Small Boats Use New DF Technique

(see p. 35)

Make Your Own:
- Hi-Fi Rumble/Scratch Filter
- Electronic Worm Digger

POPOPULAR ELECTRONICS

MAY 1957

35 CENTS

Small Boats Use New DF Technique

(see p. 35)

Make Your Own:
- Hi-Fi Rumble/Scratch Filter
- Electronic Worm Digger

www.americanradiohistory.com
AmericanRadioHistory.Com
IF PRICE IS AN OBJECT...

You must see National's brand new NC-188—a fine quality, general coverage receiver of moderate cost and chock full of wanted features including:

- Calibrated electrical bandspread for 10, 11, 15, 20, 40, and 80 meter amateur bands. Separate tuning capacitors and scales for general coverage and bandspread; large, easy-to-read, 12-inch slide-rule dial with combination edge and backlighting. Large tuning knobs.
- Has gang tuned RF amplifier stage for increased sensitivity and image rejection. Separate, temperature compensated High Frequency Oscillator insures stability.
- Receives AM, CW and SSB signals. BFO provided for CW and SSB. Has two IF amplifier stages and two audio stages with tone control; separate antenna trimmer; separate RF and AF gain control; automatic noise limiter; and "S" meter.

**COVERAGE: 540 kc to 40 mc in 4 bands.**

<table>
<thead>
<tr>
<th>BAND</th>
<th>GENERAL COVERAGE</th>
<th>BANDSPREAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>.54 - 1.6 mc</td>
<td>3.5 - 4.0 mc (80 meters)</td>
</tr>
<tr>
<td>B</td>
<td>1.6 - 4.7 mc</td>
<td>6.9 - 7.30 mc (40 meters)</td>
</tr>
<tr>
<td>C</td>
<td>4.7 - 15 mc</td>
<td>14.0 - 14.35 mc (20 meters)</td>
</tr>
<tr>
<td>D</td>
<td>14.0 - 40 mc</td>
<td>20.4 - 21.5 mc (15 meters)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>27.0 - 30 mc (10/11 meters)</td>
</tr>
</tbody>
</table>

- Handsome, two-tone grey metal cabinet with chrome trim 16-13/16" wide x 10" high x 10-7/8" deep.

For complete specifications see your National distributor or write for catalog.

**SINCE 1914**

**National® Malden 48, Mass.**

8 out of 10 U.S. Navy ships use National Receivers.

SECOND OF 3

NEW

FROM NATIONAL

ONLY $15.95* DOWN
up to 20 months to pay at most distributors.

*Suggested price $159.95
(Slightly higher west of Rockies and outside U.S.A.)

AT YOUR HAM DISTRIBUTORS NOW!

NATIONAL’S NEW NC-66
World’s most versatile receiver

www.americanradiohistory.com

AmericanRadioHistory.Com
I Will Send You A
SAMPLE LESSON FREE
to show you how easy, practical it is to
Train at Home for Good
Radio-Television Jobs

America's Fast Growing Industry Offers You Good Pay Plus a Bright Future

TRAINING plus OPPORTUNITY is the PERFECT combination for ambitious men. Let me send you a sample lesson from my course to prove you can keep your job while TRAINING at home in your spare time for better pay and a brighter future. I will also send my 64-page book to show you that Radio-Television is today's field of OPPORTUNITY for properly trained men.

Television's Growth is Making More Jobs, Prosperity

Radio is bigger than ever and television is growing fast. Government, Aviation, Police, Ship, Microwave Relay, Two Way Communications for buses, taxis, railroads are other growing fields for Radio-Television trained men.

Mail Coupon—Find Out About This Tested Way to Better Pay
Take NRI training for as little as $5 a month. Many NRI graduates make more in two weeks than the total cost of my training. Mail coupon today for Actual Lesson and 64-page Book—Both FREE. J. E. SMITH, National Radio Institute, Dept. TED4 Washington 9, D.C. Our 40th Year.

I Trained These Men

"I have a regular job as a police captain and also have a good spare time Radio and Television service business. Just opened my new show-rooms and shop." —C. W. LEWIS, Pensacola, Florida

"I decided to quit my job and do TV work full time. I love my work and am doing all right. If fellows knew what a wonderful investment NRI is, they would not hesitate." —W. F. KLING, Cincinnati Ohio

You Learn by Practicing with Equipment I Send

Nothing takes the place of practical experience. That's why NRI training is based on LEARNING BY DOING. My training includes kits of parts which you use to build equipment and get practical experience on circuits common to both Radio and Television. Shown at left is the low-power Broadcasting Transmitter you build as part of my Communications Course.

J. E. SMITH
President, National Radio Institute, 40 years' experience training men at home for Radio-TV.


SUBSCRIPTION RATES: One year U.S. and possessions, and Canada $4.00; Pan-American Union countries $4.50, all other foreign countries $5.00.

www.americanradiohistory.com
CONTENTS
FEATURE Articles and Electronic Developments
New DF Technique for Small Boats .................. Eliot Drake 35
Midwife to Dwarf Diodes ............................ 37
Racing Radio ......................................... William Carroll 39
Hams in Service Help Their Hobby .................. 40
'S7 Look in R/C ...................................... William Winter 51
Stop Those Intermittents ............................. Eugene F. Coriell 59
Hellishcaptor ......................................... Carl Kohler 74

ELECTRONIC Build-It-Yourself Projects
Building the Big Ear ................................. Elbert Robberson 43
D.C. Supply for Small A.C./D.C. Motors .......... Carleton A. Phillips 47
Can You Do Better? ... An Intelligence Tester .... Ed Bukstein 53
"Economy" Oscilloscope Calibrator ................. Richard Graham 55
Building the "Vokat" Superhet ....................... Frank H. Tooker 63
Don't Dig Those Crazy Worms ........................ R. Wayne Crawford and J. E. Pugh, Jr. 71

AUDIO and Hi-Fi Features
"Hardware Store" Hi-Fi Crossover ................... King Murdoch 48
Should It Hiss? Should It Rumble? ................. Leonard Feldman 75
Build Your Own Hi-Fi Filter ........................ Leonard Feldman 77
Is Your Head on Straight? ........................... H. H. Fantel 87

Experimenters' Workshop
Mounted Variable Resistors for Experimenters ...... Carl Dunant 54
A "Talking" Mike ..................................... Clyde D. Adams 58
Crystal Diode Mount .................................. Art Trauffer 58
Make Tandem Transistors ............................. Carl Dunant 58
2500-Cycle Multivibrator ........................... William A. Scism 58
Novel Microphone Utilizes Metal Faucet Connector .... Art Trauffer 62
Sequential Neon Flasher is Electronic Eye-Catcher ... William A. Scism 62
Adapter Connects "Tiny Plug" to Standard Phone Jack .... Art Trauffer 86
Chassis-Drilling Hint ................................ Frank H. Tooker 86
Telephone Line Antenna Provides Excellent Reception .... Serge L. Krauss 86
Make Your Own Professional-Looking Dial Plates ........ B. W. Blachford 88

Miscellaneous Electronic News
Horror in Brooklyn .................................. 38
Nosing Its Way 'Round ................................ 38
Rectifier Goes Flat .................................. 38
Space Message Expected ............................. 38
Electronic Brain—Neurotic? .......................... 42
Skin Thermometer .................................... 42
TV Keeps Dry Under Water ........................... 67
What Is It? .......................................... 42
High-Speed Printer Teems Up with Digital Computer .... 60
"Subsea Control" for Boat of Tomorrow .............. 67
Twenty-Year Battery .................................. 67

(Also see page 6 for DEPARTMENTS)

Cover photo by Maynard Frank Wolfe
Clothes courtesy of Abercrombie & Fitch
Copyright © 1957 by Ziff-Davis Publishing Company. All rights reserved.
Average Net Paid Circulation 236,551
Train in Great Shops of COYNE for better jobs in ELECTRICITY - TELEVISION - ELECTRONICS

TWO TOP OPPORTUNITY FIELDS
Whether 17 or up to 45 years of age, train the Coyne way for a better job and a real future in ELECTRICITY-ELECTRONICS or TELEVISION-RADIO, fields that offer a world of opportunities. Train on real, full-size equipment at COYNE where thousands of successful men have trained for nearly 60 years—largest, oldest, best equipped school of its kind—established 1899. No advanced education or previous experience needed. Employment service to graduates.

