and our training, send for our FREE booklet



GRANTHAM



SCHOOL OF ELECTRONICS

Train through home study or at one of our four convenient resident locations shown below:

1505 N. Western Ave.
Los Angeles 27, Calif.
(Phone: HO 7-7272)

408 Marion Street
Seattle 4, Wash.
(Phone: MA 2-7227)

3123 Gillham Road
Kansas City 9, Mo.
(Phone: JE 1-6320)

821-19th Street, N.W.
Washington 6, D. C.
(Phone: ST 3-3614)



Is the School Accredited?

Grantham School of Electronics is accredited by the Accrediting Commission of the National Home Study Council.

Is It a "Memory Course"?

Grantham School has never endorsed the "memory" or "learn by rote" approach to preparing for FCC license exams. This approach may have worked in the early days of broadcasting, to the extent that a man could get his license that way; but, Heaven help the employer who expected this man to be able to demonstrate abilities implied by possession of the license!

Fortunately for all concerned, it is no longer possible for a man to pass FCC exams by spilling out memorized information which is essentially meaningless to him. Advances in the field of electronics—and the desire of the FCC to have the license really mean something — have caused upgrading of the exams to the point where only the man who is able to *understand* and *reason* electronics can acquire the 1st class FCC license.

Learn to thoroughly understand basic electronics from the school whose graduates are successfully employed by virtually every major electronics firm in the United States. Why not join them through Grantham training?

(Mail in envelope or paste on postal card)

TO: GRANTHAM SCHOOL OF ELECTRONICS
NATIONAL HEADQUARTERS OFFICE
1505 N. Western Ave., Hollywood 27, Calif.

Gentlemen:

Please send me your free booklet telling how I can get my commercial F.C.C. license quickly. I understand there is no obligation

Name _____ Age _____

Address _____

City _____ State _____

I am interested in:

Home Study, Resident Classes

33-5



NEW CADRE C-75 CB TRANSCEIVER

The new Cadre C-75 1.5-watt, 2-channel transceiver is 15 times too powerful for youngsters (under 18 years of age) to operate, according to FCC regulations. Clearly, it's not a toy. It's designed for serious CBers who need 'big set' performance that can be used anywhere.

The new C-75, weighing less than 2 lbs; provides clear, reliable 2-way communications up to 5 miles and more. All solid state design creates an extremely rugged transceiver to absorb rough handling, stays on frequency. Two crystal-controlled channels spell perfect communications contact everytime. Sensitive superhet receiver (1 μ v for 10 db S/N ratio) brings in signals in poor reception areas. Powerful transmitter has one watt output to the antenna. Adjustable squelch silences receiver during standby. AGC assures proper listening level. In a word, the C-75 has all the features you'd look for in a quality full size CB unit.

The C-75 has all the portable conveniences you'd want, too: operates on alkaline or mercury penlite cells (8-hour rechargeable nickel-cadmium battery available); ear-phone and antenna jacks; built-in retractable antenna; jack for base operation while recharging.

Use the Cadre C-75 anywhere in the field, for vehicle, office, boat or plane. Use it constantly too, because its all-transistor modular circuit (11 transistors and 2 diodes) is virtually maintenance free. \$109.95. Recharger and 2 nickel-cadmium batteries \$31.85.

Cadre also offers a complete line of 5-watt all transistor transceivers and accessories.

See your Cadre distributor or write
CADRE INDUSTRIES CORP.
 COMMERCIAL PRODUCT DIVISION □ ENDICOTT, NEW YORK
 □ AREA CODE 607, 748-3373. Canada: Tri-Tel Assoc., Ltd.,
 81 Sheppard Ave. W., Willowdale, Ont. Export: Morhan Ex-
 porting, 458 B'way, N. Y. 13, N. Y.

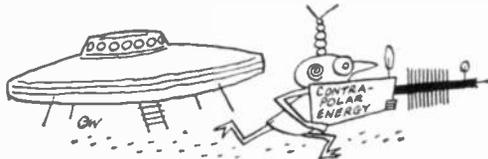
Letters

(Continued from page 8)

pad is an old one (they used tiny thermostats notorious for the r.f. noise they generated), to do as you suggest—throw it out. A less drastic remedy, successful in many cases, is to connect a .01- to .001- μ f., 600-volt ceramic capacitor across each thermostat (small bimetallic switches that open and close as the pad gets warmer or cooler) in the heating pad. The capacitors should be connected as close to the thermostats as possible, and the leads kept short. You may have to open the pad up to connect the capacitors, and then stitch it back together.

Hoax Revealed: Contra-Polar Energy

■ With reference to the article on "Contra-Polar Energy" (April, 1955, page 27), I am deeply interested in this subject and would appreciate any assistance you can give me. After an extensive



search through the Michigan and Arkansas library systems and a brief search in Washington, D.C., I was unable to locate the references mentioned in the text. Could you please advise me as to where I can obtain additional information and/or plans?

Name withheld

In answer to a number of inquiries on this article which have been received over the years, we would like to state once again that the subhead should be taken literally. It reads as follows: "In keeping with the first day of April." Careful readers will also observe that one of the footnotes refers to "a reprint of a document found in a flying saucer." Need more be said?

—30—

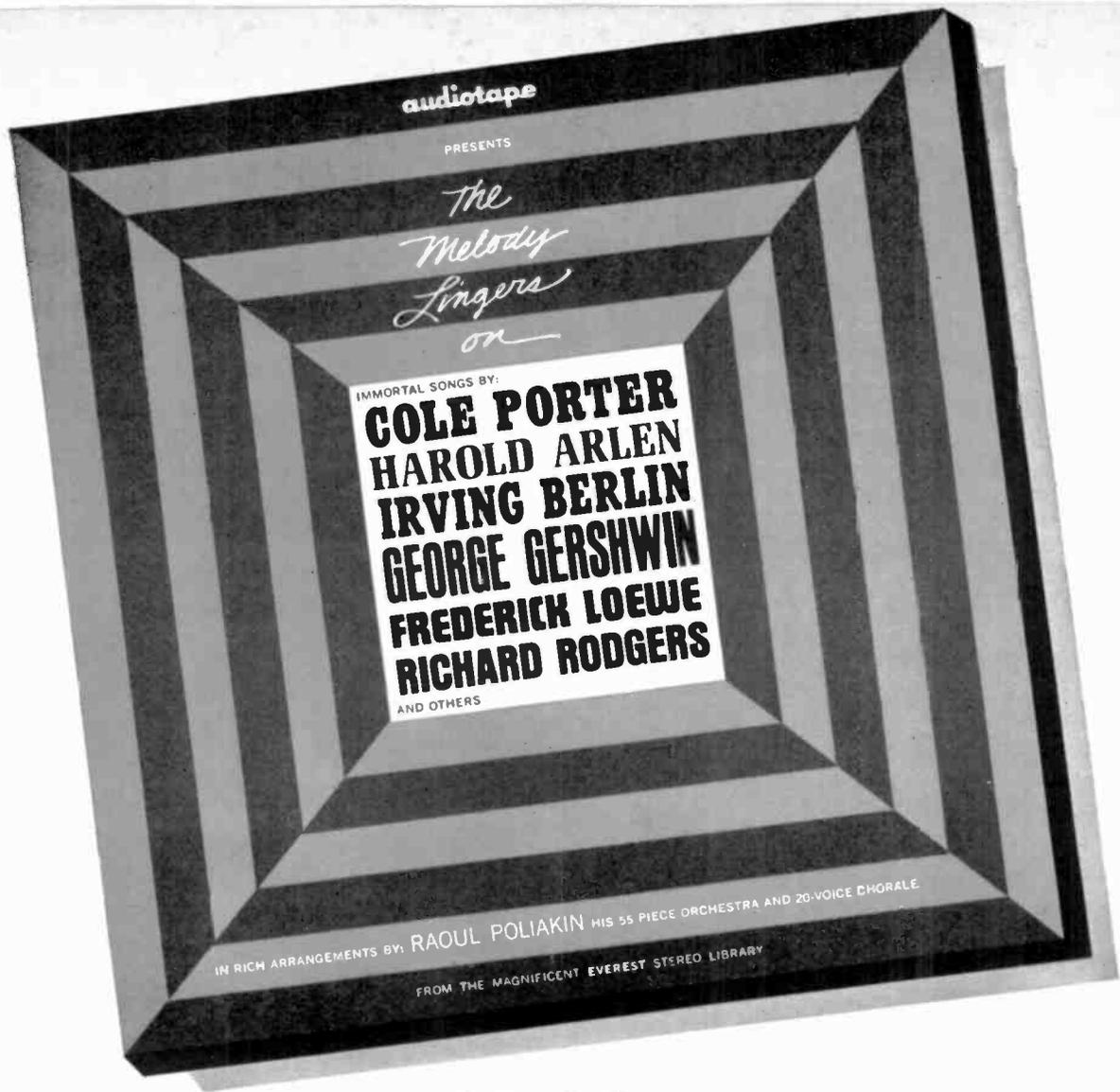
Out of Tune



Sure Cure for Ham/CB Mobile Noise (October, 1963, page 65). Through no fault of the author, the price given for the "Eliminoise" kit is incorrect. The "about \$12" figure refers to another new product being offered by the E.F. Johnson Company—a "Generator, Alternator-Regulator Suppression Kit." The Johnson/Hallett "Eliminoise" kit sells for \$29.95 (6-cylinder cars) and \$38.50 (8-cylinder cars). Our apologies to E. F. Johnson and to any readers who may have found our pricing information an inconvenience.

—30—

Always say you saw it in—POPULAR ELECTRONICS



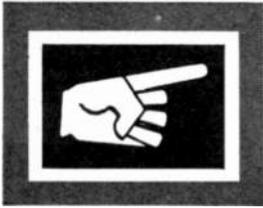
\$1.00

Christmas is early this year! We're offering a superb recorded tape for a fraction of its actual cost for trying a 7" reel of Double Recording Audiotape on Tempered "Mylar." (A great tape in itself: double length plus double strength.) ■ Just buy a reel of Double Recording Audiotape (Type 2431T) at the regular price, and for only \$1.00 additional come away with *The Melody Lingers On*—a magnificent 55-minute program of great popular standards. These unforgettable melodies are performed in luxurious arrangements from the Everest stereo library, long noted for the superb quality of its recordings. ■ The \$1.00 price tag is even more remarkable when you consider that the entire program is recorded on a reel of standard Audiotape which actually sells for more than

twice that price! So even if you erased the tape (heaven forbid!) you'd still be ahead of the game. ■ Go to any store that carries Audiotape products and buy a reel of Double Recording Audiotape, Type 2431T. Then add one dollar for *The Melody Lingers On*, a great tape that you and the women in your life will treasure. Available only in 4-track stereo. And Merry Christmas!

AUDIO DEVICES, INC.
444 MADISON AVENUE,
NEW YORK 22, NEW YORK

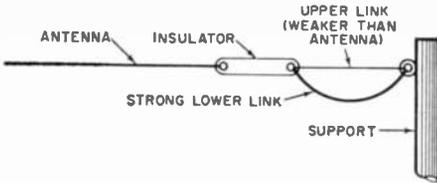




Tips and Techniques

SHIPBOARD ANTENNA SAVER FOR LANDLUBBERS

This antenna-saving idea is generally used at sea where a rugged installation is essential, but it is equally useful on land. As shown in the drawing, the antenna is sup-



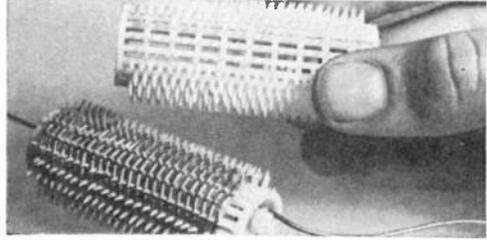
ported by two wire links, one slightly weaker than the antenna, and the other considerably heavier. When there is too much strain on the antenna, the top link

breaks—rather than the antenna—and the strong lower link takes over, giving the sky wire more slack at the same time.

—Art Trauffer

CLEVER COILS FROM HAIR CURLERS

Take a look in the little lady's cosmetic case the next time you need a small coil form for winding a coil. Hair curlers, like



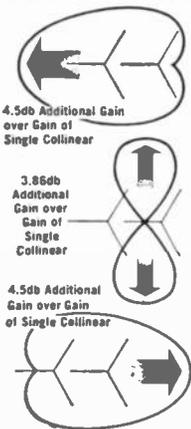
those shown or somewhat similar, are ideal low-loss, low-cost (unless she makes you buy her some more) coil forms.

—Jerome Cunningham

ERASER CLEANS CIRCUIT BOARDS

If you've ever faced the problem of having the foil separate from a printed-circuit board when you attempt to solder it, this

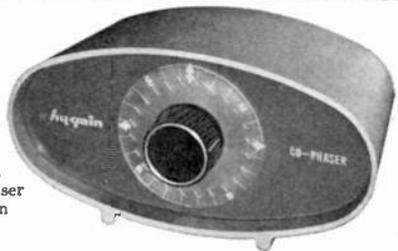
CBer's... PHASE 'EM for greater range and get up to 4.5 db ADDITIONAL GAIN with *Hy-Gain's* revolutionary CO-PHASER



Now...with Hy-Gain's revolutionary Co-Phaser, phased collinear antennas will virtually double your effective radiating power in a multi-directional pattern. This handsome little gray box of magic produces additional gain as it should be produced...by combining the natural optimum performance characteristics of two phased collinear antennas and discriminately directing their power to where you want it. With a flip of the compass rose calibrated dial, the Co-Phaser transfers you from 3.86db additional broadside gain to 4.5db additional "end-fire" gain off of either end of your phased array. The Co-Phaser also cuts out co-channel interference...gives you a stronger and clearer signal in all directions and expands your range far beyond present "fringe" areas. It requires no external power...has no tubes or circuitry, to introduce additional noise or interference.

For greater range...discriminate signals without the use of expensive rotators...you'll want Hy-Gain's sensational new Co-Phaser. Easily installed and modestly priced at only.....\$14.95 Net

Get yours today from your favorite Hy-Gain Distributor or write for address of Distributor nearest you.



HY-GAIN ANTENNA PRODUCTS CORP.

8454 N.E. Highway 6—Lincoln, Nebraska

NEW HOME STUDY PROGRAMS IN SPACE ELECTRONICS



with your choice of these specialties:

SPACE DATA SYSTEMS—Includes analog and digital computers, information theory, data acquisition and processing.

SPACE TRACKING SYSTEMS—Includes microelectronics, space propagation, masers, lasers, infrared techniques.

SPACECRAFT GUIDANCE & CONTROL—Includes inertial navigation, space radar, star tracker systems, tracking networks.

- The first extension programs developed specifically to help men in electronics apply their experience to the space effort.
- Content developed to meet employment requirements as determined by consulting government and private organizations in the space field.
- Text material prepared with the help of engineers and scientists holding key positions in leading space-oriented organizations.

CREI also offers specialized education in these important areas of electronics: Communications, Aeronautical and Navigational, Television, Automation and Industrial, Nuclear, Servomechanisms and Computers.

You are eligible for these programs if you work in electronics and have a high school education.

FREE BOOK GIVES FULL INFORMATION. For your copy, mail coupon or write: CREI, Dept. 1211-A, 3224 Sixteenth Street, N. W., Washington, D. C. 20010

Accredited Member of the National Home Study Council



The Capitol Radio Engineering Institute
Dept. 1211-A, 3224 Sixteenth St., N. W.
Washington, D. C. 20010

Please send me FREE book describing CREI Home Study Programs including new Program in Space Electronics. I am employed in electronics and have a high school education.

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

Employed by _____

Type of present work _____

Check: Home Study Residence School G. I. Bill PE-14

Tips

(Continued from page 12)

tip is for you. Before you start, carefully clean the copper foil by rubbing it with a typewriter eraser like that shown. The eraser has the correct amount of abrasive, and removes oxidation and dirt so that



joints can be rapidly tinned and soldered. Incidentally, this technique is recommended by NASA for high-reliability soldering of satellite components.

—Kent A. Mitchell, W3WTO

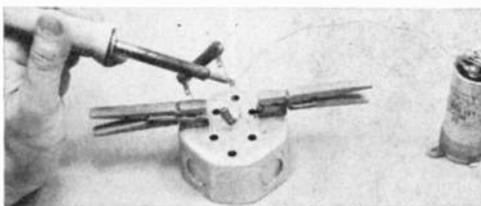
IDENTIFYING TRANSISTOR TYPES

Painted-on transistor type-numbers often wear off with repeated handling, and many transistors, especially those of the general-

purpose variety sold to experimenters, are not marked at all. If you do a lot of bread-boarding of circuits, you'll save yourself considerable time and trouble by scratching type numbers and/or other data such as "a.f." or "r.f.," and "pnp" or "npn," on the outside of each transistor case with a sharp instrument. —Stanley E. Bammel

MAGNETIC FINGERS FROM CLOTHESPINS

The use of wooden spring clothespins to hold small parts when soldering or gluing is an old idea, but if you cement a small, flat magnet to one jaw of each pin, the



clothespins will take on new usefulness. The magnets will hold them in place on steel surfaces, making it possible for you to work with a number of parts and hold a soldering iron at the same time. Plastic
(Continued on page 20)

Solve your Christmas shopping problems with the

TURNER COMBO

Yes, here's the perfect Christmas gift for any CBer — the Turner Combo Pack. Two fine Turner microphones in one package — the 350C mobile microphone and the 254C base station microphone. They're the perfect combination for insuring top performance at both ends of any CB rig. Do your Christmas shopping at your Turner dealer's — get the Turner Combo.

LIST
PRICE **\$36.00**



THE **TURNER** MICROPHONE COMPANY

946 17th Street N.E.
Cedar Rapids, Iowa

IN CANADA: Tri-Tel Associates, 81 Sheppard Ave., West, Willowdale, Ontario
EXPORT: Ad Auriema, Inc., 85 Broad Street, New York 4, New York



What Job Do You Want In Electronics?

Whatever it is, Cleveland Institute can help you get it!

Yes, whatever your goal is in Electronics, there's a Cleveland Institute program to help you reach it *quickly* and *economically*. Here's how: Each CIE program concentrates on electronics theory as applied to the solution of practical, everyday problems. Result . . . as a Cleveland Institute student you will not only learn electronics but *develop the ability to*

use it! This ability makes you eligible for any of the thousands of challenging, high-paying jobs in Electronics. Before you turn this page, select a program to suit your career objective. Then, mark your selection on the coupon below and mail it to us *today*. We will send you the complete details . . . without obligation . . . if you will act **NOW!**

Electronics Technology



A comprehensive program covering Automation, Communications, Computers, Industrial Control, Television, Transistors, and preparation for a 1st Class FCC License.

First Class FCC License



If you want a 1st Class FCC ticket quickly, this streamlined program will do the trick and enable you to maintain and service all types of transmitting equipment.

Industrial Electronics & Automation



This exciting program includes many important subjects as Computers, Electronic Heating and Welding, Industrial Controls, Servomechanisms, and Solid State Devices.

Electronic Communications



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

Broadcast Engineering



Here's an excellent studio engineering program which will get you a 1st Class FCC License and teach you all about Program Transmission and Broadcast Transmitters.

Mail Coupon TODAY For FREE Catalog

Cleveland Institute of Electronics

1776 E. 17th St., Dept. PE-10
Cleveland 14, Ohio

Please send FREE Career Information prepared to help me get ahead in Electronics, without further obligation.

How to Succeed in Electronics

CHECK AREA OF MOST INTEREST—

- | | |
|---|--|
| <input type="checkbox"/> Electronics Technology | <input type="checkbox"/> First Class FCC License |
| <input type="checkbox"/> Industrial Electronics | <input type="checkbox"/> Electronic Communications |
| <input type="checkbox"/> Broadcast Engineering | <input type="checkbox"/> _____ other _____ |

Your present occupation _____

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

Approved for Veteran's Training under Korean GI Bill. PE-10

Cleveland Institute of Electronics

1776 E. 17th St., Dept. PE-10
Cleveland 14, Ohio



Accredited Member

Exclusive with **RCA** ...

AUTOTEXT®

the faster, easier way toward a career in electronics

Amazing home training method makes learning almost automatic

Exclusive with RCA. "AUTOTEXT" the revolutionary home training method introduced by RCA Institutes, Inc., is stirring the interest of thousands. Every day, "AUTOTEXT" is helping people like yourself join the thousands of other successful electronic students who are working toward profitable careers right now! This faster, easier way to learn electronics uses the latest scientific development in the field of home training—and "AUTOTEXT" is exclusive with RCA.

Tested throughout the country. This exciting new trend in education represents a significant advance in teaching electronics. People who have been interested in careers in electronics in the past, but have had difficulty with conventional home training methods, can now begin to master the fundamental principles of electronics almost automatically. Tested in schools throughout the country, checked out and proved with thousands of students, programmed instruction is helping people learn more quickly and with less effort.

Prove it to yourself now! If you have a natural inclination or interest in the exciting field of electronics, that's all you need. RCA "AUTOTEXT" will help you do the rest. And the future is unlimited. Jobs are available for qualified technicians in Space Electronics, Communications, TV, Computer Programming, Automation, and many other electronic fields. The important thing is to get started now!

Complete course available. Right now, RCA Institutes offers you a complete Home Training Course ("Introduction to Electronics") using the "AUTOTEXT" method. You get a complete set of theory lessons, service practice lessons, experiment lessons, and all the kits you need. And most important, "AUTOTEXT" takes most of the effort out of learning the all-important groundwork of the electronics field.

Get complete information now without obligation. Send the attached postcard and check "AUTOTEXT".



Wide choice of Home Training courses in Electronics:

- Autotext
 - Introduction to Electronics
 - Introduction to Semiconductors
- TV Servicing
- Color TV
- Communications Electronics
- FCC License Preparation
- Mobile Communications
- Automation Electronics
- Electronic Fundamentals (also available in Spanish)
- Computer Programming
- Transistors
- Electronic Drafting
- Industrial Electronics
 - Automatic Controls
 - Industrial Applications
 - Nuclear Instrumentation
 - Digital Techniques

RCA Institutes Home Training Courses are complete step by step easy-to-understand units. You get prime quality equipment in the kits furnished to you, and all of it is top grade. It's yours to keep and use on the job.

Liberal Tuition Plan. RCA Institutes Home Training Courses are available under a liberal tuition plan that affords you the most economical possible method of home training. You pay for lessons only as you order them. If, for any reason, you should wish to interrupt your training, you can do so and you will not owe a cent until you resume the course. No long-term obligations!

Set Your Own Pace. RCA Institutes Home Training takes into consideration your own ability, finances and time. You learn at your own speed, in the most effective manner, with personalized instruction every step of the way. You get theory, experiment, and service practice beginning with the very first lesson. All lessons are profusely illustrated—a complete training package in every way.

CLASSROOM TRAINING

RCA Institutes Resident Schools in New York City, Los Angeles and RCA Technical Institute in Cherry Hill near Camden, N. J., offer classroom training that will prepare you to work in rewarding research and production positions in many fields of electronics. No previous technical training required for admission. You are eligible even if you haven't completed high school.

Free Placement Service. RCA Institutes Resident School graduates are now employed in important jobs at military installations, with important companies such as IBM, Bell Telephone Labs, General Electric, RCA, in radio and TV stations and in communications systems all over the country. Many other graduates have opened their own businesses. A recent New York Resident School class had 92% of the graduates who used the FREE Placement Service accepted by leading electronics companies, and had their jobs waiting for them on the day they graduated!

Coeducational Day and Evening Courses are available at Resident Schools. You can prepare for a career in electronics while continuing your normal, full-time or part-time employment. Regular classes start four times a year.

SEND POSTCARD FOR FREE ILLUSTRATED BOOK TODAY! SPECIFY "AUTOTEXT", HOME STUDY OR CLASSROOM TRAINING.

RCA INSTITUTES, INC. Dept. PE-N3

A Service of Radio Corporation of America,
350 West 4th St., New York 14, N. Y.
Pacific Electric Bldg., 610 S. Main St., Los Angeles 14, Calif.



The Most Trusted Name in Electronics

BECOME A RADIO TECHNICIAN
For ONLY \$26.95

BUILD 20 RADIO CIRCUITS AT HOME

with the New
Progressive Radio "Edu-Kit"®
ALL Guaranteed to Work!



only \$26.95
Ref. U.S. Pat. Off.

A COMPLETE HOME RADIO COURSE

- BUILD**
- 12 RECEIVERS
 - 3 TRANSMITTERS
 - SIGNAL TRACER
 - SIGNAL INJECTOR
 - CODE OSCILLATOR
 - SQ. WAVE GENERATOR
 - AMPLIFIER

- No Knowledge of Radio Necessary
 - No Additional Parts or Tools Needed
 - Excellent Background for TV
- Training Electronics Technicians Since 1946

FREE Set of Tools, Pliers-Cutters, Tester, Soldering Iron, Alignment Tool, Wrench Set.

WHAT THE "EDU-KIT" OFFERS YOU

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. You will learn radio theory, construction and servicing. You will learn how to build radios, using regular schematics; how to solder and wire in a professional manner; how to service and trouble-shoot radios. You will learn how to work with punched metal chassis as well as the new Printed Circuit chassis. You will learn the principles of RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will build 20 Receivers, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator, Amplifier and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for TV. In brief, you will receive a basic education in Soldering and Radio, worth many times the small price you pay, only \$26.95 complete.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." You begin by building a simple radio. Gradually, in a progressive manner, and at your own rate, you construct more advanced multi-tube radio circuits, learn more advanced theory and techniques, and do work like a professional radio technician. These circuits operate on your regular AC or DC house current.

THE KIT FOR EVERYONE

You do not need the slightest background in the "Edu-Kit" is the Consultation Service which we provide. We welcome students to send us their problems, whether related to any of the material covered in the "Edu-Kit" course, or encountered in other experiences in the field of electronics.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 20 different radio and electronic circuits, each guaranteed to operate. Our kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, punched metal chassis, Instruction Manual, hookup wire, solder, selenium rectifiers, volume controls, switches, etc. In addition, you receive Printed Circuit materials, including Printed Circuit, Chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, pliers-cutters, an alignment tool, professional electric soldering iron, wrench set, and a self-powered, dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide, FCC Amateur License Training Book, and a Quiz Book.

All parts, components, etc., of the "Edu-Kit" are 100% unconditionally guaranteed, brand new, carefully selected, tested and matched. Everything is yours to keep. The complete price of this practical home Radio and Electronics course is only \$26.95.

TROUBLE-SHOOTING LESSONS

You will learn to troubleshoot and service radios, using the professional Signal Tracer, the unique Signal Injector, and the dynamic Radio and Electronics Tester. Our Consultation Service will help you with any technical problems.

J. Sasalita, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" is paid for itself. I was ready to spend \$240 for a course, but I found your ad and sent for your kit."

FREE EXTRAS

- Set of Tools • Radio Book • Radio and Electronics Tester • Electric Soldering Iron • Pliers-Cutters • Alignment Tool • Tester • Printed Circuit • Chassis • Special Tube Sockets • Quiz Book • Membership in Radio-TV Club: Consultation Service • FCC Amateur License Training • Printed Circuitry • Certificate of Merit • Valuable Discount Card • Wrench Set
- "UNCONDITIONAL MONEY-BACK GUARANTEE"

ORDER FROM AD—RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS WORTH \$7.00

- "Edu-Kit" Postpaid. Enclosed full payment of \$26.95.
- "Edu-Kit" C.O.D. I will pay \$26.95 plus postage.
- Send me FREE additional information describing "Edu-Kit."

Name
Address

PROGRESSIVE "EDU-KITS" INC.

1186 Broadway Dept. 6100 Hewlett, N. Y.

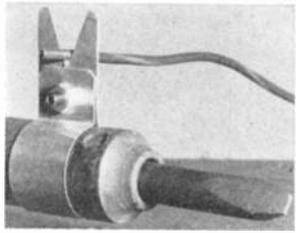
Tips

(Continued from page 14)

clothespins of the spring variety can also be used, but make certain that they are made of a material which does not soften excessively when heated. —Philip Lawson

WIRE STRIPPER FOR PLASTIC INSULATION

A handy wire stripper for plastic-insulated hookup wire can be made from a strip of sheet copper with a V-shaped slot in one end as shown in the photo. Bolt the copper in place and allow the iron to heat. The insulation will be removed as laid in the "V" and rotated. The heat will make a clean break in the insulation and permit it to be easily removed by simply sliding it off the wire. —Milton F. Dickfoss



COMING NEXT MONTH



Another sensational development in the field of automotive electronics is a transistorized substitute for the outdated noisy vibrator. Extraordinarily simple to build, the Vibrator Substitute is described in several different versions—it's suitable for inboard mounting as well as external rear panel mounting on a low-priced heat sink.

ON SALE NOVEMBER 19

● **TELEPHONE BEEPER**
A gadget to "legalize" your tape-recorded telephone conversations, the "Beeper" pipes a beeping tone signal into the mouthpiece every 12 seconds. Self-contained and transistorized, it is mounted right on your phone.

● **LOUD HAILER**
Also used in conjunction with your land-line telephone, this is a remote alarm that tells you when the telephone is ringing. It's ideal for the porch, patio, or workshop—remember how many calls you missed last summer when you didn't hear the phone?

SHURE MICROPHONES

for maximum voice punch!

BASE STATIONS



ALL-NEW...
ADJUSTABLE
HEIGHT

Model

444

for Ham and
CB Use

Gets the message through where other mikes can't. "Shaped" frequency response cuts off below 300 cps, above 3000 cps—with specially developed "rising" characteristic from 1000 to 3000... cuts through QRM, assures top intelligibility and maximum range. Touch-to-talk switch (with built-in switch provision for instant change to VOX or normal operation). Adjustable height stand minimizes operator fatigue. Dozens of other features. Only \$25.50 net.

MOBILES



FOR
"SOLID"
10-4's

Model

201

for CB Use

The low-cost hand-microphone with the "pro" features. "Shaped" response curve patterned after professional mobile and SSB amateur response curves. Virtually indestructible "Armo-Dur" case... shock-, corrosion-, and weather-proof. Long-life switch guaranteed full year. Kink-proof, peel-proof cord. "Lifetime" hang-up bracket. Only \$10.80 net.

SHURE MICROPHONES

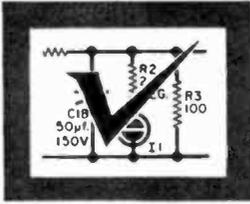
the CB improvement you can hear!

SEND FOR FREE SIGNAL CARD—Most popular "10" signals

Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois

Manufactured under U.S. patents 2,454,425 and D194,749; other patents pending.

Operation Assist



THROUGH THIS COLUMN we try to make it possible for readers needing information on out-dated, obscure, and unusual radio-electronic gear to get help from other readers. Here's how it works: Check over the list below. If you can help anyone with a schematic or other information, write him directly—he'll appreciate it. If you need help, send a post card to OPERATION ASSIST, POPULAR ELECTRONICS, One Park Avenue, New York 16, N. Y. Give the maker's name, the model number, year of manufacture, bands covered, tubes used, etc. Be sure to print or type everything legibly, including your name and address, and be sure to state specifically what you want, i.e., schematic, source for parts, etc. Remember, use a post card; we can handle them much faster than letters. And don't send return envelopes; 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

- Mobilet** VHF crystal-controlled transceiver, no model number given. (R. Cook, 7 Montgomery St., Saugus, Mass.)
- RME DB-20** preselector, USN No. 322-ME23. (Charles McGeorge, 16724 San Bernardino Ave., Fontana, Calif.)
- Zenith Model J2V158** 12-tube, 4-band receiver, late 30's; **Crosley Model 23**, 3-band BC and s.w. receiver. (Joseph Werner, 2814 S. 13th St., Niles, Mich. 49120)
- Truetone Series A-14** 9-tube, 3-band receiver, No. A14-122. 1938. (W. Hnatyszyn, 39 Norfred Dr., Lackawanna 18, N.Y.)
- BC 654-A** transmitter and receiver, Army surplus. (Roger Van Divort, Rte 2, Chatham Hill, Wenatchee, Wash.)
- Zenith Model 68223AM-SW.I**, no other data. (James Cannon, Jr., 1108 S. Benbow, Greensboro, N.C. 27406)
- Delco Model R1116**, 6 tubes, BC and s.w., no other data. (Richard W. Black, Odessa, N.Y.)
- G.E. Model F-86**, no other data. (Russell G. Feran, 3817 Napoleon Ave., New Orleans 25, La.)
- Travler TV Type No. 321-77**, ser. 2587526, (Hans-Dictu Dudcu, 5167 King Edward, Montreal 29, IPQ, Canada)
- RCA Model 96T4**, No. RC399, RCA No. 616J. (John T. Sowers, Rte 5, Lebanon, Pa. 17042)
- Guthman Model U-36** transmitter, no other data. (James DeVan, 214 Pioneer Trail, Marietta, Ga. 30062)
- Crosley Model 21**, 5-tube, 3-band BC and s.w. receiver. (Steve Mann, 1715 Greenfield St., Winston-Salem, N.C.)
- Capehart Model 400-H** complete hi-fi system, about 1940, 3-band tuner, separate bass and treble amplifiers

NOW YOU CAN SECURE A HIGH SALARIED • TOP PRESTIGE CAREER IN ELECTRONICS IN ONLY ONE YEAR!

ELECTRONICS is the fastest growing industry in America today, creating unlimited opportunities for high salaries, with rapid advancement in INDUSTRY AND THE ARMED FORCES for Bailey Trained electronic engineering technicians.

LARGE CORPORATIONS from coast to coast, and BRANCHES OF THE ARMED FORCES send recruiters to visit each graduating class at Bailey Tech, offering unusually high starting salaries.

BAILEY GRADUATES ARE BEING HIRED for such fascinating and interesting work as technical salesmen, research and development of guided missiles, electronic business machines and automatically controlled manufacturing plants, etc., also good RATINGS IN THE ARMED FORCES.

UP TO SEVEN TECHNICIANS are needed for every engineer . . . this, plus superior training is why Bailey Graduates are being paid more to start, and are advancing more rapidly than many men who have spent four years in training.

Resident training is easier and costs less than you may think! We provide housing and part-time jobs while in school, plus free nationwide employment service for graduates. If you want to quickly enter America's fastest growing and most exciting industry, write for free booklet . . . no obligation.

VETERAN APPROVED
BAILEY TECHNICAL SCHOOLS
 1645 S. Grand • St. Louis 4, Mo.



This Minneapolis-Honeywell system controls hundreds of automatic manufacturing operations. Experience on live equipment is emphasized at Bailey and is another reason for the tremendous backlog of high pay positions waiting BAILEY GRADUATES.

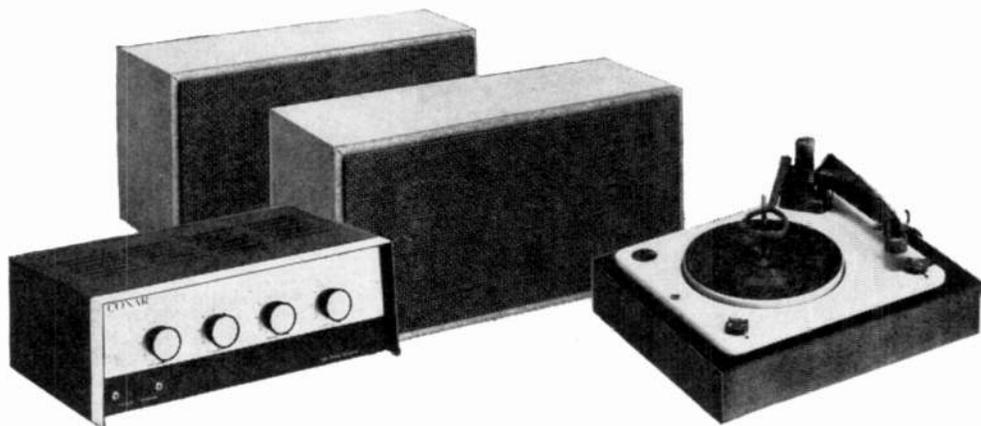
MAIL TODAY

Please mail immediately this free booklet without obligation

Phone _____ Age _____
 Name _____
 Address _____
 City _____ State _____



How do you advertise a product when legitimate claims are unbelievable?



"A really good component stereo system for \$109.00? Preposterous! Ridiculous! Absurd!"

We honestly hesitate to use the same old superlatives. Instead, we offer a dizzyingly daring LISTENER'S GUARANTEE. You prove for yourself—the new CONAR Custom "300" complete stereo system—for only \$109.00—is a real breakthrough into professional quality. You go ahead and *build* the stereo amplifier. If what you hear doesn't astonish and please you, return the whole system within thirty days, *built-up amplifier* and all. We'll *refund every penny!*

But maybe we're not so daring. Just foxy: First, there's your personal assembly handbook—so clear you can make a fascinating "dry run" without touching a part. Then there's the layout of the amplifier—so clean there are no multiple hard-to-get-at connections. If you're all thumbs, your wife can build it in a few hours—more or less. And to be real sneaky, the tricky little job of mounting a stereo cartridge correctly in a tone arm is done before the components reach you. Instant music. You just plug your components into your handsome, just-built amplifier, and you're hooked. (If hard bitten audio men could care less about a \$109.00 complete stereo system *until they heard ours*, what can you do but join the experts? Their comments dazzled and delighted us.)

Here are the components we tease you with: a Custom "300" complete stereo amplifier kit with a beauty of a baked enamel steel case; two completely assembled speaker enclosures 24 x 12 x 10, ready to finish to match your home's decor, ¾" thick acoustic wood, beige

with metallic gold grille cloth; diamond cartridge by Electro Voice; record changer with heavy duty 4-pole constant speed motor complete with oiled walnut base; plus all necessary phono and speaker cables.

The CONAR Custom "300" complete stereo system is for you if you're a beginner in audio kit building with a wife sitting on the budget . . . an audiophile who wants to forget compulsive up-grading and buy records with abandon . . . or just a plain unbeliever who can't pass up a challenge.

Unbeliever, especially, we love you . . . the CONAR Custom "300" complete stereo system—including the amplifier you BUILD—must astonish and please you or every cent back. AN OFFER UNMATCHED BY ANY OTHER KIT MANUFACTURER—could anything be fairer? So why not order today?

CONAR

MA3C

Division of National Radio Institute
3939 Wisconsin Ave., Washington, D. C. 20016

The "LISTENER'S GUARANTEE" is the fairest deal I've ever seen in kit construction. Yes, astonish and please me with the CONAR Custom "300" Stereo System:

- Full payment of \$109.00 enclosed
- I'd like to use your Easy Payment Plan \$10.90 enclosed and I agree to pay \$10.00 a month until full price is paid. (On approved credit)
- I want to know more. Enclosed is \$2.00 for Assembly Manual (\$2.00 credited to my future order)

Name.....

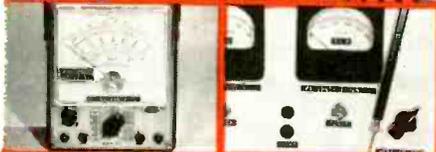
Address.....

City.....Zone.....State.....

(Custom "300" is shipped exp. chgs. coll.)



DYMO Plastic LABELS PERSONALIZE · ORGANIZE · IDENTIFY ELECTRONIC GEAR



DYMO HOME LABELMAKER

995



Self Sticking Colored Labels

Now you can make permanent, professional embossed labels in seconds. Dial letters, numbers, symbols . . . squeeze handle. Letters come out raised white on a colored background . . . ready to apply . . . and they're guaranteed to stick! With Cloth Printer accessory you can mark clothing.

1001 USES EVERYWHERE YOU GO

CAMERAS	LUGGAGE	CLOTHES
SUNGLASSES	TACKLE BOXES	POWER EQUIPMENT
TOOLS	RADIOS	LOCKERS
SPORTS GEAR	STORAGE BINS	BRIEF CASES

At Better Stores EVERYWHERE



IF YOU DON'T SEE IT - ASK FOR IT
For further information on this
and other larger models write—

DYMO INDUSTRIES, INC.
Dept. PE 3, P.O. BOX 1030, BERKELEY 1, CALIF.

Priced the same in Canada

Operation Assist

(Continued from page 22)

and speakers. (Robert D. Greene, 373 Newton St., Waltham, Mass. 02154)

Zenith chassis 6B01, 8S661, ser. A399583, 8-tube BC and s.w. receiver, about 1938. (Don Petty, 24 Berkeley Square, Los Angeles 18, Calif. 90018)

Sparton 4-6. BC and s.w. receiver, about 1938. (Leo A. Smith, 2142 N. 117th, Wauwatosa 13, Wis.)

Hickok VOM, Model 133B, ser. 51458, date unknown. (Carl A. Neste, 208 Tail Trees Dr., Vallejo, Calif. 94590)

RAX-1 4-band Command-type receiver, Navy surplus. (W. L. Cox, 3060 Cudahy St., Huntington Pk., Calif.)

Triplet Model 1632 signal generator, also operating data. (J. M. Knox, Rte. 6, Box 7, Henderson, Texas)

Grunow Model 1291, 12-tube BC and s.w. receiver. (Bradley Weekley, Wilbur, W. Va.)

DeWald Model D-508A BC and s.w. receiver. (Thomas Bertram, 2284 Fairfax St., Denver 7, Colo.)

Minivac 601 general-purpose computer, also other data. (Lance Lieberman, 50 Elm Drive, Roslyn, L.I., N.Y.)

Northern Electric Model 61 6-tube auto radio, ser. 173. (George R. Nunn, Box 357, Carstairs, Alberta, Canada)

Dayrad (Radio Products Co.) Type 320 tube tester, early 1930's. (M. L. Schultz, 30 Harriett Dr., Princeton, N.J.)

Pilot FM receiver, No. 104010, no other data. (Bo Yeargan, 120 Westmore Rd., Rome, Ga.)

Special Data or Parts

Admiral AM/FM tuner, Model 14D 53-2, any data at all; **GE** Model 18060 TV receiver, any data. (Steven McGinty, 2905 Lamona Ave., Fresno 3, Calif.)

Dumont Model 323 dual-trace oscilloscope, service manual. (T. Miller, 2639 W. Augusta Blvd., Chicago 22, Ill.)

Radio City Products Model N.S. 802 tube tester, tube testing charts. (Fred. Russo, 58 E. 32nd St., Brooklyn, 26, N.Y.)

Collaro Model RC-456 record changer, bottom layout showing parts placement. (Ed. Pacek, P.O. Box 142, Crabtree, Pa.)

Hickok Model 550X tube checker; **Ferret** Model 600A signal generator; **Stromberg-Carlson** Model AR-37A amplifier, and Model HFP-1 record player; **Weber** Model BP2719-1 tape recorder, Model BP29-781 tape recorder; **Sonora** Model 402A radio/phonograph combination. Operating manuals for all, and tube chart for tube checker. (Mark Clark, 822 Coolidge Pl., Rockford, Ill.)

Radosonde Model AN/AMT 2B Signal Corps surplus, operating manual and any other data. (B.D. Minielly, 784 Belmont Ave., W., Kitchener, Ontario, Canada)

Kolster BC receiver, ser. 126542, using six '01A tubes, about 1928, any technical data. (K & G Service Co., Box 7, Dexter, Maine)

Silvertone Wirecorder, recording wire. (Larry Thomas, 7259 Parkland, Detroit 39, Mich.)

Hallicrafters Model SX-62 communications receiver, r.f. coils, i.f. transformers, and maintenance manual. (J. Engelen, Nieuwstraat 13, Oranjestad, Aruba, Netherlands Antilles)

R-101A/ARN-6 receiver, surplus, any technical data, WL-468 vacuum tube, ratings and data for 6-meter use. (Clark Miller, Elkhardt High School Amateur Radio Club, Elkhardt, Ind.)

Tape Master Model PT-125 tape recorder, bias oscillator coil, suitable replacement unit, or inductance and Q. (Brother Henry Norman, St. Michael's College, La Salle Hall, Station 1, Santa Fe, N.M.)

Coronado AM/FM 7-tube radio, about 1938-1940, any technical data. (Quintin Davis, Rte. 1, Box 144, Olin, Ia.)

O. R. Co., of Detroit, "Monarch" BC and s.w. radio, 4 tubes, any technical data. (Ray Rayburn, 58-20 Lawrence St., Flushing 55, N.Y.)

Grigsby-Grunow Co., Majestic -7, Model 70, BC and l.w. radio; **RCA Victor** Model R-74, ser. AKL 1315; any technical data. (James Poullot, 1174 Cowesett Rd., Warwick, R.I.)

—50—

Always say you saw it in—POPULAR ELECTRONICS

TOP PERFORMANCE AT ROCK-BOTTOM COST

With money-saving RCA Electronic Instrument Kits

RCA WV-76A (K) HIGH SENSITIVITY AC VTVM KIT

Measures AC Voltages .002-Volt to 500 Volts
Doubles as a Preamplifier

An exceptional two-way kit value! As a high sensitivity AC VTVM the new RCA WV-76A measures AC voltages from 10 mv to 100 v full-scale in nine overlapping ranges; special "low-cap" switch on probe extends upper range limit to 500 v. As a flat-response preamplifier, it provides a 38 db maximum gain on the 10 mv range.

- Flat frequency response ± 1 db from 10 cps to 1.5 Mc with probe on "direct"; and from 10 cps to 500 kc with probe switched to "low-cap"
- High input impedance for accurate measurements in circuits sensitive to loading.
- Easy-to-use, direct-reading decibel scales.
- Pre-assembled shielded probe and cable, all-metal case eliminates strap pickup.
- Large power-supply filter minimizes hum.
- Compact, lightweight, portable.

Kit price: only \$57.95* • Factory-wired and calibrated \$79.95*



**RCA WV-93C (K)
SENIOR VOLTOHMYST® KIT**
Special 0.5-volt EC range for transistor circuits. Measures AC voltages 0.2 to 4200 peak-to-peak—including complex waves— ± 0.1 to 1500 rms; DC voltages 0.01 to 1500. Resistances 0.1 ohm to 1,000 megohms. Pre-assembled, AC/DC-0-MS probe. Big 6 1/2" meter. AC, DC accuracy: $\pm 3\%$ FS.
Kit: \$57.95* • Factory Wire: \$79.50*



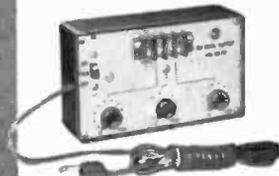
RCA WV-77E (K) VOLTOHMYST® KIT
Separate 1.5-volt rms and 4-volt peak-to-peak scales for accurate low AC measurements. Measures AC and DC voltages to 1500 volts, resistances from 0.2 ohm to 1,000 megohms. Ultra-slim probes, long flexible leads.
Kit: \$29.95* • Factory Wire: \$43.95*



**RCA WV-38A (K)
VOLT-OHM-MILLIAMMETER KIT**
Accurately measures AC and DC volts, ohms, DC current, and decibels. Special 0.25-volt and 10-volt DC ranges. 5 1/4" meter in plastic case—no glass to crack or shatter. Lacks located below switches to keep leads out of the way. Spring clips on handle to hold leads.
Kit: \$29.95* • Factory Wire: \$43.95*



RCA 90-23A (K) PORTABLE SCOPE KIT
First built-in strobing EFW and color TV, facit, hi-tape recorders. Exceptional gain and bandwidth (response to 5.5 Mc) for toughest jobs. Scaled graph screen and internal calibrating voltage source for direct reading of peak-to-peak voltage. Supplied with direct/low-cap shielded cable.
Kit: \$79.95* • Factory Wire: \$129.95*



RCA WC-307B (K) TV BIAS SUPPLY KIT
Three separate DC output voltages each adjustable from 0 to 15 volts provide bias voltages for jigging RF, F and other circuits of color and black-and-white TV receivers. Kit: \$11.95*

See them all at your Authorized RCA Electronic Instrument Distributor

For specifications and technical data on individual kits, write Commercial Engineering, Section K-133-W, RCA Electronic Components and Devices, Harrison, N. J.