START NOW—PAY LATER—Liberal Finance Plans and Easy Payment Plans. Also part-time employment help for students. Training in Refrigeration and Electric Appliances can be included.

B. W. COOKE Jr., President
FOUNDED 1899
A Technical Trade Institute Operated Not For Profit
500 S. Paulina St., Chicago, Dept. 57-71H
ELECTRICITY - RADIO - TELEVISION - REFRIGERATION - ELECTRONICS

MAIL COUPON FOR FREE BOOK
Send coupon for 48-page illustrated book "Guide to Careers in Electricity-Electronics and Television-Radio." No cost; no obligation; no salesman will call. Vets and Non-Vets get vital facts now!

B. W. COOKE Jr., President
COYNE ELECTRICAL SCHOOL
500 S. Paulina St., Chicago 12, Ill., Dept. 57-71H
Send BIG FREE book and details of your training offer. This does not obligate me and no salesman will call. I am interested in:

( ) Electricity-Electronics ( ) Television-Radio

Name
Address
City State

COYNE offers
LOW COST
TELEVISION R A D I O - C O L O R T V
Training in Spare Time AT HOME

The future is YOURS in TELEVISION!
A fabulous field—good pay—fascinating work—a prosperous future in a good job, or independence in your own business!

Coyne brings you MODERN-QUALITY Television Home Training; training designed to meet Coyne standards at truly lowest cost—you pay for training only—no costly "put together kits." Not an old Radio Course with Television "tacked on." Here is MODERN TELEVISION TRAINING including Radio, UHF and Color TV. No Radio background or previous experience needed. Personal guidance by Coyne Staff. Practical Job Guides to show you how to do actual servicing jobs—make money early in course. Free Lifetime Employment Service to Graduates.

COYNE ELECTRICAL SCHOOL
A TECHNICAL TRADE INSTITUTE OPERATED
NOT FOR PROFIT
500 S. Paulina Street, Chicago 12, Dept. 57-1177

COYNE Television
Home Training Division
500 S. Paulina St., Chicago 12, III.
Dept. 57-1177
Send Free Book and details on how I can get Coyne Quality Television Home Training at low cost and easy terms.

Name
Address
City State

May, 1957
GRANCO
HIGH FIDELITY FM-AM TUNER
A new adventure in sound from leading
sound specialists . . . a most versatile FM-AM
 tuner of fine quality, designed to provide
the best static-free FM as well as AM radio
reception by simply "plugging it in" . . . yet, in the Granco tradition of producing
much more for much less, priced lower
than any other available tuner.
More than just a component, this elegantly
styled tuner easily connects to any
instrument with an amplifier and speaker and
affords complete radio listening pleasure
. . . FM and AM.
- Exceptional sensitivity and selectivity insure
superlative FM and AM reception
- 6 tubes plus selenium rectifier
- Famous Granco coaxial tuner for smooth,
sharp, no-interference, drift-free tuning
- Straight A. C. chassis
- A complete package — built-in antennas
eliminate installation
- Compact decorator cabinet fits handsomely
into any decor.
T-270 FM-AM TUNER only $5495*

TECHNICAL FEATURES
2.5 volts maximum audio output — tuning
knob and OFF-AM-FM phono switch knob.
FM Section: 5 microvolts sensitivity for 20 db.
quieting — 88-108 mc. frequency range —
20-15,000 cycles flat audio frequency
response — 220 kcs. at 3 db. down selectivity
— 0.0% total harmonic distortion for 2.5 volts
RMS output — built-in antenna. AM Section:
20 microvolts sensitivity per meter (on loop stick)
— 535-1650 kc. frequency range
— 8 kc. selectivity at 2 times down — 2.5%
total harmonic distortion at 1 volt RMS
output — built-in antenna.

T-160 FM TUNER
(not shown) $3995*

*Prices slightly higher South and West

SEE YOUR GRANCO DEALER TODAY!
For additional literature, write GRANCO PRODUCTS, INC.
36-07 20th Ave. * Long Island City 5, N. Y.
—the leader in FM and UHF

COMING NEXT MONTH (JUNE)

(ON SALE MAY 21)
An epic event is scheduled for our June
issue—construction details on the first house-
hold application using the brand-new CBS-
Hytron 2N255 power transistor. You can get
"room-filling" volume from your portable
radio with this power amplifier. Other how-
to-build-it items include: a signal tracer with
but eight components; a pocket receiver which
requires only a short (less than 3') wire an-
tenna; and a transistorized calibrator for the
SWL.

Computers are now doing ordinary, every-
day jobs—would you like to learn to run one?
If clicks, hisses and pops are a part of your
hi-fi, they shouldn't be, so we'll tell you what
to do about getting rid of them. Do you know
how to make GOOD tape recordings? You
can find out in the June issue of POP'tronics.

IN THIS MONTH'S
RADIO & TV NEWS
(MAY)
Research at the Threshold of Space
All About Audio and Hi-Fi (Part 1)
Electronics at Redstone Arsenal
Transistorized Ultrasonic Generator
Transistor Mike Preamps
Transistorized Packet Superhet

DEPARTMENTS
Carl & Jerry .................................................. John T. Frye 10
Letters from Our Readers ............................... 22
POP'tronics Bookshelf ................................... 26
McWatts ....................................................... Carl Kohler 30
Sound Impressions ......................................... 61
Kit Builder's Korner ....................................... 68
After Class ................................................... 80
Tuning the Short-Wave Bands ......................... Hank Bennett 82
The Transmitting Tower ................................. Herb S. Brier 83
Transistor Topics .......................................... Lou Garner 89
What's the PE Answer? .................................. 96
Tips and Techniques .................................... 106

www.americanradiohistory.com
**PORTABLE 35MM TABLE VIEWER & PROJECTOR**

Use it as a table viewer or wall projector at home—school—club—sales meeting. Projects a sharp direct view image from color or black and white 35MM slides onto a self-contained 5½” x 7½” ground glass screen, or, if you wish, project your slides on a light-colored wall or projection screen and enjoy a 10 sq. ft. picture with the same sharp focus. Magazine holds 36 slides that change with the flick of a lever. Compact steel case with carrying handle measures 10” x 7” x 3½” deep. With standard 100-watt projection bulb, F3.5 lens, projection mirror, view screen, on-off switch, line cord and instructions. For 105-115V, AC-DC.

F-276—Shg. wt., 5 lbs. .................................................. Net 23.50

**FOLDING BC POCKET FLASH**

Unusual, pocket size flash gun that folds like a fan to 4” x 2”. Efficient 4½” diameter metal reflector has polished finish to eliminate hot spots. B-C combination for surefire and high voltage. Moldedatters case with built-in test lamp, bulb ejector and extension socket. Has adjustable standard shoe to fit all flash accessory clips. Uses standard bayonet base flash bulbs. Exposed guide built-in on rear of case. With cord for PC fitting and condenser. Shg. wt. 1 lb.

F-209—with Leather Case...Net 3.99

**COMPLETE STEREO CAMERA**

- With Flash Unit
- 3D Viewer—Lenses
- Leather Case—Straps


F-178—Complete Camera and Kit................Net 9.95
F-210—Pkg. of 12..........................Net .39

**F2.8 LENS**

Reg. Value 69.50 Only 34.95

**EXCLUSIVE**

F-196—Camera, less Case...Net 34.95
F-197—Leather Eveready Case...Net 3.95
F-198—Outfit with Folding BC Flash Gun...Net 41.85

**TWIN-LENS FOCUSING REFLEX**

Two F3.5 Coated Lenses
9 Speeds: to 1/200 Sec

Precision, coupled focusing of fast F3.5/60 coated lenses with stops to F2.5, gives excellent definition. Built-in flash synchronization does away with separate flash unit. Standard cable release socket. Shutter speeds 1/200, 1/100, 1/50, 1/25, 1/10, 1/5, 1/2, 1 sec. and bulb. Flip of finger resets close-up hood of ground glass viewer with magnifier. Also has built-in sports finder. Rugged, all metal covered case has tripod terminal. Takes 12, 24, or 36 pictures from standard 135 roll film. Shg. wt., 4 lbs.

F-205—Less Case................Net 19.49
F-206—Leather Eveready Case...Net 3.95
F-207—Above outfit with Collapsible Flash Gun...Net 26.39

**35MM CAMERA WITH COUPLED RANGE FINDER**

LAFAYETTE "RANGEFINDER 35"

9 Shutter Speeds . . . to 1/300 Second!

Check these features and compare Lafayette’s price with any other brand. First F2.8 coated lens and extra-wide lens aperture for brilliant, sharper full color or black and white pictures even in poor light. Light and focus through combined range-finder. Fully synchronized at all speeds for class F, M and electronic flash. Speeds from 1 sec to 1/300th. Rapid advance sets shutter, coverts to wall projector, transports film. Built-in delayed action timer. Automatic exposure counter and film stop. Hi-speed rewind with folding lever. Standard accessory shoe on top-film type indicator. PC flash terminal. Takes 20 or 36 exposures. All metal body with brushed chrome trim, black leatherette covering. Shg. wt., 3 lbs.

F-196—Camera, less Case...Net 34.95
F-197—Leather Eveready Case...Net 3.95
F-198—Outfit with Folding BC Flash Gun...Net 41.85

**Please ship following:**

- [ ] 35mm Viewer 23.50
- [ ] Stereo Outfit 9.95
- [ ] REFLEX 19.49
- [ ] CASE 3.95
- [ ] Gun 26.39
- [ ] 35mm Camera 34.95
- [ ] Outfit w/Gun 41.85
- [ ] FLASH GUN 3.99
- [ ] COMPLETE CATALOG (FREE)

I am enclosing $__________________________ Send C.O.D. I enclose 20% deposit

NAME ____________________________

ADDRESS ____________________________

May, 1957

Lafayette 165-08 Liberty Ave. JAMAICA 33: N. Y.
FASCINATING NEW TRANSISTOR KITS

knight-kit
10-CIRCUIT TRANSISTOR LAB KIT
Sensational—work with transistors! Assemble the basic parts once, then complete project after project (10 in all), just by plugging leads into proper jacks on printed-circuit board—no wiring changes needed. Make the following: AM radio, amplifier; wireless broadcaster; code practice oscillator; electronic tuner, switch, flasher; voice-operated, capacity-operated and photoelectric relays. Includes all parts, 2 transistors, battery, headphone, instructions for projects. Shpg. wt., 3 lbs.

Model Y-299

Model Y-299. Net only $15.45

knight-kit
2-TRANSISTOR POCKET RADIO KIT
Build this pocket-size, two-transistor radio—enjoy loud, clear broadcast-band reception wherever you go! Completely self-contained with built-in ferrite loop antenna—no external antenna required. Printed-circuit board for easiest assembly. Highly efficient reflex-type circuit operates for months and months on long-life alkaline battery supplied. Super-sensitive miniature earpiece gives remarkably good tone. With all parts, including simulated leather case, earpiece and transistors. 4 x 3% x 1%". Shpg. wt., 1/2 lbs.

Model Y-262

Model Y-262. Net only $14.65

knight-kit
TRANSISTOR RADIO HOBBY KIT
Experiment with the marvel of transistors! Printed circuit mounting board simplifies assembling, dust mount components, solder a few connections and enjoy excellent AM broadcast reception. Compact; fits in palm of your hand; operates from single penlight cell that lasts for months. Complete with all parts, transistor and penlight cell. Easy to assemble. Shpg. wt., 1 lb.

Model Y-765

Model Y-765. Net only $4.35

FOR HOURS OF LISTENING PLEASURE

knight-kit
"SPACE-SPANNER" BANDSWITCHING RECEIVER KIT
Thrilling 2-band receiver, easy to build—a great value. Bandswitch selects exciting short wave, including amateur, aircraft, police and marine radio (6 to 12 mc), and standard broadcast. Highly sensitive regenerative circuit. Has 4" PM speaker and beam-power output for strong volume. Kit includes calibrated panel, punched chassis, all parts and tubes (less cabinet). Easy to build from step-by-step instruction manual.7 x 10½ x 6", for 110-120 v. 60-60 cycle AC or DC. Shpg. wt., 8 lbs.

Model Y-243

Model Y-243. Net only $15.95

Model Y-247. Matching cabinet for above $2.90

knight-kit
"OCEAN HOPPER" RECEIVER KIT
Tops for exciting broadcast, long wave and short wave reception. Covers 155 to 35.0 mc with plug-in coils (below). Sensitive regenerative circuit; bandspread; for headphone or speaker use. Complete with all parts, tubes and broadcast band coil (less cabinet). Shpg. wt., 6 lbs.

Model Y-740

Model Y-740. Net only $11.75

Y-746. Matching cabinet for above $2.90

Y-741. Long Wave Coil (155-470 kc) 79c

Y-742. 1.60-470 kc coil. Y-745. 7-17.5 mc coil 75c

Y-743. 2.9-7.3 mc coil. Y-744. 15.5-35 mc coil $1.65

ORDER FROM ALLIED RADIO 100 N. WESTERN AVE., CHICAGO 80, ILL. Always say you saw it in—POPULAR ELECTRONICS
FAVORITE HOBBY KITS

knight-kit 2-WAY INTERCOM SYSTEM KIT

Model Y-295
$14.75

Easy to build—ideal for home or office. Consists of Master and Remote unit, each with press-to-talk switch. Remote can be left “open” for distant answering or baby-sitting. In “closed” position, Remote remains private, but can be called and can originate calls. High-gain 2-stage amplifier and 4” PM speakers. Delivers full volume from only a whisper. With tubes and 50-ft. cable. (Up to 200-ft. may be added.) Each unit 4 3/4 x 6 3/4 x 4 3/4"; antique white finish. For AC or DC. Easy to assemble. Shpg. wt., 6 lbs.

knight-kit PHOTO-ELECTRONIC RELAY KIT

Model Y-702
$13.50

Advanced-design, ultra-sensitive photo-electronic system at low cost. Covers 250 ft. with white light—125 ft. with “invisible” light. Consists of Relay kit and Light Source kit, below. Ideal as announcer, counter, burglar alarm (can be set to ring bell continuously when beam is broken). Hundreds of other uses. SFST relay contacts, 6-v. terminals provide power for accessories. For 105-120 v., 50-60 cycle AC. Shpg. wt., 6 lbs.

Model Y-702. Relay kit. Net only ........................................ $13.50
Model Y-703. Light Source kit. Net only .......................... $6.75

EXCLUSIVE TEST EQUIPMENT VALUE

knight-kit "IN CIRCUIT" CAPACITY CHECKER KIT

Model Y-119
$12.50

Remarkable unit checks capacitors while they’re still wired in the circuit! All you do is press a button—and the “magic eye” shows opens and shorts. Tests opens and shorts on capacitors of 20 mmf or greater, even if in parallel with a resistance as low as 50 ohms. Complete; easy to build. Shpg. wt., 5 lbs.

Model Y-119. Net only ............................................... $12.50

SEND FOR FREE SUPPLEMENT!

SEE ALL THE GREAT KNIGHT-KITS

- 23 Test Instruments
- 17 Fascinating Hobby Kits
- 4 Top Value Hi-Fi Kits
- 5 Great Amateur Kits

SEND FOR IT TODAY

ALL PRICES NET F.O.B. CHICAGO
EASY TERMS AVAILABLE

May, 1957

BUILD YOUR OWN HI-FI AND SAVE!

SENSATIONAL knight-kit HI-FI FM TUNER KIT

Model Y-751
$37.75

The best-looking, best-performing tuner kit your money can buy. Covers 88 to 108 mc; features AFC (with special disabling feature); pre-adjusted RF coils; pre-aligned 1PS; cascode broadband RF amplifier; drift-compensated oscillator; fly-wheel tuning control; illuminated lucite pointer. Sensitivity is 10 microvolts for 20 db of quieting across entire band. Printed circuit—no critical wiring. Ideal for use with 20-Watt Knight-Kit amplifier below, or any amplifier with phono-tuner switch. Easy to build—a custom Hi-Fi Tuner you’ll be proud of! Shpg. wt., 12 lbs.