RCA WE-93A (K) TRANSISTOR RADIO DYNAMIC DEMONSTRATOR KIT
Working six-transistor radio on color-coded panel board for instructional and demonstrator purposes. Removable components. Includes 30-page RCA transistor manual containing detailed data on 71 semiconductor devices, representative transistor circuits, basic theory. Kit: \$39.95*



RCA WE-95A (S) VOL-OHM-MILLIAMMETER DYNAMIC DEMONSTRATOR KIT
A functional, accurate VOM laid out on panel board for instruction and demonstration. Each basic circuit separately color-coded. Measures AC volts, DC volts, DC current and ohms. One of the most useful test instruments in electronics. Kit: \$37.95*

*User Price (excluding tax)



The Most Trusted Name in Electronic Circuits

NOW! Get All THREE in New Home Study Training!

Train at home for a top paying career in booming Electronics Industry!

PRACTICAL ELECTRONICS

—plus Appliance Repair and Electrical Wiring at **ONE LOW TUITION**



C.L. FOSTER
President

Trained Men Needed Now for:
Color TV Service
Broadcasting
Industrial Electronics
Manufacturing
Guided Missile Systems
Hi-Fi and Sound Installation

New "Instant Kits" Supplied for PRACTICAL TRAINING EXPERIENCE

Mail the coupon below for our new book, "Profits from Electronics"—Free! In words and pictures it tells about your opportunities for security and opportunity in **ELECTRONICS: Radio-TV-HI-FI Service, Color Television, Broadcasting, Communications, Industrial - Military Electronics!** Central's **NEW** home study training in Practical Electronics prepares you for specialization in any branch of Electronics you choose... **AND** includes bonus training in Appliance Servicing and Electrical Wiring that help boost your earnings. Earn while you learn! Graduate training, if desired, in one of America's best equipped resident electronics schools. Advanced home study courses in Communications Electronics, Radio-TV Broadcasting, Nuclear Technology and Industrial Electronics. Mail coupon today. Central Technical Institute, Dept. 010113, 1644 Wyandotte Street, Kansas City 8, Missouri

FREE!

No Obligation—Full Facts and "Profits from Electronics"

MAIL COUPON NOW

Central Technical Institute, Dept. 010113
1644 Wyandotte Street, Kansas City 8, Mo.
Rush FREE "Profits from Electronics" and full facts about Central Technical Training.

Name.....
Address.....
City..... Zone..... State.....



ONLY MERRELL KITS

HAS THESE STEREO RECEIVERS



Now

20 WATT FM STEREO RECEIVER \$69.95

FM MULTIPLEX 20 WATT STEREO RECEIVER, SR 436 — 89.95
AM-FM STEREO 20 WATT RECEIVER, SR 800 — 79.95
AM-FM MULTIPLEX 20 WATT STEREO RECEIVER, SR 836 — 99.95

40 WATT STEREO AMPLIFIER W/PREAMPS \$49.95

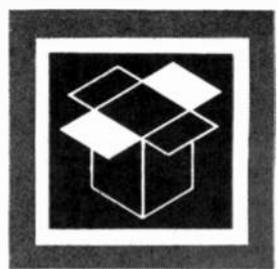


Complete line of Merrell Kits from \$19.95 covers additional Available Wired

FULL 90 DAY WARRANTY ON PARTS

Simple step-by-step instructions large diagrams

Write for Brochure, Name of Nearest Dealer 5% Higher W. of Rockies
MERRELL KITS, 519-p Hendrix St., Brooklyn 7, N. Y.
Canada - Goldstein Agencies, 6511 Lawrence Blvd., Montreal



New Products

AMATEUR COMMUNICATIONS RECEIVER

Lafayette's new HE-80WX receiver boasts 14 tubes, continuous coverage from 550 kc. to 54 mc., a product detector for improved reception of SSB, separate BFO and Q-multiplier circuits, crystal calibrator, and improved noise limiter. The tube line-up in this superheterodyne circuit (with dual conversion on 6 meters) is as follows: four 6AQ8's, three 6BA6's, two 6BE6's, one 6BL8, one 6AL5, one 6AQ5, one 6CA4, and one OA2 voltage regulator. The receiver,



which measures 17" x 10" x 7 1/2", includes a built-in S-meter. Price, \$149.50. (Lafayette Radio Electronics Corp., 111 Jericho Turnpike, Syosset, L.I., N.Y.)

ALTERNATOR NOISE SUPPRESSION KIT

A special conversion kit for suppressing interference is now available for use with 40-, 60-, and 100-ampere Leece-Neville alternator systems. The kit, designed to aid users of mobile two-way radios, consists of a filter choke and four capacitors which are installed on existing regulators in 6- or 12-volt alternator systems. Simplified instructions are included, and the job can be done by the car owner. (Leece-Neville Co., 1374 E. 51st St., Cleveland 3, Ohio)

TRANSISTOR IGNITION SYSTEM

Available in both negative and positive ground systems for either 6- or 12-volt operation, the new Sorensen "Transignition" system is designed for high reliability. All

Always say you saw it in—POPULAR ELECTRONICS



Why We Make the Model 211 Available Now

Although there are many stereo test records on the market today, most critical checks on existing test records have to be made with expensive test equipment.

Realizing this, HiFi/STEREO REVIEW decided to produce a record that allows you to check your stereo rig, accurately and completely, just by listening! A record that would be precise enough for technicians to use in the laboratory—and versatile enough for you to use in your home.

The result: the HiFi/STEREO REVIEW Model 211 Stereo Test Record!

Stereo Checks That Can Be Made With the Model 211

- ✓ Frequency response — a direct check of eighteen sections of the frequency spectrum, from 20 to 20,000 cps.
- ✓ Pickup tracking — the most sensitive tests ever available to the amateur for checking cartridge, stylus, and tone arm.
- ✓ Hum and rumble — foolproof tests that help you evaluate the actual audible levels of rumble and hum in your system.
- ✓ Flutter—a test to check whether your turntable's flutter is low, moderate, or high.
- ✓ Channel balance — two white-noise signals that allow you to match your system's stereo channels for level and tonal characteristics.
- ✓ Separation—an ingenious means of checking the stereo separation at seven different parts of the musical spectrum—from mid-bass to high treble.

ALSO: ✓ Stereo Spread
Speaker Phasing
Channel Identification

PLUS SUPER FIDELITY MUSIC!

The non-test side of this record consists of music recorded directly on the master disc, without going through the usual tape process. It's a superb demonstration of flawless recording technique. A demonstration that will amaze and entertain you and your friends.

NOW...GET THE FINEST STEREO TEST RECORD

ever produced
for just...\$4.98

Featuring Tests Never Before Available To The Hobbyist

UNIQUE FEATURES OF HiFi/STEREO REVIEW'S MODEL 211 STEREO TEST RECORD

- Warble tones to minimize the distorting effects of room acoustics when making frequency-response checks.
- White-noise signals to allow the stereo channels to be matched in level and in tonal characteristics.
- Four specially designed tests to check distortion in stereo cartridges.
- Open-air recording of moving snare drums to minimize reverberation when checking stereo spread.

All Tests Can Be Made By Ear

HiFi/STEREO REVIEW's Model 211 Stereo Test Record will give you immediate answers to all of the questions you have about your stereo system. It's the most complete test record of its kind—contains the widest range of check-points ever included on one test disc! And you need no expensive test equipment. All checks can be made by ear!

Note to professionals: The Model 211 can be used as a highly efficient design and measurement tool. Recorded levels, frequencies, etc. have been controlled to very close tolerances — affording accurate numerical evaluation when used with test instruments.

DON'T MISS OUT—SUPPLY LIMITED

The Model 211 Stereo Test Record is a disc that has set the new standard for stereo test recording. Due to the overwhelming demand for this record, only a limited number are still available thru this magazine. They will be sold by POPULAR ELECTRONICS on a first come, first serve basis. At the low price of \$4.98, this is a value you won't want to miss. Make sure you fill in and mail the coupon together with your check (\$4.98 per record) today.

FILL IN AND MAIL TODAY!

Stereo Test Record
 Popular Electronics—Dept. SD
 One Park Ave., New York 16, N.Y.

Please send me _____ test records at \$4.98 each. My check (or money order) for \$ _____ is enclosed. I understand that you will pay the postage and that each record is fully guaranteed. (Orders from outside the U.S.A. add 50c to partially defray postage and handling costs.)

Name _____
 (Please Print)

Address _____

City _____ Zone _____ State _____

SORRY—No charges or C.O.D. orders! PE 113

Mosley

EL TORO



A REVOLUTIONARY CONCEPT IN AMATEUR ANTENNAS!

3 MODELS - NEW LOW PRICE!

El Toro is available in three models. TW-3X, TW-3X Jr. and NS-3 at prices you can afford. Model TW-3X is just \$19.95. Models TW-3X Jr. and NS-3 are only \$14.95.

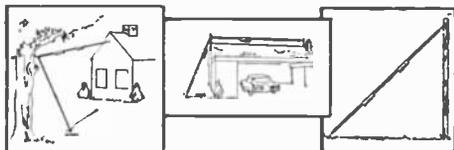
3 BAND OPERATION!

Models TW-3X and TW-3X Jr. operate on 20, 40 and 75/80 meters. Model NS-3 (novice special) operates on 15, 40 and 80 meters. All antennas are pretuned, in kit form, and have excellent broad band characteristics.

2 POWER RATINGS!

Model TW-3X has a rating of 1000 watts input to the final amplifier on AM, 2000 watts P.E.P. on CW or SSB. Models TW-3X Jr. and NS-3 are rated to 300 watts AM and 1000 watts input to the final amplifier on CW or SSB.

INSTALLATION WILL MEET YOUR REQUIREMENTS!



Mosley El Toro antennas are trap type grounded quarter wavelength antennas that, when properly installed, will equal or surpass the performance of any good vertical, depending on the type of mounting. These remarkable antennas can be mounted in varied positions to fit most any location. Mounted at ground level, no radials are needed if a good ground is provided. The maximum length of El Toro is 58 ft. and is fed with 52 ohm coax. El Toro is easily adjusted to resonate at any portion of the rated bands.

WRITE FOR FORM ET-1



Electronics Inc.

4610 North Lindbergh Blvd. • Bridgeton, Missouri, 63044

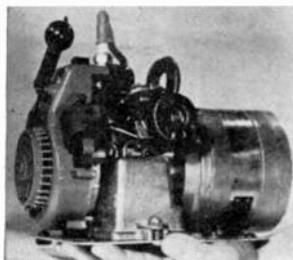
New Products

(Continued from page 26)

components are shock-mounted and sealed against moisture. The circuit uses one transistor and a Mallory coil, with ballast resistor mounted on it to simplify installation. (Sorensen Industrial Electronic Co., Highway #10, Dover, N. J.)

MINIATURE ENGINE-DRIVEN GENERATOR

This hand-size gasoline engine generator weighs just 12 pounds and is capable of operating a two-way radio, lights, a TV

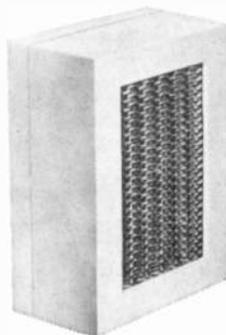


set, electric drill, or any other appliance drawing up to 300 watts. Produced by the Tiger Mfg. Co., and called the "Tiny Tiger," the unit is powered by an aluminum two-

cycle $\frac{3}{4}$ H.P. engine that burns outboard motor fuel. The generator is a permanent magnet type, and is integrated with the engine. Ideal for outings or emergencies, the engine generator delivers both 115 volts a.c. and 12 volts d.c., and can be used to charge 6- and 12-volt storage batteries as well as as for powering 112-volt a.c. equipment. Price, \$99.50 including shipping cost. (Tiger Mfg. Co., 2312 W. Pacific Coast Hwy., Long Beach, Calif.)

WIRELESS MONITOR

Effective as an electronic "baby sitter," transmitting sounds made in the nursery or play area to a radio in another room, the $3\frac{1}{2}$ " x 5" transistorized "METRO-MIKE" is also intended for use as a calling or intercom system in office buildings and as a "night watchman" in factories. Voices and sounds can be picked up on conventional home or auto radios from a distance of 300 feet. The METRO-MIKE plugs into any wall outlet.



Price, \$39.95. (Metropolis Industries, Inc., Shaker Building, Cleveland 22, Ohio) -30-

Always say you saw it in—POPULAR ELECTRONICS

“One of the most sensitive FM tuners on the market.”

—POPULAR ELECTRONICS

“We found that with only about three inches of wire connected to the antenna terminals we could get every one of the important stations in the New York area.”

—AUDIO

“In addition to fine electrical performance, it has the smooth flywheel tuning and general ‘feel’ of factory-wired Fisher tuners.”

—ELECTRONICS WORLD



And you can build it yourself for \$169.50*—with the Fisher KM-60 StrataKit!

The StrataKit method of kit construction is a unique Fisher development. Assembly takes place by simple, error-proof stages (Strata). Each stage corresponds to a *separate* fold-out page in the instruction manual. Each stage is built from a *separate* transparent packet of parts (StrataPack). Major components are *pre-mounted* on the extra-heavy-gauge steel chassis. Wires are *pre-cut* for every stage—all work can be checked stage-by-stage, page-by-page.

Front-end and Multiplex stages come fully assembled and pre-aligned. The other stages are also aligned and require only a ‘touch-up’ adjustment by means of the tuner’s laboratory-type d’Arsonval signal-strength meter.

The ultra-sophisticated wide-band Fisher circuitry of the KM-60 puts it in a spectacular class by itself. Its IHF Standard sensitivity of 1.8 microvolts makes it the world’s most sensitive FM tuner kit. Capture ratio is 2.5 db; signal-to-noise ratio 70 db. Enough said.

Another outstanding feature of the Multiplex sec-

tion is the exclusive STEREO BEAM,** the Fisher invention that shows if an FM station is broadcasting in stereo.

The Fisher KM-60 StrataKit is very close to the finest FM Stereo Multiplex tuner that money can buy and by far the finest that you can build.

FREE! \$1.00 VALUE! Write for The Kit Builder’s Manual, a new, illustrated guide to high fidelity kit construction.

Fisher Radio Corporation
21-52 44th Drive
Long Island City 1, N. Y.

Please send me without charge The Kit Builder’s Manual, complete with detailed specifications on all Fisher StrataKits.

Name _____
Address _____
City _____ Zone _____ State _____

**The
Kit Builder’s
Manual**

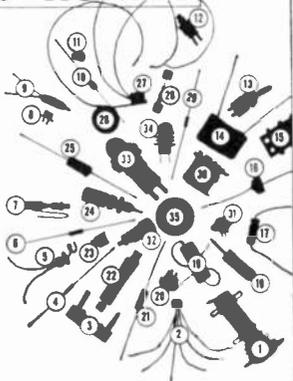
10113

The Fisher

*FACTORY-WIRED (KM-61), \$219.50. WALNUT OR HAWGANY CABINET, \$24.95. METAL CABINET, \$15.95. PR CES SLIGHTLY HIGHER IN THE PRR WEST. EXPORTS: FISHER RADIO INTERNATIONAL, INC., LONG ISLAND CITY 8, N. Y. CANADA: TRITEK ASSOCIATES, LTD., WILLOWDALE, ONT., **PAT. PENDING

COVER CONTEST WINNERS

POPULAR ELECTRONICS



YOUR fine response to our impromptu parts identification contest presented in the September issue swamped our editorial staff and resulted in a good deal of midnight-oil burning. Nonetheless, here are the five eagle-eyed winners, who may well take pride in having come out on top of so many hundreds of contestants. The first four names are listed in the order in which they were received, and each has all answers functionally correct. The fifth winner was judged most accurate among several who came to grief on a single item. Our tired-but-game editorial staff offers hearty congratulations to the winners, who will receive a free one-year subscription. Warm thanks and consolation go to all other entrants.

J. Collier, 4535 Orin Ave., La Crescenta, Calif.
P. Roberts, 1205 N. Santa Fe #47, Vista, Calif.
S. Levine, 216-69 68th Ave., Bayside, N.Y.
R. Carlson, 78 Lenox St., Rochester, N.Y.
R. Culter, 1317 Horseshoe Curve, Lake Oswego, Ore.

1. Turret tube socket. 2. Transistor transformer. 3. Resistor/fuse. 4. Resistor, ¼-watt carbon. 5. Silicon controlled rectifier. 6. Resistor, ½-watt carbon. 7. Piston trimmer capacitor. 8. Transistor socket. 9. Neon lamp. 10. Resistor, ¼-watt carbon. 11. Miniature incandescent pilot lamp. 12. Push-button switch. 13. Toggle switch. 14. Ceramic capacitor. 15. Barrier terminal strip. 16. Silicon rectifier. 17. Electrolytic capacitor. 18. Miniature phone plug. 19. Tubular paper capacitor. 20. Nuvistor socket. 21. Resistor, 1-watt carbon. 22. HV silicon rectifier. 23. Transistor socket. 24. Binding post. 25. Resistor, 2-watt carbon. 26. Potentiometer, Bourns Knobpot. 27. Potentiometer, Bourns Trimpot. 28. Fuse, Slo-blow. 29. Semiconductor diode, glass-cased. 30. Relay. 31. Transistor socket. 32. Banana jack. 33. Indicator lamp assembly. 34. Indicator lamp assembly. 35. Readout display tube, numerical.

NEW

TWO-WAY RADIO

from **PEARCE-SIMPSON**
the *ESCORT*



The "Escort" represents the last word in Citizens Band performance... a combination of all the features you have asked for!... "Big talk-power" Built-in dependability and the best sound in the industry!

also See the exciting new Companion II now at your dealer



- NEW "ESCORT" FEATURES:**
- Illuminated slide rule dial tuning with "S" meter.
 - 8 fixed channels, tunable to 23 with external crystal socket.
 - Positive spot and tuning switch.
 - Transistorized power supply.
 - All aluminum, non-corrosive cabinet and chassis.

Pearce-Simpson, Inc. DEPT. PE-11
2295 N.W. 14th St. • Miami, Florida

Please send me details on
 New ESCORT COMPANION II

Name.....

Address.....

City.....State.....



PEARCE-SIMPSON, INC.
MIAMI, FLORIDA

now MARK creates 46* out of 23 CB channels!

FIRST SPLIT-CHANNEL

TRUE SINGLE SIDEBAND



CB TRANSCEIVER
*with *Selectable
Upper and
Lower Sideband*

(*Patent Applied For)

**MARK
Model
SSB-27**

NEW MARK Sidewinder

First realistic answer to the crowded citizens band!
Opens new channels of communication within the band!

MARK TRUE SINGLE SIDEBAND

Splits the channels. Doubles the effective number of channels available from the present 23 to upper and lower single sideband 46. It's like adding another citizens band!

MORE THAN JUST MORE CHANNELS

With Mark *True Single Sideband*, there is *NO* carrier to waste power or cause interference—and *NO duplicated sideband*. Provides 100% talk power. Concentrates all legal power in only *ONE* sideband, with *selectable use of the upper or lower.

Eliminates the whistles and heterodynes normally encountered in AM. Eliminates adjacent channel interference. Permits simultaneous communications by 2 systems (one on upper and one on lower sideband) on the same channel without mutual interference. Extremely simple to tune.

MORE GAIN—GREATER RANGE

The Mark Sidewinder offers approximately 10 times gain in system effectiveness—greatly improves signal-to-noise ratio—substantially increases the range and coverage—allows you to "get thru" under conditions where A.M. fails.

Available Through Local Distributors

(Also See the MARK Antenna Line)

MORE OUTSTANDING FEATURES

CRYSTAL OVEN (a Mark exclusive) maintains constant crystal temperature for absolute stability.

CRYSTAL LATTICE FILTER provides single sideband selectivity and maximum signal-to-noise ratio for greater sensitivity.

PRECISION CRYSTALS specially manufactured with 0.0015% accuracy.

VOICE LOCK, SQUELCH CIRCUIT and many other desired features.

NEW MARK SIDEWINDER TRANSCEIVER for Mobile and Base Station Use

Immediately makes available up to 10 of the 46 channels (5 on upper and 5 on lower sideband). Supplied with one crystal for operation on upper and lower sideband of one channel. Other channel crystals available. Available for either 12 VDC or 117 VAC operation.

Model SSB-27 Sidewinder for 12 VDC. CB Net,
\$299.50

Model PS-1 AC Power Supply is available for use of Model SSB-27 on 117 VAC.

Accessory Mounting Bracket is available for easy installation in any car.

MARK PRODUCTS Division of Dynascan Corp.
1805 W. Belle Plaine, Chicago, Ill. 60613

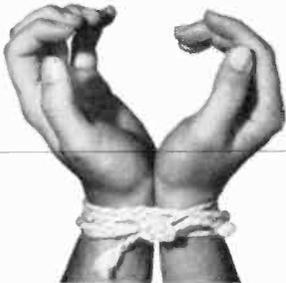
- Send new Sidewinder Bulletin SSB-27
- Send new Antenna Catalog HW-21

Name _____

Address _____

City _____ Zone _____ State _____

FREE
your hands



for Important Jobs



with New SONY
Citizens Band Transceiver

With the unique SONY CB-106 transceiver, your hands are always free for the important jobs. You have no awkward set to hold, to get in your way, since the CB-106 includes a transceiver chassis and separate foam cushioned headset with adjustable microphone. Your hands are always free, since you operate the set with a fingertip cable release. The chassis is out of the way, too, suspended in a shoulder case and belted around the waist. With 10 transistors for extreme reliability, the system includes chassis, headset-microphone, cable release, shoulder case, belt, batteries. \$199.95 per pair.



SONY[®]
RESEARCH MAKES THE DIFFERENCE

SONY CORPORATION OF AMERICA
580 Fifth Avenue, New York 36, N.Y.



POP'tronics Bookshelf

**ESSENTIALS OF VECTOR AND
PHASE ANALYSIS**

by Alan Andrews

At last somebody has gone and done it. In this slim volume by Alan Andrews you'll find the answers to some of those questions concerning a.c. circuits that have been bothering you—questions relating to the effects of inductance, capacitance, resistance, and combinations of these elements. The unique feature of this book is that it is written so that, with application, the average high school graduate can understand it. Although lack of space obviously makes a detailed presentation of all points impossible, the text is clear, concise, and authoritative. Practice problems are included.

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



ELECTRONIC CIRCUITS HANDBOOK

by Tam Kneitel

Compilations of selected circuits are becoming increasingly popular. There are books of transistor circuits, ham transmitter circuits, electronic game circuits, and many others. This book, with its 150 circuits, *should* have out-classed them all in reader interest. Unfortunately, since *Electronic Circuits Handbook* lacks an index and is organized in a disjointed fashion, it is almost impossible to find exactly what you're looking for. This may be just as well since the book is replete with misspellings, typographical errors, and other mistakes. For example, schematic 8-13 seems to be missing altogether and in its place is schematic 8-23. As another example, drawing 4-3 does not contain the designer's well-advertised corrections in resistance values (see 1963 *Electronic Exper-*
(Continued on page 38)

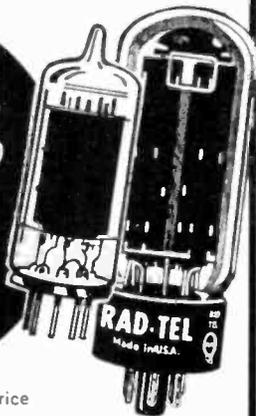
RAD-TEL'S

QUALITY

BRAND NEW TUBE SALE!

AT LOW, LOW PRICES--COMPARE

UP TO
SAVE 75% OFF*



*Manufacturers Suggested List Price

ONE YEAR GUARANTEE

RAD-TEL WILL REPLACE ANY TUBE THAT DOES NOT GIVE EFFICIENT PERFORMANCE FOR 1 YEAR FROM DATE OF PURCHASE.

ONE DAY SERVICE

OVER 500 TYPES IN STOCK

ORDER TYPES NOT LISTED

FREE! Send For New Tube & Parts Catalog
Send For Trouble Shooting Guide



TUBE SUBSTITUTION BOOK

1.25
No. 193

- Over 11,000 direct tube substitutes
- Only all-inclusive directory of electron tube equivalents:
 - For USA electron tubes
 - Substitutes for foreign tubes
 - Picture tubes, newer models
 - Picture tubes, older models
 - transistor replacements
 - Army-Navy, V.T. substitutes



CHEATER CORD

6 ft., No. 154 **29¢ ea.** Lots of 3—25¢ ea.

Easy to work on set while panel is off.



RAD-TEL TUBE CO.

TV, RADIO AND HI-FI

DEPT. P-E 55 CHAMBERS STREET, NEWARK, NEW JERSEY 07105

TERMS: 25% deposit must accompany all orders, balance C.O.D. Orders under \$5: add \$1 handling charge plus postage. Orders over \$5: plus postage. Approx. 8 tubes per 1 lb. Subject to prior sale. No C.O.D.'s outside continental U.S.A.

EACH TUBE ATTRACTIVELY BOXED & BRANDED RAD-TEL

Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
—	024	.79	—	6AU8	.87	—	6K6	.63	—	12CU5	.58
—	1AX2	.62	—	6AV6	.41	—	6S4	.52	—	12CU6	1.06
—	1B3	.79	—	6AW8	.90	—	6SA7GT	.99	—	12CX6	.54
—	1DN5	.55	—	6AX4	.66	—	65H7	1.02	—	12D4	.69
—	1G3	.79	—	6AX5	.74	—	65J7	.88	—	12DE8	.83
—	1K3	.79	—	6BA6	.50	—	65K7GT	.95	—	12DL8	.88
—	1R5	.77	—	6BC5	.61	—	65L7GT	.84	—	12DQ6	1.04
—	1S5	.75	—	6BC8	1.04	—	65N7	.65	—	12D57	.84
—	1T4	.72	—	6BF5	.90	—	65Q7GT	.94	—	12DT5	.76
—	1U5	.65	—	6BF6	.44	—	6T4	.99	—	12DT7	.79
—	1X2B	.82	—	6BG6	1.70	—	6U8	.83	—	12DT9	.78
—	2AF4	.96	—	6BH8	.98	—	6V6GT	.54	—	12DW8	.89
—	3AL5	.46	—	6BJ6	.65	—	6W4	.61	—	12DZ6	.62
—	3AU6	.54	—	6BJ7	.79	—	6W6	.71	—	12EG6	.62
—	3AV6	.42	—	6BK7	.85	—	6X4	.41	—	12EK6	.62
—	3BC5	.63	—	6BL7	1.09	—	6X8	.80	—	12EL6	.50
—	3BN6	.75	—	6BN6	.74	—	7A8	.68	—	12EZ6	.57
—	3BU8	.78	—	6BQ6	1.12	—	7AU7	.65	—	12F8	.66
—	3BY6	.58	—	6BQ7	1.00	—	7EY6	.75	—	12FA6	.79

—	3BZ6	.56	—	6BU8	.70	—	7Y4	.69	—	12FM6	.50
—	3CB6	.56	—	6BX7	1.11	—	8AU8	.90	—	12FR8	.97
—	3C56	.58	—	6BZ6	.55	—	8AW8	.93	—	12FX8	.90
—	3DG4	.85	—	6BZ7	1.03	—	8BQ5	.60	—	12GC6	1.06
—	3DK6	.60	—	6C4	.45	—	8CG7	.63	—	12J8	.84
—	3DT6	.54	—	6CB6	.55	—	8CM7	.70	—	12K5	.75
—	3GK5	.99	—	6CD6	1.51	—	8CN7	.97	—	12L6	.73
—	3Q4	.63	—	6CG7	.61	—	8CS7	.74	—	12SF7	.69
—	3S4	.75	—	6CG8	.80	—	8EB8	.94	—	12SK7GT	.95
—	3V4	.63	—	6CL8	.79	—	8FQ7	.56	—	12SL7	.80
—	4BQ7	1.01	—	6CM7	.69	—	9CL8	.79	—	12SN7	.67
—	4C56	.61	—	6CN7	.70	—	11CY7	.75	—	12SQ7GT	.91
—	4DT6	.55	—	6CQ8	.92	—	12A4	.60	—	12U7	.62
—	4GM6	.60	—	6CR6	.60	—	12AB5	.60	—	12V6	.63
—	5AM8	.79	—	6CS6	.57	—	12AC6	.55	—	12W6	.71
—	5AN8	.90	—	6CS7	.69	—	12AD6	.57	—	12X4	.47

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

—	5AQ5	.54	—	6CU5	.58	—	12AE6	.50	—	17AX4	.67
—	5AT8	.83	—	6CU6	1.08	—	12AE7	.94	—	17DQ6	1.06
—	5BK7	.86	—	6CY5	.70	—	12AF3	.73	—	18FW6	.49
—	5BQ7	1.01	—	6CY7	.71	—	12AF6	.67	—	18FX6	.53
—	5BR8	.83	—	6DA4	.68	—	12AJ6	.62	—	18FY6	.50
—	5CG8	.81	—	6DE6	.61	—	12AL5	.47	—	19AU4	.87
—	5CL8	.76	—	6DG6	.62	—	12AL8	.95	—	19BG6	1.39
—	5CQ8	.84	—	6DJ8	1.21	—	12AQ5	.60	—	19EA8	.79
—	5EA8	.80	—	6DK6	.59	—	12AT6	.50	—	19T8	.85
—	5EU8	.80	—	6DN6	1.55	—	12AT7	.76	—	21EX6	1.49
—	5J6	.72	—	6DQ6	1.10	—	12AU6	.51	—	25AX4	.70
—	5T8	.86	—	6DT5	.81	—	12AU7	.61	—	25C5	.53
—	5U4	.60	—	6DT6	.53	—	12AV6	.41	—	25CA5	.59
—	5U8	.84	—	6DT8	.84	—	12AV7	.82	—	25CD6	1.52
—	5V6	.56	—	6EAB	.79	—	12AX4	.67	—	25CU6	1.11
—	5X8	.82	—	6EB5	.73	—	12AX7	.63	—	25DN6	1.42

Fast, Dependable service — Selling direct by mail for over 16 years —

RAD-TEL Tube Co.

DEPT. P-E

55 Chambers Street

Newark, New Jersey 07105

ENCLOSED IS \$ _____

Please rush order.

SEND: _____ TUBE SUBSTITUTION BOOK, No. 193 @ 1.25 EACH

_____ Cheater Cord 29¢ ea. Lots of 3—25¢ ea. #154

Orders Under \$5.00—Add \$1.00 handling charge—plus postage.

FREE!

Send FREE Tube and Parts Catalog

Send FREE Trouble Shooting Guide

NAME _____

ADDRESS _____

CITY _____

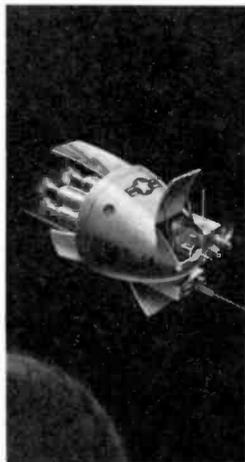
ZONE _____

STATE _____

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 and 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 DUAL SPEAKER, standard

broadcast-short wave receiver (dual speakers for better sound distribution), 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 next page.) You also receive a PROFESSIONAL MULTITESTER to use during training and on the job.

READ THESE TYPICAL "SUCCESS REPORTS" FROM N.T.S. STUDENTS AND GRADUATES:

"Your home study course in Electronics has been very beneficial to me... I earn top wages as Electronic Installer at Douglas Aircraft... my success is due to National Technical Schools' excellent training..." Arnold Jones, Los Angeles, Calif.

"... My employers are expanding and plan to open a new department within the next 2 years... they have urged me to complete your course as soon as possible... my supervisor says that your course is by far the finest one he has seen..." E. P. Gardner, No. Battleford, Canada

"... I am now in charge of Instrumentation, a new field for my company... my training has paid off better than I had hoped for..."

W. F. Fitzpatrick, Waco, Texas

START NOW. A wide, new world of opportunity awaits the man trained in Electronics by National Technical Schools—a recognized leader in technical training for 58 years. See next page.

ACCREDITED MEMBER—NATIONAL HOME STUDY COUNCIL

N.T.S. GIVES YOU EXTRA BENEFITS — IN TRAINING, ON THE JOB, IN DAILY LIFE

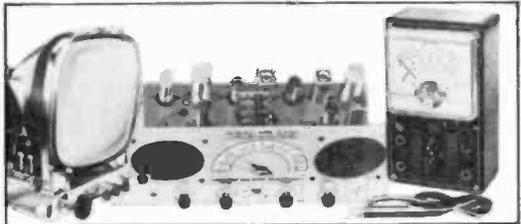
1 TRAINING BENEFITS

The N.T.S. Master Course embraces ALL PHASES of Electronics—Industrial, TV-Radio Communications, Servicing. You become that indispensable man—the all around technician.

ONE MASTER COURSE COVERS THE FIELD. ONE LOW TUITION INCLUDES EVERYTHING—lessons, manuals, counselling, all equipment. (We do not divide the field into separate courses with separate tuitions.)

YOU GET 19 KITS OF LATEST, PROFESSIONAL EQUIPMENT; including a professional, factory-made, precision Multitester and a new, wide-screen TV picture tube. All yours to keep.

VITAL ASSET: N.T.S. HOME TRAINING IS BASED ON METHODS USED IN SHOPS AND CLASSROOMS OF THE N.T.S. RESIDENT SCHOOL AT LOS ANGELES. No other method of teaching has proved so successful for home study.



The newest, professional equipment—19 kits in all. Yours to keep.

2 ON-THE-JOB BENEFITS

ALL-PHASE training puts you in an enviable position. You can pick and choose your career. Specialize or go into business for yourself. Your services will always be in demand wherever you go—and you can go anywhere. Electronics is a vital part of almost every business today.

Earn while you learn. Many students start earning extra money within a few weeks and help pay for their tuition. You can, too.

3 LIFETIME BENEFITS

Your success is ours. N.T.S. Graduate Advisory Service stands ready to help in solving technical problems of your job, in securing an FCC License, in establishing your own business, in countless other ways. No charge for this lifetime service.

Detach, fill in, and mail the postage-paid card today. A complete, fully-illustrated "Opportunity" Book and Actual Lesson will be mailed to you. Go over them carefully. We believe you will make the right decision . . . that ONE Master Course at ONE low tuition is the best way to become the "Man in Demand" in Electronics, Television, and Radio.

NATIONAL TECHNICAL SCHOOLS

WORLD-WIDE TRAINING SINCE 1905

National Technical Schools, Dept. R2G-113
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.



N.T.S. Home Training is Shop-Tested in the N.T.S. Resident School at Los Angeles.



Accredited
Member
N.H.S.C.

MAIL REPLY CARD
OR COUPON FOR
FREE BOOK AND
ACTUAL LESSON



YOU ENROLL BY MAIL—AND SAVE MONEY.
Lower costs for us means lower tuition for you.

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.

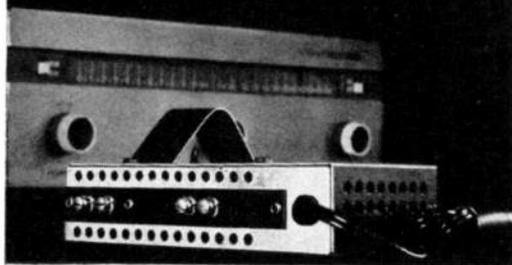
NATIONAL TECHNICAL SCHOOLS

WORLD-WIDE TRAINING SINCE 1905

4000 So. Figueroa St., Los Angeles 37, Calif.



**You'd expect an FM booster
designed by Blonder-Tongue
to be something special...**



this one is

The Blonder-Tongue FMB STEREOBOOSTER is special because it increases signal strength 8 times (18 db gain), while keeping noise down to the bare minimum (noise figure 3.8 db) . . . because it eliminates distortion caused by phase and amplitude variation and by impedance mismatch (low VSWR) . . . because it doesn't overload when there are strong local stations present . . . and because it does all these things steadily and reliably. But since Blonder-Tongue is the company with the most experience in TV and FM signal amplification, how could you expect any less? A must for multiplex stereo, and for mono in weak signal areas . . . installed quickly & easily anywhere indoors. Improves reception with an FM antenna, your TV antenna, or a home-made twinlead dipole. List **\$21**

engineered and manufactured by

BLONDER-TONGUE

9 Alling St., Newark, 2 N. J.

CANADIAN DIVISION: BENCO TELEVISION ASSOC., LTD., TORONTO, ONT.

Bookshelf

(Continued from page 32)

imeter's Handbook). There are numerous other errors that detract from what could have been a handy item on every workbench.

Published by Cowan Publishing Corp., 300 West 43 St., New York 36, N.Y. 128 pages. Soft cover. \$3.00.



MICROELECTRONICS: THEORY, DESIGN AND FABRICATION

Edited by Edward Keonjian

Microelectronics, for the purpose of this book, refers to the art of fabricating electronic circuits from extremely small parts. Although it is intended principally for engineers and scientists, anyone with a more than casual interest in electronics will find in it a wealth of fascinating material. "Microelectronics" is, in several ways, a pioneering effort—a book that brings together diverse approaches to miniaturization. The oldest approach, that of using discrete (separate) component parts is considered first. The following chapters deal with thin film circuits (circuits in which the "components" are deposited in films a few microns thick), and with semiconductor integrated circuits in which a number of electrical elements are inseparably associated on or within a semiconductor. A final chapter gives the reader a glimpse of the future—a future in which a single device, perhaps a precisely tailored crystalline structure of some sort, will perform a complex function.

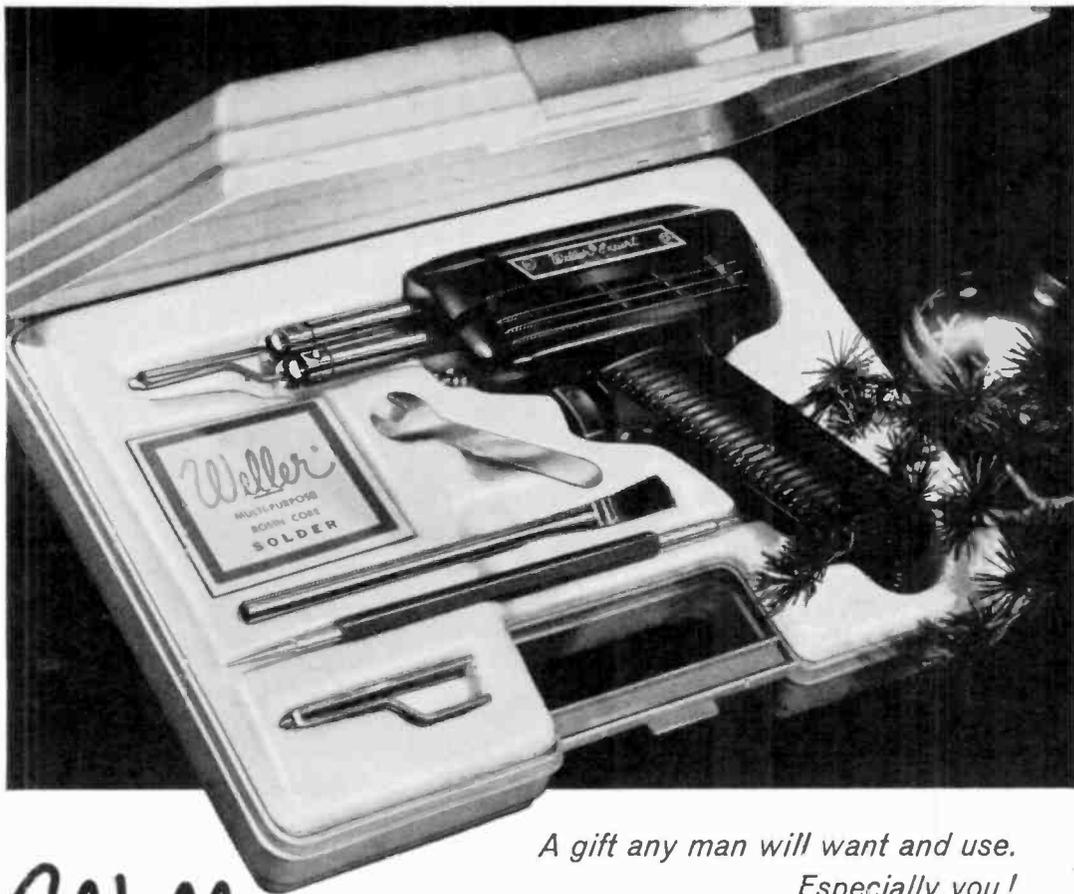
Published by McGraw-Hill Book Company, Inc., 330 W. 42 St., New York 36, N.Y. 375 pages; index. Hard cover. \$12.50.

Free Literature

An indispensable item on anyone's electronics workbench, Allied Radio's new 444-page, 1964 catalog features hi-fi, CB, ham, p.a., and test equipment in addition to components and over 100 do-it-yourself Knight-Kits. All major manufacturers are represented in the 1964 catalog, No. 230, which marks Allied's 43rd year. For your copy, write to Allied Radio Corp., 100 N. Western Ave., Chicago, Ill., 60680. . . . The physical and electrical characteristics of Sonotone's line of rechargeable nickel-cadmium batteries are described in a reprint of an article entitled "Cordless Battery Power." It's available from Sonotone Corp., Elmsford, N.Y.

~~30~~

Always say you saw it in—POPULAR ELECTRONICS



*A gift any man will want and use.
Especially you!*

Weller® Dual Heat Soldering Gun Kit

Everything that's needed for quick, easy soldering and scores of household repairs. Features the same Weller "Expert" Dual Heat Gun that's used by professional servicemen and homecrafters the world over. Pull the trigger—tip heats instantly and spotlight illuminates work. Two trigger positions give a choice of two soldering temperatures. You can switch instantly to high 140-watt or low

100-watt heat to suit the job. By using high heat only when necessary you prolong tip life. Tip is made of copper for superior heat transfer and premium plated for rigidity and long life. Included: 3 soldering tips, tip-changing wrench, flux brush, soldering aid, solder. And everything is in a colorful, break-proof plastic carrying case. Model 8200PK. **\$895** list
Weller Electric Corp., Easton, Pa.

For hi-fi kit building

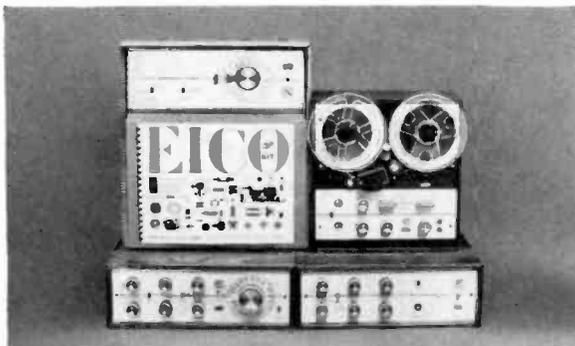
For electrical repairs

For mending metal

For many other jobs



Star Performers (in three great Eico lines)



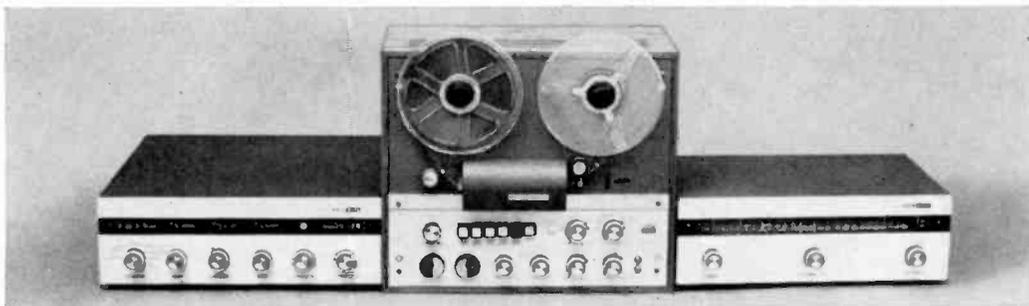
the brilliant new Classic Series

2536 FM MX STEREO RECEIVER On a single chassis: Sensitive, stable FM stereo tuner provides full stereo separation even on weak, fringe area signals. Distortion-free 36-watt stereo amplifier with remarkable overload and transient characteristics plus complete control facilities. Tuner: IHF usable sensitivity $3 \mu\text{V}$ (30 db quieting). Amplifier: frequency response ± 1 db, 15 cps to 40 kc. Kit \$154.95; wired \$209.95. (incl. FET)

2200 FM STEREO TUNER 2536 tuner section k. \$92.50; w. \$119.95 (incl. FET)

2036 36-WATT* STEREO AMPLIFIER—Same as amplifier section of 2536 plus speaker system switch, headphone jack. Kit \$79.95. Wired \$109.95.

2400 STEREO/MONO 4-TRACK TAPE RECORDER — 3-motors, electro-dynamic braking, record and playback equalization at $7\frac{1}{2}$ & $3\frac{3}{4}$ ips. Mixing mic and line level controls. Eye-tube recording level indicators. No pressure pads and precision tape guidance. Includes walnut base. Semi-kit (transport assembled and tested) \$199.95; wired \$269.95.



the widely acclaimed ST Series

ST-70 80-WATT* STEREO AMPLIFIER Accommodates all program sources. Separate pairs of inputs for turntable and record changer, tuner/auxiliary, preamplified tape and tape head with correct equalization for fast and slow tape speeds. Direct center channel speaker output. Response: $\pm \frac{1}{2}$ db, 10 cps to 50 kc. Kit \$99.95; wired \$149.95.

ST-97 FM MX STEREO TUNER 4 IF stages plus stable, sensitive front end. Filterless zero-phase shift stereo detector (Pat. pend.). Sensitivity: $3 \mu\text{V}$ (30 db quieting). Kit \$99.95; wired \$149.95 (incl. metal cover, F.E.T.)