Model Y-751. Basic FM Tuner Kit. Net only .................. $37.75

knight-kit 20-WATT HI-FI AMPLIFIER KIT

Model Y-750
$35.75

Ideal for use with above tuner—delivers deluxe Hi-Fi sound. Includes built-in preamp; inputs for magnetic phonos, mike, recorder and tuner; record compensator; base and treble controls, etc. Response: ±1 db, 20-20,000 cps. Distortion: 1% at 20 watts. Outputs: 4, 8, 16, 500 ohms. Chrome-plated chassis, 7 x 13 x 8 3/4”. With all parts, tubes and easy instructions. Shpg. wt., 20 lbs.

Model Y-750. Net only .............................. $35.75
Model Y-750. Metal enclosure for above; black finish ... $4.15

SAVE $4.00 ON TUNER-AMPLIFIER COMBINATION

SPECIAL—own the FM Tuner plus the 20-watt Amplifier (including metal enclosure) for only $73.65. Save $4.00 on this matched combination. Shpg. wt., 32 lbs.

Y-751. Knight-Kit Tuner and 20-Watt Amplifier. Net. $73.65

Only $7.37 down on our Easy Pay Plan

ORDER FROM ALLIED RADIO

ALLIED RADIO CORP., Dept. 079-17
100 N. Western Ave., Chicago 80, Ill.

Ship me the following KNIGHT-KITS:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$          enclosed. For parcel post, include postage (express is shipped collect).

[ ] Send me your FREE Supplement No. 165 describing all Knight-Kits.

Name __________________________

Address ________________________________________

City ___ Zone ___ State ___

www.americanradiohistory.com
Little Jack Horner
Sat in a corner
Listening to Hi-Fi
But his speaker was bad
And he was quite mad
For the music was naught
LOW nor HIGH

Now Little Jack Horner
Sits in a corner
His disposition's much sweeter
For the music that swells
Is as clear as a bell
From his Twin-Cone Norelco Speaker

"Holes" to the Rescue

IT WAS A PERFECT spring morning for
their fishing trip, thought Carl, as he
stepped out of his back door and started
across the yard to the basement entrance
of Jerry's home. While electronics was un-
questionably the boys' chief interest, they
also engaged in many other activities that
took them out-of-doors.

Carl clumped down the basement steps
in his hip boots and opened the door to find
his fishing partner all dressed for the occa-
sion, even to the battered black felt hat
with flies stuck in the band—but the objects
on the bench before him looked a lot more
like electronic gadgets than fishing tackle.
True, Jerry's casting rod was leaning
against the wall at the back of the bench,
but a wire clipped to the bottom of the rod
ran into the back of a little gray, crackle-
finished box about 3" x 4" x 5". There were
five black knobs on the front of this little
 cabinet, and a slide rule dial was housed
in a bulge at the top. Another coaxial lead
came out the rear of the cabinet and went
to the back of an a.c.-d.c. broadcast re-
civer on the bench.

"I thought we were going fishing," Carl
said sarcastically.

"I am fishing—for DX," Jerry answered
with a teasing grin. "Take a listen."

He turned the large center knob a bit,
and a soft Oklahoma drawl came from the
speaker of the broadcast set, but the voice
was signing a "DL" amateur call that in-
dicated he was operating a G.I. station in
Germany.

"How's that for 10-meter reception on an
improvised basement whip antenna?" Jerry
demanded.

"Slightly terrific, but where's the re-
ciever?"

"Let's see how good your memory is: do
you recall the cover picture on the Septem-
ber, 1956, issue of POPULAR ELECTRONICS?"

"Certainly. She had blue eyes, brown
hair, was wearing a black, off-the-shoulder
dress, and her name was Diane," Carl re-
cited promptly.

"Sometimes I wonder about you," Jerry
said darkly. "I wanted you to recall that
she was holding one of these Regency
ATC-1 transistor ham-band converters and

Norelco® FRS Speakers are available
in 5", 8" or 12" sizes in standard
impedances. Priced from $6.75 to
$59.98. Blueprints are available for
the do-it-yourself enclosure builder. Norelco Enclosures are available in
three sizes, priced from $33.75 to
$119.95.

ADD TO... and improve any
sound system with Norelco®

*FULL RESPONSE SPEAKERS
Write today to Dept. N5 for brochure
and prices of these unique speakers.

NORTH AMERICAN PHILLIPS CO., INC.
230 Duffy Avenue Hicksville, L. I., N. Y.
LET DEVRY TECH PREPARE YOU IN SPARE TIME AT HOME AS AN ELECTRONICS TECHNICIAN

NO PREVIOUS TECHNICAL EXPERIENCE OR ADVANCED EDUCATION NEEDED!

Laborers and bookkeepers, store clerks, shop men, farmers, salesmen — men of nearly every calling — have taken the DeVry Tech program and today have good jobs or service shops of their own in Electronics. You don't have to quit your present job. If you are 17 to 55, see how you may get yourself ready for a future in the fast-growing Electronics field.

Whether you prepare at home or in our well-equipped Chicago or Toronto Laboratories, you get sound, basic training in both principles and practice. At home, you use educational movies. You build actual circuits and test equipment. You read simple directions, follow clear illustrations. When you finish, you are prepared to step into a good job in an excitingly different field. You may even start a service shop of your own.

Mail coupon for free facts today.

Live-Wire Employment Service
Puts you in touch with job opportunities — or helps you toward a better position in the plant where you are now employed.

A SAMPLE LESSON
See for yourself how DeVry Tech trains you for real opportunities in Electronics. We'll also give you a free copy of an interesting booklet, "Electronics and YOU."

DevVry Technical Institute
4141 Belmont Ave., Chicago 41, Ill., Dept. PE-5-N
Please give me a FREE Sample Lesson and your booklet, "Electronics and YOU."

NAME
STREET
CITY
ZONE
STATE
APT.

Check here if subject to military training.

#1090 DeVry Tech's Canadian Training Center is located at 626 Rasaia Avenue, Toronto 12, Ontario
Carl & Jerry (Continued from page 10)

that there was a story about it inside the magazine.”

“I remember the article, but how did you get hold of one?”

“Dad got it for my birthday. I’ll admit I had to do a little selling job on him. I explained that it was a ‘natural’ to permit me to operate mobile without tearing the car receiver apart to bring out filament and plate leads. You see, this little transistor converter is powered by three penlite cells here at the back.

“But I think what really won Dad over was the fact that having such a converter would make it unnecessary to lug my heavy communications receiver up to our lake cottage this year. He really griped about that last summer. Now, when we get up there, I’ll just slip this little thirty-ounce job out of the car, take it into the cottage, and run it into this a.c.-d.c. set we always take along, just as I’m doing right now. Then I’ll be able to hear every ham band from 80 through 10 in fine style.”

“All very interesting,” Carl said, “but it’s not putting any fish in the skillet. Mom’s waiting in the station wagon to haul us to the river.”

“Let’s go!” Jerry said, as he unfastened the little converter, wrapped it in heavy cloth, and placed it in his tackle box. “I’ll just take this along, and if the fish don’t bite too voraciously, I’ll slip it out of the case and show you how much electronic equipment can be put in a small space these days without crowding.”

IT WAS ONLY a short drive to the river; and before long the boys had transferred their gear to a sturdy boat, clamped Carl’s powerful little outboard motor to the stern, and were heading upstream. They had a long ride ahead of them—they always went up the river until they could no longer see the little forked sticks that were placed at the edge of the bank for use as fishing-pole rests. Carl contended that as long as you saw these sticks you could be pretty sure the river was “fished out.” That meant they had to go nearly eight miles up the river to a section hard to reach by any means other than a boat. There was an old abandoned logging road along one bank, but it was too rugged for modern low-slung cars; so this section of river was free of Carl’s despised little forked sticks.

To while away the time on the way up the river, Carl got out his little portable transistorized broadcast receiver and set it on the seat cushion beside him. The outboard was well muffled, and the boys enjoyed the music delivered by the powerful

Every ham, hobbyist, technician, dealer needs it. You will find this new Transistor Manual is one of the most handy, easy-to-read, useful books on the subject. It tells you about all kinds of transistors—and how to use them. You are brought fully up to date by one of the world’s most experienced manufacturers of transistors and other semiconductor products.

The 60 fact-packed pages, illustrated with diagrams, sketches, and circuits, contain these seven important sections—

Basic Principles of Semiconductors
How Transistors Are Constructed
Transistor Applications
Specifications on G-E Transistors
Registered RTMA Transistor Types
Transistor Circuit Diagrams
Cross Reference Chart for Transistorized Radios


General Electric Company
Semiconductor Products Dept., Section S8157
Electronics Park, Syracuse, New York
Send me the new General Electric Transistor Manual—50¢ remittance is enclosed.

NAME
ADDRESS
CITY \ STATE

Progress Is Our Most Important Product

12

Always say you saw it in—POPULAR ELECTRONICS
New tests show that: your ability to think increases with age; your powers of deduction are greater; your judgment is better.

In the I.C.S. files are thousands of cases of men and women of every age. Their successes, their promotions, their raises prove that men and women past school age can learn!

I.C.S. GIVES YOU EXPERT GUIDANCE FREE! Do you have the feeling you're "stuck" in your job? Your trained I.C.S. counselor will appraise your abilities, help you plan for the future.

IT'S NEVER TOO LATE TO GET STARTED! You study with I.C.S. at home, in your spare time. There's no interference with business or social activity. Famous I.C.S. texts make learning easy. Don't delay. Pick your field from the coupon below. And mail it today!

3 FREE BOOKS

36-page, pocket-size guide to advancement, a gold mine of tips on "How to Succeed." Big catalog outlining opportunities in your field of interest. Also sample lesson (Mathematics).

For Real Job Security—Get an I. C. S. Diploma! I. C. S., Scranton 9, Penna. Member, National Home Study Council

INTERNATIONAL CORRESPONDENCE SCHOOLS

BOX 99949D, SCRANTON 9, PENNA.

Without cost or obligation, send me the "HOW TO SUCCEED" and the opportunity booklet about the field before which I have marked X (plus sample lesson):

ARChITECTURE and BUILDING CONSTRUCTION
Air Conditioning—Refrig.
Architecture
Architectural Interiors
Building Contractor
Building Estimator
Building Maintenance
Carpentry and Mill Work
Heating
Plumbing Contractor
Plumbing
Reading Arch, Blueprints
ART
Cartooning
Commercial Art
Fashion Illustrating
Magazine Illustrating
Show Card and Sign Lettering
Sketching and Painting
AUTOMOTIVE
Auto Body Rebuilding
Auto Elec. Technician
Auto-Engine Tune Up
Automobile Mechanic
AVIATION
Aeronautical Engineering Jr.
Aviation & Engine Mechanical
Business
Advertising
Bookkeeping and Accounting
Business Administration
Business Correspondence
Public Accounting
Creative Salesmanship
Federal Tax
Letter-Writing Improvement
Office Management
Professional Secretary
Relief Business Management
Sales Management
Snorkel-Discount-Sectarial
Traffic Management
CHEMISTRY
Analytical Chemistry
Chemical Engineering
Chem Lab Technician
Chemistry
Chemical Engineering
Civil and Petroleum Engineering
Plastics
Pulp and Paper Making
CIVIL, STRUCTURAL
Engineering
Civil Engineering
Construction Engineering
Highway Engineering
Reading Struct. Blueprints
Sanitary Engineering
Structural Engineering
Surveying and Mapping
DRAFTING
Aircraft Drafting
Architectural Drafting
Drafter
Electrical Drafting
Engineering Drafting
Mechanical Drafting
Mining Surveying and Mapping
Plumbing Drawing and Estimating
Structural Drafting
ELECTRICAL
Electrical Engineering
Electrical Maintenance
Electrical Contracting
Electrician
HIGH SCHOOL
Commercial (1) Good English
High School Subjects
Mathematics

"I tried studying my work on my own, but I never got the good out of it that came from my I. C. S. Course. My salary has been increased 73.3%!"

E.L.B.
Ohio

"I am president of a small corporation. A year ago I enrolled with I. C. S. as the most practical means available to me to learn what I needed."

W.J.A.
Michigan

"It's been so long since I went to school, I've forgotten much. But now that I'm taking an I. C. S. Course, I have confidence in my ability again."

H.A.R.
New Jersey

Actual statements. Posed by models.

W. J. A.
Carl & Jerry (Continued from page 12)

little set. A stiff breeze was blowing, and
the boat jarred rhythmically as it slapped
the waves. Jerry snuggled down in the
prow of the boat with his hat pulled over
his eyes to keep out the sun. Carl sat erect
at the stern and guided the boat.

Suddenly, as he felt Carl throttle back
the motor, Jerry sat up and pushed his hat
to the back of his head.

"Look over there on the bank, Jerry!" Carl
said, swinging the bow of the boat in the
direction he was pointing. "A car's slipped
off the old road and crashed against that
big sycamore."

Sure enough, a recent model car had its
hood jammed and wrinkled against the
trunk of a huge sycamore growing right
at the edge of the water. The windshield
on the driver's side was shattered.

Carl let the front of the boat run up on
the shelving sandbar that jutted out from
the bank, and both boys leaped out and ran
toward the car.

"O H, OH!" Carl exclaimed with a white
face as he stopped abruptly near the
back of the car. On the ground beside
the open door of the car was a crumpled
figure in an Air Force uniform. His eyes were
closed, and his face was blood-smeared.

"Is—is—is he dead?" Jerry whispered.

As if in answer, a low moan came from
the injured young man. Quickly the boys
determined that no one else was in the car.
Almost subconsciously, they noted the ten-
meter whip on the rear bumper of the car
and the converter fastened beneath the
dash; so they knew the poor guy on the
ground was a fellow ham.

"What are we going to do," Carl asked.
"Shall we load him into the boat and take
him back to town?"

"I'm afraid to try that," Jerry said. "You
know what we learned in that first aid
course about not trying to move a badly
injured person. He almost certainly has
some broken bones. Did you see how his
knee smashed that car radio? I'll bet every
tube in it is broken. And by the looks of
that steering wheel he may have some bad
chest injuries. I'm afraid to risk a rough
boat ride."

"Well, do you want to stay here while I
go back for help in the boat?"

"Guess that's about all we can do, al-
though it'll take a long time; and this fel-
low may not have too much time. If we
just had some way to call for help—"

"How about using his mobile rig?"

"That's no go. You saw the receiver—
Interested In Electronics - TV - Radio

then you will want to know

What Is The FCC?

It's amazing what the future holds for you in this modern world of electronics. Let me send you the entire story—FREE!

- How to pass the FCC Exam
- A sample FCC lesson
- Money-making FCC License Information

I can train you to pass the Valuable FCC exam in a minimum of time if you have any practical experience and a fair knowledge of mathematics.

CARL E. SMITH, E.E. President

Join the List of Successful Electronic Technicians

<table>
<thead>
<tr>
<th>License</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>John H. Johnson, Boise City, Oklahoma</td>
<td>1st 20 weeks</td>
</tr>
<tr>
<td>Prentice Harrison, Lewes, Delaware</td>
<td>1st 27 weeks</td>
</tr>
<tr>
<td>J. A. Nieder, Brattleboro, Pa.</td>
<td>2nd 8 weeks</td>
</tr>
<tr>
<td>Gerald J. Collier, Columbus, Ohio</td>
<td>2nd 16 weeks</td>
</tr>
<tr>
<td>W. E. Evey, Ottawa, Kansas</td>
<td>2nd 24 weeks</td>
</tr>
</tbody>
</table>

And Thousands More!

Your Guarantee—

If you fail to pass your Commercial License exam after completing our course, we guarantee to continue your training without additional cost of any kind until you successfully obtain your Commercial License.

Start Building for a Lifetime Profession

- Employers make job offers every month!
- Your FCC ticket is recognized by most employers in the Electronics field as proof of your technical ability.
- Pave the way for Your Share of the better things in life.

Cleveland Institute of Radio Electronics

Desk PE-25, 4900 Euclid Ave., Cleveland 3, Ohio

Please send Free Booklets prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below:

- Military
- Radio-TV Servicing
- Manufacturing
- Amateur Radio
- Broadcasting
- Home Experimenting
- Telephone Company
- Other

In what kind of work are you now engaged?

In what branch of Electronics are you interested?