RP-100 TRANSISTOR STEREO/MONO 4-TRACK TAPE RECORDER 3-motors incl. hysteresis synchronous capstan motor and electro-dynamic (d-c) braking; record and playback equalization at $7\frac{1}{2}$ & $3\frac{3}{4}$ ips. 3 precision-lapped shielded heads adjustable in all planes; electrical push-button operation; automatic tape lifters; monitoring direct from tape; panel selected sound-on-sound recording; mixing mic and line level controls; dual recording level meters. Transistors eliminate hum and microphonics. Semi-kit (transport assembled and tested) \$299.95; wired \$450.



the tried and performance proved Standard Series

HFT-90A FM TUNER Best-buy FM tuner. Pre-wired, pre-aligned temperature-compensated front-end is drift-free. Exclusive precision eye-tronic traveling tuning indicator. Sensitivity: $2.5 \mu\text{V}$ (30 db quieting). Kit \$44.95; wired \$69.95 (F.E.T. incl.).

HFT-12A MONO 18-WATT* INTEGRATED AMPLIFIER Provides complete front-end facilities. Preferred variable crossover, feedback type tone control circuit. Highly stable Williamson type power amplifier circuit. Kit \$39.95; wired \$59.95 (incl. cover).

MX-99 FM MULTIPLEX AUTODAPTER Designed for HFT-90, HFT-92, and ST-96 and other quality, wideband FM tuners with a MX output. Kit \$39.95; wired \$64.95 (F.E.T. incl.).

HFS-8 2-WAY SPEAKER SYSTEM Cloth bellows suspension 8" dia. woofer with powerful magnet system. $\frac{1}{2}$ " throw gives bass of conventional 12" woofer. Ducted port reflex enclosure for minimum distortion. Matching 2" tweeter for excellent "spread" of high frequencies. High efficiency. Oil finished walnut enclosure. Wired \$44.95.

You get the best values with EICO — factory wired, or if you build it yourself. Visit your EICO dealer. *IHF Music Power.

EICO ELECTRONIC INSTRUMENT CO., INC.
3300 Northern Blvd., L. I. C. 1, N. Y. PE-11

- Send free Catalog & name of neighborhood distributor.
- Send 36-page STEREO HI-FI GUIDE: 25c enclosed for postage and handling.

Name _____

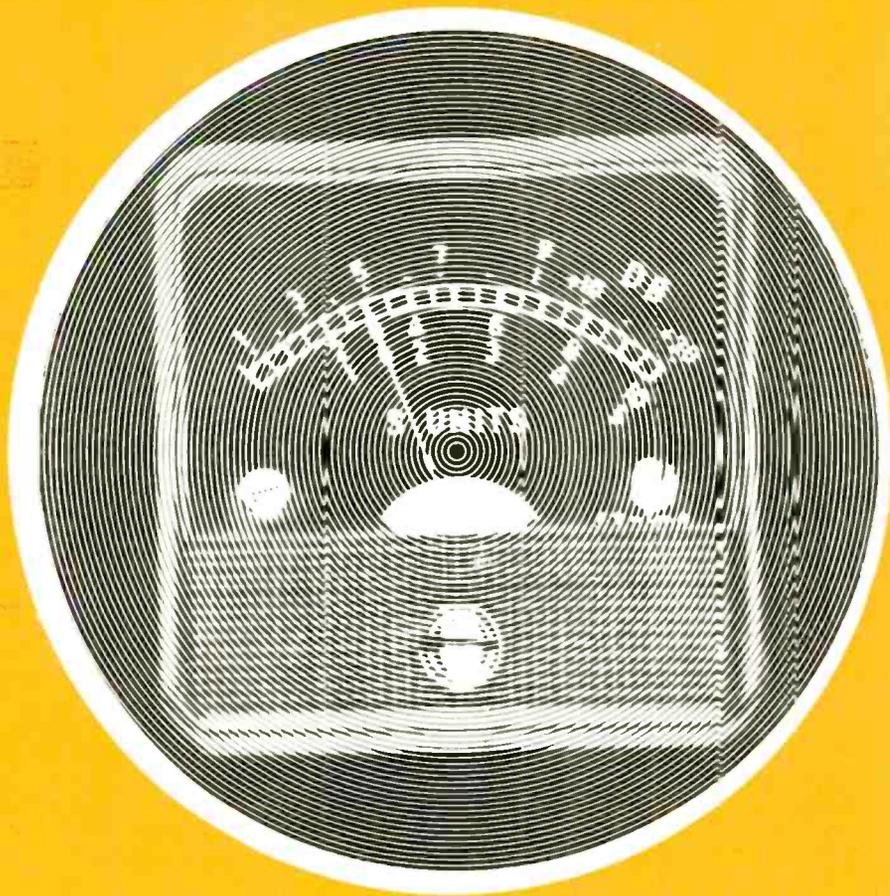
Address _____

City _____ Zone _____ State _____

Add 5% in the West



EXPORT: ROBURN AGENCIES INC., 491 GREENWICH ST., N. Y. 13.



MPX METER

Here's one that outdoes them all—simple, inexpensive and reliable, it's both a stereo and tuning indicator

By FRED BLECHMAN, K6UGT

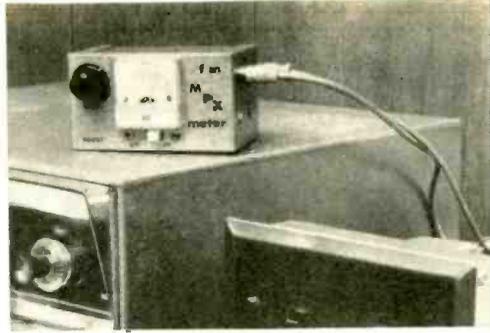
WANT A QUICK, INEXPENSIVE way to tell when you're receiving FM stereo multiplex broadcasts? The "MPX Meter," a new kind of stereo indicator which can be added to most existing equipment without wiring changes, will do the job perfectly. In addition, it doubles as a *tuning* indicator, letting you know when you are tuned exactly to the center of a multiplex station. Finally, you can custom-build the MPX Meter in any of three different versions to accommodate the output level of your particular tuner!

The principle behind the MPX Meter is simple. When an FM stereo signal is broadcast, a 19-kc. "pilot carrier" is sent along with it to permit the receiver to recreate the stereo subcarrier which is suppressed at the transmitter. The MPX Meter selects this 19-kc. signal

from the multiplex output of your tuner, rectifies it, and displays it as a meter reading. Since the pilot carrier appears only on multiplex signals, the meter reads only when you tune in a stereo program.

Practical Circuits. As shown in the schematic diagram and photos below, the simplest MPX Meter circuit uses no batteries, transistors, or switches. The 19-kc. signal from the tuner MPX output jack *C1* to the tuned circuit consisting of *C2-L1*. This tuned circuit, in combination with *C1*, forms a voltage divider for the 19-kc. signal, which is then rectified by *D1* (any general-purpose diode such as the 1N34) and passed on to a sensitive 50- μ a. meter, *M1*.

If your tuner output is insufficient to operate the simple no-transistor MPX Meter, one or two transistors can be added to greatly increase the instrument's sensitivity. The second unit, illustrated in the schematic and photos on page 43, features an *nnp* transistor rectifier-amplifier, *Q1*. During the positive half of the cycle, the 19-kc. signal applied to *Q1*'s base causes it to conduct. Since *Q1* provides additional gain, a less sensitive 1-ma. meter, *M2*, can be used. (If you use a 50- μ a. movement, insert *R1* in series with the meter to limit the cur-



Simple to install, the MPX Meter (this is the two-transistor version) plugs into the tuner MPX jack.

rent flow.) Transistor *Q1* is essentially cut off when no signal is applied, and the battery drain is so small that an on/off switch is not even necessary.

The most complicated—though still simple—version of the MPX Meter provides even more gain by using a complementary *pnp* transistor amplifier, *Q2*, following *Q1* (see the schematic on page 44). Transistor *Q2* can be any general-purpose small-signal type such as the 2N107; the four-for-a-dollar variety should prove perfectly satisfactory. A switch (*S1*) is used in this circuit, since the leakage current is slightly higher; a slight meter reading when the switch

Simple diode MPX Meter—no transistors, batteries, switches—will work with many tuners having high-output ratio detectors.

Basic Parts, All Versions

C1—0.001- μ f. ceramic disc capacitor

C2—0.01- μ f. ceramic disc capacitor

L1—1.5-10mh. TV linearity control coil (Miller Type 6322)

J1-J2—Double RCA phono jack

1—Minibox or other housing

1—Shielded cable, RCA phono plugs at both ends

1—Decal or "Instant Lettering" set (optional)

Diode Version

D1—General-purpose crystal diode, 1N34, etc.

M1—50- μ a. d.c. meter

One-Transistor Version

B1—1.5-volt penlight cell

M2—1-ma. d.c. meter

Q1—Npn transistor, 2N229, 2N170, etc.

R1—33,000-ohm, $\frac{1}{2}$ -watt resistor—see text

1—Battery holder for penlight cell

1—Transistor socket (optional)

Two-Transistor Version

B1, M2, Q1—As above

Q2—Pnp transistor, 2N107 or equivalent

R1—1000-ohm potentiometer

R2—2000-ohm, $\frac{1}{2}$ -watt resistor

2—Transistor sockets (optional)

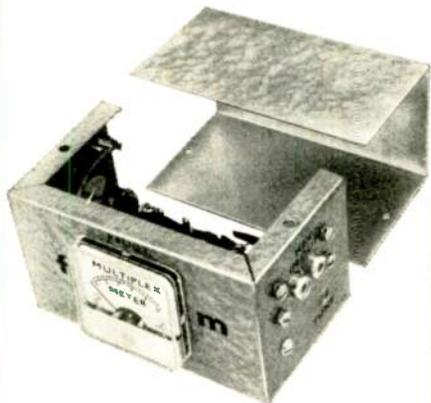
is turned on is normal in this version.

A 1000-ohm potentiometer, R1, is used to keep the high-gain circuit from pinning the meter needle. As shown in the Parts List, a 1-ma. meter is used just as in the one-transistor version. All of the meters employed in the prototypes of the MPX Meter are of the inexpensive, imported variety; they range in price from \$2 to \$4 depending upon sensitivity and the supplier.

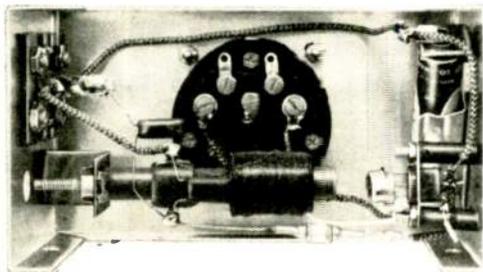
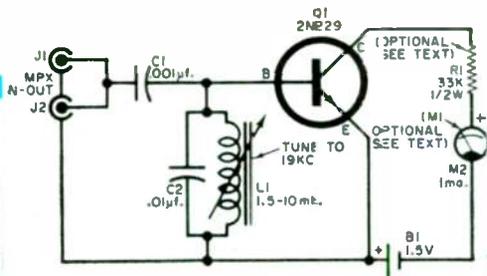
Choosing Your Circuit. Whether or not you need Q1, or Q1 and Q2, depends on the output level of the tuner. First check the instruction manual or schematic of your FM tuner or receiver, and deter-

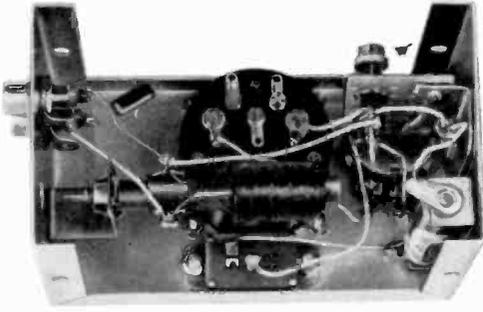
mine whether it uses a ratio detector or a discriminator to demodulate the FM signal. A discriminator is usually preceded by a limiter stage (although it may not be labeled as such); a ratio detector is fed by the last i.f. stage of the tuner or receiver.

If your tuner has a ratio detector, chances are the simple no-transistor MPX Meter will do the job for you, but you may have to add Q1. If your equipment uses a discriminator, you should build Q1 into your MPX Meter, and you may also have to add Q2. If you're not sure what kind of detector your tuner has, build the two-transistor MPX Meter

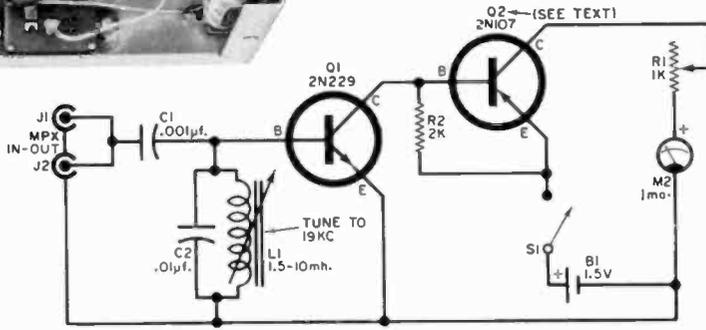


A single transistor is used as a rectifier-amplifier in this version. Either M2 may be used, or M1 along with R1.





Two transistors are used in the high-gain version of the MPX Meter. Control $R1$ is added to prevent the needle from pinning on strong signals. This circuit will work with any tuner, regardless of output level.



—you can always reduce the gain by adjusting control $R1$.

Construction and Hookup. Layout and construction are noncritical (the photos will serve as guides), and the unit may be housed in any metal or plastic box. If there is room on the front panel of your tuner, you can even mount the meter on it and tuck the simple circuitry away inside the chassis or behind the panel on a small perforated circuit board. Coil $L1$ (and control $R1$ in the two-transistor meter) requires only initial adjust-

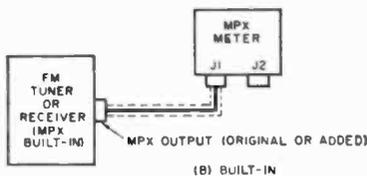
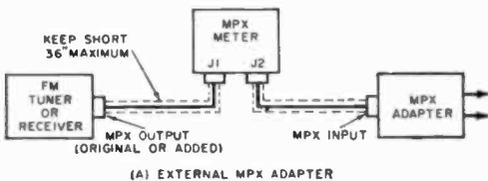
ment, so it does not have to be immediately accessible. The life of battery $B1$ should be about a year or so, making replacement problems minimal.

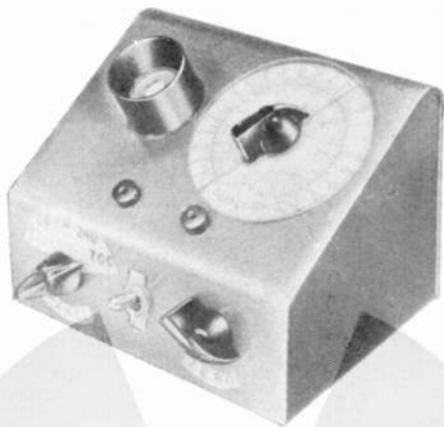
Mount $L1$ with a bracket bent from a strip of aluminum. Also mount the input and output jacks, the meter, and $R1$, $S1$, and the holder for $B1$ if needed. The transistor(s) can be soldered in place or mounted in socket(s) attached to a small piece of perforated circuit board. Solder the connections carefully, using a heat sink to protect $D1$, $Q1$, and $Q2$ as required. Be sure to observe proper polarities when connecting these components and the battery and meter into the circuit you select.

Most tuners sold in recent years are equipped with a multiplex output jack. If the MPX adapter is built in or if no jack is evident on your tuner, one can be easily added. Information on how to do this can often be obtained from the manufacturer, or by following the data provided with "universal" outboard multiplex adapters.

Plug the MPX Meter into the multiplex output jack, using shielded cable to make the connection. If you have an add-on stereo adapter, the double input jack on the MPX Meter will save the use of a "Y" adapter. The block diagram on page (Continued on page 113)

Jacks $J1$ and $J2$ are simply paralleled so that the MPX Meter can be installed between a tuner and outboard adapter.



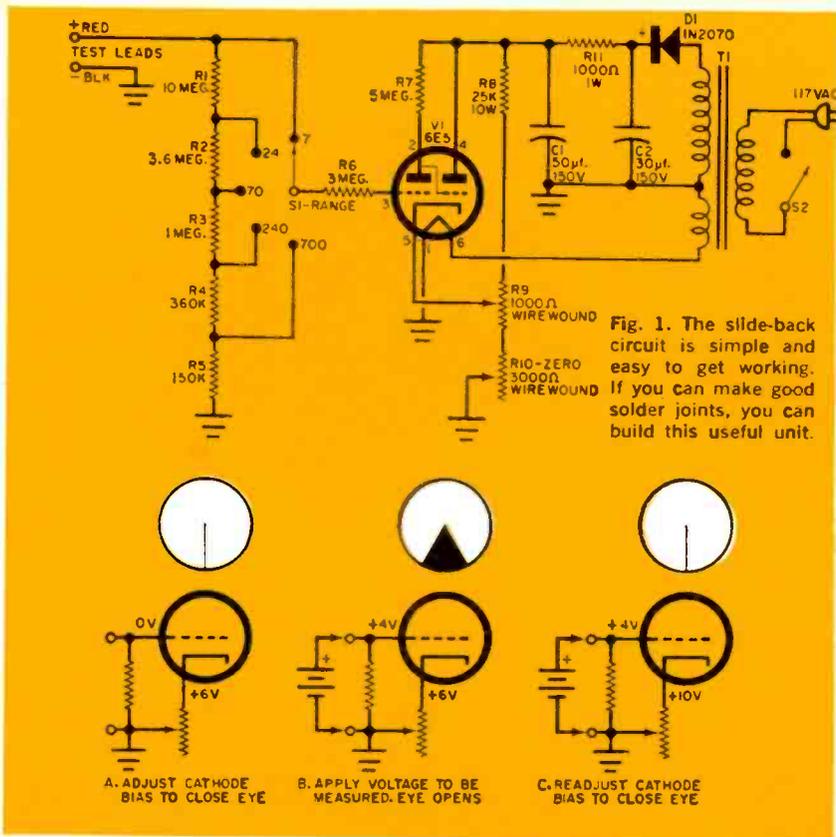


meterless vtvm

By WILLIAM J. MILLARD

When you need a high-impedance voltmeter, you usually need it bad—this one uses no meter, and twelve bucks buys the parts

THE trusty multimeter is generally the first measuring instrument bought for the average home workshop, and often it's the *only* one the experimenter's budget will permit. But what do you do when the voltage to be measured is in a very high impedance circuit? Even if the multimeter is one of the fairly expensive sort having a 20,000-ohm-per-volt movement, the input impedance on a low-voltage range, say 3 volts full scale, is only 60,000 ohms. If you're trying to measure the bias on the oscillator grid of a mixer, or in a low-level audio stage having a 5-megohm (or higher) grid resistor, the multimeter looks pretty much like a dead short circuit to the voltage being measured. In such cases you either give up (unthinkable!), buy a vacuum-tube voltmeter ("unfundable"), or rummage in your junk box and build the "Meterless VTVM."



PARTS LIST

C1—50- μ f., 150-volt electrolytic capacitor
 C2—30- μ f., 150-volt electrolytic capacitor
 D1—1N2070, 400-PIV silicon diode
 R1—10 megohms
 R2—3.6 megohms } $\frac{1}{2}$ -watt carbon
 R3—1.0 megohm } resistor, 5%
 R4—360,000 ohms } tolerance
 R5—150,000 ohms }
 R6—3.0 megohms } $\frac{1}{2}$ -watt carbon,
 R7—5.0 megohms } 10% tolerance
 R8—25,000-ohm, 10-watt, wire-wound resistor
 R9—1000-ohm, linear taper, wire-wound potentiometer

R10—3000-ohm, wire-wound potentiometer
 R11—1000-ohm, 1-watt carbon resistor
 S1—Single-pole, 5-position rotary switch
 S2—S.p.s.t. toggle switch
 T1—Power transformer; 125 volts @ 15 ma.,
 6.3 volts @ 0.6 ampere (Stancor PS-8415 or
 equivalent)
 V1—6E5 electron-ray indicator tube
 1—Aluminum box, sloping front (Bud AC-1612
 or equivalent), or constructor's choice
 Misc.—6-prong tube socket, line cord and plug,
 red and black pin jacks (one each), test prods,
 solder, hookup wire, hardware, etc.

It's true that the Meterless VTVM won't measure resistance or current, except by indirect methods, but the multimeter can still take care of those chores as before. And the Meterless VTVM will provide a bonus "instrument." You can use it when you're measuring a voltage that may suddenly take a drastic jump as you make adjustments, thereby avoiding the risk of wrapping the pointer of your multimeter around the stop pin! The repair of this all-too-common laboratory ailment (known as Technician

Goofitis) will deflate your piggy bank by at least \$10, and it can cost more. Such transient voltage jumps are taken in stride by the Meterless VTVM.

How do you measure voltage without a meter? By reviving a voltmeter circuit so old and out of use that it has probably been forgotten by many old-timers . . . and maybe never learned by newcomers to the electronics field. It's called the slide-back voltmeter circuit, and it originated back in the 1930's. It doesn't require a meter (although one can be

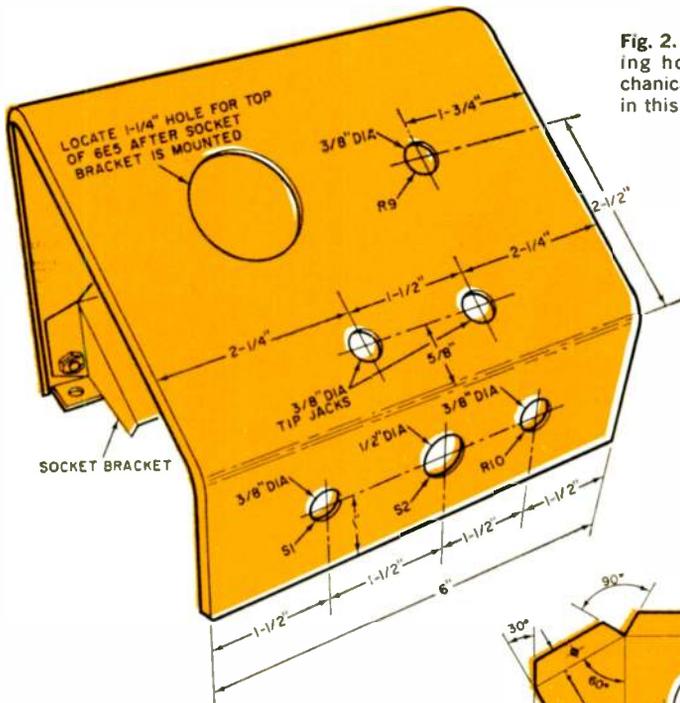
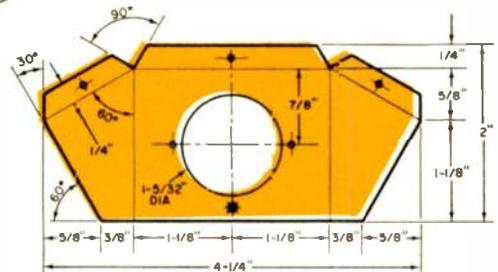


Fig. 2. Details of the mounting holes and other mechanical work are shown in this dimensioned sketch.

Fig. 3. Cut the sheet metal for the bracket as shown before bending to final shape.



• MOUNT TUBE SOCKET SO THAT P N 5 IS AT THIS POINT. SHADOW WILL THEN BE AT 6 O'CLOCK WHEN TUBE IS INSERTED.

used, of course), because all that is needed is a means of indicating when two voltages have been adjusted to be equal, and a tuning indicator ("magic eye") tube can do that very nicely.

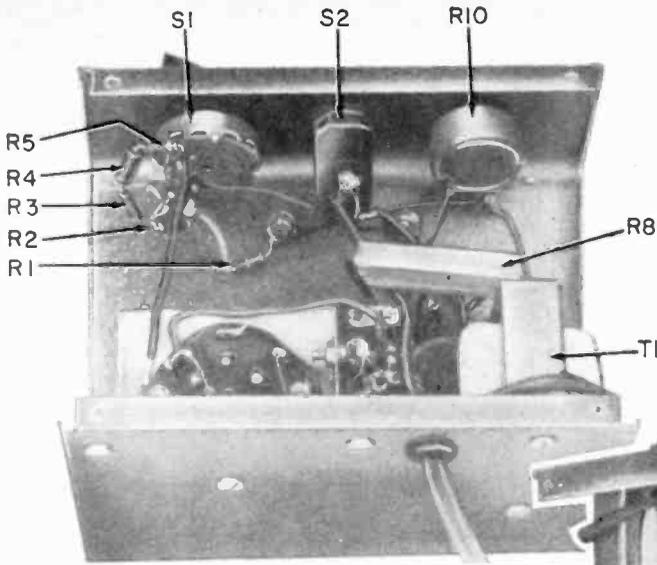
Years ago these miniature cathode-ray tubes were used by the thousands as tuning indicators in broadcast and other receivers. Today, they're still used widely in the less costly tape recorders. Naturally a lot of them are lurking in the junk box waiting to be put into service again, and if you don't have one on hand, the cost of a new one is far below that of a respectable meter.

How It Works. Take a look at the schematic diagram in Fig. 1. If you set the arm of potentiometer *R9* to the low-voltage end of the resistance element, and adjust potentiometer *R10* to bias *V1* so that the "eye" just closes, as in Fig. 1(A), application of a d.c. voltage to the input leads will cause the eye to open again—see Fig. 1(B). Now, by readjusting the bias by means of potentiometer *R9*, you can cause the eye to just close again, as in Fig. 1(C). And if you calibrate the position of the arm of *R9* on a suitable dial scale, you can read off the

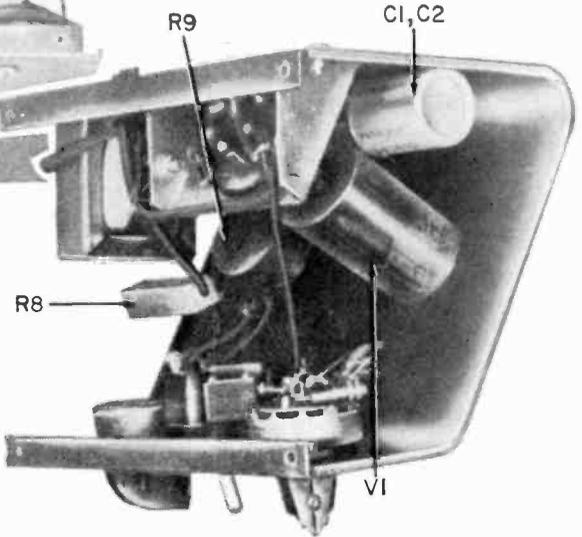
unknown voltage as quickly as the eye-closing adjustment can be made.

How do you calibrate the scale of *R9*? By applying known voltages, such as from combinations of batteries, or by measuring voltages in low-impedance circuits simultaneously with your multimeter and the Meterless VTVM.

Since the range of measurement potentiometer *R9* is limited, the switchable voltage divider network has been included to extend the usefulness of the circuit to higher voltages. For stable operation and ease of calibration, *R9* must be a linear taper wire-wound potentiometer, if you want the voltage scale to be uniform. The 1000-ohm value used by the writer provides a good spread of the dial markings without requiring too many steps of the range switch, but other values can be used to suit the individual constructor's needs. Use of 5% tolerance resistors adds little to the cost of



Layout and wiring are not critical, but assembly is easier if the order given in the text is followed.



the unit, and provides better accuracy and ease of calibration.

Construction. Since the box used to house the writer's unit has no chassis, all controls and associated parts are mounted on the sloping front panel, as shown above. Solder resistors *R1* through *R5* to the terminals of the range switch before you mount it. It's also a good idea to mount *R9*, *R10*, *S1*, *S2*, and the test prod jacks before installing the transformer and indicator tube.

For details of the angle bracket used to support the socket of *V1*, see Fig. 3. When the socket is in place, you can determine the exact location of the 1/4" hole in the front panel for the eye end of the tube. Cut this hole and cement a piece of blackened cardboard mailing tube around it as a light shield.

Fasten the filter capacitor to the rear surface of the box by means of the machine screw in the center hole of the tube socket bracket. A three-lug terminal strip on the side of the tube bracket supports diode *D1* and resistor *R11*. Resistors *R6* and *R7* (not indicated in the photos) are supported by the tube base lugs to which they are soldered.

Calibration. When you have completed and checked the wiring, switch the unit on and let it warm up until the eye pattern stabilizes. Set range switch *S1* to the lowest range and turn *R9* counter-clockwise so that the arm is at the end nearest to *R10*. This is zero volts on all

ranges. Then short the test leads together and adjust the zero setting control (*R10*) so that the eye of tube *V1* just closes.

Now fasten a piece of paper under the knob of *R9* with Scotch tape, for use as a temporary scale. Apply a known voltage such as from a single flashlight cell, and adjust *R9* until the eye is just closed again. Mark the temporary scale accordingly. Continue with other voltages until the low range is calibrated.

This scale will hold for ranges three and five if you multiply the scale markings by 10 and 100, respectively. Ranges two and four are calibrated in the same way, after which you have only to transfer the temporary markings to a permanent scale for mounting under the knob.

Want to use your unit for a.c. also? Just add a 0.02- to 0.05- μ f., 200-volt capacitor from pin 2 of *V1* to ground, and you're in business.



LIGHTED COPS—Traffic officers of N.Y.C. Bridge and Tunnel Authority are now equipped with light-generating safety belts. The 12 lamps in belt, powered by nickel-cadmium battery, flash 60 times a minute.

R/C DUCK—Though it would make a perfect lure for hunters, Dr. Eckhard H. Hess in charge of the animal behavior lab at the University of Chicago, uses an R/C duck in experiments on the behavior of ducklings.

World's Fair to Feature Ham Radio

A three-position amateur radio station to be operated by ARRL members will be a part of the Coca-Cola Co. pavilion at the 1964-1965 New York World's Fair. Visitors to the fair will have a chance to watch and listen, and licensed hams will be permitted to operate the equipment.

Good \$5 Radios Wanted

With an inexpensive yet reliable battery radio in every native village, developing countries could jump the barriers of illiteracy and power lines, according to Dr. Wilbur Schramm, director of Stanford

University's Institute for Communication Research. Transistor radios that operate for many hours from dry cells could be used, he pointed out in a recent article, and other power sources might be wind-driven or charcoal-burning generators.

Pioneer Company Changes Name

"The Marconi Company Limited" is the new name recently adapted by the former Marconi's Wireless Telegraph Co., Ltd., a designation the organization has used since 1900, three years after it was founded by Marconi. The change reflects the firm's greatly expanded activities.

HIGH-SPEED TRAIN SCANNER—An electronic scanner developed by Sylvania identifies moving passenger cars by sending out a white light, and then analyzing colored light reflected from a special label on the car. The information is relayed to a track-side recorder-transmitter.



BREAKTHROUGHS

Brief news flashes on important developments in the field of electronics

HIGH RESOLUTION RADAR capable of discriminating between objects separated by inches. Developed by General Dynamics, it involves the use of extremely short microwave pulses in the sub-nanosecond range to make possible the detection and separate display of signals reflected from many points on an object, rather than just a summation of all reflected energy as in conventional pulsed radar.

COLOR COMPUTER that can distinguish 100,000,000 different colors including 8,000,000 shades of red. Demonstrated by Toshiba Electric Co., the unit automatically draws a spectral curve of an object's color in two minutes, and then calculates and prints the results within seconds.

ELECTRONIC PEN that writes 100 feet a second, by Richard G. Sweet, Stanford electronics engineer. Designed for recording signals up to 10 kc., the pen operates somewhat like an electron gun, but it fires fine drops of ink instead of electrons. The drops pass between charged plates which attract or repel them to produce a wave pattern on paper.

TELESCOPIC TV CAMERA that can spot a basketball at 100 miles, by Bendix. The BX-7 image orthicon TV camera and a 2500-lb. telescope were mated to produce a system used to follow astronaut Gordon Cooper into space. It is expected to be the forerunner of more sensitive pickups for visual tracking.

A ROCKET POWER SYSTEM utilizing the rocket exterior and parts of the bulkhead structures as capacitor plates to be charged by solar cells. Invented by Robert J. Schwinghamer of the NASA Marshall Space Flight Center, the system could be used to store power to energize such equipment as lasers, radar, and electric engines.

UNDERWATER ATOMIC BEACONS emitting high-frequency sound as an aid to ship navigators. Currently being developed by the Martin Co. under A.E.C. contract, the device will use heat from radioisotopes to make steam which will, in turn, drive a sound-producing transducer.

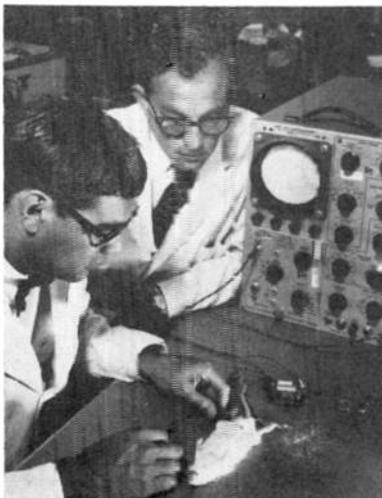
VIDEO PLAYBACK UNIT said to produce both pictures and sound on a standard TV set from 33 $\frac{1}{3}$ rpm long-playing records. Known as the "Videogram," the device utilizes a special pickup head and extended frequency range. It's under development by Wolverhampton Radio and Supply Co., Ltd., Wolverhampton, England, and is expected to sell for about \$100 in final form.

PATTERN RECOGNITION SYSTEM that can learn to recognize photos of aircraft, people, or other objects, by Scope, Inc. Described as a conditioned reflex machine, "Conflex I" is capable of recognizing 4800 different patterns, including pictorial displays, numbers and geometric designs, with 99.6 per cent accuracy. Digital solid-state circuitry and magnetic-disk memory storage are used.



THIN-FILM R.F. AMPLIFIER (above) about the size of half a stick of gum will replace the conventional electron tube version at the left. Developed by ITT, it includes four transistors, 12 capacitors, 16 resistors, and associated wiring. It's made by depositing successive thin-film layers, comprising the circuit elements, on top of each other.

BODY-PRODUCED ELECTRICITY can be used to power electronic devices implanted in an organism to regulate its functions or report on physiological reactions, say GE scientists conducting experiments in bioelectrogenesis. During research, power to operate a 500-kc. transmitter was drawn from electrodes implanted in the body of a rat (photo below) without disturbing vital biological functions.



CRYSTAL SUPER CALIBRATOR

By R. A. SCHEIDEL

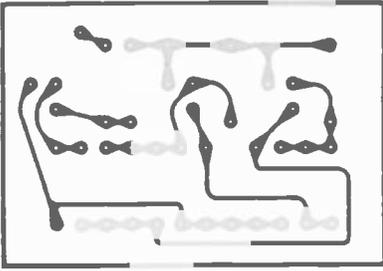
Like port and starboard channel buoys for the navigator, crystal calibrator harmonics mark the band edges for hams and others

NEXT TO MONEY, hardly anything serves certain needs of the ham, the SWL, and the set builder better than a good crystal calibrator. For the ham, those stable signals precisely 100 kc. apart mark the band edges of most of the amateur bands with an accuracy that removes the gnawing fear of an unwanted FCC QSL for out-of-band operation. For the SWL, the rather sketchy calibration of many short-wave receiver dials no longer causes such exasperating difficulties when trying to identify an unknown station. And the set builder and experimenter can calibrate the dial of the new receiver, oscillator, or other tunable device with some assurance that the figures they put down on the scale mean something definite.

Crystal calibrator kits are available from several companies, and many receivers feature a plug-in socket for a calibrator, or have a calibrator built in at the factory. Even so, the unit described here has several solid advantages that more than justify its moderate cost and the time required to build it.

First of all, the "super" calibrator is small, rugged, and can be constructed as a completely self-contained unit if you wish. This makes it a natural choice for field day, portable, or mobile use. It also means you don't need to cut into other equipment to steal power, although of course you can power the unit

COVER STORY



this way if you choose, and a circuit for this construction scheme is provided. Next, crystal current is very low, even if you elect to use the highest battery voltage the design permits, and all other sources of thermal frequency drift are weak. For these reasons, stability is significantly better than is usual for units not operating in a temperature-controlled oven.

Third, the super calibrator is so easy to build, thanks to a high-quality printed-circuit board, that you can choose just about any final assembly form that suits your own needs. This can range from building the unit into an existing receiver to making it the basis for an elaborate home lab signal source, with additional multivibrators to provide outputs at multiples and sub-multiples of the basic 100-kc. frequency. Because of the "foolproofness" of the design, constructors are encouraged to adapt the unit to their own requirements, although the version described here can be duplicated exactly if desired. And even for this completely self-contained model, certain optional choices are given in the Parts List.

And as the final clincher, the super calibrator provides usable harmonic output to well beyond 100 mc., thanks to an output amplifier stage of optimum design. This last feature alone should perk up the interest of 6-meter hams, and DX'ers who comb the mobile bands above 30 mc., for this is where many calibrators get feeble, and receiver gain also begins to droop.

How It Works. The oscillating circuit of the super calibrator is essentially a multivibrator, with the crystal connected in the feedback path from the collector of transistor Q_2 to the base of transistor Q_1 . The crystal operates in this circuit at its series-resonant frequency; that is,

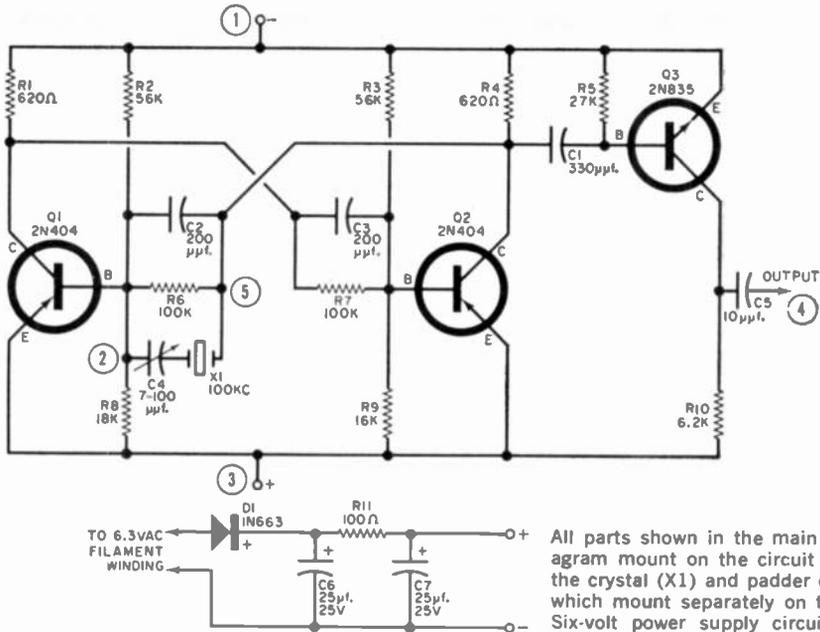


Where accurate frequency check points are a must, as when checking a BC-221 at 100-kc. points, the super calibrator speeds and eases the operation.

it presents a relatively low series impedance at 100 kc., and a relatively high impedance at all other frequencies near 100 kc. As a result, the circuit made up of Q_1 , Q_2 , and associated resistors and capacitors oscillates at 100 kc., since this is the only frequency at which there can be enough positive feedback to sustain oscillation. The exact frequency of oscillation can be adjusted over a small range by means of padder capacitor C_4 , making it possible to adjust the calibrator to zero beat (of a harmonic) with WWV, or another standard frequency signal source.

The base of output transistor Q_3 is coupled to the collector of Q_2 by capacitor C_1 . Transistor Q_3 is an *npn* type (2N835), and is capable of being switched from cutoff to fully conducting condition in about 10 nanoseconds. This high switching speed is just another way of saying that it can handle very high frequencies.

Since the input waveform from the oscillator circuit is substantially a 100-kc. square wave, Q_3 amplifies this wave and all harmonics to at least 100 mc.,



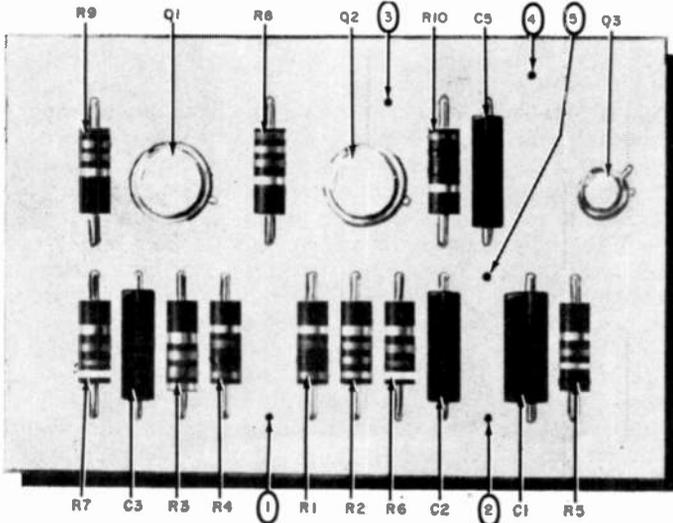
All parts shown in the main schematic diagram mount on the circuit board, except the crystal (X1) and padder capacitor (C4) which mount separately on the box cover. Six-volt power supply circuit is optional.

PARTS LIST

B1*—1.5-volt to 10-volt battery to supply 4- to 12-ma. drain—see text
 C1—330- μ f. silver mica capacitor, voltage rating not important
 C2, C3—200- μ f. silver mica capacitor, voltage rating not important
 C4—7-to-100 μ f. air dielectric variable capacitor, ceramic insulation (alternate for easier fine adjustment; 7-to-24 μ f. size)
 C5—10- μ f. silver mica capacitor, voltage rating not important
 J1*—Crystal jack, to suit 100-kc. crystal used—see text
 Q1, Q2—2N404 pnp transistor
 Q3—2N835 npn transistor
 R1, R4—620 ohms
 R2, R3—56,000 ohms

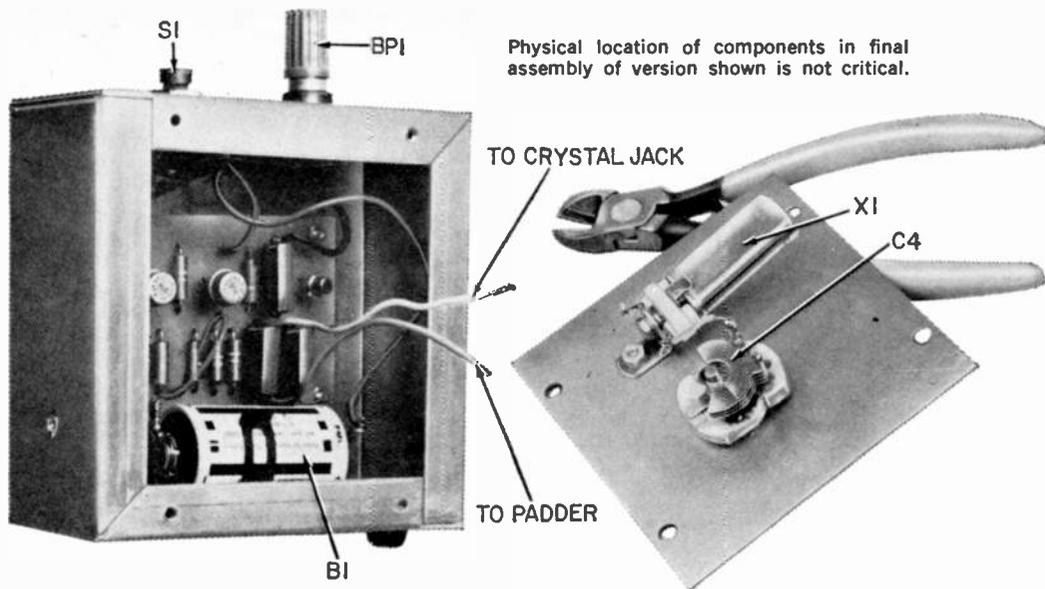
R5—27,000 ohms
 R6, R7—100,000 ohms } all resistors
 R8—18,000 ohms } carbon, 1/2 watt
 R9—16,000 ohms
 R10—6200 ohms
 S1*—Any small on-off switch—see text
 X1—100-kc. standard type crystal (Petersen Z-6A or equivalent)
 1—Printed circuit board (available from R. A. Scheidel, 2272 Placentia, Costa Mesa, Calif., \$3.00, three-week delivery)
 1—Small aluminum box (4" x 4" x 2" used here)
 Misc.—Binding post or pin jack for outputs, screws and spacers for mounting board, hookup wire, solder, rubber feet for box, etc.

*Not shown in schematic, constructor's option



- ① POWER CONNECTION (-)
- ② PADDER CONNECTION
- ③ POWER CONNECTION (+)
- ④ OUTPUT CONNECTION
- ⑤ CRYSTAL CONNECTION

Parts placement is set by circuit board layout. Note orientation of the transistor locating lugs when inserting leads in circuit board openings.



Physical location of components in final assembly of version shown is not critical.

and delivers the amplified version to the output terminal through *C5*. The output stage is of relatively low impedance, so that moderate loading such as by the input circuit of a receiver under test will not seriously reduce the output or alter the unit's frequency stability.

Construction. The type of box chosen to enclose the unit does not affect the construction greatly, since almost all of the parts are mounted on the printed-circuit board. However, the type of switch chosen, and the type and size of the battery used to power the unit do affect the choice of the box, so it is well to select these components before you buy the box.

If you choose to duplicate the construction illustrated, begin by drilling holes for 4 x 32 machine screws in the three corners of the printed-circuit board that are clear of printed conductors. By drilling before the parts are mounted on the board, the chance of damaging anything is greatly reduced. With the holes in the board drilled, use the board as a template to locate the mounting holes to be drilled in one of the box covers. In doing this, be sure to spot the holes so the board will clear the lip of the box when it is mounted on the cover, noting that the board will be supported far enough from the cover to allow ample clearance for the solder side.

With this done, mount the padder ca-

pacitor, *C4*, and the crystal jack (if one is used) on the other box cover, as shown in the illustration. The crystal can be soldered into the circuit if desired, but most constructors may prefer to mount a ceramic crystal jack as shown, and insure the crystal against accidental removal due to jarring by securing a rubber band around the holder and crystal can.

Mount the output binding post and the on-off switch on one side of the box frame, and the battery holder on the opposite side.

Wire the circuit parts on the printed-circuit board in the positions shown. Use normal care in soldering, and be sure to use a heat sink (such as a copper alligator clip or pair of long-nose pliers) when soldering the transistor leads.

When all parts have been soldered in place and the ends of the leads have been trimmed close to the solder surface, connect five pieces of insulated hookup wire to the points on the board numbered 1 through 5 in the photograph showing the mounted parts. If you use a different color for each wire, it will help prevent errors when you make the final hookup. Leave these wires long enough to permit completion of the wiring when the board and other components are mounted in their final positions.