Name Age Address

City Zone State

Special Tuition Rates to Members of Armed Forces

May, 1957

CARL E. SMITH, E.E., President

How Can I Get a Valuable FCC COMMERCIAL LICENSE?

My Passport to Future Security Get These Free

These Three Booklets Tell You

1. Where to apply to take FCC Examinations.
2. Scope of knowledge required.
4. Positive knowledge check.

And additional data of great value.
Carl & Jerry (Continued from page 14)

it’s entirely smashed. Even if the transmitter would still work—which is doubtful—we couldn’t rely on sending out a blind call and not know whether it was received or not. Guess you had better get started—Hey! Wait a minute! Let’s see if that transmitter will work.

JERRY SLID GINGERLY into the driver’s seat and turned on the transmitter filament switch. In a few seconds he picked up the microphone and pressed the push-to-talk switch. As he did so, the whir of a dynamotor came from the closed trunk, and he saw the pointer of a little field strength meter mounted over the rear-view mirror swing up-scale.

“That proves the transmitter works—but we still don’t have a receiver,” Carl said.

“Bring your transistor receiver up here by the car while I get my transistor converter out of the tackle box,” Jerry ordered.

In a few minutes he had taken a short length of copper wire from his tackle box and fashioned it into a crude four-turn coil a couple of inches in diameter. The ends of this coil were fastened to the tip and shell of the plug on the end of the coaxial lead coming from the output of the converter.

“Now let’s tape this coil on the outside of the case of your set near the cold end of the loopstick antenna on the inside,” Jerry said, pulling a roll of friction tape from his tackle box.

In a matter of seconds the coil was fastened into place so that the output of the converter would be induced into the receiver’s antenna; the receiver was tuned to 1230 kilocycles; and both it and the converter were turned on. The boys were bit-
EARN MORE MONEY... GET INTO

TELEVISION

ELECTRONICS-RADIO

Learn ALL 8 PHASES in ONE MODERN HOME-STUDY COURSE

YOU GET ALL THIS NEWEST PRACTICAL EQUIPMENT

- Parts to build a modern TV set, including all tubes plus a large screen Picture Tube
- Parts to build a powerful Superhet Receiver, standard broadcast and short wave
- Parts to conduct many experiments and build Continuity Checker, RF Oscillator, TV Circuits, Audio Oscillator, TRF Receiver, Signal Generator
- A Valuable Professional Multimeter

YOUR NATIONAL SCHOOLS TELERAMA COURSE COVERS ALL 8 PHASES

1. TELEVISION, INCLUDING COLOR TV
2. RADIO, FM AND AM
3. INDUSTRIAL ELECTRONICS
4. SOUND RECORDING AND HI FI
5. PREPARATION FOR FCC LICENSE
6. AUTOMATION
7. RADAR AND MICRO WAVES
8. COMMUNICATIONS

YOU ARE NEEDED IN THE TELEVISION-ELECTRONICS-RADIO INDUSTRY!

You can build a secure future for yourself if you get into Electronics NOW! Today's shortage of trained technicians creates tremendous opportunities. National Schools Shop-Method trained technicians are in constant and growing demand for high-pay jobs in Broadcasting and Communications, Electronic Research, Servicing and Repair, and many other branches.

Let National Schools, a Resident Technical School for over 50 years train you for today's unlimited opportunities in electronics! Our Shop Method trains you to be a MASTER TECHNICIAN. Completely up to date, developed by experienced instructors and engineers, your Telerama Course will teach you all phases of the industry quickly, clearly and correctly. You can master the most modern projects, such as Color TV printed circuits — even prepare for FCC License without taking a special course. You can handle sales, servicing, manufacturing, or make good money in your own business. SEND FOR FACTS TODAY!

EARN AS YOU LEARN. Many of our students earn their entire tuition and more in spare time jobs we show them how to do while learning.

YOU GET EVERYTHING YOU NEED — Clear, profusely illustrated lessons, shop-revised manuals, modern circuit diagrams, practical job projects — all the valuable equipment shown above — many other materials and services — consultation privilege with our qualified staff, and Graduate Employment Service. EVERYTHING YOU NEED for outstanding success in Electronics.

RESIDENT TRAINING AT LOS ANGELES

If you wish to take your training in our Resident Schools at Los Angeles, the world's TV capital, start now in our high modern Shops, Labs, and TV-Studios. Here you work with latest Electric equipment, professional instructors. Personal attention, Graduate Employment Service. Help in finding home near school — part-time job while you learn. Check box in coupon for full information.

NATIONAL SCHOOLS

TECHNICAL TRADE TRAINING SINCE 1935

LOS ANGELES 37, CALIFORNIA

GET FAST SERVICE — MAIL NOW TO OFFICE NEAREST YOU

11100 S. FIGUEROA ST. LOS ANGELES 37, CALIF

187 N. LA SALLE ST. CHICAGO 1, ILL


APPROVED FOR G.I. TRAINING

NATIONAL SCHOOLS

4000 S. FIGUEROA ST., LOS ANGELES 37, CALIF.

187 N. LA SALLE ST., CHICAGO 1, ILL.

May, 1957
Carl & Jerry (Continued from page 16)

...terly disappointed when nothing but a rushing noise was heard.  
"Hey! We were so excited we forgot the antenna," Carl pointed out.  

Only a few more seconds were needed to connect a short piece of wire from the bottom of Jerry's steel casting rod to the antenna input jack of the receiver, and immediately several strong 'phone signals were heard.  

"You get into the car and work the transmitter while I work the receiver," Jerry said. "First, just hold the carrier on for a second while I spot your frequency. Okay, I've got it. Now blast loose with a distress call. Let's not fool around with 'S O S,' 'May Day,' or anything like that. Just use the good old c.w. emergency call of 'QRRR.' Every ham should recognize that."

Obediently, Carl pushed the button on the mike and began to call: "QRRR, QRRR, QRRR! This is W9EGV calling. QRRR, QRRR, QRRR! This is W Nine Easy George Victor calling QRRR and tuning around this frequency."

As the transmitter snapped off, the loudspeaker of the little transistor receiver burst forth with: "W9EGV, W9EGV, W9EGV; this is W7XXX of Tucson, Arizona, returning. What's wrong, OM?"

QUICKLY Carl explained the situation and asked the Arizona ham to put in an emergency long-distance call to the police department of the boys' home town. This the W7 did while the boys stood by. In a surprisingly short time, he was back with a report that the message had been delivered and that help would soon be on the way. The boys signed with him after promising to let him know how things turned out. Then they got some water from the river and washed some of the blood from the face of the young man, who was still moaning faintly.

"It will take an ambulance a long time to get up that road," Carl remarked. "I don't see how this fellow ever got up here at all. He must be from the air base south of town or he would have known—"

He broke off speaking as he heard an odd sound. Looking up, the boys saw a helicopter hovering directly above them. As they watched in fascination, it settled gently on the sand spit that ran out into the stream. A couple of corpsmen bearing a stretcher leaped out and ran toward them.

"The police called us and said one of our men was hurt up here," one of the corpsmen explained, as they gently and expertly slid the injured youth onto the stretcher.

"The chopper was the quickest way to get..."
NOW... there's a
GARRARD
Auto-Manual
Record Changer
for every
hi-fi system

World's Finest
RECORD PLAYING EQUIPMENT
from Manual Players to
Professional Transcription
Turntables

New
RC 88
Deluxe Changer
$54.50
net

New
RC 98
Super Changer
$67.50
net

New
RC 121
Miss Changer
$42.50
net

Garrard's most compact, economi-
cal changer - fits any cabinet. Simplicity. Operation permits
stacking all record sizes together.

All RC 88 features, including full
manual position and true-turret
drive, PLUS continuous + or -
variable speed control on all 3
speeds.

Supreme in its class. Individual card gives
performance measurements for
each unit. Dynamically balanced
cast aluminum turntable. Heavy-
city, 4-pole shaded motor.

This is the
answer for a
quality budget system. Incorporates all record playing features
of the famed RC 80 record
changer. 4-pole motor; automatic
stop.

MAIL THIS COUPON TODAY
All Garrard and other B.I.C. components are
illustrated and described fully in the B.I.C.
High Fidelity Plan Book, a useful guide in plan-
ing any hi-fi system.
A quality-endorsed product of the B.I.C. Group

MAIL THIS COUPON TODAY
To: British Industries Corporation
Dept. G6-357
Port Washington, N.Y.
Please send B.I.C. High Fidelity Plan Book.
Name
Address
City
State

May, 1957
you get down to fundamentals with GOODMANS ARU 3-WAY speaker systems

ARU ENCLOSURE

AUDIOM Woofer

MIDAX Mid-Range

TREBAX Tweeter

Reproduce bass fundamentals to as low as 20-cycles with no resonant peaks above that frequency, and provide smooth response to 20,000 cycles.

ROCKBAR CORPORATION
650 Halstead Avenue, Mamaroneck, N.Y.
Canada: A. C. Simmonds and Sons Ltd., Tor., Ont.

Please send me complete details on Goodmans ARU 3-Way Speaker Systems and ARU Enclosure Kits.

NAME
ADDRESS
CITY ZONE STATE

Carl & Jerry (Continued from page 18)

him out. You kids certainly used your noodles in not trying to move him. With the injuries he has, trying to move him without a stretcher would almost certainly have meant his death.

After the whirlybird rose vertically into the air and took off down river, Carl and Jerry called the W7 in Tucson and reported the success of the operation. Then they began to disassemble their improvised receiver.

"JER," Carl said slowly, "this experience really has convinced me that transistors are here to stay. I was just thinking that we were receiving that station from Tucson without the aid of a single tube. All we had to snatch his voice out of the air was a bunch of negative electrons and positive 'holes' moving through some semiconductors. A year or so ago, I remember, it was considered quite a feat to make a transistor work clear across the broadcast band, but we were receiving that station on twenty-nine megacycles! We've sure come a long way."

"Yes," Jerry agreed; "it certainly makes you think. After the way that hay-wire combination worked, I can see no reason at all why we shouldn't have excellent transistor communications receivers in a very short time. They should be lightweight, rugged, and about one-tenth the size of present communications receivers. Being powered with a few flashlight batteries, they'll be entirely independent of the light line, and a.c. hum will be no problem."

"If this trend keeps on, a fellow is going to be able to pack a whole ham station into a shoe box!" Carl exclaimed.

... After the whirlybird rose into the air and took off down river, Carl and Jerry called the W7 in Tucson and reported the success of the operation...

Always say you saw it in—POPULAR ELECTRONICS
BUILD 16 RADIO CIRCUITS AT HOME
with the New Improved 1957 PROGRESSIVE RADIO "EDU-KIT"
only $19.95

A Practical Home Radio Course

NOW ALSO INCLUDES:
- NO KNOWLEDGE OF RADIO NECESSARY
- NO ADDITIONAL PARTS OR TOOLS NEEDED
- EXCELLENT BACKGROUND FOR TV

WHAT THE "EDU-KIT" OFFERS YOU

The "EDU-KIT" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train you in Radio and TV concepts, making use of all the most modern methods of home training. You will learn radio theory, construction practice, and servicing techniques, all in a professional manner.

You will work with a standard type of printed circuit chassis as well as the latest development of Printed Circuit chassis. You will work with RF and AF amplifiers, detectors, rectifiers, test equipment, and practice your knowledge and skills, using the accompanying instructional material.

You will receive training for the Novice, Technician, and Amateur Class radio operators. You will also receive training as a Transmitter, Code Oscillator, Signal Generator, and as a Signal Injector, for the Technician and Service Technician classes.

The "EDU-KIT" is the practical home radio training course. It is designed to provide you with a basic educational program in radio and TV, and will allow you to understand any radio or TV problem at a price of $19.95. The "EDU-KIT" alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

You are not the only one who has grown up with Radio and Electronics because you have always been interested in building radios or repairing them. But you may have been looking for a way to learn more about your work at home. Here is your chance! You can now become a professional radio technician.

We offer the "EDU-KIT" to you in order to allow you to learn the necessary knowledge at home without having to pay the high cost of tuition at a college or university. The "EDU-KIT" is designed for practical application and is an excellent investment. It is a complete practical radio course that will allow you to learn the necessary knowledge at home.

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. This is because the "EDU-KIT" uses the most modern teaching methods and instructional materials, and it gives you direct hands-on experience. It serves as a complete curriculum, and is designed to teach you the necessary knowledge in a practical way, without the need for expensive equipment.

The "EDU-KIT" is not just a kit, it is a comprehensive course of study that covers all aspects of radio and electronics. It is a complete educational program that will allow you to learn the necessary knowledge at home without having to pay the high cost of tuition at a college or university.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 16 different radio circuits at home, all guaranteed to operate. This includes Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a complete set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio & Electronics Tester. The "EDU-KIT" also includes Code Instructions and the Progressive Code Oscillator, in addition to basic training in Circuit Concepts and Electronics. You will also receive training in all aspects of radio and electronics, including troubleshooting.

FREE EXTRAS

- SET OF TOOLS
- RADIO & ELECTRONICS TESTER
- ELECTRIC SOLDERING IRON
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE
- QUizzes
- TELEVISION BOOK
- RADIO TROUBLESHOOTING BOOK
- MEMBERSHIP IN RADIO-TY CLUB
- CONSULTATION SERVICE
- FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITS

SERCIVING LESSONS

You will learn about radio and electronics, and will practice repairing and servicing in a progressive manner. This will give you the skills needed to work with RF and AF amplifiers, detectors, rectifiers, test equipment, and practice your knowledge and skills, using the accompanying instructional material.

You will receive training for the Novice, Technician, and Amateur Class radio operators. You will also receive training as a Transmitter, Code Oscillator, Signal Generator, and as a Signal Injector, for the Technician and Service Technician classes. You will be able to do practical repair work for your friends and neighbors, and charge fees which will far exceed the price of the "EDU-KIT." Our Consultation Service will help you with any technical problems you may have.

* Statistics of 25 Popular Pil., Waterbury, Conn., writes that she paid seven kits for her friends and made money. The "EDU-KIT" is worth $240 for a Course, but I found your ad and sent for...

FROM OUR MAIL BAG

Ben Valens. P. O. Box 21, Manna, Utah: "The "EDU-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different Kits, the Signal Tracer works fine. I also like to let you know that I am proud of becoming a member of your Radio Club.

Robert L. Shuff, 1234 Monroe Ave., Huntington, W. Va.: "I have a friend in the United States, and he..."

CONSULTATION SERVICE

One of the most important aspects of the "EDU-KIT" is the FREE Consultation Service which we provide. We have over 500 experts on call to answer any questions you may have. We are always looking for new students to send our answers to, and we are always happy to help. If you have any questions about the "EDU-KIT," we are always here to help.

UNCONDITIONAL MONEY-BACK GUARANTEE

ORDER DIRECT FROM AD

FREE "EDU-KIT" POSTPAID

Receive FREE BONUS RESISTOR KIT WORTH $5

Send "EDU-KIT" Postpaid. I enclose full payment of $19.95.

Send "EDU-KIT" C.O.D. I will pay $19.95 plus postage.

Send me FREE additional information describing "EDU-KIT." Include FREE value Hi-Fi, Radio and TV Servicing Literature.

Name:

Address:

PROGRESSIVE "EDU-KITS" INC.

497 Union Ave., Room 532D, Brooklyn 11, N. Y.

May, 1957

21
Covering Comments

- Movies may be getting better than ever, but so are the POP'tronics covers! How could anyone resist buying your February issue? But, one question; if I buy the Hammarlund receiver, do I get that particular model?

  Frank Mariani
  Buffalo, N. Y.

- Please send complete picture of the girl on the February cover.

  D. B.
  Oakland, Calif.

Okay men, take it easy. Our February cover gal has been doing some further modeling (she was originally on the Jackie Gleason show) and you should be seeing some photos of her in other magazines.

Citizens Band in Canada

- As far as I have been able to find out from the Department of Transport (the Canadian FCC), there are no channels here for private citizens. This is in response to the query from Roy Smyth, (March issue, page 28).

  I am engaged in the Lake Ontario Air-Sea Rescue Service and would like to see reasonably priced equipment made available to Canadians. The establishment of a Citizens Band in Canada would benefit all concerned.