At this point you can either "go for
(Continued on page 112)

Assemble a PHONE-BOOST

By LOU GARNER

Low headphone volume? Here's a unit that makes inexpensive magnetic types better than the best

ALMOST EVERYONE owns a pair of inexpensive, rugged, reliable, standard magnetic headphones. With impedances ranging from 500 to 2000 ohms, they have just one major shortcoming—lack of sensitivity. This defect can be easily overcome, however, by building the "Phone-Boost," a simple, compact, one-transistor amplifier that fits into any housing about 1" x 2" x 3", and plugs into a headphone jack. The

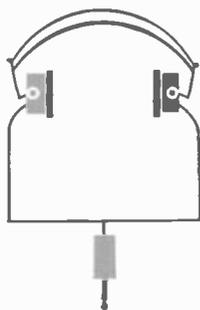
ting operation of the Phone-Boost in the field as well as on the bench.

As shown in the schematic on the next page, the circuit is that of a common-emitter amplifier. Almost any small-signal transistor will work for *Q1*. A *pnp* type was used in the original model, but an *npn* unit can be substituted if battery (*B1*) polarity is reversed. Capacitor *C1* is used as a combination coupling-d.c. blocking capacitor, and the magnetic

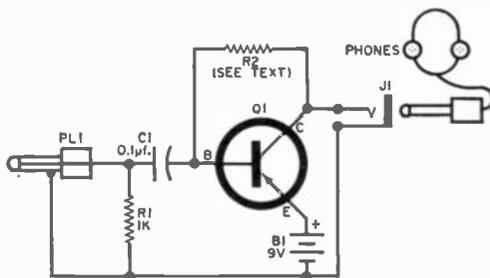
Phone-Boost is extremely versatile, and can be used with communications receivers, signal tracers, monitors, CPO's, and any other piece of equipment that has a phone jack. The unit will accept a wide range of input signals without overloading, and is "automatic" in that no power switch or gain control is needed, since no power is consumed until the phones are plugged into the output jack. Finally, the circuit is temperature-compensated, permit-

headphones serve as *Q1*'s collector load.

The Phone-Boost differs from more familiar common-emitter stages in that the base bias resistor, *R2*, is returned to *Q1*'s collector rather than to *B1*. This puts part of the amplified output signal into the base circuit as negative feedback, the result of which is to reduce circuit distortion and make the stage less sensitive to overloading by strong signals. Resistor *R2* also provides tempera-



PHONE-BOOST

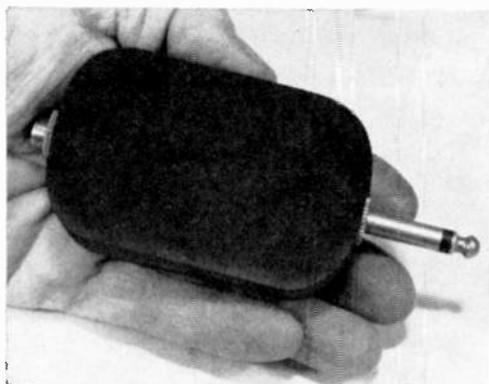


Circuit is that of a common-emitter amplifier with negative feedback and temperature compensation.

ture compensation. Base bias is dependent on collector voltage which, in turn, depends on collector current. An increase in temperature, which results in an increase in collector current and corresponding decrease in voltage, also causes a decrease in base bias voltage, and therefore tends to restore collector current to its optimum value. Since base

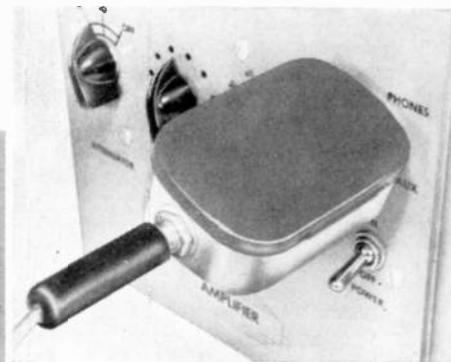
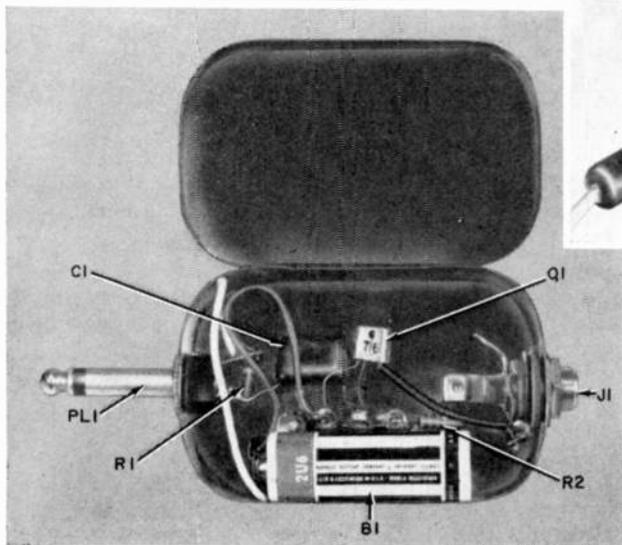
PARTS LIST

- B1—9-volt battery (Burgess 2U6)
- C1—0.1- μ f., 50-w.v.d.c. ceramic capacitor
- J1—Open-circuit phone jack
- PL1—Standard phone plug
- Q1—Pnp transistor (CK722, 2N107, 2N109, etc.)
- R1—1000-ohm, $\frac{1}{2}$ -watt resistor—see text
- R2—20,000- to 100,000-ohm, $\frac{1}{2}$ -watt resistor (noncritical—see text)
- Misc.—Small plastic or metal case, terminal strip, battery connector, wire, solder, etc.



bias and collector voltage are not applied until the collector circuit is completed by the headphones, no power switch is needed.

Although R_2 's value is not critical, it can be determined experimentally for best performance with the particular transistor and phones used. Simply clip
(Continued on page 114)



A metal cough-drop box provided the case for the original Phone-Boost. Small, convenient to use, and inexpensive to build, it plugs into a receiver or other headphone jack, providing an audio "boost" and greater sensitivity for low-impedance magnetic headphones. Layout and design is noncritical. Almost any small-signal transistor can be used in the circuit.

VHF

adventurer

PART 2

By JAMES G. LEE, W6VAT

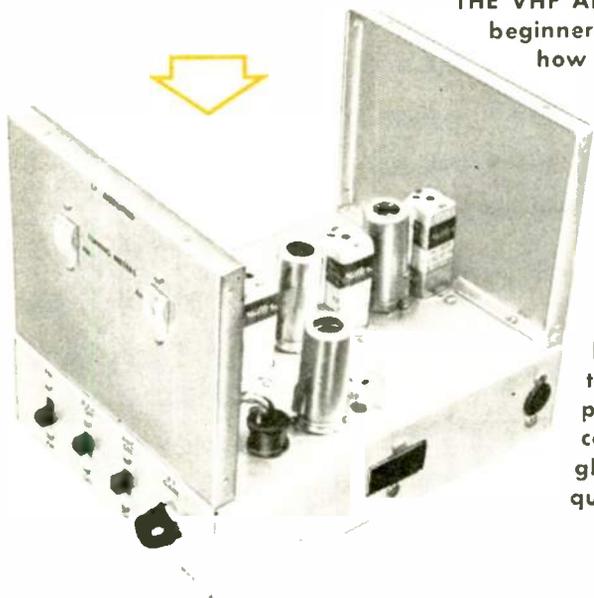
A quality AM/FM superhet in three parts: Here we present the i.f. strip—second of two modules needed to operate the converters

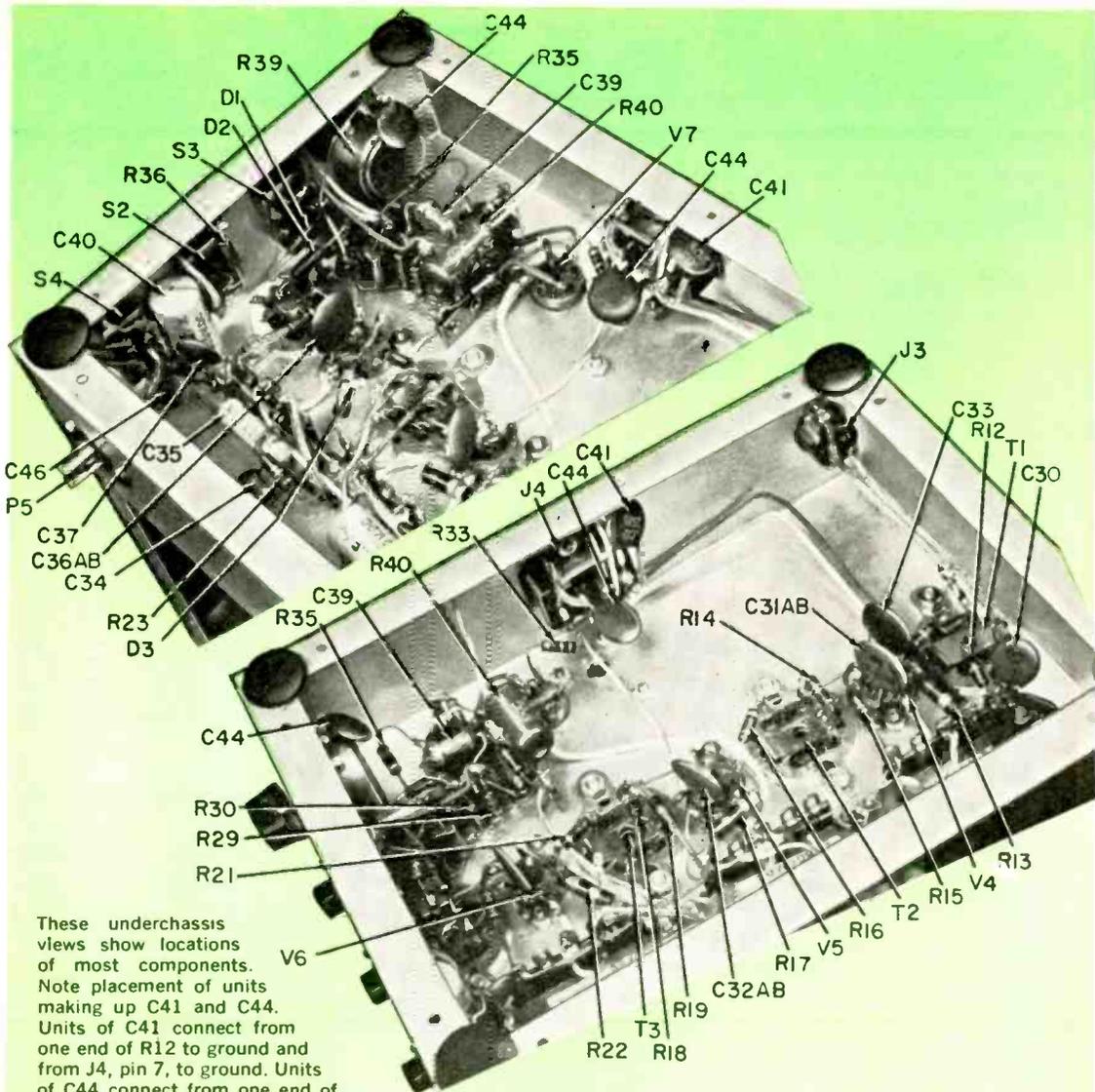
IF YOU'RE READY to advance beyond the limitations of simple "rush box" superregenerative VHF receivers, this modular design will be right down your alley. Built in three separate sections—audio/power supply (described in the October issue, page 41), i.f. strip and detectors (this issue), and 30-50 mc. converter (coming next month)—the VHF ADVENTURER does everything a good superhet receiver is expected to do. The converter modules for the various VHF bands are also designed as individual units, and each offers high sensitivity and good bandspread tuning. The i.f. strip is sufficiently broad to provide good reception of both FM and AM transmissions. In addition, noise limiter, a.g.c., a.f.c., S-meter, FM carrier deviation and BFO circuits are included.

THE VHF ADVENTURER is not a project for a beginner, although exhaustive details on how each module is constructed are presented. Several items of test

equipment will be required to properly align the i.f. strip and the converters, and wiring techniques in the converter stages must be exceptionally good.

Care and patience are prerequisites in making your VHF ADVENTURER work properly. Some builders may find it advantageous to await publication of all three parts of this article before starting construction. The Editors will be glad to answer any specific inquiries about this project.





These underchassis views show locations of most components. Note placement of units making up C41 and C44. Units of C41 connect from one end of R12 to ground and from J4, pin 7, to ground. Units of C44 connect from one end of resistor R13, J4, pin 5, and "hot" end of potentiometer R39 to ground.

Construction. Assembling the i.f. module will be somewhat more difficult and exacting than the audio/power supply module described last month. Chassis layout dimensions of the major components are shown on page 62. While it is not absolutely necessary to follow this arrangement, the author's experience indicates that it will cut down on the possibility of feedback and self-oscillation in the i.f. strip.

Begin mechanical assembly by mounting the socket for V5, followed by the i.f. transformers and other tube sockets on either

side of V5. Three 5-terminal Cinch-Jones strips (Type 2005) are also mounted under the chassis adjacent to the tube sockets; these strips are important and should be mounted in approximately the positions shown in the photos and drawings. Mount single solder lugs under each bolt holding the 5-terminal strips; they will be used as your grounding connections.

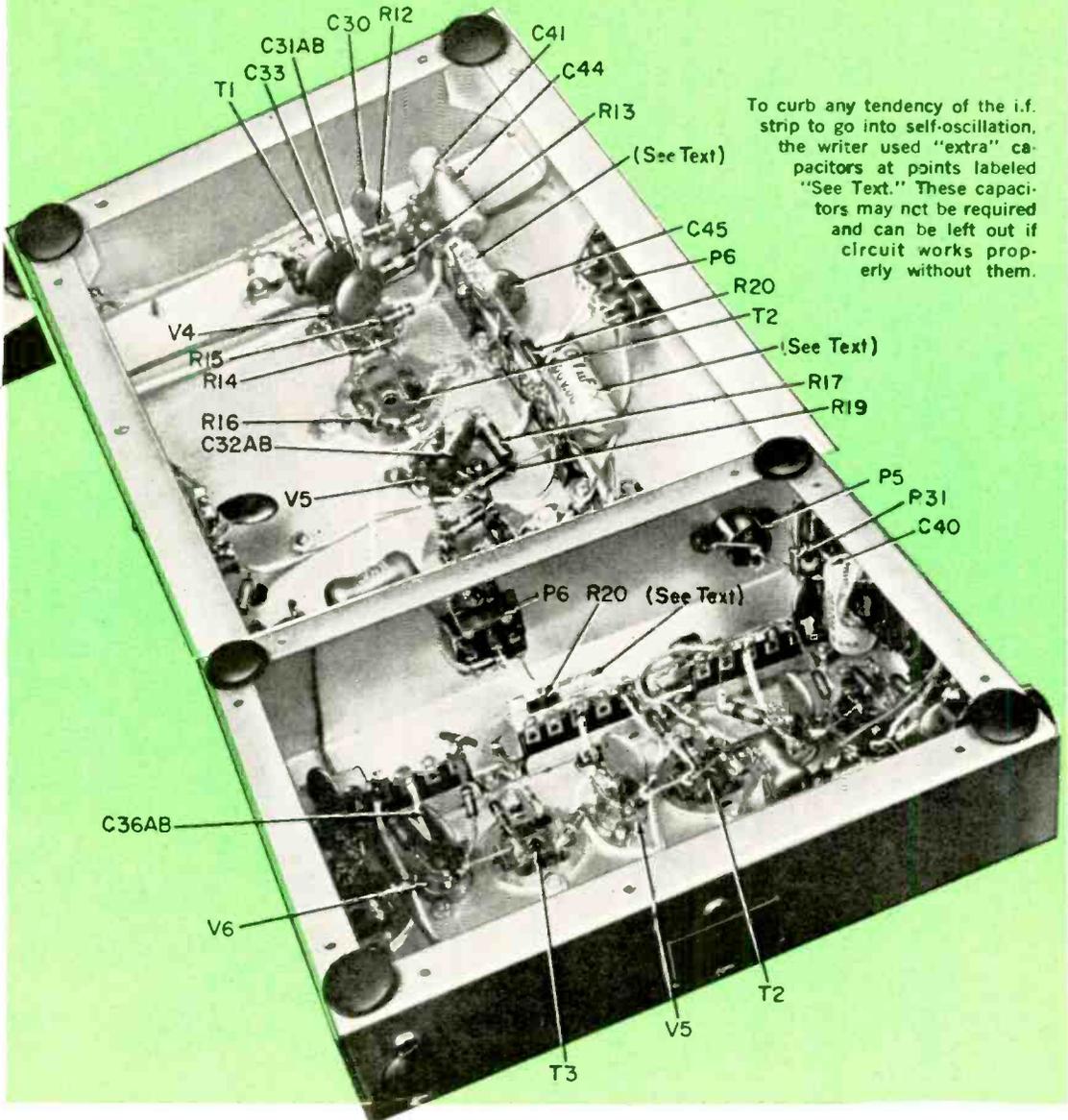
The i.f. input transformer, T1, is at the rear of the chassis, ratio transformer T4 all the way to the front. Slight departures from the spacing and positioning of these

parts from that given in the layout drawing are relatively unimportant. Zero-set potentiometer *R32* should be placed as shown with a single hole passing through the deck of the chassis to permit connection to *R33*. Any 5000-ohm potentiometer can be used in place of the one specified, but be sure that it does not mechanically interfere with the positioning of *J4*.

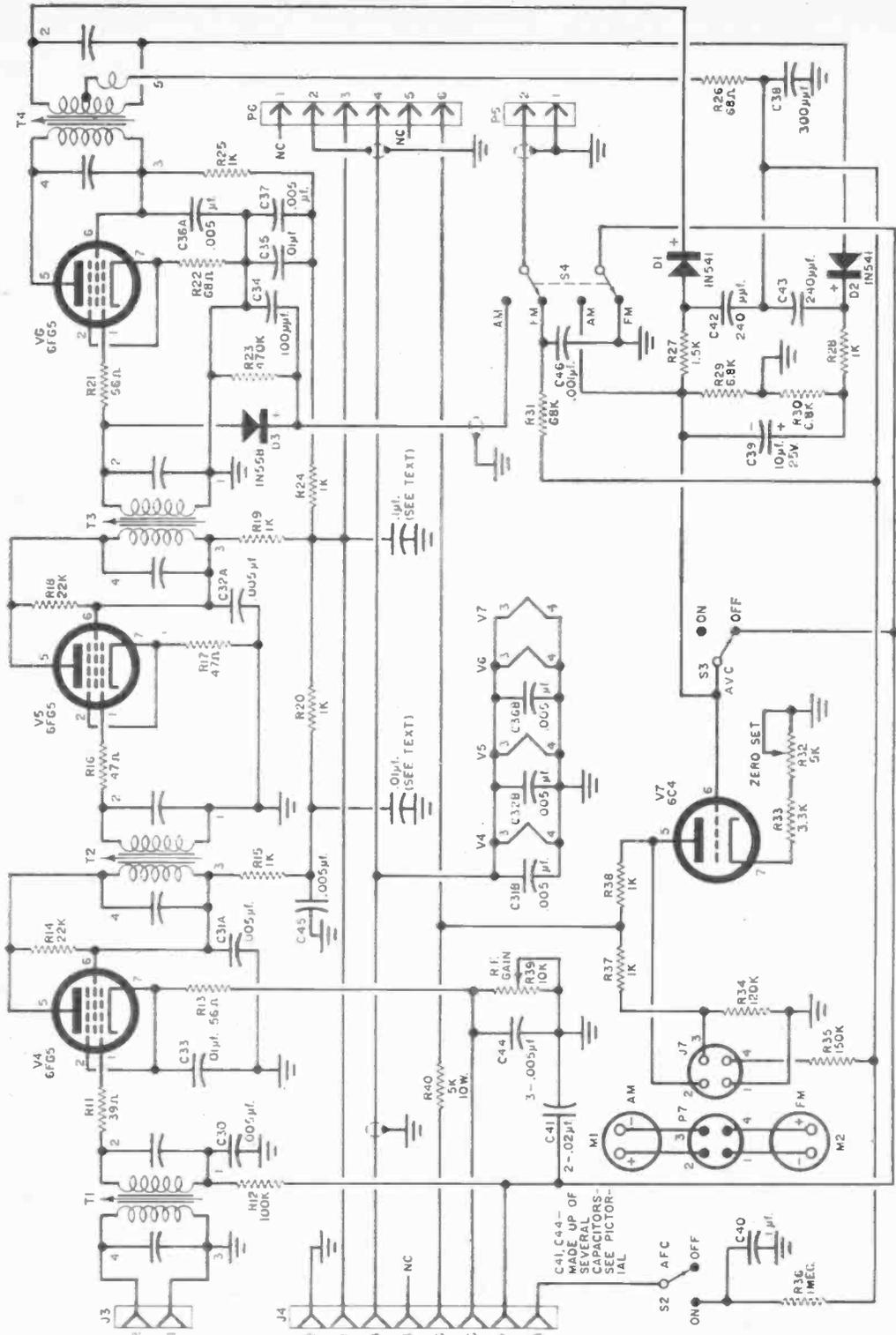
A fourth 5-lug terminal strip and a 2-lug tie point are mounted near *J7*. The 2-lug strip is used to mount *R40* while the 5-lug strip holds *C38*, *C39*, *C42*, and *C43*. Drill

the holes to mount these strips after you are sure of sufficient clearance away from *R39*. The three slide switches (*S2*, *S3*, and *S4*) are equally spaced along the front skirt of the chassis.

Considerable care must be exercised in cutting out holes for *P5* and *P6*. These two plugs must mate with jacks *J5* and *J6* on the audio/power supply module. The dimensions shown in the drawing on page 62 should be followed so that the panels of the two units are flush—when the plugs and jacks are mated. This may sound difficult



To curb any tendency of the i.f. strip to go into self-oscillation, the writer used "extra" capacitors at points labeled "See Text." These capacitors may not be required and can be left out if circuit works properly without them.



PARTS LIST

- C30, C37, C45—0.005- μ ., 600-volt ceramic capacitor
 C33, C35—0.01- μ ., 600-volt tubular capacitor (extra capacitor may be required—see text)
 C31ab, C32ab, C36ab—Dual 0.005- μ ., 600-volt ceramic capacitor (Centralab Duo-Kaps DD2-502 or equivalent)
 C34—100- μ l. mica capacitor
 C38—300- μ l. mica capacitor
 C42, C43—240- μ l. mica capacitor
 C39—10- μ l. 25-volt Tantalex capacitor (Sprague 132D106CC2025U0 or equivalent)
 C40—0.1- μ l., 600-volt tubular capacitor (one extra capacitor may be required—see text)
 C41—(2 required) 0.02- μ l., 600-volt disc ceramic capacitor (see photographs for placement in circuit)
 C44—(3 required) 0.005- μ l., 600-volt disc ceramic capacitor (see photographs for placement in circuit)
 C46—0.001- μ l., 600-volt ceramic capacitor
 D1, D2—1N541 germanium diode; buy matched pair known as 1N542 (Amperex or equivalent)
 D3—1N55B germanium diode (Raytheon or equivalent)
 J3—Chassis-mounted jack (Cinch-Jones S-302-AB or equivalent)
 J4—Chassis-mounted jack (Cinch-Jones S-306-AB or equivalent)
 J7—Chassis-mounted jack (Amphenol 78-S4S or equivalent)
 M1—Tuning or S meter (Lafayette Radio TM-12 or equivalent)
 M2—F.M. tuning meter (Lafayette Radio TM-13 or equivalent)
 P5—Chassis-mounted plug (Cinch-Jones P-302-AB or equivalent)
 P6—Chassis-mounted plug (Cinch-Jones P-306-AB or equivalent)
 P7—4-prong miniature plug (Amphenol 71-4S or equivalent)
 R11—39 ohms
 R12—100,000 ohms
 R13—56 ohms, 1 watt
 R14, R18—22,000 ohms
 R15, R19, R20, R24, R25, R28, R37, R38—1000 ohms
 R16, R17—47 ohms
 R21—56 ohms
 R22, R26—68 ohms
 R23—470,000 ohms
 R27—1500 ohms
 R29, R30—6800 ohms
 R31—68,000 ohms
 R32—5000-ohm potentiometer (Mallory FL-5k or equivalent)
 R33—3300 ohms
 R34—120,000 ohms
 R35—150,000 ohms
 R36—1.0 megohm
 R39—10,000-ohm, 2-watt potentiometer (Ohmite CU1031 or equivalent)
 R40—5000 ohms, 10 watts
 S2—S.p.s.t. slide switch
 S3—S.p.d.i. slide switch
 S4—D.p.d.i. slide switch
 T1, T2, T3—4.5-mc. i.f. transformer (J. W. Miller 6203 or equivalent)
 T4—4.5-mc. F.M. ratio detector transformer (J. W. Miller 6205 or equivalent)
 V4, V5, V6—6FG5 tube
 V7—6C4 tube
 1—California Chassis Co. Type A-120 chassis; if not available locally, write to 5445 E. Century Blvd., Lynwood, Calif. (or use Bud AC-406 or Premier ACH-404 which are 1" larger in depth and width, and adjust cutouts accordingly)
 Misc.—Tube sockets and shields, wire, screws, bolts, nuts, decals, knobs, solder, etc.

but it is really a simple job requiring only a little extra care.

When mounting the tube sockets, place a small grounding solder lug under the mounting screw nearest to pin 4. This lug will serve as the ground point for each individual stage.

Wiring. Begin the wiring by soldering the grounding lug to pin 4 on all four tube sockets. Next, connect the tube heaters. This is done by running a short wire from pin 3 of V4, V5, and V6 to the center terminal of the three adjacent 5-lug strips. Run a wire from pin 3 of V7 over to pin 3 of V5. Now wire all of the center lugs on the strips together and connect to pin 4 of P6. Use a length of shielded lead to run a filament lead from P6 to pin 4 of P4.

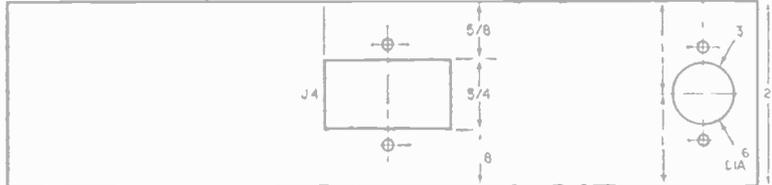
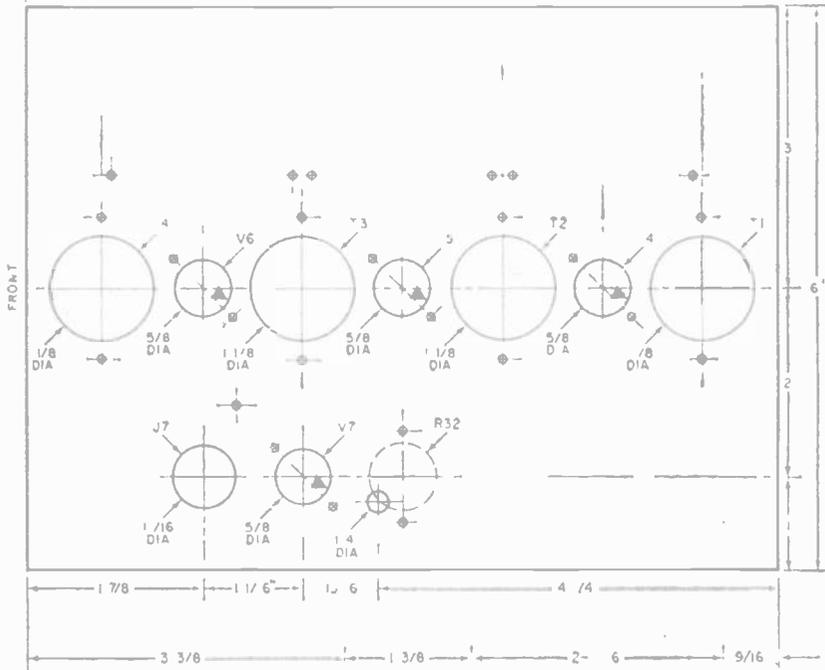
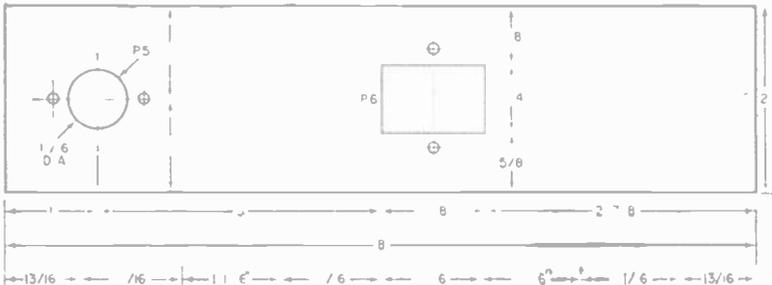
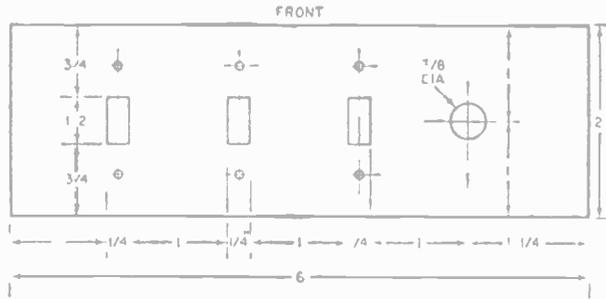
Wire in R33 between pin 7 of V7 and R32. Temporarily remove the 5-lug strip near R39 and number the lugs 1 through 5 from front to rear. Wire in C43 between lug 3 and lug 5 on the side nearest gain control R39. Slip two 1/2" pieces of spagueti tubing over the R27 leads and wire it between lugs 5 and 1 on the same side of the strip. Then wire C43 from lug 4 to lug 2 on the opposite side. Resistor R28 is between lug 4 and 2 while C38 is wired with just one end connected to lug 3.

Remount the above terminal strip and solder the free lead of C38 to ground. Between pin 4 of T4 and lug 3 of the terminal strip, wire in R26. Pair R29 and R30, and twist one set of their leads. Preform and cut their leads so that the two free leads of the combination may be soldered to lugs 1 and 2 of the five-lug strip. Wire the twisted leads of the pair to the solder grounding lug under the T4 mounting plate. Solder in diodes D1 and D2 last, being careful of heat conduction along the leads.

The photographs show how the remaining part of this module is wired. The very last items to be soldered in place are the special Centralab Duo-Kaps C31ab, C32ab and C36ab. Their leads must be short and in each case the capacitor should straddle the tube socket with the center wire soldered to the center post of the socket.

Obviously a plug and jack (J7 and P7) are not really necessary for connecting up the two meters. The author

Chassis cutout dimensions are based on the use of the Type A-120 chassis recommended by the author. If you use a substitute chassis (as listed on page 61), adjust layout accordingly. Diamonds indicate locations of blank pins for mounting the tube sockets.



found it a convenience, but other constructors may prefer to run leads from below the chassis through a grommited hole to the meters.

After wiring, check to see that all connections are soldered and that no accidental short circuits have been created. Take the audio/power supply module and mate it with the i.f. module. Do not plug in any of the tubes in the new module, but turn on the a.c. power and see if the AM S-meter reads full-scale. If it does not, turn off the power and adjust *R34* until it does. Less than a full-scale meter reading means that the value of *R34* is too high.

Alignment. A signal generator and a VTVM are required to align the i.f. module of the VHF ADVENTURER properly. If you do not have these two pieces of test equipment, try to borrow them from a fellow experimenter or local ham. They will be required again to align the 30-50 mc. converter module which will be discussed next month.

Start the alignment procedure by plugging in *V6* (not *V4*, *V5* or *V7*); setting the r.f. gain, *R39*, to maximum (wiper closest to *R13*); a.f.c. switch *S2* to off; a.v.c. switch *S3* to on; and the AM-FM switch, *S4*, to AM. Connect the signal generator through a 0.001- μ f. coupling capacitor to pin 4 of i.f. transformer *T3*. Set the generator to 4.5 mc. with about 50% audio tone modulation output.

Now connect your VTVM to the junction of *R27* and *R29*; this is the a.v.c. "take-off" point. Set the VTVM for -d.c. volts and adjust the generator r.f. output and VTVM scale for a discernible reading. Set the audio gain control, *R41*, to a comfortable aural setting. With a plastic hex alignment tool, adjust the top and bottom slugs of *T3* and the bottom slug of *T4* for maximum VTVM indication. You will find it necessary to readjust the generator, VTVM, and audio as the i.f. transformers come into alignment.

Turn off the power and plug in *V5*. Move the signal generator connection (with coupling capacitor) to pin 4 of i.f. transformer *T2*. Turn on the power and, after the tubes heat up, tune the top and bottom slugs of *T2* for a maximum VTVM reading. Now go back and retune *T3* and the bottom slug of *T4* for maximum output. Finally, shift back and forth among all five tuning adjustments until you're satisfied the second i.f. stage is aligned.

Repeat this process after plugging in *V4* and connecting the signal generator to pin 4 of *T1* or pin 2 of *J3*. Keep reducing the output from the signal generator to be sure that the i.f. stages are "on the nose" and not swamping the a.v.c. line.

Then insert tube *V7* and set *R32* to maximum resistance. Disconnect the signal generator and switch *S3* to off. You should now be able to zero the AM S-meter by carefully setting *R32*. Once the S-meter is set on zero, re-connect the signal generator to *J3*, switch *S3* to on, and observe whether the meter deflects upwards. If you wish, you can safely use the S-meter to align all i.f. transformers except the top slug adjustment of *T4*.

Rotate the BFO control on the audio module and set the knob pointer to approximately mid-scale. Keep the signal generator on and tune *C57* until a beat note is heard. Set *C57* so that zero-beat occurs at the mid-scale point.

Turn the BFO off and, with a fairly strong signal coming from the signal generator, slowly rock the generator above and below 4.5 mc. by about 100 kc. The needle of the FM tuning meter (*M2*) should vary from its center position to follow this rocking action. Now repeak the signal generator to 4.5 mc. by observing the S-meter and prepare to tune the top slug of *T4*.

Adjust the last slug (top of *T4*) until the VTVM and FM tuning meter are both set on zero. This point should occur simultaneously if all the i.f. stages are in alignment. Rock the signal generator back and forth to double-check this adjustment—the two meters should swing in the same rhythm.

Problems. It's possible that some self-oscillation or regeneration may appear in the i.f. strip as alignment is taking place. This trouble results from the use of high-gain tubes and the minor wiring differences that may exist between the author's prototype and your model. Regeneration is an indication of unwanted coupling between stages or between the input and output connections of the same stage. Generally, the problems in the VHF ADVENTURER i.f. strip can be solved by additional B-plus bypassing or changing the lead dress.

Wire your i.f. strip without the 0.01- μ f. and 0.1- μ f. capacitors shown as "See Text" in the schematic and photographs. You may not need them. However, if regeneration does occur, solder them into the circuit in the positions shown.

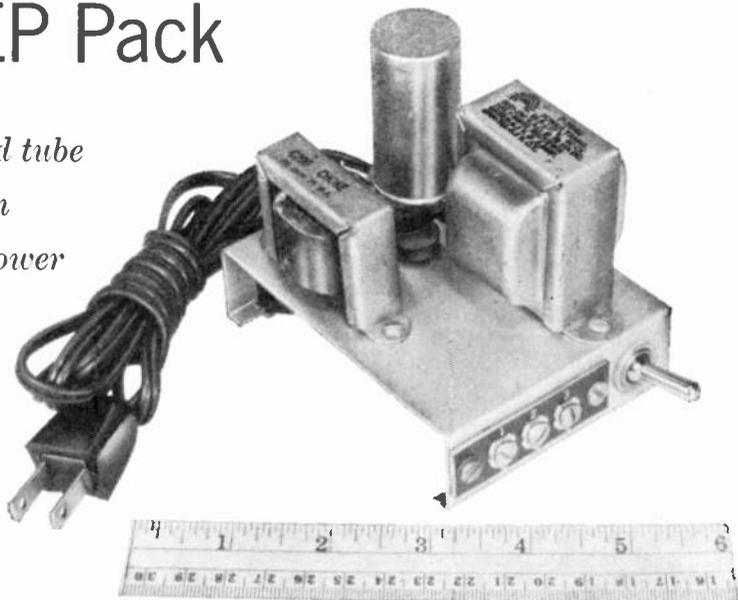
Finishing Up. Once again a perforated chassis cover dresses up the module. Cut it out of Reynolds aluminum stock sold in numerous hardware stores. Decals may be applied to the panel switches using any one of the various sets of dry transfers which are becoming so popular.

Set the two completed modules aside to wait for the 30-50 mc. converter which has bandswitching and tunes the 20-mc. frequency range in two bands.

(To be continued next month)

Handy EP Pack

Like to breadboard tube circuits? Here's an Experimenter's Power pack that makes it easy



By E. G. LOUIS

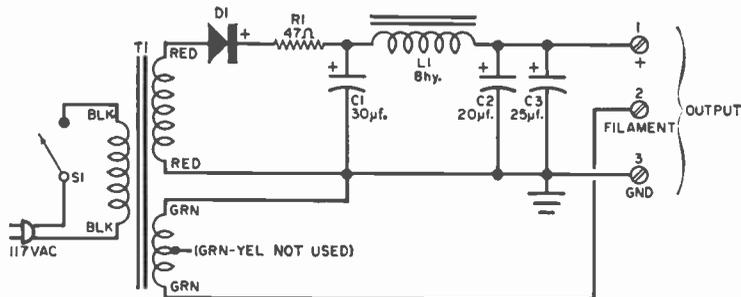
ONE OF THE BIG REASONS transistor circuits are popular with experimenters is that the only power supply required is a small battery. Tubes can do a number of jobs better than transistors, however, and if you take an hour or two to assemble this simple supply, your power problems for one- and two-tube circuits will be ended.

Since the EP Pack is a medium-voltage supply, a rather elegant filter section can be used without straining the budget; in any case, the junk box should provide numerous substitutions. Transformer *T1* (Merit P-3046 or equivalent) delivers 150 volts at 25 ma., and 6.3 volts at 0.5 ampere. A half-wave rectifier circuit is used with a 50-ma., 300-PIV (or better) silicon rectifier (*D1*). Resistor *R1*—1 watt will suffice—prevents surge damage to *D1* as *C1* charges. The filter capacitors (*C1*, *C2*, *C3*) are all in one multi-section can, and should be rated at 250 w.v.d.c. Use an 8-henry choke for *L1* (Stancor C1355). The only other parts required are a small chassis, tie points, a s.p.s.t. toggle switch, and a three-terminal, screw-type terminal strip.

Mount the major components, placing the capacitor can so that it is not in direct contact with the heat-producing transformer. Also, some degree of separation between the choke and transformer should be maintained to prevent hum coupling. The wiring under the chassis is connected to standard tie points. Be sure to observe capacitor and rectifier polarities; use a heat sink when wiring the rectifier.

If the supply will not be connected to a constant load, add a bleeder resistor (60,000 ohms, 2 watts) between terminals 1 and 3 (the B-plus and ground terminals). If isolated filament output is desired, a four-screw terminal strip can be used—five screws if the filament winding of the transformer employed has a center tap. A neon pilot lamp can be connected across *T1*'s primary, and another optional feature would be a 1/2- or 1-amp fuse connected in one leg of the primary.

Simple power supply for experimenting with tube circuits is cinch to build, and can usually be put together with junk box materials. If you use a higher voltage transformer, you must rate other components accordingly.





BRIDGE

By FRANK A. PARKER

Having trouble reading the markings on your junk box capacitors? The C Bridge will enable you to measure them more accurately than the maker marked them.

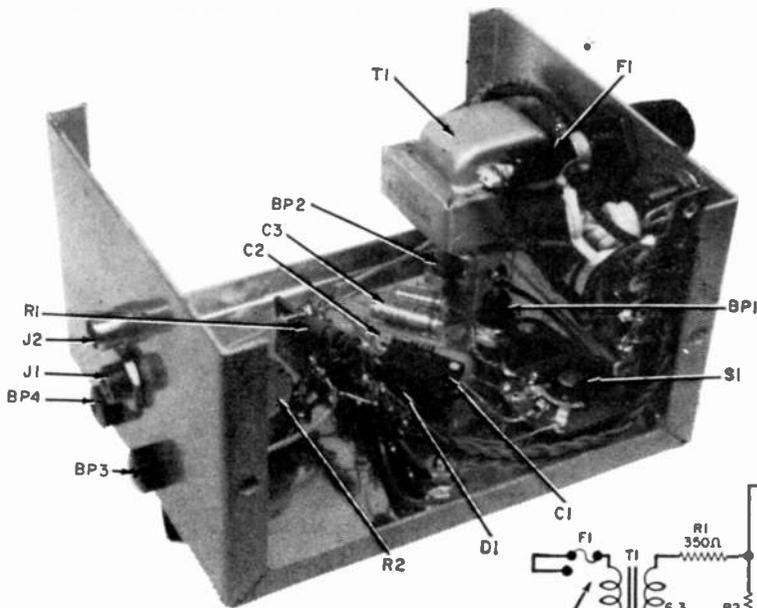
MOST OF US have many capacitors gathering dust in the junk box because the markings can't be read. It's easy to measure the values of the unknowns if you have access to a capacitance bridge, but most such instruments come high, due to the wide range, sensitivity, and accuracy that must be provided in a laboratory instrument.

For those who can't afford so much frosting on their technical cake, the "C Bridge" will do the job very well. And you can make the accuracy high enough to yield far closer values than the maker puts on ordinary bypass and coupling capacitors. Best of all, since no sensitive null detector is built in, you can construct the C Bridge for about \$12.00, even if you buy all new parts. If your

junk box contains a few of the common parts needed, you can easily cut that cost in half.

How It Works. Any bridge works by comparing the signal voltage across the unknown part with the same signal across an adjustable known part that is accurately calibrated. The C Bridge is no exception, but by using a null indicator that you already have on hand, and making the a.c. line provide the bridge signal, a lot of the cost of the precision lab bridge is avoided.

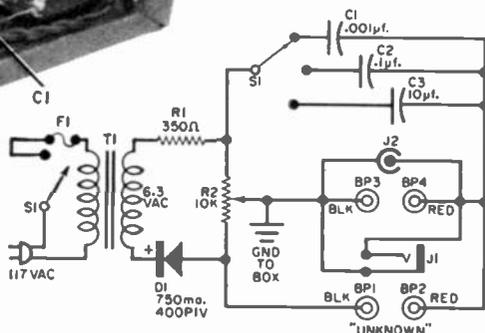
The bridge circuit consists of potentiometer *R2*, the "known" capacitor selected by switch *S1*, and the unknown capacitor connected between binding posts *BP1* and *BP2*. Notice that *R2* actually forms two arms of the bridge



Label positions of range switch S1 "x.01," "x 1.0," and "x 10.0." Use capacitors of known value singly and in parallel combinations to calibrate your C Bridge. By borrowing or buying a few 5% capacitors, you can give your scales greater accuracy.

---PARTS LIST---

- BP1, BP2—Universal binding post (one black, one red)
 - BP3, BP4—Insulated pin jack (one black, one red)
 - C1—100- μ f., 200-volt silver mica capacitor—see text
 - C2—0.1- μ f., 200-volt Mylar or paper capacitor—see text
 - C3—10- μ f., 25-volt electrolytic capacitor—see text
 - D1—750-ma., 400-PIV silicon diode
 - F1— $\frac{3}{8}$ -ampere, 250-volt type 3AG fuse
 - J1—Open-circuit phone jack
 - J2—Phono jack, RCA type
 - R1—350-ohm, $\frac{1}{2}$ -watt carbon resistor
 - R2—10,000-ohm, linear taper, carbon element potentiometer (Ohmite CMU-1031 or equivalent)
 - S1—Single-pole, 3-position rotary switch
 - T1—6.3-volt, 0.6-ampere filament transformer
 - 1—5" x 4" x 3" aluminum utility box
 - Misc.—Hardware, knobs, terminal strips, wire, solder, etc.
- Note: Four 0.0001- μ f. and four 0.01- μ f. capacitors for use in calibration may be required if capacitors of known value are not at hand



of transformer T1 is that many inexpensive earphones don't reproduce a 60-cycle signal very well.)

The signal voltage across the known and unknown capacitors in series will be divided according to their relative capacities. By adjusting the arm of potentiometer R2, a point will be found where the voltage is the same as the voltage at BP4, the common point of the known and unknown capacities. In a pair of headphones plugged into J1, this will be heard as a "null" point, at which the signal disappears. Once the dial scale of the potentiometer is calibrated, the value of the unknown capacitor can be read from the scale as fast as you can find the null point.

Construction. All parts of the circuit mount in the cover portion of the box. There is nothing electronically critical about the parts layout, but potentiometer R2 should be located so that the calibrated scale can be made relatively large and easy to read. The writer's layout is convenient, but need not be followed exactly.

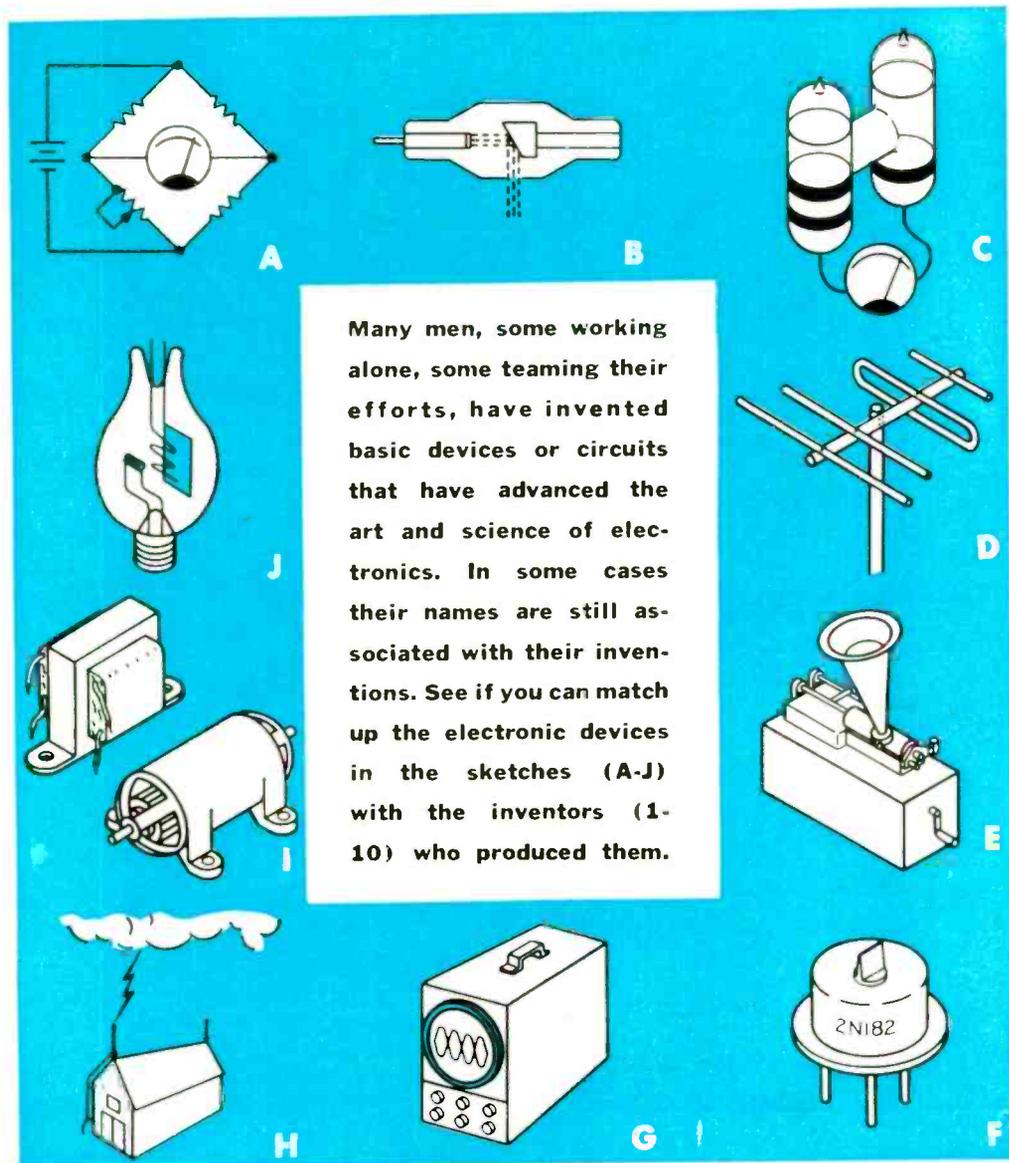
First drill and deburr all the holes
(Continued on page 109)

circuit, since its moving contact is grounded, and the signal is connected across the whole resistance element of R2.

The signal? That's a harmonic of the 60-cycle a.c. line frequency generated by diode D1. It's mostly the 180-cycle third harmonic, since diode D1 acts as a half-wave rectifier, but the exact frequency does not matter very much, as long as it can be heard in headphones or measured with a multimeter or VTVM. (The reason for not using the 60-cycle line frequency from the 6.3-volt secondary

ELECTRONIC INVENTORS QUIZ

By ROBERT P. BALIN

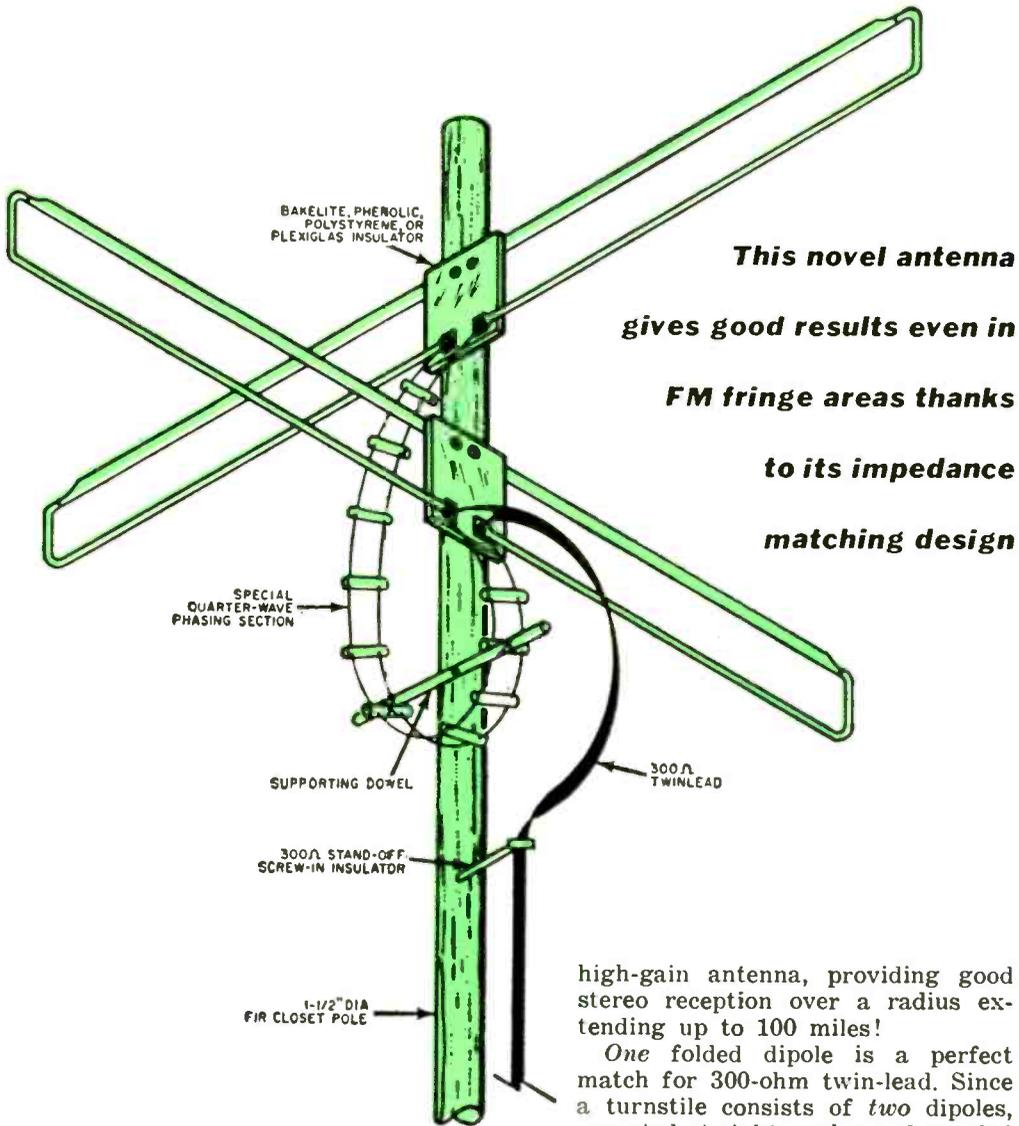


(Answers on page 92)

- 1 Bardeen, Brattain, and Shockley _____
- 2 De Forest _____
- 3 Edison _____
- 4 Faraday _____
- 5 Franklin _____

- 6 Lissajous _____
- 7 Roentgen _____
- 8 Weston _____
- 9 Wheatstone _____
- 10 Yagi _____

Build a Turnstile



This novel antenna gives good results even in FM fringe areas thanks to its impedance matching design

high-gain antenna, providing good stereo reception over a radius extending up to 100 miles!

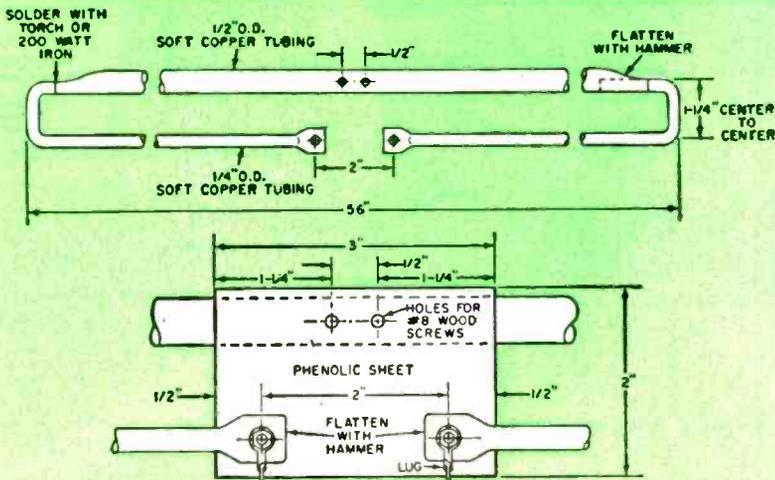
One folded dipole is a perfect match for 300-ohm twin-lead. Since a turnstile consists of *two* dipoles, mounted at right angles and coupled through a special quarter-wave phasing section, the common feed-point is a match for 150-ohm line, and the use of twin-lead gives a 2:1 mismatch. Fortunately, there's a way out of the dilemma: Increase the impedance of each of the folded dipoles to 600 ohms by making them with conductors of unequal diameter, and couple them with 600-ohm line for a 300-ohm output.

The folded dipoles are made of soft

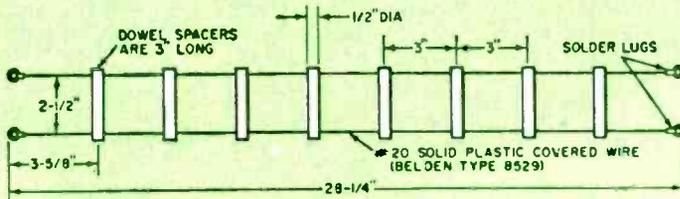
IN MOST locations, good stereo requires a good antenna. Widely separated FM stations pose another problem—an antenna with a rotator or an omnidirectional antenna is required. Turnstile antennas, available commercially, are omnidirectional; unfortunately, for reasons which will become apparent, they rarely give as much gain as they should. The version described here, thanks to its design, is both an omnidirectional and

for Stereo

By **FREDERICK J. HAINES, W2RWJ**



Unique construction of two folded dipoles using $\frac{1}{4}$ " and $\frac{1}{2}$ " soft copper tubing gives them an impedance of 600 ohms each, 300 ohms when coupled together. Hammer the tubing together and solder. Mount ends to insulators (see text), and connect 300-ohm twin-lead and/or phasing section. Quarter-wave phasing section is $28\frac{1}{4}$ " of open wire line spaced $2\frac{1}{2}$ " apart with dowels. Use #20 plastic-covered wire, and spray line with acrylic spray.



NOTE: SPRAY ENTIRE ASSEMBLY LIBERALLY WITH ACRYLIC SPRAY

copper tubing, available at hardware and plumbing supply stores, which is easy to work and solder. Materials required are 112 inches of $\frac{1}{2}$ "-o.d. copper tubing, 117 inches of $\frac{1}{4}$ "-o.d. copper tubing, a 10' closet pole $1\frac{1}{2}$ inches in diameter, a $\frac{1}{8}$ " sheet of polystyrene or other insulating material from which to cut two 3" x 3" antenna insulators, 3 feet of $\frac{1}{2}$ " wood doweling, 6 feet of #20 plastic-insulated wire, spar varnish, acrylic spray, TV standoff insulators, and hardware (brass screws and bolts should be used).

Cut antenna alignment notches at right angles and 3 inches apart in the closet pole for the top elements of the two dipoles; give the pole two coats of

spar varnish. Cut the copper tubing to size for the folded dipoles—hammer the pieces of tubing together before soldering carefully with a small torch or heavy soldering iron. Then give the joints several coats of acrylic spray.

Make up the phasing section, cutting the doweling into 3" lengths, and notching the ends so the two wires will be spaced $2\frac{1}{2}$ inches apart. Spray it with several coats of acrylic spray (but do not spray the connecting ends).

Finally, mount the two dipoles with four #8, $1\frac{5}{8}$ " brass screws through the insulators and copper tubing. Bolt the bottom sections to the insulators, using additional nuts to secure the phasing line and lead-in.

Hobnobbing
with
Harbaugh



"Dah-dit-dit, dit-dah, dah-dit-dit, dah-dit-dit, dah-dit-dah-dah!"

Those Happy Happy Hams



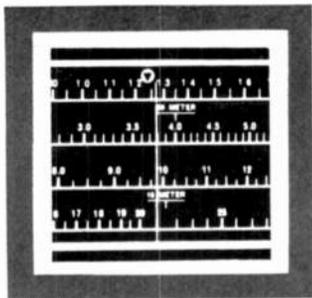
"Well, tell VK2AX it isn't 12 noon here!"

"The electric company would like you to QSL them \$200.00."

"Wait a minute . . . he's lowering your antenna."



POPULAR ELECTRONICS



Across the Ham Bands

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

ARRL SWEEPSTAKES—1963

WANT to make a load of new contacts? Think you can pick off hundreds of fast QSO's in the 50 states of the U.S. and Canada's seven provinces in just two hectic week ends on the lower ham bands? Would you like to add a couple of states to your total for the 6-meter and higher bands? If all this sounds good to you, be on deck for the 30th annual ARRL Sweepstakes contest, scheduled for the November 9-11 and 16-18 week ends. Regardless of the license you hold—Novice, Technician, or Conditional/General—there's something in the Sweepstakes for you, even if you don't capture one of the high-scorer certificates that go to the winner in each of the 73 ARRL sections.

Contest Rules. The contest begins at 2300 GMT (6:00 p.m., EST) Saturday, and ends at 0801 GMT (3:01 a.m., EST)

Monday, on both week ends. You may operate a maximum of 40 hours on all frequencies authorized by your license, using either c.w. or phone, or both (but in this case, you must file two separate logs), as you choose. To take part, you exchange contest "preambles" with as many other stations as possible in the 73 ARRL sections. (These are listed on page 6 of any issue of QST.) The contest preamble you transmit consists of these six parts: (1) sequential number of the contact; (2) station call; (3) your RST signal report of the station you work; (4) name of ARRL section you are in; (5) Greenwich Mean Time of the contact; and (6) the date.

The sequential number is merely the number you assign to each contact consecutively as you make it, beginning with 1, 2, etc. The sequential number

Novice Station of the Month

When this picture was taken, Brian Hayek, WN9FAB, La Crosse, Wis., had contacted 41 states with his well-equipped Novice station. Brian is shown here keying his Heathkit DX-60 transmitter via the Hammarlund HK-1B transistorized electronic keyer on top of the transmitter. His receiver is a Hallicrafters SX-110, and a 40-meter dipole antenna completes the installation. For submitting this photo in our Novice Station of the Month contest, Brian will receive a one-year subscription to **POPULAR ELECTRONICS**. If you want 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 your operating achievements. Even if you don't win, we'll try to publish your picture as space permits. All entries should be sent to Herb S. Brier, Amateur Radio Editor, **POPULAR ELECTRONICS**, P. O. Box 678, Gary, Indiana.





It took Jim Landers, WN2DIA, Bronx, N. Y., nine months to work 34 states on 40 meters. Then he tried 15 and worked 5 countries in two weeks. His antenna is a 40-meter dipole.

you transmit will not be the same as the one you receive, except by coincidence, for the first station you contact may have you for his fifth contact, or fiftieth, for that matter.

Scoring. You earn one point for each preamble sent and another point for each one received. Your total score is the number of points earned multiplied by the number of sections worked, and multiplied again by a power multiplier. If your transmitter power doesn't exceed 150 watts at any time during the contest, your power multiplier is 1.25 on c.w. and 1.5 on phone. If you run over 150 watts, the multiplier is 1.

The ARRL will award certificates to the highest scoring phone and c.w. stations in each ARRL section. In addition, separate Novice and Technician certificates will be awarded in each section in which there are three or more Novice or Technician entries. The ARRL will also award certificates to the highest scoring phone and c.w. stations in any club in which three or more club members submit scores and identify the club to which they belong.

You send your score to The American Radio Relay League, Inc., 225 Main St., Newington 11, Conn. A request to the same address will bring you a supply of Sweepstakes log sheets, which will simplify logging and reporting your score.

Making Contacts. To participate in the contest, you simply call "CQ SS" on c.w. or "CQ Sweepstakes" on phone and also answer such calls. When you make a contact, be brief; send your contest in-

Flora Strickhausen, WA5DPU (formerly WN5DPU), of Galveston, Texas, ran up a total of 41 states, the Canal Zone, Canada, Mexico, Puerto Rico, and Venezuela, with her Hallicrafters "twins"—the HT-40 and SX-140—and Gotham V-80 vertical antenna.



formation, acknowledge the other station's information, sign off, and immediately try for another contact.

Don't waste time sending your name and address, station description, weather report, etc. The other operator couldn't care less about such details. If he wanted to rag-chew, he wouldn't be in the contest in the first place. If you want to rag-chew, don't call or answer "CQ SS."

Good hunting!

TECHNICAL TIP

If you are fortunate enough to own a surplus BC-221 (or Navy LM) frequency meter but are troubled by very low headphone output, check the audio-coupling choke between the crystal oscillator and the mixer and the output tube for an open winding. If the choke (#30, 450 henries in the BC-221M instruction manual) is open, indicated by an extremely high ohmmeter reading across its terminals, replace the choke.

Finding a replacement that will fit the available space may be something of a chore. One suitable replacement is the United Transformer Company #24, 500-henry, 3-ma. audio choke with a d.c. resistance of 6000 ohms. The UTC #23 choke will also work, but it has an inductance of only 300 henries.

The above tip was sent to us by Harold Reed, Hyattsville, Md.

ARMED FORCES DAY RESULTS

During the 12½-hour communications test on May 18, 1963, a total of 7366 in-

(Continued on page 110)

A Carl and Jerry Adventure in Electronics

The Lightning Bug

By
JOHN T. FRYE
W9EGV

CARL, Jodi, Jerry, and Thelma were parked in a secluded spot on a country road not far from the campus of Parvoo University. It was a beautiful, late-October, Indian summer evening, but their conversation was not of romance.

"You girls ready to be introduced to the Lightning Bug?" Jerry asked.

"It won't hurt us, will it?" Thelma inquired nervously.

"Of course not!" Jodi scoffed. "I told Carl and Jerry we needed something unusual that would sort of uncurl the Toni's of those pledges we're initiating tomorrow night, and they spent their whole week end at home building this—this thing. We're ready, Jerry."

Jerry turned off the headlights, and Carl took a bulky object from the trunk and carried it several yards down the road in front of the car and placed it on the black-topped surface. Then he returned to his place in the back seat with Jodi.

When Jerry flipped the headlights back on, the thing in the beam of light instantly came to life. It lumbered around in a little half-circle and headed for the car with an odd, hunting, zigzagging motion. Snapping sounds like the clicking of teeth came from it, and the rear part of its body glowed intermittently after the fashion of a lightning bug. The closer it came, the faster it moved, and Thelma, sitting beside Jerry, let out a little shriek.

Jerry turned the headlights off again, and immediately the strange object halted and sat there in front of the car, completely silent and motionless.

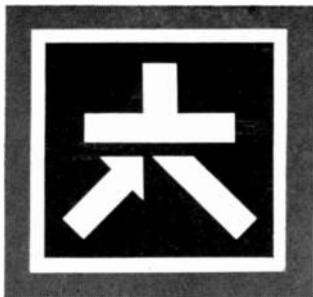
"Here, take this flashlight and walk around on the other side of the Lightning Bug and turn the light on it," Carl instructed Jodi.

A little hesitantly, Jodi got out of the car and walked in a very wide circle



around the silent object in the road. Finally, from a distance of several yards, she turned the beam of the powerful flashlight on it. Immediately the body began to pulse with light, and the thing wheeled around and started for her. She started backing up, but it picked up speed and began to gain on her.

(Continued on page 94)



Transistor Topics

By LOU GARNER, Semiconductor Editor

OUR *Transitips* discussion on AM wireless microphones (July, 1963) brought forth a number of letters from readers asking for our "favorite" circuit. This is a difficult request to comply with, for we don't have a favorite design. Your Semiconductor Editor has personally tried a number of different circuits in the past and, in most cases, has been able to obtain satisfactory results by adjusting component values.

One circuit that has given good results is illustrated in Fig. 1. Inexpensive, readily available components are employed and the instrument can be assembled quite easily into a case no larger than a package of king-size cigarettes. The resulting "Home Broadcaster" can be used for fun at parties or in similar applications. Its range is limited, in keeping with FCC regulations, yet ample for use around the house.

Referring to the schematic diagram, transistor *Q1* serves as the r.f. source, while *Q2* acts both as an audio amplifier and modulator. Transistor *Q1*'s base bias is established by *R1*, bypassed by *C1*, with *Q2*'s base bias provided through *R2*, bypassed by *C6*. The common-emitter configuration is used in both stages. A single battery (*B1*) supplies power to both transistors, which are connected *in series* as far as the d.c. source is concerned.

Transistor *Q1* operates as a "tickler feedback" oscillator. The operating frequency is determined by the tuned circuit made up of *C3* and *T1*'s primary winding. The *T1* secondary winding provides the feedback necessary to start and sustain oscillation. Capacitor *C4*, in *Q1*'s emitter-collector circuit, serves to "swamp" the transistor's interelectrode capacities and thereby to minimize frequency modulation. The r.f. is coupled to the antenna through *C2*.

Sound waves striking the crystal microphone are converted into electrical signals which are applied to *Q2* through matching transformer *T2*. Since *Q1* and *Q2* are in series, *Q1*'s emitter current is the same as *Q2*'s collector current and varies in the same way. Thus, the r.f. signal developed by *Q1* is amplitude-modulated in accord-

ance with the amplified audio signal delivered by *Q2*. Capacitor *C5* serves as an r.f. bypass in *Q1*'s emitter circuit to prevent interaction between r.f. and audio stages.

Although the instrument is small, it is easily assembled, for the miniature parts leave plenty of elbow room for wiring. If you have average skill, you can duplicate this unit in one or two evenings.

Resistors *R1* and *R2* are rated at one-half watt. Capacitors *C1* and *C5* are disc ceramics, while *C2*, *C3*, and *C4* are tubular ceramics. Capacitor *C6* is a 15-volt electrolytic, and any value from 10 to 20 μ f. will give good results. Coil *T1* is a standard transistor oscillator coil; a Lafayette MS-165 was used in the model, but similar coils will work as well. The audio transformer, *T2*, is an Argonne AR-129 and has a 50,000-ohm primary and 1000-ohm secondary. The microphone may be any standard crystal microphone cartridge. Battery *B1* is a miniature 15-volt unit (Burgess Y10) and a s.p.s.t. slide-type power switch is used for switch *S1*.



Easy-to-assemble wireless microphone in miniature case gives good results when used around the home. All components are both inexpensive and readily available.

Almost any *pnp* r.f. transistor will do for *Q1* . . . typically, a CK760, 2N394, or 2N409. Transistor *Q2* is noncritical also, and a variety of *pnp* audio types may be used here—a CK722, 2N107 or 2N402, for example. Depending on the exact transistors used, results may be improved by experimenting with different values for bias resistors *R1* and *R2*.

The unit shown was assembled in a standard plastic box measuring $2\frac{5}{8}$ " x $3\frac{5}{8}$ " x $1\frac{1}{4}$ " over-all, and a small piece of perforated phenolic sheet was used as a "chassis." The layout can be modified to meet individual needs. Major components are

mounted with either general-purpose cement or small machine screws and nuts.

Use a small, clean soldering tool, pre-tin lead wires, and take the normal precautions against overheating the transistors. Do not install the transistors or battery until all wiring is completed. Identify the positive terminal of the battery box with a dab of red fingernail polish or enamel.

The antenna consists of an 18" to 30" length of #12 or #14 busbar soldered to a small lug and attached to the case with a small machine screw and nut. Its exact length is not critical but, in general, the longer the antenna, the better the radiation.

A flexible lead may be substituted if preferred.

Once the wiring is completed and double-checked for errors, the antenna, battery and transistors can be installed. Afterwards, the instrument should be adjusted in accordance with the following standard procedure.

(1) Turn on a standard AM broadcast-band receiver and tune to near the middle of the band (around 800 kc.) where there is a "dead" spot (no stations received). Adjust the volume control to maximum.

(2) Holding the instrument in your hand about 3 to 6

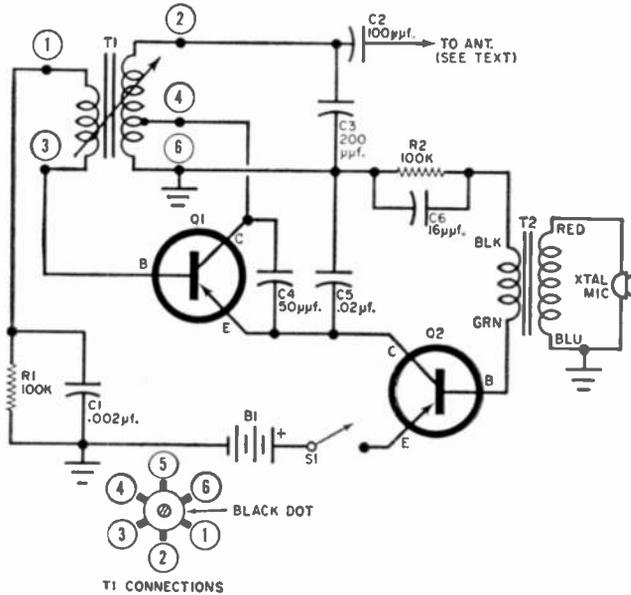
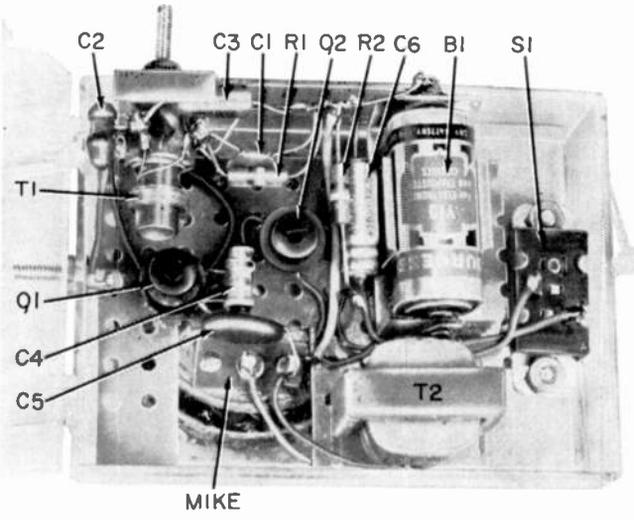


Fig. 1. Two *pnp* transistors are connected in series in wireless microphone circuit. Changing value of *C3* shifts tuning range; a smaller capacitor raises operating frequency, a larger one lowers it. Note uncrowded layout in photo at left.



inches from your mouth, flip the power switch (*SI*) "on."

(3) Whistle, sing or count while adjusting *T1*'s "slug." Adjust the slug slowly, listening for a signal from the receiver.

(4) When you hear your voice coming from the receiver, adjust the slug for clearest and loudest reception, then move farther away from the broadcast set, readjusting the slug for best results.

Coil *T1*'s slug provides a moderate range of frequency adjustment, but does not cover

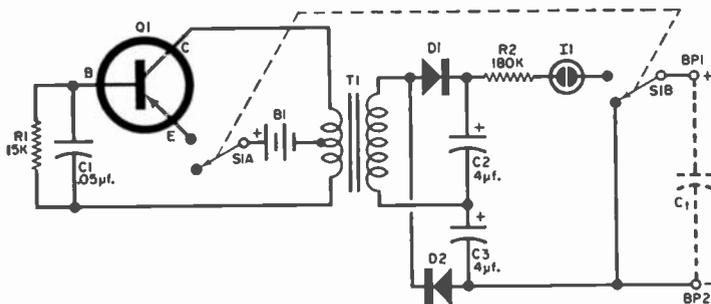


Fig. 2. "Condenser leakage tester" circuit sent in by reader Melvin Hyatt supplies over 100 volts d.c. for checking capacitors rated at 150 volts or more.

the entire band. To shift the tuning range, change the value of $C3$. A smaller capacitor raises the operating frequency; a larger one lowers it. Unless the lower end of the broadcast band is well-filled with stations in your locality, you'll find you can obtain better results by keeping to frequencies below 1000 kc. Typical values for $C3$ range from 50 $\mu\text{f.}$ to 350 $\mu\text{f.}$

Reader's Circuit. With their low voltage and power requirements, transistors are ideal components for battery-operated and portable test instruments. Many readers have recognized this fact and used transistors in signal generators, test amplifiers, signal tracers and similar instruments. One interesting instrument application is illustrated in the circuit of Fig. 2. Submitted by reader Melvin T. Hyatt (2810 W. 73 Terrace, Prairie Village, Kan.), the device is a *condenser leakage tester*. Although powered by a pair of penlight batteries, the instrument supplies in excess of 100 volts d.c. for checking paper, mica and ceramic capacitors with ratings of 150 volts or more.

Referring to the schematic diagram, a *pnp* power transistor, $Q1$, is used in the common-emitter configuration as a low-frequency oscillator. A standard filament transformer, $T1$, is connected "in reverse," with its center-tapped low voltage winding serving as $Q1$'s collector load and furnishing the feedback necessary to start and maintain oscillation. Transistor $Q1$'s operating power is supplied by $B1$, controlled by one section of d.p.d.t. switch $S1$. The transistor's base bias is established by series resistor $R1$, bypassed by $C1$.

In operation, the a.c. voltage developed by oscillator action when $S1a$ is closed is stepped up by $T1$'s primary (used, in this case, as a secondary winding) and rectified by a conventional voltage-doubler, $D1$ - $D2$ and $C2$ - $C3$. The resulting d.c. test voltage is applied to the tested capacitor (Ct) through current limiting resistor $R2$, a neon test indicator ($I1$) and the control switch ($S1b$). When $S1$ is returned to the "off" po-

sition, $S1b$ connects a jumper across the capacitor under test, discharging it.

Readily available components are used in the instrument. Transistor $Q1$ is an experimenter's power transistor (such as a Motorola 2N554). Transformer $T1$ is a 1- or 2-ampere, 6.3-volt filament transformer, $R1$ and $R2$ are half-watt resistors, $C1$ a small paper or ceramic capacitor, and $C2$ and $C3$ are oil-filled 200-volt "bathtub" paper types. The diodes, $D1$ and $D2$, are GE 1N538's. Test switch $S1$ is a d.p.d.t., spring return, toggle, push-button or lever type. Almost any small neon bulb can be used as test indicator ($I1$) . . . typically, an NE-2 or NE-51. Insulated binding posts $BP1$ and $BP2$ serve as output terminals, while power is supplied by a pair of penlight or flashlight cells connected in series ($B1$).

With neither layout nor lead dress critical, the *condenser leakage tester* may be assembled in a wood, plastic, or metal case, depending on individual preferences. A small Minibox makes an ideal case. Good wiring practice should be followed, of course, with care taken not to overheat the diode or transistor leads when installing these components. While exact component values are not too critical, Melvin cautions against the use of electrolytic capacitors for $C2$ and $C3$; electrolytics have relatively high leakage and may overload the oscillator circuit to the point where it fails to operate.

The completed instrument can be given a professional touch by labeling the control switch and output terminals with suitable decals or nameplates. If decals are used, they should be protected, after application, with a coat or two of clear lacquer.

To test a capacitor, connect it between $BP1$ and $BP2$, then close $S1$. If the capacitor is leaky, $I1$ will light and remain lit as long as the switch is held closed. If the capacitor is in good condition, the neon lamp will not remain lit, although it may flash momentarily in the case of large value capacitors (0.1 to 0.5 $\mu\text{f.}$, for example).

(Continued on page 106)



Monthly Short-Wave Report

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

LIGHTNING STRIKES HCJB

SEVERAL MONTHS AGO we received sketchy information to the effect that HCJB, Quito, Ecuador, had been struck by lightning. We were unable to get any specific details although various reports and our own monitoring indicated that the station was still on the air, but with a considerably reduced signal on some channels. Now we have received the latest issue of *Call of the Andes* which contains the full story.

Some 278 feet of steel came tumbling to

the ground on March 26 when HCJB's long-wave tower was struck by lightning during a violent thunderstorm at Pifo, the transmitter site. A critical supporting cable burned and shortly afterward the giant tower was crumpled on the ground—a mass of twisted steel. Also damaged were the 16- to 19-meter curtain antennas used for broadcasting to Europe.

The total damage was estimated in thousands, but fortunately no one on the mis-

DX Awards Presented

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

One Hundred Countries

Gerry L. Dexter (WPE0JJ), Minneapolis, Minn.
Mark Alan Weiss (WPE6ETS), Sherman Oaks, Calif.

Seventy-Five Countries

F. R. Cook (VE3PE1WX), Toronto, Ont., Canada
Steve Russell (WPE8CW), Kalamazoo, Mich.
Marlin A. Field (WPE8FRE), Benton Harbor, Mich.

Fifty Countries

Robert L. Rankin (WPE4CBX), Tifton, Ga.
Jack Lane (WPE9EVU), Lafayette, Ind.
Steven Shook (WPE4FFO), Lexington, Ky.
Owen Williamson (WPE0BBSL), Minneapolis, Minn.
Mike Flomp (WPE2IXH), Valley Stream, N. Y.

Twenty-Five Countries

Warren Nordgren (WPE9DGI), Waukegan, Ill.
Larry Tompkins (WPE2INO), Long Island City, N. Y.
Tommy N. Thompson (WPE9FHP), Jeffersonville, Ind.
Jack J. Carr (WPE8CCF), Cincinnati, Ohio
Percy G. Miller (WPE3EWQ), Fullerton, Pa.
John J. Watermeier III (WPE5CCN), New Orleans, La.
George H. Seaman (WPE2BAG), Maple Shade, N. J.
Bruce J. Brown (WPE9CVN), Skokie, Ill.
Sheldon Daitch (WPE4EDU), Louisville, Ga.
Pat Montgomery (WPE8EEW), Cincinnati, Ohio
Denis O'Keefe III (WPE0CLL), Omaha, Nebr.
Louis Rappaport (WPE4EOH), Miami, Fla.
Dieter O. Kaetel (WPE7IA), Seattle, Wash.
Warren Hunter (WPE3DHY), Arlington, Va.
Kenneth Shafer (WPE9DCK), Whitestown, Ind.

Paul Rubinfeld (WPE2JBK), Millburn, N. J.
Claude Schwesig (VE2PE1CM), Verdun, Que., Canada
Robert Nardini (WPE2IVU), North Bergen, N. J.
Garry C. Hess (WPE3CXT), Washington, Pa.
Michael Wilson (VE6PE4N), Calgary, Alta., Canada
Victor Perla (WPE2IBQ), North Bergen, N. J.
Paul Herman (WPE6EKB), Montebello, Calif.
Emil Vandevelde (WPE2KHS), Oakland, N. J.
Roy Moore (WPE4FHH), Hazard, Ky.
George Oppgard (WPE3LI), New Castle, Del.
Alan Trainer (WPE4GCF), Memphis, Tenn.
Cecil Waugh Jr. (WPE0CKU), St. Joseph, Mo.
Barry Tepperman (VE3PE1SD), Toronto, Ont., Canada
David Brown (WPE6EMI), Woodland Hills, Calif.
Steven K. Molnar (WPE8AFX), Elyria, Ohio
David Mark Reed (WPE4FCL), Raceland, Ky.
William McGrath (WPE1FBH), Norwich, Conn.
Robin Martin (WPE2GEF), Glen Head, N. Y.
Joseph C. Perez (WPE6LN), Santa Clara, Calif.
Joseph L. Snyder (WPE3BDU), Baltimore, Md.
Ken Rusnak (VE3PE1XL), Port Arthur, Ont., Canada
James Jackson (WPE7BSN), Reno, Nev.
Herbert Keesecker (WPE8FAX), Cortland, Ohio
John Long (WPE3CYU), Lebanon, Pa.
Michael C. Clapshaw (WPE7BSJ), Port Angeles, Wash.
Robert Reinecker (WPE3BZK), Coraopolis, Pa.
Howard G. Bogrow (WPE8ANI), Detroit, Mich.
David L. Borino (WPE7EZ), Cheyenne, Wyo.
A. L. Pelletier (VE3PE1VD), Toronto, Ont., Canada
Richard Shannahan (WPE2GJC), Binghamton, N. Y.
Craig F. Anderson (WPE9BTA), Orono, Maine



The impressive line-up of units in the listening post of Grant Power, VE2PE6K, Montreal, Quebec, includes a National NC-57 receiver with an Explor-Air as a stand-by, VHF converter for 136 mc., Gonset G-15X transceiver, and tape recorder. Grant is a commercial radio operator with the calls XM52470 (base) and XM52210 (mobile). As an SWL, he has 32 countries confirmed so far. His antenna farm is even more impressive—it contains a 90' inverted L, 40-meter Windom, a quad for 2 and 6, a 20-meter dipole, 33' vertical, and ground planes for 10 and 11.

sionary staff was injured. The missionary engineers (Phil Turrel, Art Larson, and Bob Moore) and national employees immediately started to repair the damage. Until the job is finished, however, they will be using a temporary long-wave antenna which can handle only about half the power normally used. Normal functioning on 16 and 19 meters to Europe is possible thanks to antenna repairs already completed.

This would seem to be a good time to emphasize to our readers that their receiving antennas should be protected against lightning. A lightning bolt striking an antenna can cause far more damage than the loss of the antenna wire—property and lives may be lost also. Granted, this particular time of year is not conducive to thunderstorms, especially in the northern half of the country, (Continued on page 101)

ENGLISH-LANGUAGE NEWSCASTS TO NORTH AMERICA

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

COUNTRY	STATION	FREQUENCY (kc.)	TIMES (EST)
Australia	Melbourne	17,840, 15,220 9580	2030, 2130, 2330 0745
Bulgaria	Sofia	6070 (and/or 9700)	1900, 2000, 2300
Canada	Montreal	15,190, 11,720, 9625	1800 (Caribbean)
East Congo	Leopoldville	11,755	1630, 2100, 2230
West Congo	Brazzaville	11,725	2015
Czechoslovakia	Prague	11,990, 9795, 9550, 7345, 5930	2030, 2330
Denmark	Copenhagen	9520	2100, 2230
Finland	Helsinki	15,185	1530 (Mon., Fri.)
West Germany	Cologne	15,405, 11,795 9640, 6160 11,795, 9735, 6145	1010 2035 0000
Hungary	Budapest	11,910, 9833, 7220 9833, 7220	1900 2230
Italy	Rome	9575, 5960	1930, 2205
Lebanon	Beirut	11,770	1630
Netherlands	Hilversum	15,445, 11,950 17,810, 15, 445 15,445, 9715 9590, 5985	1030 (Tues., Fri.) 1415 (Tues., Fri.) 1630 (exc. Sun.) 2030 (exc. Sun.)
Portugal	Lisbon	6185, 6025 (and/or 9740)	2105, 2305
Spain	Madrid	9360, 6130	2215, 2315, 0015
Sweden	Stockholm	17,840 11,805	0900 2045, 2215
U.S.S.R.	Moscow	9740, 9730, 9700, 9680, 9660, 9650, 9620, 9610, 9570, 7320, 7310, 7240, 7200, 7150 (may not all be in use at any one time)	1730, 1900, 2000 2100, 2300, 0040
Vatican City	Vatican City	9645, 7250	1950



Short-Wave Broadcast Predictions

NOVEMBER 1963

BY STANLEY LEINWOLL, Radio Propagation Editor

SINCE January 1963 the basic propagation data on which these predictions are based have been derived from a numerical mapping technique with the aid of an electronic computer. This has increased the accuracy of the information published each month by the Central Radio Propagation Laboratory (CRPL) of the National Bureau of Standards. The computer program and methods for calculating the maximum usable frequency on specific point-to-point paths are described in the recently published "NBS Handbook 90, Handbook for CRPL Ionospheric Predictions." The do-it-yourself DX'er interested in propagation data for paths other than those appearing in the tables below can obtain this handbook for 40 cents from the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C.

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

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

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

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



On the Citizens Band

with **MATT P. SPINELLO**, 18W4689, CB Editor

TO START a Citizens Band radio club is one thing. To orient the attitudes of its members towards a worthwhile goal—and then achieve it—is another matter! In the past year we have spotlighted successful CB clubs in the West, the Midwest, the South and Canada. This month we move to the East Coast and visit the Delaware Valley Citizens Band Association (D.V.C.B.A.).

DELAWARE VALLEY CB'ERS

With headquarters in one of our smallest states (in area only), the D.V.C.B.A. is one of the best organized CB clubs around, and one of the first to start functioning following the FCC's allocation of 11 meters to CB in 1958. The D.V.C.B.A. came into being early in 1960 when most of the equipment used on 11 meters was either home-brew or could be purchased in a brown paper bag from a local distributor. (In case you've forgotten, this bag contained a bundle of parts with a printed schematic and some brief instructions. This was a kit! This was CB!) Just three months short of their fourth birthday, the D.V.C.B.A. now numbers over 150 strong, and it's still growing.

Following a January, 1960, meeting with organization-minded CB'ers from Trappe, Pa., a planning committee was elected. Among those chosen to put the machinery in motion were Delaware CB'ers Bill Young, 3W3140; Chick Dean, 3W1590; Gerry Gastor, 3W1750; and Jim Crosby, 3W2285. Today, the D.V.C.B.A. credits these gentlemen as being the pioneers who started the CB ball rolling in the Delaware Valley.

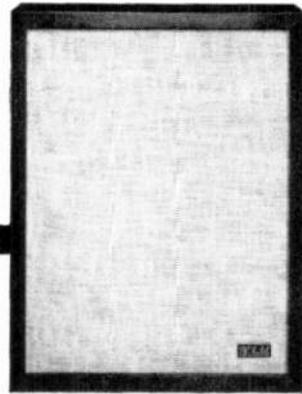
Before the first organizational meeting was held, the planners saw to it that the proposed organization received exposure via radio, newspapers and personal contacts. Before the third meeting was over, members had finalized the club name, bylaws and constitution, rules and regulations, the club motto ("Service Through Unity"), and made information available to new members covering FCC Rules and Regulations, sources of equipment, applications for licenses and literature regarding CB, its uses and applications. They also enlisted the services of an attorney to draw up bylaws, ratified their new constitution, established club dues, set up functional committees and elected officers—in just three meetings!

Originally, the organization was named the Delaware Citizens Band Association, but
(Continued on page 84)

Some of the current officers—there are 13 in all—of the Delaware Valley Citizens Band Association. Twelve committee chairmen and their committees plus a newspaper ("On Frequency") staff complete the administrative roster. The fact that approximately 150 people are working to hold the association together is the main reason for the continuing success of the D.V.C.B.A., which, organized early in 1960, was one of the first CB clubs to get started.



Breaking the 'small enclosure barrier' with... frequency contouring



KLH Model Fourteen
18 x 14 x 3 3/4"
\$49.50*

KLH has introduced a new, small speaker system — the Model Fourteen — designed to reproduce music (a) with the natural, musical, octave-to-octave balance for which KLH speakers are famous, and (b) with more uniform bass than has ever before been possible for a compact speaker system.

There are two major problems in achieving good reproduction in a small speaker — to reduce distortion and to provide decent bass performance. Always, the process of solving one of these problems has intensified the other. To reduce distortion, we need precise control over the movement of the cone. To provide adequate bass output, we need to move large volumes of air. The smaller the cone in relation to the size of the magnet, the more precisely it can be controlled. But the larger the cone, the more air it can push. The customary solution — a separate large speaker for the bass — can not be fully effective in a small enclosure. The unavoidable compromise of these factors in a small speaker system has always meant unacceptable bass performance and/or unacceptable distortion.

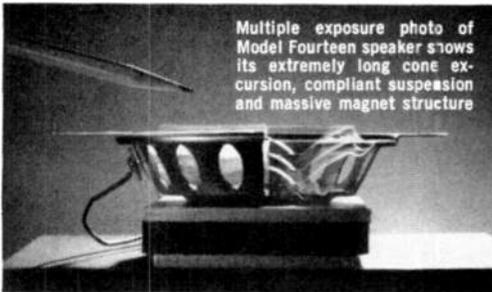
In order to solve these problems, the KLH Model Fourteen embodies a series of vital departures from any speaker system ever produced before. The Model Fourteen contains two extremely compliant speakers. The diameter of their cones is only 3". Yet they are

lem, since the damping effect of the heavy magnet increases at the lower frequencies, tending to restrict the bass output of the speaker. The crucial innovation in the Model Fourteen — designed to extend its bass output while preserving the advantages of a heavy magnet and a small cone — is the first use, in a small multi-speaker system, of the revolutionary technique called frequency contouring. This technique was pioneered by KLH in the now famous Model Eight FM Receiving System and Model Eleven Portable Stereophonic Phonograph. Incorporated in the Model Fourteen is a passive electronic network which has been designed with the speakers as an integrated unit. This network reshapes the power output of any conventional amplifier to match exactly the low frequency power requirements of the speakers, so that their bass output remains flat far below its normal roll-off point. Through the magic of this new technique, it is at last possible to avoid the drawbacks of tweeter, midrange speaker, woofer and crossover networks in a compact speaker system. It is now possible to have all the advantages of a small-diameter, high-compliance speaker and heavy magnet — flawless smoothness throughout its frequency range; clean transparent midrange and highs — and full, undistorted bass performance, too. The KLH Model Fourteen, at any given loudness level within its operating range, will deliver more bass power, at lower frequencies, with less distortion than any other speaker of comparable size or cost.

The unique smoothness and balance of sound quality in the Model Fourteen can only be achieved commercially in a speaker which can be manufactured to duplicate precisely a particular response profile. Only because the speakers used in the Model Fourteen — including their impregnated paper cones and the special miniature rubber-and-cloth suspensions which permit such a long excursion — are designed, manufactured and assembled in our own plant can they be held to the rigid uniformity required to justify the use of frequency contouring. No commercially supplied cones have the necessary uniformity. No other manufacturer of small full-range speakers produces its own cones.

During its development, the Model Fourteen has been tested against every other small speaker system with any claim to respectability, in order to help us define and solve the special problems of the small speaker. The result of this development is a clarity, smoothness and freedom from distortion, a frequency range, dynamic range and bass performance you have never heard before in a compact speaker. You will find that the overall sound quality of the Model Fourteen is not only beyond that of all other compact speaker systems, but also beyond your fondest hopes for any compact speaker.

*Slightly higher west of Rockies



Multiple exposure photo of Model Fourteen speaker shows its extremely long cone excursion, compliant suspension and massive magnet structure

full-range speakers. Their maximum excursion (the forward and backward travel of the cone) is an unprecedented 3/8". This excursion is controlled by the highest ratio of magnet power to cone weight ever engineered into a loudspeaker.

FREQUENCY CONTOURING. The combination of a small speaker with a very powerful ceramic magnet and long excursion provides two great advantages — the precise control over cone movement necessary for freedom from distortion, and the ability to move an ample volume of air. It also creates a new prob-



KLH RESEARCH AND DEVELOPMENT CORPORATION
80 CROSS STREET, CAMBRIDGE 39, MASSACHUSETTS

KLH Research and Development Corporation, P-3
30 Cross Street, Cambridge 39, Massachusetts
Please send information on KLH Model Fourteen
and franchised KLH dealers to:

Name _____
Address _____

Now...new EASTMAN Sound Recording Tapes!



Stop!

Accidents will happen! New DUROL Base provides extremely high tensile and yield strength, yet should equipment failure take place, the tape will break clean without stretch. As a result, splices are made easily, quickly—with minimum program loss.



Look!

New "Lifetime Coding!"

...Your assurance of highest quality! A permanently printed legend continuously repeated on the back of all new EASTMAN Magnetic Sound Recording Tapes (1) identifies Eastman Kodak Company as the manufacturer; (2) provides a convenient means of indexing tapes.

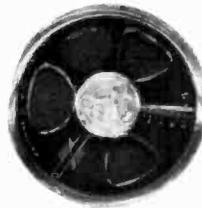
Three important new developments give you sound recording at its best!



Listen!

The new "R-type" binder, a super-smooth, tougher homogeneous oxide layer suppresses tape noise and distortion . . . prevents oxide build-up on the head; at the same time, chemical stability extends longevity. Even more important are the superb magnetic characteristics of the new "R-type" binder dispersions. These make possible two superlative tapes of widely different performance characteristics . . . an extra-low print-through and a high-output low-noise tape.

Remember: It's Eastman for superb sound recording tapes.



For fast loading—extra convenience . . . the unique ultra-handly Thread-Easy Reel with indexing scale and built-in splicing jig.

©Eastman Kodak Company, MCMLXI

For information, see your electronic supplier or write
Magnetic Product Sales

EASTMAN KODAK COMPANY, Rochester 4, N.Y.

Ask for them at leading electronic supply houses: Type A303, a vastly superior low-print tape with output comparable to a fine general-purpose tape . . . Type A304, a high-output tape with remarkably low print-through.



The neat-looking shack at left belongs to Bob Bryant, the D.V.C.B.A.'s president. Bob also serves as civil defense director of Ashton Township, Green Ridge, Pa.



Both state police and fire companies take advantage of the D.V.C.B.A.'s services. The shot above was snapped during "Operation Sky Rocket," at which plans were laid for an emergency net. Fire chief Harvey Grant is the one with the straw hat.



Among the more unusual public service activities of the D.V.C.B.A. is scuba diving. Here, Ray Houck, director of the emergency net committee, instructs various members in proper use of scuba suits and equipment.

avid interest, help and membership from the neighboring states of Maryland, New Jersey and Pennsylvania quickly initiated a change-over to the present name. Besides making possible a larger membership, this move enabled the D.V.C.B.A. to create two-state communications networks. It also brought volunteers from miles around into the fold, insuring the widest possible range of ideas and opinions.

Chick Dean successfully served as president to the rapidly expanding D.V.C.B.A. in its first year. Also serving as club historian, Chick has kept up a detailed record of the club's activities since its organization in 1960. A big factor in the club's successful four years of operation is the number of well-organized committees the D.V.C.B.A. has put into service. Thirteen officers, twelve chairmen, their respective committees, and a newspaper editor, with a staff of writers, make up the administrative roster. When you include the members working with these officers on a dozen different committees, you've got most of the membership involved. This counts—definitely! With every member assigned a duty, an obligation to

participate in building a better organization, chances of failure are slim.

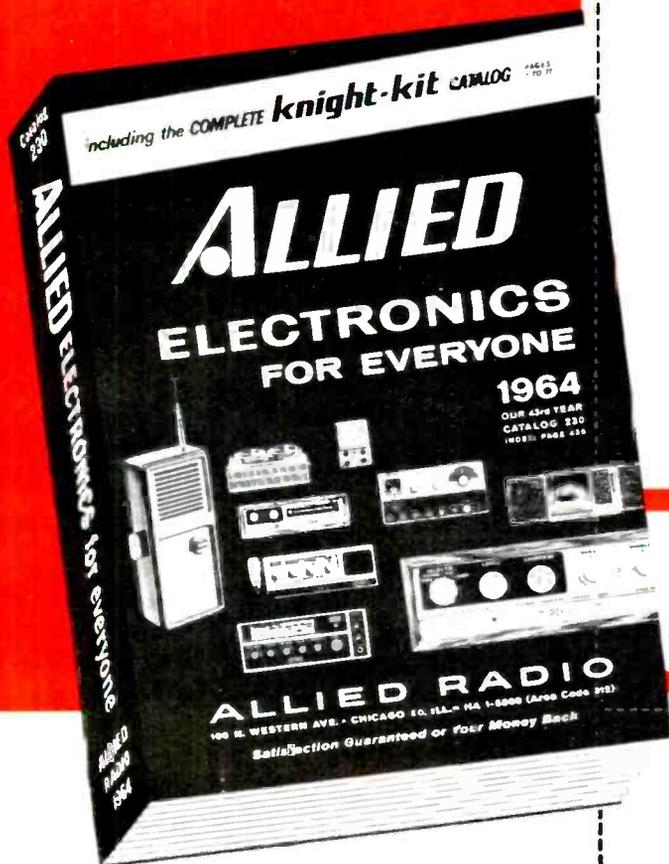
As for paper work, club secretary Bill Young, 3W3140, has headed an able staff of writers since 1960 as editor of *On Frequency*, the club's newspaper. Their efforts have created an excellent publication that is currently exchanged on a monthly basis with clubs throughout the country. Additional paper work, as much a part of the club as the newspaper, involves a series of "Know-How" manuals which detail the specific duties of officers and committee members.

The club also furnishes each member with a set of emergency radio network operating instructions, and a complete record of active, paid-up, and "I.O.U." members. All of this paper work is topped by 18 pages of constitution and bylaws which are available to each member.

As a public service organization, the D.V.C.B.A. has participated in public and civic aid from Christmas to Thanksgiving, year to year. To supplement the regular committees and activities, there are special groups to handle technical advice, emergency net communications, programming

FREE

MAIL NOW



Name _____ PLEASE PRINT
 Address _____
 City _____ Zone _____
 State _____

3-L

YOUR **FREE**
ALLIED
 1964 CATALOG



send for your money-saving

ALLIED 444-PAGE 1964 CATALOG

WORLD'S LARGEST ELECTRONICS CATALOG
BIGGEST SELECTION • BIGGEST SAVINGS!

satisfaction guaranteed or your money back

NO MONEY DOWN: NOW! MORE BUYING POWER
WITH YOUR ALLIED CREDIT FUND PLAN!

Name _____ PLEASE PRINT
 Address _____
 City _____ Zone _____
 State _____

3-L

YOUR **FREE**
ALLIED
 1964 CATALOG



**SEE
 OTHER
 SIDE**

For your FREE 1964 ALLIED Catalog, fill in card, detach and mail. (Please give other card to an interested friend.)

**SEND
 CARD
 TODAY**

MAIL NOW

P.O. Box 4398

To:
ALLIED RADIO
CHICAGO 80, ILLINOIS

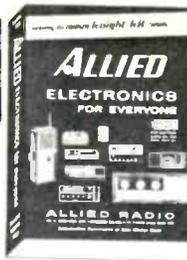
PLACE
STAMP
HERE

P.O. Box 4398

To:
ALLIED RADIO
CHICAGO 80, ILLINOIS

PLACE
STAMP
HERE

MAIL
NOW



FREE SEND TODAY
FOR YOUR
MONEY-SAVING
ALLIED
1964 CATALOG

WORLD'S LARGEST • BIGGEST SELECTION • BIGGEST SAVINGS



1964 knight-kits®
Over 100 great build-your-own kits: Hi-Fi, Hobby, Citizens Band, Intercom, Amateur, Test Instrument—savings up to 50%.



Stereo Hi-Fi
Complete selection of components and systems; latest all-transistor hi-fi; super-value Knight® hi-fi; all the famous makes—save most!



Citizens Band Radio
Latest 2-way radio—no exam required—complete selection of top-value CB equipment, including Walkie-Talkies.



Tape Recording
Largest selection of tape recorders, tape decks, pre-amps and accessories; quality recording tapes at biggest savings.



FM-AM & AM Radios
Best buys in all types of compact transistor radios, including quality FM-AM portables—big money-saving selection.



Phonographs, Accessories
Top values in phonographs; latest Stereo portables; full selection of phono accessories.



Ham Station Equipment
Largest selection of receivers, transmitters, antennas—everything in Ham station gear at substantial savings.



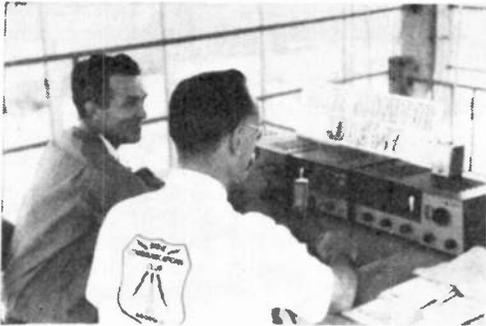
Test Instruments
Save on every type of instrument for home or professional use—all leading makes in stock.

PLUS • PA Systems & Intercoms • Big Buys in Tools & Hardware
• TV Tubes, Antennas • Parts, Tubes, Transistors, Books
satisfaction guaranteed or your money back

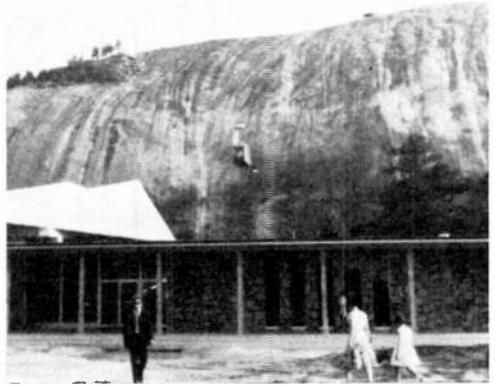
NO MONEY DOWN: Now! More Buying Power with Your Allied Credit Fund Plan!

MAIL
NOW

FREE SEND CARD TODAY FOR
your 1964 Allied Catalog
AND GIVE ONE CARD TO AN INTERESTED FRIEND



Bill Kirkman, vice president of the Dixie Communications Club of Decatur, Ga., stands by while Bud Horton, president, keys the mike of their station on top of Stone Mountain for the first time.



Located on the sixth floor of the Stone Mountain tower, which stands 1686 feet above sea level, the Dixie Monitor now keeps a tuned ear on channels 9 and 15 from 7 to 11 p.m. week nights and 24 hours a day on week ends. Transportation to and from the tower is via cable car.



and entertainment, public relations, and practices and procedures. The D.V.C.B.A. emergency net was put into operation near the end of 1960; since that time they have made their services available to civil defense agencies in the area, the state police, fire companies and any other worthwhile group requiring communications.

Not to be outdone, the YL's and XYL's have their own ladies' auxiliary within the D.V.C.B.A., led by a full complement of officers. Their duties include assists at picnics, meetings, outside activities and other club functions that may require the feminine touch. Current chairman of the auxiliary is Jean Grubb, 3Q3040, wife of D.V.C.B.A. club treasurer, Alex Grubb.

As we see it, this is the type of makeup that builds and strengthens any organization. Sure, the D.V.C.B.A. has problems, but with 150 people working to hold the association together, rather than a handful (which is true in most cases of CB club failure) things just seem to work out in the long run.

Many congrats—Delaware Valley Citizens Band Association—for a very commendable

four-year performance! Also, our humble thanks for our honorable membership in the D.V.C.B.A.—expiration date, March 31, 1968.

A Page From the Log. The following data was taken from the *Dixie Monitor* log book. It is a record of the type of communications and aid being handled by the Dixie Communications Club of Decatur, Ga., and all other CB clubs in a 100-to-150 mile radius of Stone Mountain.

2:30 p.m.: KDB-3209—Mrs. Parnell advised that Athens CD and Tri-County CB Club request assistance in search for Oconee River drowning victims. Need 12-15 men with walkie-talkies to search five miles of river bank.

2:35 p.m.: KDD-1100—Lawrenceville CB Club offers help for Athens search. Advised to stand by.

3:35 p.m.: KDD-3209—Info on units in search area. State and county CD present.

4:00 p.m.: KDD-1100—Lawrenceville CB Club to proceed to rescue control in Athens.

4:20 p.m.: KDD-0547—Dixie Monitor advised all DCC mobile units to report to base for instructions.

5:10 p.m.: 6W1458—Dixie Monitor advised Dixie Communications Club en route to Athens.

11:00 p.m.: Duty change. Marvin Ramge, Dixie Monitor duty officer.

12:20 a.m.: KDB-0264—DCC returning from Athens. Car believed located under water. Search to continue by daylight.

Dick Elder was the duty officer who handled the above communications during a tragic June afternoon and evening in which two adults and six children met with death when their automobile plunged into the Oconee River at Athens, Ga. CB'ers, quick to answer the call for assistance, aided authorities by patrolling the river bank with walkie-talkies for one solid week until they had recovered all of the victims' bodies.

As many will remember, we stated in our March, 1963, OTCB column, that the Dixie Monitor Station, atop the 1686-foot, one-and-a-half billion tons of exposed granite better known as Stone Mountain, was near completion. As this material goes to press, the station has been in successful operation for over two months. The skeleton framework we showed you in March has since been shaped into a highly efficient observation and communication tower, in which the *Dixie Monitor* has become the sixth-floor occupant. At present the station is in operation from 7:00 p.m. to 11:00 p.m. weeks nights and from 7:00 p.m. Friday evenings straight through to 11:00 p.m. on Sunday.

A strict set of rules and regulations has been initiated for the monitoring station by the D.C.C. which has been allocated the authorized call-sign of KDD-0547 by the FCC. The station's purpose is to serve as a control point for mobile vehicles providing communications for Civil Defense, for governmental agencies, or for civic organizations. The station will also attempt to render assistance to any mobile CB unit seeking aid, or in emergencies to those without telephone service available. They will also relay messages of importance for other monitoring stations.

The D.C.C. has chosen channel 9 (na-

tional emergency and calling channel) and channel 15 (national transportation channel) as the official monitoring channels of the Dixie Monitor Station. Both channels are monitored continuously.

Headset Walkie-Talkie. "Look, ma, no hands!" That would appear to be a fitting quote for the operation of the Sony Corporation's new CB-106 100-mw. unit. While basically a hand-held transceiver, operable in the conventional manner, the CB-106 features a separate foam-cushioned boom-type microphone-headset which may be plugged into the unit. Included is a shoulder case which is worn around the waist by means of a special strap supplied. The transmitter is keyed with a fingertip cable much the same as those used for photographic purposes. And that's about as "hands-free" as you can get.

Features of the CB-106 include ten-transistor, two-diode circuitry, crystal control, a built-in 5' telescopic antenna and built-in 2" microphone-speaker. The unit operates on eight penlight batteries and weighs just 1.23 pounds. The complete CB-106 package includes chassis, headset-microphone, cable release, shoulder case and batteries. Sony claims the unit will average an effective range of from 1.8 to 9.3 miles, depending on location and terrain. Price tag on this latest CB innovation is \$99.95.

Club Chatter.—The Corn Belt Citizen Banders will hold their third annual dinner on Nov. 23 at the Sinorac, located at the intersections of U. S. Highways 66 and 51 in Bloomington, Ill. Last year's event drew close to 200 CB'ers, including out-of-staters from Texas, Pennsylvania and Indiana. The club plans an excellent dinner, entertainment, displays and door prizes. (Your CB Editor has humbly accepted an invitation to speak at this event. If you decide to attend, bring your QSL cards; I'll expect one from each of you!) For more information regarding this hoopla, contact A. James

with **EXCLUSIVE NOISE BLANKER**



Complete with 1 pair of crystals and microphone

\$22950

EXTRA QUALITY & VALUE!

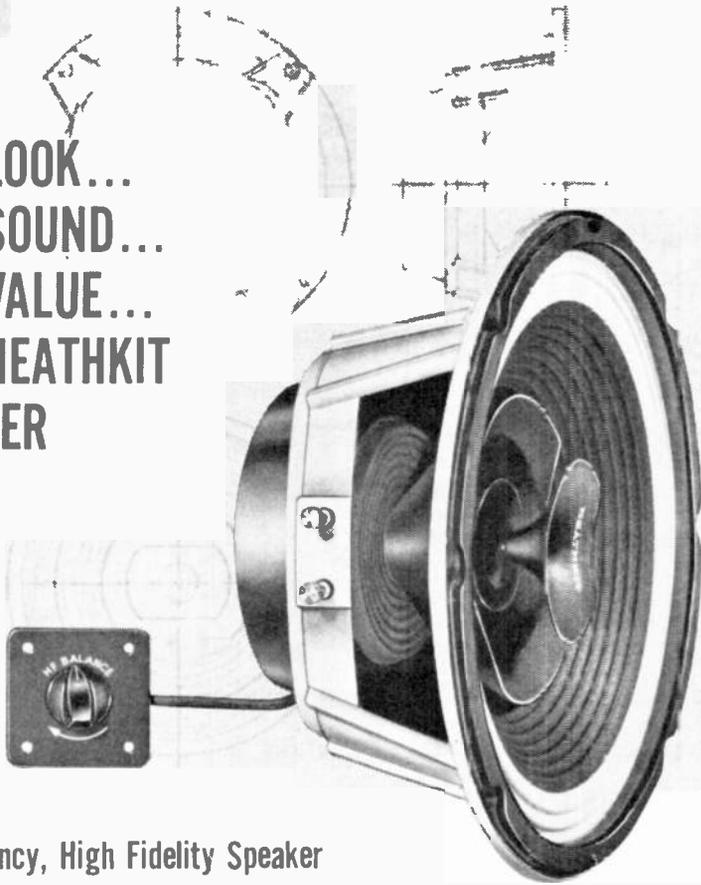
Sonar CITIZENS BAND RADIO

No where else but at Sonar can you get such performance and quality at this low price! Check these features: Dual conversion • RF output meter • Signal strength meter • Crystal spotting switch • Illuminated panel • 8 channels, crystal-controlled • Receiver tunes 23 channels • Class "B" modulation • 1-year guarantee

SONAR RADIO CORPORATION, 73 Wortman Ave., B'klyn 7, N. Y. Please send me complete information on Model "G" CB Radio.

NAME _____ 277
ADDRESS _____
CITY _____ STATE _____

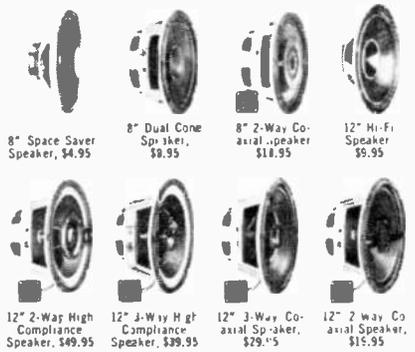
**NEW LOOK...
NEW SOUND...
NEW VALUE...
NEW HEATHKIT
SPEAKER
LINE**



**Need A High-Efficiency, High Fidelity Speaker
For A Particular Music System Job?**

...You'll Find It In Heath's Exclusive New Line!

Whether you want an advanced-engineered, professional-performing speaker for your custom music system, or need to replace a radio or TV speaker, you'll find it in this exciting new Heathkit line. Specially designed to meet Heath's exacting specifications, each speaker has been carefully crafted to perform a particular job. And regardless of which speaker you choose, each has a ceramic annular ring magnet for high efficiency and superior performance, plus polarized speaker terminals for proper phasing. All speakers except the least expensive in each size, have rugged, die-cast metal frames for life-long, trouble-free performance. In addition, each speaker is handsomely styled in a richly warm two-tone cinnamon and light tan motif, and carries a full one-year guarantee. Prices range from \$4.95 to \$49.95 . . . truly superb performance at unmatched savings! Send for your free Heathkit Catalog now, and select the proper Heathkit speaker to fulfill your needs!



HEATH COMPANY
Benton Harbor 1C, Michigan 49023

Please send Free copy of new 1964 catalog.

Name

Address

City State Zip Code

HEATHKIT-1964

**NEW! FREE
1964 HEATHKIT CATALOG**

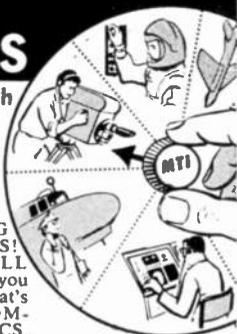
See the latest new products in Heathkit's wide, wonderful line. Over 250 do-it-yourself kits for stereo hi-fi, marine, TV, electronic organ, amateur radio, test instruments, educational, home and hobby that will save you up to 50%. Send for your free copy today!



JOBS LOOK for YOU in ELECTRONICS

Learn FAST—EARN FAST with MTI's Unique Exclusive Training at Home.

Whether it's a BIG PAY JOB you want or the chance to be YOUR OWN BOSS — your big opportunity today is WAITING for YOU in ELECTRONICS! MTI's unique SELECT-A-SKILL method quickly, easily qualifies you for the type of electronic work that's exactly right for YOU — COMMUNICATIONS ELECTRONICS, INDUSTRIAL ELECTRONICS, or RADIO & TV SERVICING. Previous experience proved unnecessary. Age no obstacle. Right at home you learn by doing, using your hands as well as your head — building electronic equipment, testing and experimenting with SEVEN BIG MASTER ELECTRONIC KITS! And you can earn while you learn!



SKILLS PAY BILLS

With millions unemployed — there is NO PLACE for men without special skills! Let MTI give you the training you NEED to insure your future!



MASSEY TECHNICAL INSTITUTE
Dept. 11-AS-02, Jacksonville 6, Florida
An ACCREDITED Member, National Home Study Council
MAIL COUPON TODAY for FREE BOOK and MTI's unique SELECT-A-SKILL Opportunity Finder that can take the guess-work out of YOUR FUTURE!

Please rush to me, without obligation your FREE BOOK

Pick Your New World of Opportunity in Electronics — PLUS your SELECT-A-SKILL Opportunity Finder.

MASSEY TECHNICAL INSTITUTE
Dept. 11-AS-02, Jacksonville 6, Florida

Name
Address
City Zone ... State.....

NEW - - by KUHN

AM/FM VHF RECEIVER

Covers 26-54 and 108-174 MC in six calibrated bands with excellent sensitivity. Ideal for rapid scanning for CB, Amateur, Aircraft, or FM Police, Fire, etc. signals with controllable selectivity.

353-A
\$48.70



AIRCRAFT • POLICE • FIRE



348A
Complete
\$34.95

315-B
5-54 MC
\$17.95



115-160 MC
\$18.95

Transistorized, directly tuneable converter. Powered with self-contained mercury cell. Excellent sensitivity and stability. Designed for car, home or portable receivers.

Converts home or car radios to receive Fire, Police, Aircraft, CB, SW, etc. Exceptional sensitivity on High and Low Bands. High Band type adjusts to bracket 115-160 MC. Low Band type should be ordered for 33-47 MC, 40-52 MC, 26-30 MC, 9-12 MC, etc. May be adapted for transistorized car radios.

Order today or send for free catalog on full line of converters and receivers for every application.



20 GLENWOOD
CINCINNATI 17,
OHIO

Brook, KHA4158, at 216 Robinhood Lane, Bloomington, Ill.

Rosalind Hoxsie, KFC1363, co-editor of *Break-Break*, official publication of the Santa Clara County Citizens Radio League, has forwarded us one of the neatest-looking CB club papers we've read while at this desk. The illustrations jump out and "grab" you; the articles are well-written and interesting. Comparing one part of the paper in particular with some we've seen, *Break-Break* just won the National Spelling Bee! Rosalind states that club membership totals 80 at present. Current projects for the clan include the formation of a Volunteer Emergency Communications (V.E.C.) unit, association with Civil Defense, and increasing membership.

The Athens Contact Club of Athens, Ga., has made up a "travel packet" to be presented to mobile units passing through town. The packets contain QSL cards from all the club members, a copy of the 10-Code, a Georgia road map showing the call letters of various CB units throughout the state, historical information on the city of Athens, and a city street map with all of the members' addresses marked. The packet may be obtained from any member's "transmitter site!" You can't get any more hospitable than that!

The Delaware County Citizens Radio League of Havertown, Pa., dates back to November, 1959. Present officers are: Jack Coleman, 3W3207, president; Charles Matson, KCC3207, vice president; Ray Cox, 3Q0175, treasurer; Frank Howerd, KCC-1169, secretary. The group meets on the second Thursday of each month and they have an Emergency Patrol and a club newspaper—the *Citizens Broadcaster*. (So send us one, Charlie.)

Membership is now open for CB'ers in



"These hula-hoop antennas are really designed for hard-top cars."



Who says
you can't
afford
an organ
this
Christmas?

**This New Feature-Packed 1964 Model Of the Heathkit
2-Keyboard "Transistor" Organ Costs Just \$349.95 . . .
And You Can Build It!**



What a delightful surprise on Christmas morning! And there's endless hours of fun, relaxation, education and achievement satisfaction ahead for the whole family with Heathkit's 1964 version of the famous Thomas Organ. You'll be saving big money too, by easily building it yourself! No experience necessary! And you're assured long, faithful performance with the full 5-year warranty on tone generators. Can't play a note? Learn quickly and easily with a complete 48-lesson self-teacher course on 4 LP records (GDA-232-2) that's valued at \$50 . . . it's yours for only \$19.95! Like to hear it perform? Send 50c to the address below, and ask for demonstration record GDA-232-5. Plan now to give your family the exciting dimension of live music with the 1964 Heathkit Electronic Organ this Christmas!

Kit GD-232R, Organ, 160 lbs., no money dn., \$23 mo. **\$349.95**

GDA-232-1, Matching walnut bench, 16 lbs., no money dn., \$5 mo. **\$24.95**

Attention Heathkit Organ Owners! Add Variable Repeat Percussion to your Heathkit Organ with the easy-to-install kit.

GDA-232-4, 1 lb. only **\$9.95**

**COMPARE THESE
FEATURES WITH UNITS
COSTING TWICE
AS MUCH!**

- 10 True Organ Voices; Trombone, Reed, Flute, Oboe, Cornet, Violin, Saxophone, Horn, Viola, Diapason
- New! Variable Repeat Percussion; produces effects of banjo, marimba, mandolin, balalaika, etc.
- Variable Bass Pedal Volume Control • Manual Balance Control; adjusts volume of keyboards in any degree for solo work
- Variable Vibrato • Standard Expression Pedal; adjusts volume from soft to full
- 13-Note Heel & Toe Bass Pedals • Two Over-Hanging Keyboards; each with 37 notes, range C thru C
- Beautiful Walnut Cabinet; modern styling, hand-rubbed, hand-crafted • 20-Watt Peak-Power Amplifier & Speaker • Compact Size; 34 1/2" H x 39 1/2" W x 21 1/2" D • Transistorized; for longer life, better tone, trouble-free operation.



Heath Company, Benton Harbor 10, Michigan 49023

- Enclosed is \$349.95, plus postage, please send my Heathkit Electronic Organ, model no. GD-232R.
- Enclosed is \$24.95, plus postage, please send matching walnut bench, model no. GDA-232-1.
- Please send my free copy of the new 1964 catalog.

Name _____

Address _____

City _____ Zone _____ State _____



**NEW! FREE
1964 HEATHKIT CATALOG**
See all the latest products in Heathkit's exciting line. Over 250 do-it-yourself electronic kits in all . . . by far the world's largest line. There's something for every interest . . . stereo/hi-fi . . . marine . . . amateur radio . . . test and lab . . . television . . . home . . . and hobby. Send for your free copy today, and learn how you can save up to 50%.



Olson

*** FREE**

*** Fill in coupon for a FREE One Year Subscription to OLSON ELECTRONICS' Fantastic Bargain Packed Catalog—Unheard of LOW, LOW, WHOLESALe PRICES on Brand Name Speakers, Changers, Tubes, Tools, Stereo Amps, Tuners, CB, and other Bargains.**

NAME _____
 ADDRESS _____
 CITY _____ ZONE _____ STATE _____

If you have a friend interested in electronics send his name and address for a FREE subscription also.

**OLSON ELECTRONICS
 INCORPORATED**

842 S. Forge Street Akron, Ohio 44308



NEW!
transistorized CB-5
MARK II!

with a first-class engineering breakthrough in noise immunity



\$219.95

- ★ New principle of internal suppression virtually eliminates conducted noise
- ★ Battery drain negligible — only .225 amps on standby
- ★ 100% modulation; sensitivity less than 1µv.
- ★ No external noise-stopping device needed
- ★ AC power pedestal, battery pak and selective calling accessories optional

Write today for complete specifications

hallicrafters

Dept. 4, 5th & Kostner Aves., Chicago, Ill., 60624

the Oregon Citizens Band Association, 13633 S. E. Stephens Place, Portland 33, Ore. This group participates in several events throughout the year, meets on the first and third Thursday of each month. Interested parties should contact Chester A. Mumper, secretary, at the address above.

The CB-Aires meet on the third Thursday of each month at Rathskeller of Hamiltonian in the Federal Savings and Loan Building, St. Louis, Mo. More information regarding this group may be obtained from Michael D. Kersulov, 722 Brookridge Drive, Webster Groves 19, Mo.

That does it for now! Keep the news, the pictures and the club papers coming.

I'll CB'ing you,

—Matt, 18W4689

Inventors Quiz Answers

(Quiz on page 67)

- 1 - F John Bardeen, Walter H. Brattain, and William B. Shockley invented the point-contact transistor in 1948.
- 2 - J Lee De Forest invented the grid Audion, the first practical three-element amplifier tube, in 1906.
- 3 - E Thomas A. Edison invented the cylinder phonograph, the forerunner of the modern record player, in 1877.
- 4 - I Michael Faraday discovered the principle of the electric motor in 1821, and of the transformer in 1831.
- 5 - H Benjamin Franklin invented the lightning rod in 1750.
- 6 - G Jules A. Lissajous first observed the combination of two waveforms now called "Lissajous figures" in 1857. The effect is often seen when using the modern oscilloscope.
- 7 - B Wilhelm K. Roentgen first observed the effects of "Roentgen rays," or X rays, in 1895.
- 8 - C Edward Weston invented the Weston cadmium cell in 1893. It is still in worldwide use as a standard of electromotive force or voltage.
- 9 - A Sir Charles Wheatstone first demonstrated the bridge circuit that now bears his name in 1843. It was originally devised by Samuel H. Christi in 1833.
- 10 - D Hidetsugu Yagi developed his directional, parasitic element antenna in Japan in the early 1920's.

INTRODUCING THE
FIRST IN A NEW
SERIES OF
DELUXE HEATHKIT
AMATEUR RADIO
GEAR

SB-300



SSB RECEIVER—\$264.95

CHECK THESE FEATURES!

• Professional styling & features at 60% savings! • Complete coverage of 80 through 10 meter amateur bands with all crystals furnished, plus provision for VHF converters • Prebuilt, calibrated linear master oscillator (LMO) • 25 KC per tuning knob revolution offers bandspread equal to 10 feet per megacycle • Built-in crystal calibrator • 2.1 KC crystal bandpass filter • Stability of 100 CPS after initial warmup • Wiring harness & two heavy-duty circuit boards for easy assembly

CHECK THESE SPECIFICATIONS!

Frequency range (megacycles): 3.5 to 4.0, 7.0 to 7.5, 14.0 to 14.5, 21.0 to 21.5, 28.0 to 28.5, 28.5 to 29.0, 29.0 to 29.5, 29.5 to 30. **Intermediate frequency:** 3.395 megacycles. **Frequency stability:** 100 cps after warmup. **Visual dial accuracy:** Within 200 cps on all bands. **Electrical dial accuracy:** Within 400 cps on all bands. **Backlash:** No more than 50 cps. **Sensitivity:** Less than 1 microvolt for 15 db signal plus noise-to-noise ratio for SSB operation. **Modes of operation:** Switch selected: LSB, USB, CW, AM. **Selectivity: SSB:** 2.1 kc at 6 db down, 5.0 kc at 60 db down (crystal filter supplied). **AM:** 3.75 kc at 6 db down, 10 kc at 60 db down (crystal filter available as accessory). **CW:** 400 cps at 6 db down, 2.5 kc at 60 db down (crystal filter available as accessory). **Spurious response:** Image and IF rejection better than 50 db. Internal spurious signals below equivalent antenna input of 1 microvolt. **Audio response: SSB:** 350 to 2450 cps nominal at 6 db. **AM:** 200 to 3500 cps nominal at 6 db. **CW:** 800 to 1200 cps nominal at 6 db. **Antenna input impedance:** 50 ohms nominal. **Muting:** Open external ground at Mute socket. **Crystal calibrator:** 100 kc crystal, $\pm .005\%$. **Front panel controls:** Main tuning dial; function switch; mode switch; AGC switch; band switch; AF gain control; RF gain control; pre-selector; phone jack. **Rear apron connections:** Accessory power plug; HF antenna; VHF #1 antenna; VHF #2 antenna; mute; spare; anti-trip; 500

ohm; 8 ohm speaker; line cord socket; heterodyne oscillator output; LMO output; BFO output; VHF converter switch. **Tube complement:** (1) 6BZ6 RF amplifier; (1) 6AU6 Heterodyne mixer; (1) 6AB4 Heterodyne oscillator; (1) 6AU6 LM osc.; (1) 6AU6 LMO mixer; (2) 6BA6 IF amplifier; (1) 6AU6 Crystal calibrator; (1) 6HF8 1st audio, audio output; (1) 6AS11 Product detector, BFO, BFO, amplifier. **Power supply:** Transformer operated with silicon diode rectifiers. **Power requirements:** 120 volts AC, 50/60 cps, 50 watts. **Dimensions:** 14 $\frac{1}{2}$ " W x 8 $\frac{1}{2}$ " H x 13 $\frac{3}{4}$ " D.

The SB-300 SSB Receiver is the first in an exciting new series of Heathkit SSB amateur gear designed to bring you the finest in communications facilities at great savings. Its professional styling, quality and features offer performance never before found in kit equipment.

Features include a crystal-controlled front-end for same rate tuning on all bands; prebuilt, Linear Master Oscillator (LMO) for linear tuning with 1 kc dial calibrations; built-in crystal calibrator; hermetically-sealed 2.1 kc crystal bandpass filter; smooth, non-backlash vernier dial drive mechanism; optional AM & CW filters; high frequency I. F.; AGC control; provision for transceive operation with matching transmitter available soon.

Kit SB-300 ... 17 lbs. ... no money dn., \$25 mo. \$264.95
SBA-300-1 CW Crystal Filter (400 cps) ... 1 lb. \$ 19.95
SBA-300-2 AM Crystal Filter (3.75 kc) ... 1 lb. \$ 19.95

WATCH FOR ANNOUNCEMENT OF OTHER MODELS
IN THIS DELUXE HEATHKIT HAM SERIES!



FREE CATALOG
Send for your free copy today! Fully describes over 250 exciting Heathkits at savings of 50% or more! Choose from the world's largest selection of quality ham gear... "Mobile" ... "Fixed" and Accessories.

HEATH COMPANY Benton Harbor 10, Mich. 49023

Please send FREE 1964 catalog
 Enclosed is \$264.95, plus postage. Please send model SB-300.

NAME _____
 ADDRESS _____
 CITY _____ ZONE _____ STATE _____

LEARN

ELECTRONICS

TELEVISION

ELECTRICITY

Train in the new shop-labs of the world famous



COYNE ELECTRICAL SCHOOL

on a quarter of a million dollars worth of equipment for a Big Pay Job and an Exciting Career. Special finance plans. Part time employment service while in school. Also Free graduate employment service.



Use this coupon to get our FREE BOOK "YOUR OPPORTUNITIES IN ELECTRONICS"

COYNE ELECTRICAL SCHOOL, Dept. of Electronics 83M
1501 W. Congress Parkway, Chicago 7, Illinois

NAME _____ PHONE _____

ADDRESS _____ AGE _____

CITY _____ ZONE _____ STATE _____

Unlike most other schools, we do not employ salesmen

Now!! A 2-Way
Communication System
for Outdoor Use!!



GENERAL VS-2
Industrial Transceiver
with
GENERAL MH-6
"Weather-Rak"

The General VS-2 Industrial Transceiver meets all outdoor requirements and may be used with utmost confidence on boats, trucks, fork lifts, tractors, combines, or any equipment demanding rugged dependability.....\$139.95. The MH-6 "Weather-Rak" is designed for outdoor protection of the VS-2. Features: snap latches for instant insertion or removal of VS-2. Mounted on 4 heavy duty shock absorbers. Provision for mounting antenna directly atop unit. Weather resistant telephone black finish..\$29.95

10% DOWN!! EASY PAYMENTS!!

See your local General Dealer or write: Dept. P11

GENERAL RADIOTELEPHONE COMPANY

3501 West Burbank Boulevard, Burbank, California
Phone: 849-6891 Area Code: 213

The Lightning Bug

(Continued from page 73)

"Turn off the flashlight!" Carl shouted.

She obeyed, and instantly the "animal" seemed to die in its tracks.

Jerry turned the headlights back on once more, and they all got out and joined Jodi. As the weird creature headed back toward the car, Carl fearlessly picked it up and did something to it that seemed to quiet its snapping and flashing.

Standing around the object in the light from the automobile, the girls saw that it was crudely shaped like a huge lightning bug. The body of the "bug" was some 30 inches long and a foot high, and tucked down out of sight under the body were three small rubber-tired wheels. The rear two were on a straight axle, but the front one swiveled. Most of the mechanical creature was made of painted plywood, but the back lower half was constructed of translucent plastic. Carl lifted off the top to show the girls a couple of small electric motors operating through gear trains and belts to drive the two rear wheels. There were also some six-volt lantern batteries and a few other electronic parts wired together.

"Tell us how it works," Jodi said, obviously impressed by the device.

"Well," Jerry began, "both rear wheels are driven by a separate PM, high-torque motor. They don't draw much current, and they're geared way down so they don't have much work to do."

"But what makes that thing come after you when you shine a light on it?" Thelma asked.

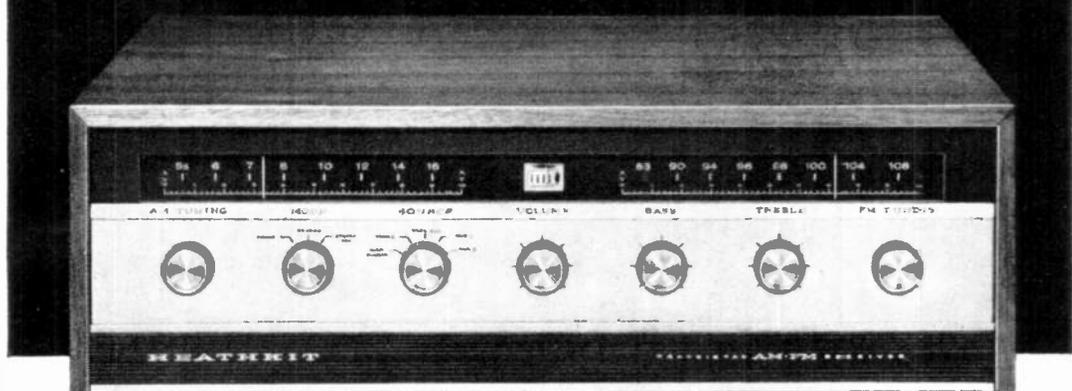
"These two 'eyes' here on the head that look sort of like glass-topped power transistors are actually special-type photocells whose resistance varies with the amount of light falling on them," Jerry explained.

"The right eye is in series with a lead to the motor driving the left wheel, and the left eye is in series with a lead to the motor driving the right wheel. Each eye 'looks' toward the side as well as straight ahead because they're mounted at a forty-five degree angle. If light comes

Always say you saw it in—POPULAR ELECTRONICS

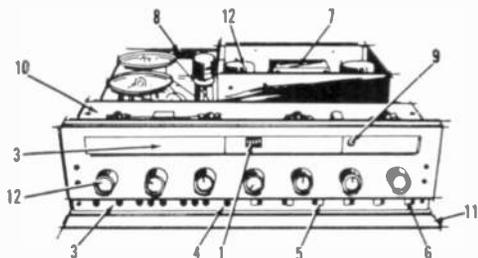
another example of Heathkit[®] pioneering

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

Two 20-watt power amplifiers...two separate pre-amplifiers...plus wide-band AM, FM and FM Stereo...all beautifully hoisted 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!



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. Preamsembled 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 5 3/8" H x 14 3/4" D.

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 this Christmas!

Kit AR-13, 30 lbs., no money down, \$19 mo...\$195.00

HEATHKIT-1964 **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 10, Michigan 49023

Name _____

Address _____

City _____ State _____ Zip No. _____

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.



MICROPHONE HOLDER

FOR CB and other MOBILE RADIOS

For cars, boats, base stations . . . puts the mike where you want it . . . when you want it . . . on any metal surface. Heavy duty magnet really holds. Fits most mikes. No holes to drill, nothing to mount . . . all one piece, ready to go.

GC PART NO. 65-525 — Net 99c.

99c

NET

AVAILABLE FROM YOUR CB INSTALLER OR GC ELECTRONIC PARTS DISTRIBUTOR. If you cannot secure locally, write to GC ELECTRONICS, Dept. R-2.

GC ELECTRONICS 400 S. WYMAN, ROCKFORD, ILL., USA

NOW PERSONAL TV LISTENING



You Can Enjoy TV... Or Ignore It

With the

TELEX
TV LISTENER

Enjoy television in private without disturbing others. Full rich sound through a comfortable, lightweight individual earphone. Others don't hear a thing. Keeps house quiet and peaceful during noisy Westerns and children's programs. Ideal for late night viewing after family is asleep. Switch sound on or off, and control volume remotely from your chair. 15 ft. listener cord and 5 ft. Earset® cord. Tune down commercials. Perfect for the hard of hearing, motels, institutions. With extra Earset® two can listen. See your local dealer.

A Product of Sound Research

TELEX Acoustic Products

COMMUNICATIONS ACCESSORIES

3054 Excelsior Blvd. • Minneapolis 16, Minn.

from the right, the resistance of the right eye drops, and the left-hand motor starts up and turns the bug toward the light. When it's facing the light, both eyes receive the same amount and the two motors make it move straight ahead. As more and more light falls on the photocells, the faster the motors run."

"Aren't photocells only supposed to carry tiny currents?" Jodi asked. "I don't see how you can run the motors."

"This brand-new LDR-25 Power Photocell developed by the Delco Radio Division of General Motors at Kokomo, Indiana, is the only one I know of that will carry the kind of current needed," Jerry answered. "When you mount one on a heat sink, it'll dissipate twenty-five watts without any trouble. It's nonpolarized and handles d.c. current up to half an amp, and a.c. or d.c. up to two hundred volts.

"In the dark, its resistance is half a meg, but it falls to four hundred ohms with ten foot-candles of light, to eighty ohms at a hundred foot-candles, and to fifteen ohms at a thousand foot-candles. I tried putting a little NE-two-H neon lamp right up against it, and the resistance dropped to seventy-five ohms!"

"What sort of things can you use it for?" Thelma wanted to know.

"Almost any kind of photocell control circuit handling up to forty watts," Jerry replied. "It can be hooked in series with a small a.c. motor of the type used on food mixers or electric sewing machines, and the speed of the motor can be varied continuously just by regulating the amount of light falling on the cell."

"I suppose we could make the cell even more sensitive by using a lens to concentrate the light," Carl suggested.

Jerry shook his head. "That's not a good idea with this cell. The active area is about nine-tenths of a square centimeter, and all of this should share in the heat dissipation. A lens would concentrate the current and the heat in a small portion and might damage that spot even though the total heat dissipated was below twenty-five watts."

"Are these cute little antennae that curve down and back from below each eye just for looks?" Thelma asked.

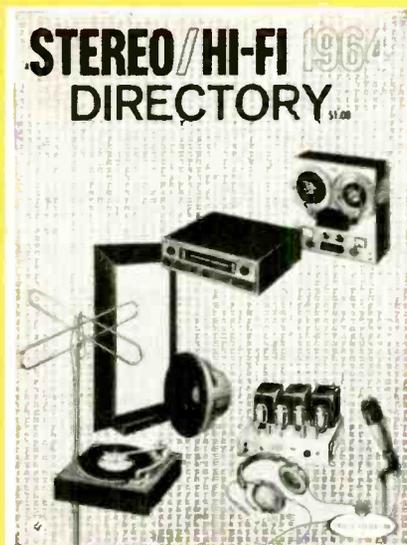
"No, those are really fiber-optic rods made up of bundles of very thin glass

OVER 2000 COMPONENTS...

Amplifiers
Phono Equipment
Tuners
Tape Machines
Speakers & Cabinets
Accessories

...are covered in the
1964 edition of the

STEREO/HI-FI DIRECTORY



It's the world's most comprehensive **BUYERS' GUIDE** to the hi-fi market. Everything you need in sound is featured in the 180 product-packed pages of the 1964 **STEREO/HI-FI DIRECTORY**. It gives you the vital statistics — photos, prices, and performance data—on over 2000 components from 177 different manufacturers. It's the best way to see and compare speakers, enclosures, cartridges, changers, amplifiers, tone arms, FM tuners, tape recorders and FM antennas *before* you buy.

Plus you get these special features:

- How to select an FM tuner
- Tips on buying Tape Recorders
- Complete listing of all FM Stereo Multiplex Stations broadcasting in the U.S. and Canada (as of September 1963).

- Complete listing of all Hi-Fi dealers throughout the United States.

The 1964 **STEREO/HI-FI DIRECTORY** is your indispensable guide to the total-sound market. It's on sale now at your favorite newsstand or hi-fi dealer's. Or fill in this coupon and we'll send you a copy.

Price only \$1.00

Ziff-Davis Service Division Dept. SD
589 Broadway, New York 12, New York

Please send me a copy of the 1964 **STEREO/HI-FI DIRECTORY**. I enclose \$1.00, the cost of the **DIRECTORY**, plus 15¢ to cover mailing and handling charges. (Canada & Overseas: \$1.25 plus 25¢ postage.)

NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

(Add 4% sales tax if N.Y.C. resident)

PE113

fibers treated so that they can conduct light just like a wave guide conducts radio waves. The rods are curved so light coming from angles at the rear of the bug will be conducted to one or the other of its eyes and make it wheel around. A snapper working off the wheels makes the clicking sound. It's just for effect. So is the pulsing light shining through the plastic. A light-blinker inside is turned on by a relay in series with the com-



mon battery lead so it comes on when either motor is drawing current. The lantern batteries are hooked in series to produce twenty-four volts for the motors. That's about all there's to it."

"I think it's wonderful," Jodi exclaimed. "Boy, will it scare those pledges to death tomorrow night, especially since it's Halloween!"

"On the way out to that old barn where we're holding the initiation we'll talk about the battle between man and insects and how super-insects born of resistance to insecticides and mutations caused by atomic radiation may even now be lurking in dark corners ready to attack."

"Then we'll send them into the old barn to make sure it's safe for the rest of us to come in," Thelma broke in. "The Lightning Bug will be there waiting in a dark corner for their flashlight to bring it to life. It still scares me, even though I know how it works. I can just imagine what it will do to them in that dark, cobwebby old barn."

"We'll be sure not to arrive before ten o'clock," Jodi promised. "That will give you boys plenty of time to set up the Bug and get out of there before we send in the pledges."

NINE o'clock the next night found Carl and Jerry walking across a field toward the old deserted barn that stood beside the charred ruin of what had been a house. While a road ran past the ramshackle building, the boys decided it would be wiser to park in a lane down the road and walk back. The weather was still warm, but a strong damp wind was blowing gustily from the south, and now and then a fast-flying cloud scudded across the face of the full moon just coming up over the horizon.

Carl and Jerry let themselves into the dark, musty-smelling barn through a door whose rusty hinges squeaked with a spine-tingling sound right out of a Class-B horror movie.

"I've seen cozier places," Carl muttered as he played his flashlight around over the dusty floor and the rotting harness hanging on pegs beside the empty stalls. "What say we put the Bug right over there in that corner? The girls will be sure to shine their light there, and when the Bug starts moving it will seem like it's trying to cut off their exit through the door."

"Sounds good to me," Jerry agreed. "Let's hurry up and get out of here. This place gives me the creeps."

He held the flashlight while Carl carefully arranged the Bug in the corner and swept away the straw in front of it so that the rubber wheels would have good traction. Just as he finished, Jerry abruptly turned off the flashlight and whispered hoarsely, "Someone drove up in a car! Do you suppose it's the girls already?"

"I don't know, but we've got to get out of sight or we'll spoil the whole thing. Let's climb up in the hayloft until we see what gives."

Guided by the moonlight shining through cracks in the side of the barn, Carl led the way up a rickety ladder he had spotted when they first entered. Jerry was right behind him.

They barely had time to stretch out on the floor of the empty hayloft and wipe the cobwebs off their faces when the screeching hinges of the door announced the arrival of company. Peering down through wide cracks in the floor, the boys could make out the restless beam of a flashlight and two shadowy masculine figures.

ARE YOU sure this is the barn you heard Thelma talking about, Roger?" a voice asked.

"Sure I'm sure. I just want to look it over a bit, and then we'll park the car down the road and come back. Sid, we're going to give those girls a scare they'll never forget, and I don't mean just the pledges! Let's take a look up in the hayloft. That's where we'll hide when the girls get here."

In the darkness Jerry could feel Carl's head turn toward him questioningly, but he never had to make a decision. The wandering spot of light below fell on the Lightning Bug, and it immediately came to life. Flashing its tail, snapping menacingly, it crawled out of the corner straight toward the frozen boys.

"Wh—wh—what's that?" Sid quavered, edging toward the door.

"I don't know, but don't leave me here with it," Roger, who held the flashlight, begged as he circled out of the way of the relentlessly approaching machine. His dodging did no good, for the Bug followed every move of the flashlight.

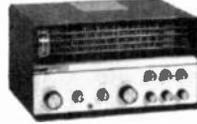
"It's getting mad . . . its tail is flashing faster and its teeth are snapping worse! I think it's getting ready to spring!" Sid shouted from the open doorway.

Roger had backed into a corner directly beneath the boys. As the light grew brighter on the photocells, the motors speeded up and the Bug seemed to be literally lunging at the horrified youth. He gave a scream of pure terror, dropped his flashlight, and made a great leap over the attacking machine. There was a wild scramble of feet on the gravel outside, and then a car motor started and roared off into the night.

Carl and Jerry, peering down through the hole in the hayloft floor, saw the Lightning Bug crawl to the still-burning flashlight and then stop as the shadow of its own body cut the light off from the photocells.

The boys scrambled down and placed the Lightning Bug back in the corner to await the arrival of the girls. Then they walked to their car and started toward the campus. They had gone only half a mile when two cars, headed in opposite directions but stopped side by side in the middle of the highway, blocked their way. In one car were Jodi,

TWO GREAT NEW RECEIVERS FROM NATIONAL...



NC-121 This handsome, feature-packed general coverage receiver is a natural for the amateur, short-wave listener, and hi-fi enthusiast. Features full coverage from 550 KC to 30 MC, large illuminated signal strength meter, noise-limiter, SSB/CW features, and peaking Q-multiplier for optimum selectivity. National's exclusive Tuner Output allows use of the NC-121 with hi-fi equipment. \$129.95. With walnut case (NC-121W) \$149.95

NC-77X An exceptional value for the novice radio amateur or beginning short-wave listener, the NC-77X is a full coverage superheterodyne all-band receiver with electrical bandspread on all frequencies. Transformer-operated circuitry for safety, increased sensitivity, and low noise. Giant easy-to-read dial has standard AM Broadcast, Marine, Aircraft, Citizen's Band, CD, WWV, amateur and foreign short-wave bands clearly marked. \$69.95. With walnut case (NC-77XW) \$89.95

NATIONAL RADIO COMPANY, INC.
37 Washington Street
Melrose, Mass. 02176

Rush Me Free Your Complete Guide To National Receivers!

Name _____

Address _____

City _____ State _____

37¢ ea.

MICRO

ELECTRON TUBE CO.

P.O. Box 55, Park Station
Paterson 3, New Jersey

\$35 PER HUNDRED ASSD

*Fabulous Low Prices!
Large Select Stocks!
Dependable, Fast Service!*

SEND FOR FREE COMPLETE LIST OF TUBES				
024 1A7GT 1B3GT 1H4G 1H5GT 1L4 1L6 1N5GT 1Q5GT 2A3 2AF4 3BC5 3BN6 3BZ6 3CB6 3CF6 3CS6 3LF4	3Q4 4BZ7 5AS8 5AT8 5AV8 5AW4 5BK7 5J6 5T8 5U4G 5U8 6A7 6A8 6AB4 6AC7 6AF4 6B8 6BA6	6BC5 6BC8 6BD6 6C1 6C5 6C8 6CB6 6CD6G 7A4/XXL 7A5 7A5 7A7 7AB 7B1 7B5 7B8 7B7 7B3 7C1	12A8 12AQ5 12AT6 12AT7 12AU6 12AU7 12AV6 12AV7 12AX1GT 12AX7 18BG6G 19J6 19T8 24A 25AV5 25BQ6 25DN6 25L6GT 25W4GT	25Z5 25Z6 26 35A5 35B5 35C5 35L6GT 35W4 35Y4 35Y4 35Z5GT 37 39/44 42 43 45 50A5 78 80 14/6Z4 17Z3

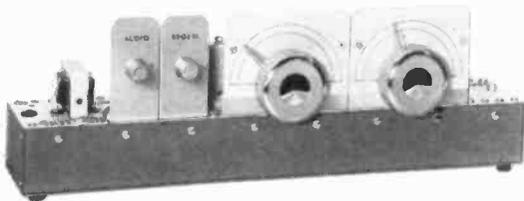
• All tubes lab-tested for mutual conductance, life test. • Guar. FR3: 1 yr. replacement any tube falling under all operating cond. • Adv. tubes not necessarily new; may be elec. perf. fact. records or used—clearly marked.

POSTAGE PAID. Send 35¢ handle. for orders under \$5. 25% dep. C.O.D. Send approx. post. on Can. & foreign orders.

EXPERIMENTER, SWL or RADIO AMATEUR

Select your receiver, transmitter, or VFO from easy-to-build International AOC kits.

Simple step-by-step instructions show you how to assemble factory prewired units. Designed for top performance at a low cost!



RECEIVER KITS

This new line of International receiver kits cover a wide range of amateur, Citizens band and special frequencies. Designed for AM, CW, or SSB reception, this basic receiver using a superheterodyne circuit* with regenerative second detector may be expanded to a more elaborate receiver by the addition of other Add-On-Circuits. Sensitivity usable to below 10 microvolts for voice and 1 microvolt for code. Nuvistor rf amplifier, mixer, oscillator, I.F. transformer, detector/1st audio, and power audio amplifier. Tube lineup: 6DS4 nuvistor, 6BE6, 6U8, 6AQ5. Shipping weight: 15 lbs.



Receiver kit includes 4" speaker and power supply.

Kit	Frequency	Price
AOR-40	Special	\$69.00
AOR-41	150 kc — 450 kc	62.50
AOR-42	2 mc — 6 mc	62.50
AOR-43	6 mc — 18 mc	62.50
AOR-44	80 meter/40 meter	62.50
AOR-45	15 meter/10 meter	62.50
AOR-46	6 meter	66.50
AOR-47	2 meter	66.50
AOR-48	Citizens 27 mc	62.50

*AOR-41 uses a tuned rf circuit with 6BA6



TRANSMITTER KIT

A compact package delivering a plate input of 50 watts for CW operation on 80 or 40 meters. 12BY7 crystal oscillator—6DQ6 power amplifier. Pi-network final. When used with AOR-44 receiver, transmitter operates from receiver power supply. Meter and TR switch.

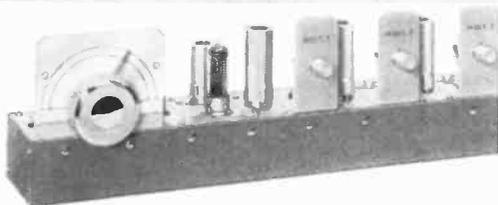
AOT-50 transmitter kit less power supply and key, but with one 40 meter novice band crystal. Shipping weight: 5 lbs. \$35.00



POWER SUPPLY KITS

AOP-100 350 volts, 150 ma intermittent or 100 ma continuous service, 6.3 volts @ 5 amps. Shipping weight: 8 lbs. \$18.50

AOP-200 650 volts, 250 ma intermittent or 200 ma continuous service, 6.3 volts @ 10 amps. Shipping weight: 10 lbs. \$32.50



VFO KITS

The International AOF series of variable frequency oscillator kits is available in three versions. For example, the AOF-91 kit is a complete driver unit to be used with 6 meter and 2 meter transmitters. Approximately .5 watt of power is available on both bands. Tube lineup: 6BH6 oscillator, OB-2 voltage regulator, 12BY7 buffer-amplifier/multiplier. Shipping weight: 5 lbs.

Kit	Frequency	Price
AOF-89	VFO 8 mc — 9 mc and buffer	\$22.00
AOF-90	VFO 8 mc — 9 mc plus buffer multiplier and 6 meter output	29.00
AOF-91	VFO 8 mc — 9 mc plus buffer multiplier, 6 meter/2 meter output	36.00

INTERNATIONAL CRYSTAL MFG. CO., INC.
18 NORTH LEE, OKLAHOMA CITY, OKLAHOMA

Please ship _____

I enclose \$ _____ Send free catalog _____

Name _____ (print)

Address _____

City _____ Zone _____ State _____

Include sufficient remittance to cover postage. See shipping weight.



INTERNATIONAL CRYSTAL MFG. CO., INC.
18 NORTH LEE, OKLA. CITY, OKLA.

Thelma, two sorority sisters, and two wide-eyed pledges. Roger and Sid were talking earnestly to them.

"I tell you," Roger said to Thelma and Jodi, "you're crazy to go into that old barn. It's infested with some kind of horrible rats as big as Shetland ponies, and—I know this sounds kooky—but their tails light up. One attacked us not more than twenty minutes ago, and we were lucky to get out alive. I wouldn't go back there for a guaranteed six-point-zero index for the semester—and believe me I could use it."

"The things have long curving tusks, too," Sid threw in.

Jodie looked questioningly at Carl, who nodded very slightly.

"It's awfully sweet of you fellows to warn us," she said smoothly in her rich Southern drawl, "but membahs of this sorority have to be brave. They really do. Drive on, Thelma."

"I just hope," Carl reflected as he watched them drive away, "that those pledges turn out to be braver than Roger and Sid!"

-50-

Short-Wave Report

(Continued from page 78)

but we have seen serious lightning strokes even during a heavy snowstorm.

Make sure that your antenna is properly guarded by the correct installation of a lightning arrestor—these gadgets, available at any hardware store, are extremely inexpensive, and the protection they afford far outweighs the cost.

Club News. We recently received sample bulletins from two of the newer radio clubs, one being the bulletin of the Canadian International DX Club. The activities of this group are now centered in and around the Winnipeg-St. Charles area but they hope to expand operations soon. Their publication covers the SWL, ham, and medium-wave bands, and runs around 14-18 pages; a sample can be obtained for 10 cents from Jim Rzdakiewicz, 112 Hespeler Ave., Winnipeg 5, Manitoba. Membership dues are \$3.00 yearly.

The second bulletin is from the Kentucky DX'ers Association. Published in conjunction with Browning Laboratories, Inc., Laconia, N.H., this bulletin consists of four legal-

FREE CAREER BOOKLET



To guide you to a
successful future in

ELECTRONICS RADIO-TV COMPUTERS ELECTRICAL ENGINEERING

This interesting pictorial booklet tells you how you can prepare for a dynamic career as an Electrical Engineer or Engineering Technician in many exciting, growing fields:

**MISSILES • AVIONICS • AUTOMATION
SALES • DEVELOPMENT
ELECTRICAL POWER • ROCKETRY
RADAR • RESEARCH**

Get all the facts about job opportunities, length of study, courses offered, degrees you can earn, scholarships, part-time work — as well as pictures of the Milwaukee School of Engineering's educational and recreational facilities. No obligation — it's yours free.

MILWAUKEE SCHOOL OF ENGINEERING

MAIL COUPON TODAY!

Milwaukee School of Engineering
Dept. PE-1163, 1025 N. Milwaukee St., Milwaukee, Wis.
Please send FREE "Your Career" booklet

I'm interested in

Electronics Radio-TV Computers
 Electrical Engineering Mechanical Engineering

Name..... Age.....
PLEASE PRINT

Address.....

City..... Zone..... State.....

I'm eligible for veterans education benefits.
Discharge date.....

MS-117

NOW! THE FIRST "UNIVERSAL" SHIELDING KIT FOR AUTOMOTIVE IGNITION SYSTEMS!

Break the strangle-hold ignition noise puts on two-way communications . . . improve AM, FM broadcast receiver performance! NOT A SUPPRESSION KIT — but a complete ignition shielding kit to control both radiated and conducted interference. Easy to install — utilizes shielding techniques and materials used in "customized" systems by police, taxi and other operators of two-way radio equipped fleets.

6 Cylinder Kit..... \$2995 NET 8 Cylinder Kit..... \$3850 NET

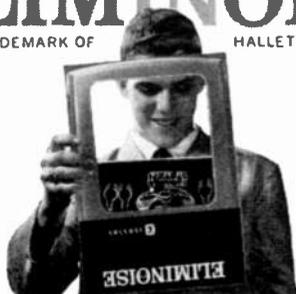


E. F. JOHNSON CO.
2406 10th Ave. S.W. • Waseca, Minn.

ELIMINOISE

A TRADEMARK OF

HALLETT MFG. CO.



NICKEL-CADMIUM BATTERIES 95¢ ea.

The Battery That's Used In Guided Missiles
Now Released as Government Surplus



Ideal for photography, models, searchlights, anywhere a lightweight high capacity storage battery is needed. Sintered-plate Nickel-Cadmium, plastic-cased, alkaline storage batteries designed for "NIKE" Missile and now surplus. A lifetime battery with no known limit of service (over 5000 recharges on test without loss of capacity). Other features: Virtually indestructible, compact and lightweight, withstands heavy shock and vibration, flat voltage curve during discharge retains charge year or more, high discharge rate up to 50 amps for this cell. No corrosive fumes to harm clothing or equipment, spill-proof construction, discharges in any position, indefinite storage without deterioration, operates in temperatures -60°F. to +200°F.

Each cell is approx. 4 ampere hour capacity. Nominal voltage per cell is 1.25 volts. (A 6-volt battery requires 5 cells). Cell size 6" H. x 2" W. x 1/2" T. Wt. 6 oz. ea. Uses Potassium-Hydroxide (30% by weight) electrolyte. Add only distilled water periodically. A fraction of Government cost.

Used cells \$.95 ea.
Brand New cells 2.49 ea.

MOTOR STARTING CELLS

30 A.H. cells, Nickel-Cadmium, steel-cased, with 1/2" screw terminals for mom. current drains to 1000 amps. Size 8 1/2" H. x 3" W. x 1 3/16" T. Wt. approx. 3 1/4 lbs. Permanently sealed. No filling necessary.

Used cells \$2.95 ea.
New cells 5.95 ea.

All cells guaranteed to your satisfaction or money refunded (less postage).

ESSE RADIO COMPANY

42 W. South St. Indianapolis, Indiana, 46225

sized pages and primarily covers SWL'ing, but does include a few items on the medium waves and card swapping. The price is 20 cents per copy. Further details can be obtained from David Reed, WPE4FCL, 546 Pond Run Rd., Raceland, Ky.

In listing various new clubs in this column, please keep in mind that we cannot assume any responsibility for their future. We can only give you the facts as they are presented to us. Many new clubs spring up from time to time, and within a few months most of them silently fold up or wither away. The reader is strictly on his own if he wants to join one of the newer groups.

On the other hand, the small clubs need your support. Two of the small organizations that have made the "big time," largely through excellent leadership, are the Canadian DX Club and the American SWL Club. Should you see fit to join a new club, do so, by all means; and then give them all the help and support you can.

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., 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.

Argentina—*Radiodifusion Argentina Al Exterior*, Buenos Aires, is scheduled to Eastern N.A. at 2000-2300 (Eng. from 2200) and to Western N.A. at 2300-0200 (Eng. from 0100) on 9690 kc. Their General Service is listed as 1400-2000 on 11,730 kc., 1400-1700 on 6090 and 11,780 kc., 2000-0200 on 11,730 kc., and 2100-0200 on 6090 kc.

Bahamas—DX'ers needing this country might try for the commercial telephone stations that operate around 4500 kc. Noted within a short time were: ZSM2, Nassau; ZSM3, Morse Island; ZSI, Spanish Isle; ZSQ6, Nassau; ZSQ4, Normans Cay; ZSH6, Rose Island; and ZSK5, Alvins Cay.

Bolivia—*R. San Jose*, Casilla 314, Oruro, 5872 kc., is back on the air with a Philips xmtr and asking for reports. It has been noted as early as 1715 in Spanish to around 2130, but later on Saturdays. Station CP74, *R. Indoamerica*, Potosi, is noted on 4786 kc. with frequent ID's and Spanish commercials from 2117 to 2158/close. Station CP75, *La Cruz Del Sur*, La Paz, 4985 kc., has Eng. at 2130-2200 but c.w. QRM is usually heavy.

Brazil—The correct call for *R. Guarani*, Belo Horizonte, 6175 kc., is PRH6; a 24-hour station, it is listed at 10 kw. power, and verification is by registered airmail. Station

Always say you saw it in—POPULAR ELECTRONICS

ZYR60, *R. Cultura de Araraquara*, Sao Paulo, 4915 kc., is heard well from 0300 s/on with music, ads, and local Portuguese news. A new outlet on 4855 kc. is either *Radiodifusora de Bahia* or *Emissoras da Bahia*; this one has been tuned from 0330 s/on to 0430 fadeout.

British Honduras—A VOA Eng. newscast is given over *R. Belize*, 3300 kc., at 2200-2215.

Cambodia—*R. Cambodge*. Phnom Penh, is heard on 17,705 kc. at 2055-2130 with news in Eng. at 2100, news in French at 2115.

China—The latest Eng. schedule from Peking reads: to United Kingdom and W. Europe at 1400-1500 on 6210, 7080, 9457, and 11,650 kc. and at 1530-1630 on the same channels plus 9595 kc.; to Eastern N.A. at 2000-2200 on 9480, 9945, 11,945, 11,975, and 15,095 kc.; to Western N.A. at 2200-0000 on 9457, 11,715, 11,820, 15,060, and 17,745 kc.; to Australia and New Zealand at 0330-0530 on 9945, 11,650, 15,060, and 17,835 kc.; to S.E. Asia at 0700-0800 on 9480, 11,685, 11,800, and 15,060 kc.; to Ceylon, India, Nepal, and Pakistan at 0900-1100 on 7350, 9480, 11,685, 11,740, and 15,140 kc.; to Africa at 1100-1300 on 7350, 9775, 11,705, 12,055, and 15,095 kc., at 1300-1400 on 6125, 7350, 9595, 9785, and 12,055 kc., and at 1630-1730 on 5950, 7480, 9570, and 11,980 kc.

Colombia—HJLB, *La Voz de Tolima*, Ibaque, 6040 kc., was heard at noon local time (in Iowa—Ed.) with a readable signal. *La Voz de Llano*, Villavencio, 5950 kc., was noted from 2015 to 0000 s/off (at times to past 0100 with special events) with Latin American programs and Spanish ads; listed as HJIQ, the on-the-air ID is definitely HJIK.

Comoros Island—*Radiodiffusion Francaise*, Dzaoudzi, 7260 kc., has s/on daily at 2200 in French, and is heard only until about 2240 when London signs on in Russian. It can be heard again after 2300 with news in French and at 2315 with music.

Congo (West)—A new frequency for Brazzaville is 9675 kc., heard from 1545 to 1601 s/off with music and anmts in French.

Denmark—Copenhagen's xmsns to N. & S. Africa have been reversed and now read: to N. Africa and Middle East at 1445-1545, to S. Africa at 1330-1430, both on 15,165 kc. All other xmsns remain unchanged including the ones to N.A. at 2030-2130 and 2200-2300 on 9520 kc.

Ecuador—*R. Internacional*, Quito, is a new

outlet operating on 10,136 kc. (heard) and 19,615 kc. (not heard) with usual Latin American programming around 1800; no commercials were noted. Station HCA5, *R. La Voz del Tarqui*, Cuenca, 3995 kc., has a request program in Spanish from 2337 to past 0115.

Ethiopia—*R. Voice of the Gospel* (ETLF-?) Addis Ababa, 15,410 kc., has news at 1430; s/off at 1454, after request for reports to P. O. Box 654, Addis Ababa.

France—Paris has terminated all of its Eng. programs "as an economy measure." The French lessons and the Far Eastern Service will continue as before.

Ghana—The Eng. schedule that appeared in the June issue is still intact. However, your Short-Wave Editor omitted the following two Eng. xmsns: to W. Africa at 1500-1545 and 1630-1715. (The 1545-1630 broadcast is in French.) Reports go to Propagation Engineer, Ghana Broadcasting Corp., P. O. Box 1633, Accra.

Guinea—Conakry is noted on 9650 kc. at 1530 with news in French and at 1545 with African instrumentals. It is also heard on 3375 kc. from 0130 in English.

India—*All India Radio*, Delhi, has Eng. to S. E. Asia at 1930-1940 on 9765, 11,785, and 15,125 kc.; to E. Africa and Mauritius at 2330-2340 on 15,130, and 17,855 kc.; to N. E. Asia at 0500-0600 on 11,710, 11,730, 15,105, 15,290, and 17,855 kc.

The U. S. Information Agency has announced an agreement to build a VOA relay station in Calcutta, rated at one million watts. The U.S. will broadcast for five years to S. E. Asia, after which the station will be turned over to Indian officials. No frequency was given.

Iraq—*R. Baghdad* is again broadcasting at 1530-1600 in French, to 1630 in German, and to 1700 in Eng. on 6030 and 6095 kc.

Lebanon—Beirut has been noted on 15,175 kc. with news in Spanish at 1600 and s/off at 1618. English to N.A. is broadcast on 11,770 kc. at 1630-1645; Arabic and French follow to 1715.

Malaya—*R. Malaya*, Kuala Lumpur, 7200 kc., is noted in England in Eng. with the Home Service around 0500. There is considerable QRM from *R. Australia* on 7190 kc.

Martinique—Try for Fort de France on 4895 kc. at 1700-1800 in French with dance music;

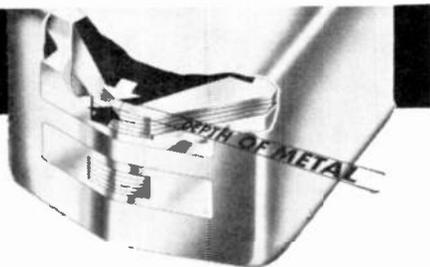
ALL TAPE HEADS WEAR OUT! HERE'S HOW AND WHY!

Magnetic tape itself is the real cause of head wear—its abrasive action as it passes over the head face gradually wears away the *depth of metal* (see at right). Wear is nearly always uneven with craters or ripples forming on the face making it impossible to achieve good contact between the head gap and signal recorded on the tape! Severe high frequency losses and erratic output result from such poor tape-to-gap contact—the outstanding fidelity of tape reproduction is lost!

Head wear should not be permitted to reach this point—much less go beyond it to the limit where the gap actually begins to open up.

Examine your heads for wear or have your Hi Fi dealer, Radio/TV serviceman or camera store check them. Insist on Nortronics replacement heads and "Quik-Kit" mounting hardware; both correctly matched to your recorder.

Write for FREE NORTRONICS Tape Head Replacement Guide



"Music sounds best on tape—
Tape sounds best with Nortronics heads"

Nortronics®



8135 10th Ave., N. • Minneapolis 27, Minn.

18 TOOLS IN ONE!

FOR HOME · CAR · SHOP
HOBBIES · SPORTS



RATCHET ACTION SOCKETOOL BY SHELTON

Offers Unlimited versatility—handles popular sizes of nuts, bolts and screws with slotted, recessed, square or hex heads!

Features fast action speedy 3-way ratchet handle that operates in either direction or locks; regular and recessed-head screwdrivers; straight and offset adapters; eight hex and square sockets from 1/4" to 3/16". Does the work of 18 tools—8 straight and 8 offset wrenches, plus 2 screwdrivers, yet fits in a 5 1/4" x 4 1/4" case. **\$2.95** ONLY

complete with case—attractively packed in gift sleeve upon request.

FULLY GUARANTEED! MAIL COUPON TODAY!

Ziff-Davis Publishing Company PE-113
Consumer Service Division
One Park Avenue, New York 16, New York

Please send me SOCKETOOL sets at \$2.95 each. (N.Y.C. residents please add 4% Sales Tax). My check (or money order) for is enclosed. I understand that you will pay the postage and that each SOCKETOOL is fully guaranteed.

Check here for gift sleeve packing.

Name

Address

City Zone State

(SORRY—No Charges or C.O.D. Orders)

SHORT-WAVE ABBREVIATIONS

anmt—Announcement
c.w.—Morse code
Eng.—English
GMT—Greenwich Mean Time
ID—Identification
IS—Interval signal
kc.—Kilocycles
kw.—Kilowatts

N.A.—North America
QRM—Station interference
R.—Radio
s/off—Sign-off
s/on—Sign-on
VOA—Voice of America
xmsn—Transmission
xmtr—Transmitter

the 3315-kc. outlet is also noted around 3315 with generally better signals than on 4895 kc.

New Guinea—A verification lists the new outlet on 5015 kc. as being VLT5; no schedule is given but presumably it is the same as on VLT6. Another new outlet is VLK3, 3925 kc., 10 kw., scheduled Sundays to Fridays at 0200-0930 and 1500-1700 and Saturdays at 0200-0900 and 1530-1700. It was heard in Iowa fighting it out with and eventually winning over JOZ2, Japan, at 0330-0430.

Peru—Among the stations being heard are: OAX4Q, *R. Victoria*, Lima, 6010 kc., to 0100 with music and ads; OAX6S, *Onda Popular*, Lima, 6260 kc., also to 0100 with music and ads; *R. Progreso*, Piura, 5910 kc., to 0100 (they play the "Happy Birthday" song and the "Anniversary Waltz" nightly at 2359); *R. Cuzco*, *La Voz de la Capital Arqueologica de America*, 6250 kc., with Latin American programs and many ads to 2100, then a 'live' audience musical show; and OAX5V, *R. Villarica*, Huancavelica, 4943 kc., at 2207-2250 in Spanish but heavily QRM'ed by HCXZ1, Ecuador, and ZYE23, Brazil.

St. Pierre & Miquelon—Radiodiffusion Television Francaise operates a medium-wave outlet on 1375 kc. with 1 kw. that has been heard in the northeast. The schedule: Mondays, Tuesdays, Wednesdays, and Fridays at 0500-0700, 1000-1130, and 1630-2000; Thursdays at 0500-0700, 1000-1300, and 1630-2000; Saturdays at 0500-0700, 1000-1300, and 1600-2100; Sundays at 0500-1300 and 1630-2100. The ID is generally given in both French and English.

Surinam—Paramaribo, 15,465 kc., is noted around 1935 with Eng. pop music and Dutch anmts. An ID in Dutch at 1954 was followed by more pop music, news in Dutch at 2001.

Thailand—Bangkok is scheduled to N.A. at 2315-0015, to Thai Forces in Korea, Vietnam, and Cambodia at 0430-0520, in the General Overseas Service at 0525-0657, and with a Home Service relay at 0800-0900, all on 11,910 kc. Additionally, the N.A. service and the General Overseas Service are also carried on 7305 and 6160 kc. National Home Service programs in Thai are given at 1900-2000 and 0700-1030 on 4830, 6070, 7305, and 11,910 kc. Other xmsns: Laotian at 2005-2310 on 4830 kc.; Chinese at 2130-2145 on 6097 kc.; French (Monday to Friday) at 0030-0100 on 11,910 kc.; Malay at 0130-0145 on 4830 kc.; and Laotian at 0800-0830 on 6097 kc.

U.S.A.—According to the American Short-wave Listeners Club, the VOA has set up a mobile station near Yuma, Arizona, and is operating at 1400-1530 on 15,350 kc., and at 1530-1700 on 11,760 kc.

U.S.S.R.—*R. Yerevan*, Armenia, broadcasts to Armenians in N., S., and Central America on Saturdays and Sundays at 1430-1530 on

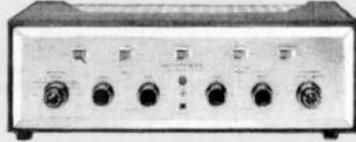
11,850 kc.; there is some Eng. during this period. Another Russian station, on 12,030 kc., is noted from 1700 s/on. The regular Moscow IS is given at the opening but an IS given during the program differs from that used in the Home Service. Apparently not a Pacific Coast Siberian station, this one may be in use for a special xmsn to Russians in Cuba.

Vatican City—The latest English schedule from *R. Vatican* reads: to N.A. daily at 1950 on 7250 and 9645 kc.; to E. Africa daily at 0500 and to S. and Central Africa daily at 0520, both on 17,735 and 21,490 kc.; to Australia and New Zealand at 0630 daily on 15,120 and 17,840 kc., and at 1700 on 9645 and 11,740 kc.; to the British Isles daily at 1000 on 9645, 11,740, and 15,120 kc. and at 1315 on 7250, 9645, and 11,740 kc.; to India, Pakistan, and Ceylon on Mondays, Wednesdays, and Saturdays at 1100 on

SHORT-WAVE CONTRIBUTORS

Bernard Dodge (WPE1C1Q), Waterbury, Conn.
Jonathan Hoyt (WPE1DRY), Clinton, Conn.
Vincent Caravella (WPE1DVL), Lunenburg, Mass.
Marshall Cannell (WPE1FHL), Wellesley Hills, Mass.
Michael Chabak (WPE2AUJ), Astoria, N. Y.
Jack Germain (WPE2EOL), New Milford, N. J.
Amedeo Calviello (WPE2FAE), Brooklyn, N. Y.
John Whitmore (WPE2FVR), Garden City, N. Y.
Jerry Bond (WPE2FXO), Watertown, N. Y.
Robert Grill (WPE2FZJ), Huntington, N. Y.
Vincent Argenzio (WPE2GME), Rutherford, N. J.
Nicholas Nicastro (WPE2HHS), Hoboken, N. J.
Robert Wechsler (WPE2IGE), Brooklyn, N. Y.
Dan Grumet (WPE2IMF), Toms River, N. J.
Craig Anderton (WPE2JHM), Ridgewood, N. J.
Al Quagliari (WPE2KMI), Albany, N. Y.
Bill Wilson (WPE3JUC), Folcroft, Pa.
John Feldman (WPE3EHU), Feasterville, Pa.
Grady Ferguson (WPE4BC), Charlotte, N. C.
Steve Dunning (WPE4BJR), Rocky Mount, N. C.
Chuck Edwards (WPE4BNK), Fort Lauderdale, Fla.
John Brunst (WPE4BO), Neptune Beach, Fla.
Roger Bowman (WPE4ESK), Orlando, Fla.
Bruce Churchill (WPE4EVD), Norfolk, Va.
Paul Gonzalez (WPE4FEH), Tampa, Fla.
B. C. Grigsby (WPE4FJV), Bristol, Va.
Kenneth Alyta, Jr. (WPE4FNB), Charlotte, N. C.
Tom Palmer (WPE4GEL), Sanford, Fla.
William Bing (WPE5AG), New Orleans, La.
Jack Keene (WPE5BMP), Houston, Texas
Shaler Hanisch (WPE6BPN), Pasadena, Calif.
Al Burzunski (WPE6DJB), Glendale, Calif.
Warren Van Orden (WPE6EVU), Berkeley, Calif.
Michael Clapshaw (WPE7BSJ), Port Angeles, Wash.
Robert Kipp (WPE8BBL), Detroit, Mich.
John Dyckman (WPE8BY), Canfield, Ohio
Scott Strodman (WPE8ETO), Grand Rapids, Mich.
Robert French (WPE8FGH), Bellaire, Ohio
John Forslin (WPE8FKB), Wayne, Mich.
John Pirnat (WPE8FVU), Euclid, Ohio
Mike Kander (WPE8MS), Dayton, Ohio
Robin Fisher (WPE8OG), Beach City, Ohio
J. P. Arendt (WPE9DN), Aurora, Ill.
Richard Hallowell (WPE9EIT), Pekin, Ill.
Bob Horrell (WPE9FFX), Mt. Prospect, Ill.
Robert Vandevender (WPE9FZL), Muncie, Ind.
Bill Kirk (WPE9CIT), Boone, Iowa
J. W. Harre (WPE9CSJ), Marshall, Mo.
Steven La Croix (WPE9DLR), Wayzata, Minn.
Robert Garwood (WPE9DLT), Wayzata, Minn.
John Wagaman (WPE9DPX), Knoxville, Iowa
Jack Perolo (PY2PEIC), Sao Paulo, Brazil
Gregg Calkin (VE1PE3L/G5), London, England
Gary Cooper (VE3PE1MX), St. Catharines, Ont., Canada
Ken Taylor (VE3PE1SP), Kincardine, Ont., Canada
Dave Bennett (VE7PE1R), Richmond, B. C., Canada
Michael Collins, Stratford, Conn.
Wendel Craighead, Kansas City, Kan.
Paul Eaton, APO, New York, N. Y.
Andrew Kasparson, Auburn, Mass.
Gregory Kordes, Tustin, Calif.
Joe Piechuta, Meriden, Conn.
Jim Wedewer, Dyersville, Iowa
World Radio TV Handbook

FROM SCOTT FREE STEREO KIT CATALOG



Have fun . . . save money . . . build the best! Now world-famous Scott stereo components come in easy-to-build kit form. You can build a multiplex tuner and a powerful stereo amplifier that perform like factory-built units. Prices start as low as \$99.95 for the superb LK-30 30-watt stereo amplifier kit shown here! Send this coupon now!

H. H. Scott, Inc.
111 Powdermill Road
Maynard, Mass.

SCOTT

Dept. 520-11

Rush me complete information on Scottkits and factory wired components.

Name _____

Address _____

City _____ Zone _____ State _____

Export: Morhan Exporting Corp., 458 Broadway, N. Y. C.
Canada: Atlas Radio Corp., 50 Wingold Ave., Toronto

TAPE RECORDER



(liquidation stock)

\$8.99

Liquidation of our special purchase of tape recorders complete with excellent 2 1/2" speaker and microphone. A \$20

value. This production left over from giant national department store promotion where recorders were taped with a message to give to passing customers. Comes complete with standard 1/4" magnetic tape. Use for messages, rig with remote control invisible thread for detective work. Has unique endless loop feature. Hide anywhere conceal in toy animal and let it make outrageous remarks to guests. Hundreds of uses. While they last. Send \$1 deposit for C.O.D. Satisfaction guaranteed.

MISSION LIQUIDATORS,

735 Celis Street, San Fernando 49, California

year-round program

Small stimulating college . . . B. S. Degree in 36 months in Engineering and Business Administration. One-year Drafting-Design Certificate program. Founded 1881 . . . rich heritage. Professionally oriented. Excellent faculty. Small classes. Well-equipped lab. New library. Residence halls. 200-acre campus. Outstanding placement of graduates. Modest costs. Enter Jan., March, June, Sept. Write J. D. McCarthy, Director of Admissions.



TRI-STATE COLLEGE

36113 College Avenue • Angola, Indiana

MOVING?

ATTACH LABEL HERE

If you've recently changed your address or plan to in the near future, be sure to notify us at once. Place magazine address label here and print your new address below.

NEW ADDRESS:

Name _____
PLEASE PRINT

Address _____

City _____ Zone _____ State _____

PLEASE FILL IN MOVING DATE BELOW

If you have any other questions about your subscription be sure to include your magazine address label when writing us.

Mail to: POPULAR ELECTRONICS,
434 So. Wabash Ave., Chicago 5, Ill.

11,740 and 15,120 kc.; and to the Philippines on Mondays, Wednesdays, and Fridays at 1730 on 7260 and 9645 kc.

Vietnam (North)—Hanoi has Eng. from 1029 to 1057/close on 15,100 kc. News is given at 1030.

Windward Islands—A new frequency for St. Georges is 11,730 kc., noted in dual to 3280 kc. at 2000-2115. A newscast is given at 2100.

Clandestine—*World Radio TV Handbook* reports that an unidentified station on 11,400 kc. is *Radio Peyk e Iran*, which broadcasts in languages of the Near East on 9559, 11,410, and 11,696 kc. No times were given. This station is believed to be in the German Democratic Republic. —50—

Transistor Topics

(Continued from page 76)

The battery drain, according to Melvin, is quite low and, since the batteries are used only intermittently, their operating life should approximate normal battery shelf life.

Transitips. Base bias is perhaps the most important single factor affecting transistor operation. With incorrect bias, a transistor oscillator may fail to operate or may deliver a very distorted output signal—an amplifier may be completely "dead," be weak (have low gain), or may distort the amplified signal. Where power transistors are used, incorrect bias may not only cause poor operation but, under some conditions, may cause the transistor to overheat and even burn open.

A number of years ago, when the transistor was still relatively new, it was common practice to use a separate battery to supply base bias. Today, a single power supply is generally used for both collector and base current. Any of several techniques can be employed to supply the base bias, depending on circuit requirements and intended application.

As far as hobbyists and experimenters are concerned, the most popular biasing method is the use of a series resistor between the base and the power supply, as illustrated in Fig. 3 (A). Here, base bias is supplied by *B1* through series resistor *R1*. Resistor *R2* is *Q1*'s collector load, which in some circuits is replaced by a relay, coil, or transformer primary winding.

The series technique, while inexpensive and effective, has one serious disadvantage: it is extremely sensitive to temperature variations. If the ambient temperature rises, the transistor's internal base-emitter resist-

ance drops. This in effect reduces the total resistance in the bias path and thus increases the bias current. In some cases, an increase in bias current leads to internal heating due to the resulting increase in emitter-collector current and this, in turn, increases the bias current still more.

In order to reduce the effects of temperature variations on bias currents, many designers supply base bias through a voltage divider network, as illustrated in Fig. 3 (B). Here, the base bias is determined by the relative values of voltage-divider resistors $R1$ and $R2$. Since $R2$ shunts $Q1$'s base-emitter circuit, it tends to minimize changes in over-all base-emitter resistance with

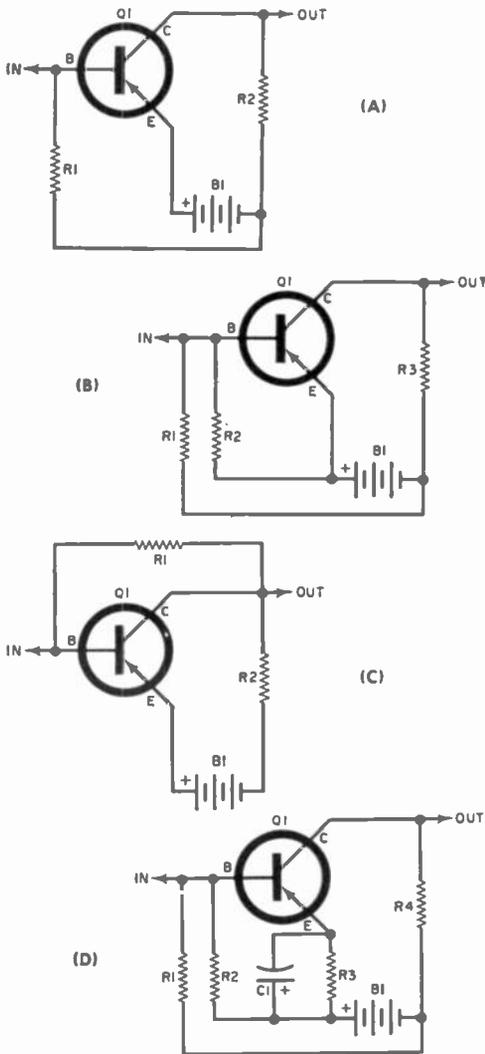


Fig. 3. Methods of supplying base bias: (A) series technique; (B) voltage-divider network; (C) collector feedback; and (D) emitter-compensated bias.

FREE GIANT NEW CATALOG

BURSTEIN-APPLEBEE CO.

Dept. 1A, 1012 McGee St., Kansas City 6, Mo.

Rush me FREE 1964 B-A Catalog.

Name

Address

City

State

SEND FOR IT TODAY

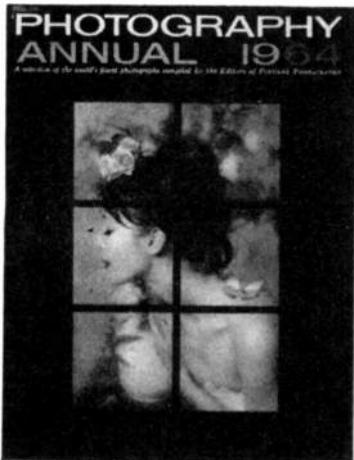
FREE

EARN Electronics DEGREE

Engineering
You can earn an A.S.E.E. degree at home. College level HOME STUDY courses taught so you can understand them. Continue your education, earn more in the highly paid electronics industry. Missiles, computers, transistors, automation, complete electronics. Over 27,000 graduates now employed. Resident school available at our Chicago campus—Founded 1934. Send for free catalog.

AMERICAN INSTITUTE OF ENGINEERING & TECHNOLOGY
1137 West Fullerton Parkway, Chicago 14, Ill.

GREAT SUBJECTS, GREAT PICTURES IN



The editors of Popular Photography have gathered the year's outstanding examples of the art of the camera for the 1964 Edition of Photography Annual. It features: 5 personal portfolios, a forecast on next year's Pulitzer Prize-winning picture, excerpts from the outstanding photo books of the year, selections from photography exhibits and a famous International Portfolio of fine pictures. You won't want to miss

PHOTOGRAPHY ANNUAL 1964

It's now on sale at newsstands and camera stores. Be sure to get your copy today—or send in this coupon and we'll mail your copy to you.

Only \$1.25

Ziff-Davis Service Division PE-113
Dept. PA, 589 Broadway, New York 12, New York
Please send me a copy of PHOTOGRAPHY ANNUAL 1964. I enclose \$1.25, the cost of the ANNUAL, plus 15¢ to cover mailing and handling charges. (Canada & Overseas: \$1.25 plus 25¢ postage.)

NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

(Add 4% sales tax if N.Y.C. resident)

changes in temperature and thus to stabilize the base bias.

Another technique for stabilizing the base bias is shown in Fig. 3 (C). Here, base bias is fed back from the collector through series resistor $R1$. If there is a tendency for collector current to increase, the voltage drop across the collector load ($R2$) increases, reducing the d.c. voltage available for bias and thus the base bias current. This, in turn, reduces collector current and tends to return it to the designed value.

The collector feedback technique has one disadvantage. The amplified a.c. signal as well as the bias current is coupled back to the base. Since this signal is of opposite polarity when compared to the input signal, it reduces the effectiveness of the input signal and thus stage gain. However, it is an excellent biasing technique where maximum gain is not needed, for the inverse (a.c.) feedback introduced stabilizes over-all operation, reduces distortion and, in general, extends the circuit's frequency response.

Where maximum stage gain coupled with maximum bias stability is needed, the technique shown in Fig. 3 (D) is often used. Here, a voltage-divider bias network, $R1-R2$, is used in conjunction with a series emitter resistor, $R3$, bypassed by a large capacitor, $C1$. In operation, the base bias established through $R1-R2$ is offset by the d.c. voltage drop across $R3$ which, in turn, varies directly with emitter-collector current. If collector current tends to increase, as with increasing temperature, the voltage drop across $R3$ also increases, reducing the base bias current and restoring collector current to its design value. The bypass capacitor, $C1$, serves as a "short" for a.c. signal currents and thus prevents inverse feedback, permitting the stage to operate at maximum gain.

The emitter-compensated bias method is perhaps the most popular of these four techniques for industrial and commercial equipment, but is the most costly, for it requires the most components per stage.

In summary, if a proven transistor circuit fails to work properly, and all components check "good," one of the first steps should be a check on the base bias current. If necessary, the base bias can be readjusted experimentally for optimum performance. Where a circuit works well on the workbench, but fails to operate under field conditions (outdoors, for example) where different temperatures are encountered, it may indicate the need for a compensated biasing method, such as those illustrated in Figs. 3 (B), (C) and (D).

That concludes our semiconductor story for this month. Adios, amigos . . .

—Lou

C Bridge

(Continued from page 66)

needed for mounting the parts. Note that in the unit shown the transformer, line fuse, and a neon pilot lamp (optional) are all mounted in one end of the box, with all connections for the null detector at the opposite end. One of the two terminal strips is mounted near the center of the box lid, and supports *D1*, *R1*, and the common ends of capacitors *C1*, *C2*, and *C3*. Use a heat sink when soldering *D1*.

Standard capacitors *C1* and *C2* can be bought in 10%, 5%, 2%, or even 1% tolerance. The 5% tolerance is recommended for *C1* as the best compromise in price and accuracy. For *C2*, the saving for the 10% tolerance may be enough to be worthwhile. Capacitor *C3* is actually made up of two small 25-w.v.d.c. electrolytics in parallel. This was necessary in order to bring *C3* to within the desired 5% accuracy, since ordinary electrolytics are not made to close tolerances. The writer found that two Sprague Type TE capacitors marked 6 and 2 μ f. totalled 10 μ f. when paralleled.

An optional neon pilot lamp was included in the writer's unit. If you wish to add this feature, connect a plastic-encased NE-2A (or similar) neon lamp in series with a 200,000-ohm, 1/2-watt carbon resistor across the primary of transformer *T1*.

Calibration. The C Bridge is calibrated by connecting known values of capacitance across the "unknown" binding posts, adjusting potentiometer *R2* to the null point, and marking the position of the knob pointer with the value of the known capacitor. To do this, connect the null detector by plugging it into the appropriate jacks (*J1*, *J2*, or *BP3* and *BP4*), and plug the C Bridge into the a.c. line.

You can use high-impedance phones, a VTVM, or best of all, an amplifying type a.c. VTVM as the null detector. The higher the impedance and the greater the sensitivity, the better. If you have only headphones, the "Phone-Boost" (see page 55) will greatly increase the accuracy of measurement. —50—

FREE!

RADIO SHACK 1964 Bargain CATALOG

Write Today!



- Exclusive Items!
- Sale Bargains!
- Hi-Fi Stereo!
- Kits & Parts!
- CB & Amateur!

Get the most popular electronics catalog in the country FREE. See Radio Shack's fabulous Realistic audio and kit line! Everything in solid state! Greatest mail-order values in our 41 years! Just printed — newest catalog available! Paste coupon on postcard and mail NOW!

FANTASTIC SALE!



SAVE
40%

HALLICRAFTERS 3-Band Radio \$20 OFF AT RADIO SHACK!

EXCLUSIVE! Radio Shack bought Hallicrafters entire stock of S-119 receivers to sell below dealer cost while they last! Hear 2-5.5 mc and 5.7-16.4 mc shortwave, plus regular broadcasts. Wired, not a kit. Made in USA. Metal cabinet; speaker; voice/code and speaker/tone switches; straight AC superhet handwired circuit; 64-page shortwave booklet. It's the fabulous "Sky Buddy", the biggest bargain in Radio Shack history and just in time for Christmas giving. Order by mail while supply lasts. Add shpg. 9 lbs. Tune in the world and save \$3 at Radio Shack!

Regularly

~~\$49.95~~

29⁹⁵

Now 23 stores: Mass. — Brookline, Boston, Cambridge, Worcester, Framingham, Springfield, Saugus, Braintree, Conn. — New Haven, Hartford, Stamford, R.I. — Cranston, N.H. — Manchester, Me. — Portland, Texas — Ft. Worth, Dallas, Houston, San Antonio, Cal. — San Leandro.

RADIO SHACK CORPORATION

730A Commonwealth Ave., Boston 17, Mass.

- Send 1964 Catalog — FREE
- Send Halli. S-119 — \$29.95

Name _____

Street _____

Town _____ Zone _____ State _____



Add these great new developments to your kit... understand

SEMICONDUCTOR FUNDAMENTALS

Devices and Circuits By A. H. SEIDMAN, Pratt Institute, and S. L. MARSHALL, Editor, Semiconductor Products Magazine.

How they operate . . . how to use them

This solid new book takes you from the basic physics of transistors and diodes into construction and manufacture. Then you'll see how the transistor operates as a circuit element, how it's applied in computers, with examples of diode-transistor logic (DTL) and NOR logic. There's a full chapter on tunnel diodes. *PLUS* these hows and whys of transistors: equivalent circuits • using characteristic curves • biasing, stabilizing • amplifiers • negative feedback • oscillators • electrical measurement • problems for self-testing.

The basic book for the technician and serious amateur. 1963 278 pages \$6.50

at your bookstore, or

JOHN WILEY & SONS, Inc.

605 THIRD AVENUE, NEW YORK, N. Y. 10016

TV LAMP CLOCK

with FOCALIZED "STARE-BREAK" relieves
Eyestrain from constant TV stare and glare



"TIME
AT A
GLANCE"

Model 710
WALNUT
\$11⁹⁵

1 YEAR GUARANTEE

This T-V Lamp Clock is wholly new in concept! Fully automatic self-starting electric clock . . . calculating and registering every second, minute, 10 minute and hour. Big, bold, easy-to-read "Time at a Glance" colorama numerals. Glorite luminescent face GLOWS IN THE DARK. Has a comforting night light for bedroom or nursery controlled by independent switch. Plastic case, 5 3/4" H, 6" W, 3 1/2" D. UL approved motor and cord. 110V, 60 cy., AC. Plus applicable tax. Dealer Inquiries Invited.

At Your Local Dealer or ORDER DIRECT from

PENNWOOD NUMECHRON CO.

7249 FRANKSTOWN AVE.

PITTSBURGH 8, PA.

110

Across the Ham Bands

(Continued from page 72)

dividual contacts were made between the six Air Force, Army, and Navy stations (AIR, WAR, NSS, AG6AA, A6USA, and NPG) operating on regular military frequencies, and radio amateurs operating on amateur frequencies.

In addition, 654 perfect copies of the message from the Secretary of Defense, Robert S. McNamara, to radio amateurs sent on c.w. at a speed of 25 wpm were made, as well as 583 perfect copies of the radioteletype (RTTY) message. Four Novices, KN1YRP, WN4LUO, WN5ERR, and WN9GQC, were among those who copied the c.w. message perfectly!

News and Views

Robert C. Garceau, KN1YRP, 241 Providence St., Putnam, Conn., really must have concentrated on his code practice; after six months as a Novice, he recently took his General Class exam with an ARRL 30-wpm code certificate on the shack wall! On the air (mostly on 80 meters), his Heathkit HX-11 transmitter running 50 watts, Hallicrafters S-120 receiver, and dipole antennas ran up 200 contacts in 24 states. Bob rates the state of Washington worked on 80 meters as his best DX. . . . **Steve A. Corbitt, WN4KXC**, 4055 Three Notch Rd., Rt. 2, Mobile, Ala., is a 40- and 15-meter man. With five months to go on his Novice ticket, he has 48 states and 10 countries confirmed—he is still waiting for QSL cards from another 13 countries to show up in his mail box. A Heathkit DX-60 transmitter agitating a 40-meter dipole antenna, 40' high, and a Hallicrafters SX-110 receiver are his secret weapons. . . . **John Zuris, WN9ICQ**, 11412 So. Maplewood Ave., Chicago, Ill. 60655, reversed the usual belief that it is easier for a beginner to make contacts on 40 or 80 meters than on 15 meters by spending six weeks on 40 meters without making a single contact. Then he went on 15 meters, and presto! In two weeks, he worked 20 states, Canada, Panama Canal Zone, Corsica, and Vashman Island in the Irish Sea. An EICO 720 transmitter pushes his signal out through a 40-meter dipole surrounded by rain gutters, and a Knight-Kit R-100 receiver handles the incoming signals.

Are you among those hams who think there's no DX to be worked on the 40-meter Novice band? Well, **Jim Hartwell, K7UDG**, Chief Op. at DL4IZ in Germany, has news for you. Jim has heard U.S. Novices in most call areas regularly on 40 meters, and he has called many, as well as "CQ WN KN"—all in vain. As DL4IZ has a power of 500 watts feeding a beam antenna 90' high and has no

Always say you saw it in—POPULAR ELECTRONICS

trouble working U.S. Generals, Jim is certain the trouble is that Novices just don't listen for DX outside the Novice band (he generally uses 7145 kc. when calling Novices). Ivor, VK3XB, had the same trouble in Australia a few years ago, but when word got around that he was hearing and calling Novices on 7149 kc., Ivor worked 7-mc. Novices in all 50 states! Unfortunately, Jim will probably be back home at K7UDG by the time you read this, so he won't have a chance to work you from DL4IZ. But all is not lost. **John Stone, DL4ZF**, will be on 40 meters almost every night until next summer looking for Novices. In turn, look for John around 7145 kc., usually between 0100 and 0500 GMT (8:00 p.m. and midnight, EST).

Marty Kapp, WN2DYV, 16 Largo Lane, Livingston, N.J., is a busy ham. He works 80, 40, and 15 meters using a Lafayette HE-30 receiver and a Heathkit DX-40 transmitter feeding separate antennas for each band. He has logged 43 states and five countries on these bands. On two meters, Marty uses a Heathkit Twoer feeding a "home-brew," 5-element beam for local rag-chews. When not hamming, Marty SWL's as WPE2ICT. . . If you still need a Nevada contact for your worked-all-states (WAS), **Norm Thompson, K7LWK**, and **Tony Morgan, K7TRG**, will be glad to arrange skeds. They can nominate you for the Rag Chewers' Club, too. Write them at 925 Mezpah St., Las Vegas, Nevada. . . **Tom Barker, KN7SWX/WPE7BPN**, 5613 North 12th St., Phoenix, Ariz. 85014, uses two "ionosphere agitators," a Heathkit Apache—crystal-controlled and held down to 75 watts—and a Heathkit DX-40. He receives on a Hammarlund HQ-170C, and alternates between an 80-meter doublet, a Hy-Gain 14-AVS vertical, and a home-brew 15-meter beam. Forty-eight states and 48 countries confirmed and 761 QSL cards on hand indicate that everything, including the operator, is working properly.

Eric Keener, WN6EST/WPE6EJQ, 719 Bungalow St., El Segundo, Calif., finds a home-built crystal calibrator a big help in spotting frequencies on his Hallicrafters S-120 receiver. He transmits with a Heathkit DX-60 via a coaxial dipole antenna. . . **Tom Cote, WN81BO**, 1807 Long Point, Pontiac, Mich., started out by building his own 30-watt transmitter, and he still uses it more than the 50-watt commercial unit he obtained later. A 40-meter dipole antenna radiates his signal to far places (17 states so far), and a well-aged RME-69 receiver separates the wanted from the unwanted incoming signals. . . **Walt Hughen, WN0GJZ**, 745 Glenvista Pl., St. Louis 22, Mo., took an Advanced Radio course in summer school, which made it easy for him to "bone up" for his General exam. In a month on the air, his Hallicrafters S-38E receiver, plus Q-multiplier, Heathkit DX-40 transmitter, and inverted-V antenna have racked up 275 contacts in 28 states and Canada.

Remember, *Across the Ham Bands* is your column; so let's see your "News and Views," pictures and comments. Send them to: Herb S. Brier, W9EGQ, Amateur Radio Editor, POPULAR ELECTRONICS, P.O. Box 678, Gary, Indiana 46401. 73,

Herb, W9EGQ

DO YOU SAVE YOUR COPIES OF POPULAR ELECTRONICS



Make sure they're kept neat and always handy for instant reference—with this handsome file that's designed to hold a full year's copies!

- washable Kivar cover creates a leather-like appearance
- available in maroon backing with black sides or black with maroon
- 24-carat solid gold leaf embossed lettering for magazine's name
- attractively priced at only \$2.95 each, 3 for \$8.00, 6 for \$15.00
- files are shipped to you prepaid and are fully guaranteed

NOTE: these special-quantity prices apply for any combination of titles, so you can have them for all your favorite magazines.

Order several today—for all the Ziff-Davis magazines: Popular Photography, Modern Bride, HiFi/Stereo Review, Electronics World, Popular Electronics, Flying, Car and Driver, Popular Boating, Amazing, and Fantastic, and for your other favorite publications, as well.

Jesse Jones Box Corp., Dept. P.E. Box 5120
Philadelphia 41, Pa.

Please send me: (Fill in title, quantity and check appropriate column for color desired)

MAGAZINE TITLE	QUANTITY	BLACK BACKING/ MAROON SIDES	MAROON BACKING/ BLACK SIDES
Popular Electronics	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

\$2.95 each, 3 for \$8.00 or 6 for \$15.00—shipped prepaid—fully guaranteed

Total amount enclosed _____

Name _____

Address _____

City _____ Zone _____ State _____

Crystal Super Calibrator

(Continued from page 54)

broke," and complete the final assembly, or you can hook everything up on the bench with clip leads and make sure it works before assembling the unit in the box. If it doesn't oscillate, recheck everything, particularly the transistors.

When you're ready, mount the circuit board on the inside of the prepared box cover, taking care to space it clear of the cover with quarter-inch spacers, or with extra nuts on the mounting screws. Put the cover on, and complete the wiring to the battery, on-off switch, and the output binding post. Last, connect the two wires going to the crystal and padder capacitor, put on the second cover, and you're ready to fire up.

Adjustment. To adjust for zero beat with WWV, tune in the 10-mc. transmission (or the 5-mc. signal if you can't hear the 10-mc. signal at your location). Couple the output of the calibrator to

the receiver antenna, either directly or through a small capacitor, and fully mesh the padder capacitor plates. Then back off on the padder slowly, listening as the beat note gets lower, until zero beat is reached.

When the frequency difference between the calibrator harmonic and the standard signal gets down to a few cycles, a regular oscillation of the receiver signal strength meter will be seen. This indication is more sensitive than the audible one, and permits adjustment to within one cycle per second or better! If you adjust your calibrator this carefully, the harmonic will be within 15 cycles of the correct frequency, even at 150 mc!

Bear in mind that, while the unit will function with a 1.5-volt, one-cell battery supply, it will also operate on higher voltages (safely to at least 10 volts), and will give commensurately greater output, at some small sacrifice in thermal stability. And you can even use an a.c. power supply running off the receiver heater circuit, as shown in the schematic, if the few milliamperes of battery drain worry you. -50-

Edgar Rice Burroughs

Revisited!

The famous creator of "Tarzan" was also a great science-fiction writer. The mythical city which he invented and called Pellucidar was the scene of some of the most fertile imaginings in the annals of science fiction.

Recently a hitherto unpublished novelet was discovered among Burroughs' possessions. It's entitled SAVAGE PELLUCIDAR and it's featured in November AMAZING STORIES.

Now on sale—don't miss it!



MPX Meter

(Continued from page 44)

44 shows hookup used with any setup.

Adjustment. Tune to a station you know is transmitting stereo, and adjust the slug of *L1* for maximum meter reading. If the meter "pins," detune the slug until the meter reads about 80 per cent of full scale. Try other stations, and adjust your MPX Meter for the best all-around compromise—a setting that will give satisfactory readings on all stations in your area.

Some jumping of the meter needle may be seen between stations due to the high-frequency noise components present. However, when you are clearly receiving a station, the MPX Meter will either be reading positively, or not at all; there is no ambiguity.

If your meter is transistorized, try to place it in a ventilated spot—not on top of the amplifier or tuner—since there will be increased leakage current if the unit gets very hot.

While there are other types of stereo "beacons"—a light or an audible tone that comes on when a stereo program is being transmitted—all require relatively



"I hope I've made myself clear enough so that you can explain it to me . . ."

LATEST SAMS BOOKS FOR EVERYONE IN ELECTRONICS



USE THIS HANDY ORDER FORM

- Modern Dictionary of Electronics (Revised).** All-new edition of the most complete dictionary in electronics—now defines over 12,500 terms and words. Over 400 pages, handsome hard-binding. Order DIC-2. *Special prepub price through November 30 (\$6.95 thereafter), only . . . \$5.95*
- Test Equipment Maintenance Guidebook.** Describes the proper calibration and maintenance for all types of service instruments; gives step-by-step illustrated "how to" procedures. Order TSE-1, *only \$2.95*
- TV Service Training Manual.** Outstanding and practical—minimum theory with emphasis on actual circuit trouble-shooting. Uses special "programmed" charts which guide you quickly and practically to the faulty stage. Order TSR-1, *only \$3.95*
- Electrical Control Circuits and Wiring.** New and practical approach to industrial electrical control circuit wiring, from simple power circuits to the more complicated wiring used in industry today. Order ECW-1, *only . . . \$4.95*
- Transistor Ignition Systems Handbook.** Clearly explains the principles, installation and tuning up of these new transistor ignition systems which are revolutionizing the auto industry. Order IGS-1, *only \$2.50*
- Practical Projects in Radio Electronics.** Through a series of easy-to-construct projects, this book provides the beginner with a sound background for understanding radio electronics theory and circuitry. Order RSM-1, *only . . . \$4.95*
- Business Radio Handbook.** Provides all the facts about UHF mobile communications setups in the new Business Radio class; facts about equipment, mobile or fixed; channels; licensing, etc. Order BRS-1, *only . . . \$3.95*
- Electronic Engineers & Technicians Reference Handbook.** A one-source reference on electronic theory and applications. Shows how to use theorems, laws and principles; includes tables of symbols, abbreviations, math constants, etc. Order ERH-1, *\$4.95*
- Audels Domestic Compact Auto Repair Manual.** AUD-52 . . . \$5.85
- Audels Foreign Auto Repair Manual.** AUD-53 . . . 5.00
- Audels Television Repair Manual.** AUD-39 . . . 5.00
- Science Projects in Electronics.** SPJ-1 . . . 2.95
- How to Read Schematic Diagrams.** RSD-1 . . . 1.50
- TV Servicing Guide.** SGS-1 . . . 2.00
- Radio Receiver Servicing.** RS-2 . . . 2.95
- So You Want to Be a Ham.** HAM-3 . . . 2.95
- Handbook of Electronic Tables & Formulas.** HTF-2 . . . 3.95



FREE! Ask for the Sams Booklist, describing over 300 important books.

FREE! Index to Photofact, world's finest circuit data on 56,000 TV & radio models.

HOWARD W. SAMS & CO., INC.

Order from any Electronic Parts Distributor or mail to Howard W. Sams & Co., Inc., Dept. L-93, 4300 W. 62nd St., Indianapolis 6, Ind.

Send books checked above. \$ _____ enclosed.

Send FREE Booklist. Send Photofact Index.

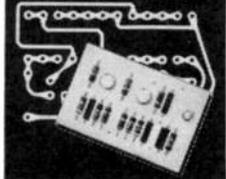
Name _____

Address _____

City _____ Zone _____ State _____

IN CANADA: A. C. Simmonds & Sons, Ltd., Toronto 7

POPULAR ELECTRONICS NOVEMBER 1963 35



**Send
POPULAR
ELECTRONICS
Every
Month**

NAME.....

ADDRESS.....

CITY..... ZONE..... STATE.....

3 years for \$10
Check one: 2 years for \$7
 1 year for \$4

In the U. S., and possessions.

Payment Enclosed Bill Me
Foreign rates: Canada and Pan American Union countries, add .50 per year; all other foreign countries, add \$1 per year.

New Renewal

Mail to: POPULAR ELECTRONICS
Dept. 1-1037, 434 S. Wabash Ave., Chicago 5, Ill.

B. S. DEGREE IN 36 MONTHS

INDUSTRY AND GOVERNMENT NEED 50,000 NEW ENGINEERS EACH YEAR! Accelerated year-round program puts you in the job-market a whole year early! Accredited. Aerospace, Chemical, Civil, Electrical, Mechanical, Electronics; Math, Chemistry, Physics. Also diploma in Engineering in 27 months. Quality instruction; widely recognized. Graduates employed from coast to coast. Self-help program. Moderate rate. Start Jan., March, June, Sept. Catalog: 1614 E. Washington Blvd., Fort Wayne 2, Indiana.



ASSEMBLE THIS ALL BAND BATTERY SHORT WAVE RADIO FOR \$9.95



LISTEN AROUND THE WORLD—UP TO 12,000 MILES AWAY! Ships, Aircraft, Voice of America, Russia, London, Australia, Amateur, Citizens, Police—Also USA Broadcast. 5 WAVE BANDS: 15 to 40 MC (calibrated tuning dial, Wx only 3 lbs.—NOW HEAR THE WHOLE WORLD TALKING DAY OR NIGHT!) SEND ONLY \$2.00 (cash, ck. mo.) and pay postman \$7.95 COD postage or send \$9.95 for P.P. delivery. Complete Basic Kit includes all parts less tubes—EZ Instructions. Order Yours Now. Available only from Western Radio, Dept. BEL-11, Kearney, Nebr.

GET INTO ELECTRONICS

V.T.I. training leads to success as technicians, field engineers, specialists in communications, guided missiles, computers, radar, automation. Basic & advanced courses. Electronic Engineering Technology, an ECET accredited Technical Institute curriculum. Associate degree in 29 months. B.S. obtainable. G.I. approved. Start February, September. Dorms, campus. High school graduate or equivalent. Catalog.

VALPARAISO TECHNICAL INSTITUTE
DEPARTMENT PE, VALPARAISO, INDIANA



complex circuitry. The light needs filament voltage, and the sonic indicator has to be disabled to listen to the multiplex program being broadcast. None of the popular built-in MPX indicators provide positive tuning indication. The MPX Meter is noncritical, inexpensive, and easy to construct and install—what more can you ask? -50-

Assemble a Phone-Boost

(Continued from page 56)

a 100,000- or 250,000-ohm potentiometer into the circuit, adjust for best results, and measure the resistance with an ohmmeter.

The input resistor, *R1*, is not needed for circuit operation, but is included simply to provide a "d.c. return" when the unit is connected to other equipment. A larger or smaller value can be employed here, or *R1* may be omitted entirely if not needed by the equipment with which the Phone-Boost is used.

Assembly. A can, small box, plastic container, or even a short length of tubing will serve as a housing for the Phone-Boost. The model shown in the photos was constructed in a metal cough-drop box and finished with two coats of enamel.

Carefully solder *Q1* in place, using a heat sink to protect it (a transistor socket can be used if you desire). Battery voltage is not critical, and any battery furnishing 3 to 9 volts will work. A standard phone plug (*PL1*) and open-circuit jack (*J1*) were employed in the author's model as input and output connectors, but other types of connectors—phone tips and jacks, etc.—can be substituted.

The Phone-Boost is easy to use. Simply plug it into your receiver or other piece of equipment and connect a pair of magnetic phones to the unit's output. When the Phone-Boost is not in use, unplug the headphones to avoid a steady drain on the battery. The Phone-Boost's power requirements are low, however, and a fresh battery should give good service for up to a year or more. -50-

Always say you saw it in—POPULAR ELECTRONICS

ELECTRONICS MARKET PLACE

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

FOR SALE

GOVERNMENT Surplus Receivers, Transmitters, Snooper-scopes, Parabolic Reflectors, Picture Catalog 10¢. Meshna, Nahant, Mass.

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

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

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

SAVE dollars on radio, TV-tubes, parts at less than manufacturer's cost, 100% guaranteed! No rebrands, pulls. Request Bargain Bulletin. United Radio, 1000-E, Newark, N. J.

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

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

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

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

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

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

MILITARY Discount—Name Brands Free Recording Tape and Stereo Handbook. Include Rank and Serial Number. Electronics International Inc. Box 3066, Charlottesville, Virginia.

SUPERSENSITIVE directional microphone picks up faint sounds at 300 feet. Detects sound through ordinary walls. Easily built for \$7.00. No electronic experience necessary. Plans, \$2.00. Dee Company, Box 7263-F, Houston 8, Texas.

"LISTEN-in-coil" picks up any telephone conversation in vicinity. No connection to telephone necessary. Easily concealed. \$2.98 complete. Consolidated Acoustics, 1302-Y Washington St., Hoboken, N. J.

CB-QSL Cards—45 designs, free catalog. Woody, 2611 Shenandoah, St. Louis 4, Missouri.

DECALS; WPE-SWL-CB-HAM, your call letters in gold 2" high—\$1.00. Ramco, Box 356, No. Hollywood, Calif.

"LITTLE-Listener" picks up both ends of telephone conversation without detection. Easily concealed up to 100 feet from any telephone. No wires directly to telephone required. No expensive amplifier necessary as with "coil" type pickup. Complete with earphone, \$4.95. Deeco, Box 7263-AD, Houston 8, Texas.

PROTECT your expensive transistors! Build an experimenters power supply featuring a selectable current limit. Could easily pay for itself by saving one transistor. Also features continuously variable, regulated voltage output. Plans: \$3.00. Bammel Electronics, P. O. Box 400, Wheaton, Illinois.

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

NEW Book short-wave listening \$2.50. Check our catalog station listings, programs, call signs, all short-wave, CB and VHF. Gilfer, Box 239-A, Park Ridge, New Jersey.

RADAR Range. Cook 12 pound roast in less than 10 minutes. Costs less than \$60. Construction Details \$4.75. Seaway Electronics, 6311 Yucca Street, Hollywood 28, California.

ULTRASONIC Dishwasher. Cleans in seconds. Build for \$40. Plans \$4.75. Seaway Electronics, 6311 Yucca St., Hollywood 28, California.

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

EAVESDROP with a pack of cigarettes. Miniature transistorized FM Radio Transmitter Complete diagrams and instructions \$2.75. C. Carrier Co., 6311 Yucca St., Hollywood 28, Calif.

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.

BE A Spy. Correspondence course on Wire Tapping, Bugging, Telescopic sound pickup, recording techniques, microphotography, and invisible photography. Lessons in Surveillance, tailing, and use of equipment. Complete course \$22.50. 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, 8959 Wonderland Ave., 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, 8959 Wonderland Ave., 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.

TV Camera. Build for less than \$50. Construction details \$4.75. DB Enterprises, 8959 Wonderland Ave., Hollywood 46, Calif.

TAIL Transmitter. Tiny Transistorized Transmitter for the Private Eye. Signals its location for miles. Construction Details \$4.75. DB Enterprises, 8959 Wonderland Ave., Hollywood 46, Calif.

GOVERNMENT Sells Surplus: Electronics; Oscilloscopes; Transceivers; Test Equipment; Radar; Sonar; Walkie-Talkies; Boats; Jeeps; Aircrafts; Misc.—Send for "U.S. Depot Directory & Procedures"—\$1.00—Brody, Box 425(PE), Nanuet, New York.

THERMOCOUPLES 10¢ each postpaid. 1.5 volt cells \$10 plus postage. Batteries made to your specifications. Power-Lab, 121 Hollywood Circle, Creve Coeur, Illinois.

ELECTRONIC Bargains, discounts from net, free brochure. Franklin Electronics, Box 51a, Brentwood, New York 11717.

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

TRANSISTORIZED treasure finder kits, assembled models from \$19.95. Free catalog. Relco, Box 10563, Houston 18, Texas.

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

IN San Diego, Calif. it's Alpha Electronics, 7077 University, for everything in electronics at discount prices.

TRANSISTORIZED Directory. 50 Japan, Hong Kong firms. Send \$1.00. Nippon Shogyo, Box 6266, Spokane, Washington 99207.

TRANSISTOR ignition described June and October Popular Electronics, "Operation Pickup." Complete kit quality components quickly assembled. No drilling. Complete instructions. Guaranteed. \$14.95 Postpaid. Electromart, 1616 S. 81st St., Milwaukee, Wis.

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

FREE Bargain catalog: transistors, diodes, rectifiers, components. Poly Pak, Box 942EC, Lynnfield, Mass.

SCIENCE Fair Project. Build computer that reads. Designed by five-time science fair winner. Schematic, diagrams, and suggestions, \$1.00. Ken McAdams, 5426 Hampton, Fayetteville, N. C.

ALL QSL'S \$2.50/100 Free catalogue. Longbrook, Box 393-C, Quakertown, New Jersey.

TELEPHONES. How to connect them. Build your own dial systems. Send for free index to available circuits. R. Dinlocker, P. O. Box 293, Sellersville, Pennsylvania.

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.

QUALITY—CB, QSL cards. Send for new catalog containing 90 designs—25 cents refundable with order. Dunnahoo Graphic Services—64 Wilbraham Road, Springfield, Massachusetts.

OHM'S law never forgotten with copyrighted tool. \$2.00 Postpaid. Beck Radio, 6323 South Dale Mabry, Tampa, Florida 33611.

TELEPHONES, Modern Dial, Desk and Wall Type. Completely Reconditioned, Like New, Guaranteed, Not Government Surplus. Specify type. Dial \$6.95. Without Dial \$3.95. Evergreen Electronics, Box 2233, Everett, Washington.

BARGAINS! New, used CB, Ham transmitters, receivers, test equipment. Interesting lists 10¢. Brand's, Sycamore, Illinois.

250 Business cards—\$2.29 ppd. Samples. Garner's Service, 6486 Gale, Long Beach, Calif. 90805.

HAM EQUIPMENT

CBER'S Hams: Compact AAA-1 Clipper-Filter Kit triples talk-power, fits any CB transceiver, improves selectivity, \$10.99. Double reception with SK-3 Preselector for GW-10, GW-11, SK-4 Preselector fits GW-12 internally! Kit, \$8.99; wired, \$11.99. SK-20 Preselector, tunable 3.5-30 megacycles, kit, \$18.98. Noisejector, NJ-7, \$4.49. Prices postpaid! (Free kit, antenna list.) Holstrom Associates, P. O. Box 8640-E, Sacramento 22, Calif.

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.

SAVE 30% 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.

RECORDING Tapes. Free sample. Mail 25¢ (handling). Towers, Lafayette Hill, Penn.

FREE information. How To Add Professional Sound To Tape Recorders. Fack 14-PE, Stockholm 10, Sweden.

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

SPACE age by-product restores tape to original magnetic condition. Bulk eraser \$3.00. Box 78421, Los Angeles 16, California.

BARGAIN! Ampex (Shamrock) tape 1800' Mylar 7" reel. 12 for \$24.95 postpaid. Moneyback guarantee. Lowest quotes: all components, recorders. Pofe Electronics, 1716-B Northfield, Muncie, Indiana 47304.

HIGH-FIDELITY

DISGUSTED with "Hi" Hi-Fi Prices? Unusual discounts on your High Fidelity Requirements. Write Key Electronics, 120 Liberty St., New York 6, N. Y. DI 6-4191.

WRITE for lowest quotations, components, recorders. No Catalogs. Hi-Fidelity Supply, 2817-QC Third, New York City 55.

HI-FI Components, Tape Recorders at guaranteed "We Will Not Be Undersold" prices. All brands in stock. 15-day money back guarantee. 2 year warranty. Write your requirements for quotation. No Catalog. Hi-Fidelity Center, 1797-P 1st Ave., New York 28, N.Y.

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

RECORDERS, Components. Free wholesale catalogue. Carston, 125-P East 88, N. Y. C. 28.

"**FM/Q**" Metropolitan Broadband Antenna, the finest compact yagi made, completely rustproof, only \$14.95 prepaid. FM Book with station directory 30¢. FM/Q, Wethersfield, Connecticut.

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.

TOP price for Unconverted BC-603!! Hoffman, 3225 Neptune, Brooklyn 24, New York.

TUBES

"**FREE Catalog—name brand tubes 65% discount,** phono needles 80% or more discount, phono cartridges, picture tubes 75¢ inch, parts, parts kits, silicon and selenium rectifiers, transmitting tubes, 7" T.V. test tube \$6.99, improved batteries, tube testers, etc. Want to swap or sell tube inventory? Send us your offering. Arcturus Electronics Corp., Dept. Z.D., 502—22nd St., Union City, N. J.

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., 461 Jericho Turnpike, Mineola, N. Y.

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

TV-Radio Tubes—Lowest prices—100% guaranteed. Send for free listing. Tube Mart, 840 Main St., Paterson 3, N. J.

RADIO & T.V. Tubes—35¢ each. Send for quantity discounts & free list. Cornell, 4213 University, San Diego, California.

TEST EQUIPMENT

SIGNAL Tracer-Injector. New easy, safe method for using your radio (12 connections) to pinpoint trouble in radios and amplifiers. Terrific educational and service tool. Comprehensive instructions, Tested Isoprobe. All parts. Satisfaction Guaranteed. Order AM #116 \$5.95—AM/FM #216 \$7.95. Waltronics, 1814 N. 84th, Milwaukee, Wisconsin 53226.

REPAIRS AND SERVICING

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.

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

DIAGRAMS: Radio, Television, HiFi Stereo; \$1.00. State make, model. Schematic Collector, 618 4th St., Newark 7, New Jersey.

KITS professionally wired, equipment built to your specs. Beco, 436 Hatcher, Rocky Mount, Va.

YOUR Electronics Problem Solved by Engineering Staff. \$1.00 Answers, P.O. Box 363, Norman, Oklahoma.

PATENTS

PATENT Searches, \$6.00! Free "Invention Record"/Information.—Miss Hayward, 1029 Vermont, Washington 5, D. C.

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, Box 10634, Jackson 9, Miss.

LEARN While Asleep, Remarkable, Scientific, 92% Effective. Details Free. ASR Foundation, Box 7021, Dept. e.g., Lexington, Kentucky.

LEARN Radio, TV, Stereo. Read "Introduction to Electronic Servicing". Complete beginners' course including building projects. \$2.95 at parts distributors (Sams BSJ-1) or send dollar to Electronic Books, Box 8433-F, University Park, Denver 10, Colorado. Pay postman \$1.95 plus COD postage.

LEARN Electricity, slide-rule calculations, and appliance repair in 32 compact lessons. Worldwide Institute, Dept. 1001, 2555 Shelley Drive, Indiana, Penna.

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.

GOVERNMENT SURPLUS

GOVERNMENT Surplus direct from Government. Jeeps \$264.00, Radios \$2.53. Typical prices. Guns, Typewriters, Cameras, Tools, thousands more Amazing low prices. How, where to purchase, Merchandise available, etc. Only \$1.00 to: Surplus, P.O. Box 50512, Dept. R, New Orleans 50, Louisiana.

JEEPS \$178, Airplanes \$159, Boats \$7.88, generators, \$2.68, typewriters \$8.79, are typical government surplus sale prices. Buy 10,001 items wholesale direct. Full details, 607 locations, procedure only \$1.00. Surplus, Box 177-C1, Abbotstown, Penna.

JEEPS—\$111.68, Typewriters—\$4.15, Receivers—\$5.65, Televisions, Recorders, Oscilloscopes, Multimeters. Typical Government Surplus Prices. Exciting Details Free. Enterprises, Box 402-B5, Jamaica 30, New York.

SAME Surplus Directory, plus Surplus Catalog, 75¢. 8959 Wonderland Ave., Hollywood 46, Calif.

JEEPS \$111.68, Boats \$6.18, Airplanes, Electronic Equipment, Typewriters, thousands more, typically at up to 98% savings. Complete information \$1.00. Surplus Service, Box 820, Holland 10, Michigan.

GOVERNMENT Surplus Sales Bulletin—"Directory-Procedure"—50¢—Industrial, Box 770(A), Hoboken, N. J.

GOVERNMENT Surplus: Jeeps, Boats, Guns, Electronic Equipment, etc. You can now buy direct from government at amazingly low prices. For complete instructions send only \$1.00 today, to Surplus Dept.-PII, Box 5741, Washington 14, D. C.

BOOKS

HORROR books—Buy direct from publishers! Bargains! Free details. Trans-International, P.O. Box 2942, Paterson, N. J.

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

WANTED: Short stories, books, articles, plays of all descriptions for sale to publishers, producers. Free Literature! Literary Agent Mead, Dept. 39A, 915 Broadway, N.Y.C. 10.

BOOK 200 Electric Stunts \$1.00. Cutziff, 875 Arastrodero, Palc Alto, Calif.

LEATHERCRAFT

FREE "Do-It-Yourself" Leathercraft Catalog. Tandy Leather Company, Box 791-Q49, Fort Worth, Texas.

STAMPS AND COINS

TERRIFIC Stamp Bargain! Israel-Iceland-Vatican Assortment—plus exotic triangle set—also fabulous British Colonial Accumulation—Plus large stamp book—All four offers free—Send 10¢ to cover postage. Empire Stamp Corp. Dep: Z2, Toronto, Canada.

TOPS! Free illustrated booklet "How To Collect Coins." Approvals. Littleton Coin Co., Littleton E12, N. H.

20 Different Commemoratives 1893 up 10¢. U.S. Approvals, K & B. Box 70, Brooklyn 23, N. Y.

YOUR Station on photostamps. 100—\$1.50. Samples 10¢. Morgan, 443 Euclid, Akron, Ohio

PHOTOGRAPHY-FILM, EQUIPMENT, SERVICES

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

SCIENCE Bargains—Request Free Giant Catalog "CJ"—144 pages—Astronomical Telescopes, Microscopes, Lenses, Binoculars, Kits, Parts, War surplus bargains. Edmund Scientific Co., Barrington, New Jersey.

EDUCATIONAL OPPORTUNITIES

DETECTIVE Profession. Home Study. Lapel pin, Certificate. Future. 2759C1 W. Broadway, Los Angeles 41, Calif.

X-RAY Technicians always in demand. Information on training schools, qualifications, employment outlook. \$2.00 X-Ray PO Box 781, El Sobrante, California.

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.

EARN Extra money selling advertising book matches. Free samples furnished, Matchcorp, Dept. MD-53, Chicago 32, Illinois.

EMPLOYMENT Resumes. Earn more by presenting yourself to prospective employers more effectively. Send only \$2.00 (cash or money order) for complete Resume Writing Instructions, including sample and instructions for letter of transmittal. J. Ross, 63-61 Yellowstone Blvd., Forest Hills 75, New York, Dept. 6J-PE.

BUSINESS OPPORTUNITIES

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 work shops. Free Catalog. HBS Equipment Division, 3445 Union Pacific, Los Angeles 23, Calif.

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.

BIG Money—Operate own fix-it shop. Service household appliances, motors, mowers, saws, skates, etc. Free book. Christy Trades School, A1314, 3214 W. Lawrence, Chicago 25.

SONGS into \$\$\$\$—New, unknown Songwriters, Song-poets, Composers share \$33 millions yearly. Any subject, we collaborate, publish, promote. Largest firm, information, appraisals Free. Send Nordyke Publishers, 6000 Sunset, Hollywood, California 3-90028.

FREE "Franchise Profit Letter" tells how unique NFR service is helping thousands seeking profitable businesses. Write today. National Franchise Reports, PE-528, 333 North Michigan, Chicago 1.

PIANO Tuning learned quickly at home. Tremendous field! Musical knowledge unnecessary. Information Free. Empire School of Piano Tuning-PE, Champaign, Illinois (Founded 1935).

IF you have something to sell, let the readers of Popular Electronics know about it through the classified advertising columns. It costs very little—only 60¢ a word, including your name and address. Your ad will be seen by more than 400,000 active buyers of electronic gear and components. Act now! Write your classified ad today, enclose payment and mail to: Martin Lincoln, Popular Electronics, One Park Avenue, New York 16, New York. January issue closes November 5th.

MISCELLANEOUS

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

NEW Vortex theory with a unique structural explanation for elementary particles and forces. Nuclear theory challenged. New 1963 edition. 25 cents postpaid. C. F. Krafft, 4809 Columbia Road, Annandale, Va.

HYPNOTIZE Unnoticed, quickly, effortlessly, or refund! Thousands delighted! \$2.00. Minter, Box 244-D, Cedarburg, Wisconsin.

INDEPENDENT Thinkers—investigate Humanism, the scientific personal philosophy! Free literature. American Humanist Association, Dept. PE2, Yellow Springs, Ohio.

DO-it-Yourself—Bath Massage! Automatic and fingertip controls. Attaches to your vacuum cleaner. Complete kit and instructions \$16.69. Butch Bath Co., 435 N. Roxbury Drive, Suite 105-B, Beverly Hills, Calif.

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.

FAMILY Wine Formulas! Elderberry, Concord, Dandelion, many others! Hydrometers, Supplies Headquarters! Manual \$2.00. Brugenheimer Company, Box 201-3, Lexington, Massachusetts.

"HOME Brew Recipes"—Beer, Ale, Liquors, Wines! Recipes, \$2.00 Postpaid. Supplies, Hydrometers list included! Research Enterprises, 29-WF Samoset Road, Woburn, Massachusetts.

WILD Labels, bumper strips! Strange, startling, unconventional! Crazy Labels, Box 15-H, Olympia, Washington.

DO you know why the Continent of Mu was destroyed? Send 20¢ for Issue 662—The Submerged Continent of Mu. Write: Lemurian Viewpoint, Ramona 15, California.

FIRECRACKERS—Booklet gives history, theory, instructions for making at home. \$1.00. International Pyrotechnics, Box 278-A, Nutley, N. J.

HYPNOTIZE Unnoticed, quickly, effortlessly. Thousands delighted \$2.00. Gypsy, 209 Tyne Road, Louisville 7, Ky.

"HYPNOTIZE . . . One Word . . . One fingersnap," on stage. Satisfaction—or refund. \$2. Hypnomaster, Box 9309-E8, Chicago 90.

STAMMER—Stutter—No More. (Dr. Young.) Write: Gaucho, Box 9309-E, Chicago 90.

IF you have something to sell, let the readers of Popular Electronics know about it through the classified advertising columns. It costs very little—only 60¢ a word, including your name and address. Your ad will be seen by more than 400,000 active buyers of electronic gear and components. Act now! Write your classified ad today, enclose payment and mail to: Martin Lincoln, Popular Electronics, One Park Avenue, New York 16, New York.

POPULAR ELECTRONICS

November 1963

Advertisers Index

Allied Radio	85, 86
Amateur Electronic Supply	7
American Basic Science Club, Inc.	107
American Institute of Engineering & Technology	107
Audio Devices, Inc.	11
Ballley Technical Schools	22
Blonder-Tongue	38
Burstein-Applebee Co.	107
Cadre Industries Corp.	10
Capitol Radio Engineering Institute, The	13
Central Technical Institute	16
Cleveland Institute of Electronics	25
Columbia Products Company	8
Conar	23
Coyne Electrical School	94
DeVry Technical Institute	3
Dymo Industries, Inc.	24
EICO Electronic Instrument Co., Inc.	40
Eastman Kodak Company	82, 83
Esse Radio Company	102
Fisher Radio Corporation	29
GC Electronics Co.	96
General Radiotelephone Company	94
Grantham School of Electronics	9
Hallcrafters	92
Heath Company	89, 91, 93, 95
Hi-gain Antenna Products Corp.	12
Indiana Institute of Technology	114
International Crystal Mfg. Co., Inc.	100
Johnson Company, E.F.	102
KLH Research and Development Corporation	81
Kuhn Electronics Inc.	90
Lafayette Radio Electronics . . . THIRD, FOURTH COVER	
Mark Products Division Dynascan Corp.	31
Massey Technical Institute	26
Merrell Kits	26
Micro Electron Tube Co.	99
Milwaukee School of Engineering	101
Mission Liquidators	105
Mosley Electronics Inc.	28
Multicore Sales Corp.	107
National Radio Company, Inc.	99
National Radio Institute	SECOND COVER, 1
National Technical Schools	34, 35, 36, 37
North American Philips Co., Inc.	4
Nortronics	103
Olson Electronics Incorporated	92
Pearce-Simpson Inc.	30
Pennwood Numechron Co.	110
Polytechnic Laboratories, Inc.	5
Progressive "Edu-Kits" Inc.	20
RCA Electronic Components and Devices	25
RCA Institute, Inc.	16, 17, 18, 19
Rad-Tel Tube Co.	33
Radio Shack Corporation	109
Sams & Co., Inc., Howard W.	113
Scott Inc., H.H.	105
Shure Brothers, Inc.	21
Sonar Radio Corporation	88
Sony Corporation of America	32
Telex	96
Tri-State College	105
Turner Microphone Company, The	14
Valparaiso Technical Institute	114
Weller Electric Corp.	39
Wen Products, Inc.	6
Western Radio	114
Wiley & Sons, Inc., John	110

Printed In U.S.A.

LAFA

FREE!

422 GIANT-SIZE PAGES

422 GIANT-SIZE PAGES

LAFAYETTE RADIO ELECTRONICS 1964 CATALOG NO. 640



Lift This Flap-

Read How LAFAYETTE Gives You More in '64! Then Mail the Card Below TODAY!

LAFAYETTE GIVES YOU MORE IN '64!

Lafayette, "World's Hi-Fi & Electronics Store" gives you more in '64... more



MORE STEREO HI-FI . . . there's a new selection of stereo hi-fi equipment. All famous brands plus Lafayette's components, in kit form and pre-wired.



MORE CITIZENS BAND . . . Lafayette transceivers, more Walkie-Talkies accessories than ever before.



MORE TAPE RECORDERS . . . portable recorders to complete your collection. Find just the recorder you need at Lafayette price.



MORE HAM GEAR . . . for receive as well as the smallest accessories everywhere make Lafayette their choice for all their gear.

PLUS MORE RADIOS MORE TEST EQUIPMENT
MORE TOOLS MORE TV and RADIO TUNERS
ACCESSORIES MORE CAMERAS • MORE
• MORE P.A. EQUIPMENT • MORE BCI

DEPT. 1K-3

LAFAYETTE RADIO ELECTRONICS
P.O. Box 10
SYOSSET, L.I., N.Y.

PLACE
STAMP
HERE

(A) LAFAYETTE 12-TRANSISTOR
"WALKIE-TALKIE"
With Squelch

39.95 each
2-for-78.88

HE-100L



(B) LAFAYETTE
3-TRANSISTOR
"WALKIE-TALKIE"



HA 70L

10.95 each
2-for-21.00

(C) NEW! LAFAYETTE
1-WATT
13-TRANSISTOR
"WALKIE-TALKIE"
With Squelch



HE-75L

66.50 each
2-for-129.00

LAFAYETTE RADIO ELECTRONICS

"WORLD'S HI-FI & ELECTRONICS
SHOPPING CENTER"

FREE! 1964 LAFAYETTE
CATALOG 640

Mail Post card on reverse side or
write Lafayette Radio Electronics,
Dept. 1K-3, P.O. Box 10,
Syosset, L. I., N. Y.

(E) LAFAYETTE 24-WATT
STEREO AMPLIFIER



LA-224WX

49.95

RK-155



169.95

(F) LAFAYETTE
PROFESSIONAL-TYPE
4-TRACK STEREO RECORDER



RK-140

(G) LAFAYETTE
DELUXE 4-TRACK
STEREO TAPE DECK

99.50
less case



(D) LAFAYETTE AMATEUR
COMMUNICATIONS RECEIVER

HE-30 Wired

79.95

KT-320 Semi-Kit

64.95

(A) LAFAYETTE
12-TRANSISTOR
"WALKIE-TALKIE"
With Squelch

Features separate micro-
phone and speakers for bet-
ter sending and receiving,
positive push-to-talk action
and 46" telescoping anten-
na. May be operated on AC
with optional 117VAC power
pack. Includes crystals,
earphone, leather carrying
case, batteries. Imported

(B) LAFAYETTE
3-TRANSISTOR
"WALKIE-TALKIE"

Completely Wired—Not a Kit
A terrific little Walkie-Talkie
for up to 1/4 mile reliable
communications. Ideal for
hunting, fishing, camping,
golfing, etc. Great fun for
kids too—at a price even
they can afford. Complete
with antenna, crystal, bat-
tery and plastic carrying
case. Imported.

(C) LAFAYETTE 1-WATT
13-TRANSISTOR
"WALKIE-TALKIE"
With Squelch

10 times more powerful than
conventional 100 mw units
— with 40% greater range.
Uses powerful silicon tran-
sistors, automatic noise
limiter, push-pull audio out-
put. Plug-in battery case for
penlight or optional, re-
chargeable nickel cadmium
batteries. Comes complete
with antenna, earphone,
leather carrying case, pen-
light batteries, crystals. Im-
ported.

(D) LAFAYETTE
AMATEUR
COMMUNICATIONS
RECEIVER

Designed for Today's
Crowded Amateur Bands
8-tube superheterodyne cir-
cuit covers 4 bands. Out-
standing bandspread, selec-
tivity with a built-in Q-multi-
plier. Imported

(E) LAFAYETTE 24-WATT
STEREO AMPLIFIER

A dual 12-watt stereo am-
plifier, coupled with a versatile
stereo preamplifier, offering
a full range of control facili-
ties for complete stereo
capability and flexibility.
Complete with case and
legs. Imported.

(F) LAFAYETTE
PROFESSIONAL-TYPE
4-TRACK STEREO
RECORDER

Records Sound-On-Sound
Plays back 4 and 2-track
stereo and 4-track monaural
records 4-track stereo and
monaural. Features built-in
amplifiers, two full-tone
stereo speakers, two level
meters, 2 speeds — 3 3/4 and
7 1/2 ips. With case, two
dynamic mikes, output
cables, tape reel, 1200-ft.
reel of tape. Imported

(G) LAFAYETTE DELUXE
4-TRACK STEREO TAPE DECK

Records Sound-On-Sound
Features built-in, transistor-
ized stereo record/play pre-
amps. Plays 4-track stereo,
2-track stereo, 4-track, 2-
track and full track mono.
Records 4-track stereo and
mono. 2 speeds 3 3/4 and 7 1/2
ips. Plays reels up to 7",
4 connecting cables. Imported