  J. Brichenden
  Toronto, Canada

Oscilloscope Techniques

- As a suggestion, how about some articles on how to detect, recognize, and distinguish separate harmonics and patterns with moderately priced oscilloscopes. I am thinking of identifying traces so that we would know what they mean.

  William A. Sander
  Redondo Beach, Calif.

Your idea sounds swell, Bill, and the author of our recent article on Lissajous figures (March 1957 issue, page 63) has consented to a new series on servicing and fault-finding by oscilloscope tracing. It is shaping up into a fine series (scheduled to start soon) which will be of value to numerous readers.

Glad We Could Help

- I want to thank you for the series of articles on becoming a radio amateur. This was just the nudge I needed to get started in the right direction toward a ham "ticket." I am now the proud owner of station KN2UWW, using a Heath AT1 and Hallicrafters SX-99.

  Bill Addison, KN2UWW
  Niagara Falls, N. Y.

- Guess I misjudged your magazine. I am an SWL and figured you might be letting us down,

Audax KT-12: KIT, $14.55 NET
Factory-assembled, $24.00 NET

Audax KT-16: KIT, $17.55 NET
Factory-assembled, $30.00 NET

Always say you saw it in—POPULAR ELECTRONICS
RCA offers you the finest training at home in Radio-TV electronics, TV servicing, Color TV

SEND FOR THIS FREE BOOK NOW!

The instruction you receive and equipment you get (and keep) will start you on your way. Pay-as-you-learn. You pay for only one study group at a time. This 52 page book contains complete information on Home Study Courses for the beginner and the advanced student.

RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N. Y.


May, 1957
Letters

(Continued from page 22)

but then the February issue and the article by Stew West changed things. I'll stick around and here's my three bucks for a subscription—that's what really counts.

G. Killam
Reading, Mass.

Kit Builder's Korner

- I read the "Kit Builder's Korner" item on the Packard-Bell receiver. I was a little hesitant before reading the article, but now I feel like an old hand and will soon be getting the kit.

Mike Green, Jr. Montclair, N. J.

- I think "Kit Builder's Korner" is great. I would like to see the Heathkit Model AR-3 reviewed in this column.

Kevin Hurley Berkeley, Calif.

- In regard to "Kit Builder's Korner," I would like to see the Precise tube checker, Model 3111, reviewed as soon as possible.

G. R. Wiggins St. Catherines, Ont.

Duplicates of Our Projects

- I finally got around to building the "Economy Signal Chaser" (November 1956 issue, page 63) and found that it works satisfactorily. I built it into an old electrolytic capacitor can about 1 1/4" in diameter and 4 1/2" long, and used a bolt mounted in one end of the can for a test prod.

Edwin Prusinowski Winnipeg, Manitoba

- The TV tube rejuvenator (February, page 61) works well and only cost me $7.00 to build.

Robert Roam Fowler, Calif.

What Happened?

- Why did you discontinue "What's The PE Answer?" I think it was an outstanding feature giving information that everyone could use.

David Junchen Sherrard, Ill.

We were sorry to drop the "Answer" column temporarily, Dave. However, it's back in this issue on page 66, so we hope that you will continue to enjoy it.

Earth Satellite

- How are the chances that you will have articles on the earth satellite? Our newly formed science club has elected the IGY program as its first project, and I'm sure there are other experimenters interested in the satellite program.

Ron Baird Jackson, Mich.

Ron, we've been keeping it under wraps, but if our present plans work out, we will have a red-hot item for you in the July issue. Keep your eyes peeled for a flashy cover announcement—should it work out!

Industriial Electronic-Automation Technicians

Desperately Needed!

Never in history has there been such a tremendous demand for Electronic Technicians at the servicing, maintenance and assistant Engineering level, in all fields of electronics. Industries, Businesses, large and small are turning to electronically controlled machinery... AUTOMATION!

Whether it's a Robot airplane, an automobile plant with an integrated line of machinery, a Sensing Device, Computing System or Communications—each require electric power applied through automatically controlled processes. This means there are positions open at all levels and phases for Electronic Technicians.

- TOP PAY
- UNLIMITED OPPORTUNITY
- SECURE FUTURE

Let us send you FREE, without obligation, complete details of our Resident Electronic Training Program—originated by Bailey Schools—acclaimed by Electronic Engineers. See how you save time as you learn-by-doing with intensive laboratory work on the most recently developed Electronic equipment, plus classroom required physics, mathematics, etc.

We help you find part time work while in our school—help place you with America's leading companies after graduation. Act now—mail coupon today!

VETERAN APPROVED

Bailey Technical Schools
1626 S. Grand • St. Louis 4, Mo.

MAIL TODAY

Please mail immediately this free booklet without obligation.

Name
Address
City____________________ State

Always say you saw it in—POPULAR ELECTRONICS
People listen with interest when you say you're with Univac.

The mere mention of this world-famous organization sets you apart as someone interesting and important. And rightly so ... for as a Univac engineer or technician you'll be involved in some of the most fascinating scientific work of our day. You'll contribute to research and development that are completely revolutionizing concepts of national defense, scientific research, business and industry.

The special pride you feel when you say, "I'M WITH UNIVAC", is just one of the many satisfactions of a career with Univac — world leader in the field of electronic computers. For top salaries, excellent working conditions and opportunities unlimited say "I'M WITH UNIVAC."

IMMEDIATE OPENINGS FOR...

FIELD LOCATION ENGINEERS • FIELD LOCATION TECHNICIANS
ENGINEERING WRITERS

... AT PERMANENT COMPUTER INSTALLATIONS THROUGHOUT THE UNITED STATES

Send complete resume to:

Remington Rand Univac
DIVISION OF SPERRY RAND CORPORATION
MR. PHIL WILSON
Dept. MyS-31 • Univac Park • St. Paul 16, Minn.
DON'T THROW OLD RADIOS AWAY!

This giant book shows exactly how to fix them . . . without a lot of previous experience!

Just look up the how-to-do-it data on that old radio you want to fix!

The 764-page Ghirardi RADIO TROUBLESHOOTER'S HANDBOOK gives you exactly the information you need. Tells what is likely to be causing the trouble . . . shows how to fix it. Covers practically every radio receiver model made by over 4,800 manufacturers between 1925 and 1942. Using it, even beginners can easily fix old sets which might otherwise be thrown away because service information is lacking. With a few simple repairs, most of these old sets can be made to operate perfectly for years to come.

Included are common trouble symptoms and their remedies for over 4,800 models of old home, auto radios and record changers: Airline, Apex, Arvin, Atwater Kent, Belmont, Boyle, Brunswick, Clarion, Crosley, Emerson, Fada, G-E, Kellog, Majestic, Midland, Mine, Philco, Piel, RCA, Silvertone, Sparten, Stromberg and dozens more. Includes hundreds of pages of invaluable tube and component data, service short cuts, etc. Price $6.95—10-day free trial.

HERE'S EVERYTHING YOU NEED TO KNOW ABOUT OSCILLOSCOPES!

Learn to service ANY Radio or TV easier, better, faster

 Oscilloscopes are gold mines for servicemen who learn to use them fully . . . and here is THE book that really shows you how! MODERN OSCILLOSCOPES AND THEIR USES explains where, when and exactly how to use them. No involved mathematics! Every detail from making connections to adjusting circuit components and setting controls is clearly explained. You learn how to get the most out of your 'scope on all types of AM, FM and TV service (including color TV) . . . from locating troubles to handling tough realignment jobs. You learn to analyze patterns fast and accurately. Almost 400 illustrations make things doubly clear. More widely used than any other book of its type! Price $6.50.

PRACTICE 10 DAYS FREE!

Send book(s) checked below for free examination. In 10 days, I will either send price shown (plus postage) or return book(s) prepaid and over nothing.

MODERN OSCILLOSCOPES and Their Uses, $6.95

Send book(s) checked below for free examination. In 10 days, I will either send price shown (plus postage) or return book(s) prepaid and over nothing.

1. RADIO TROUBLESHOOTER'S HANDBOOK, $6.95
2. MODERN OSCILLOSCOPES and Their Uses, $6.50

Name .....................................................
Address ...................................................

Always say you saw it in—POPULAR ELECTRONICS
Send for FREE booklet and get the BIG PAYOFF in RADIO-TV-ELECTRONICS

What would a $10 or $20 a week raise mean to you?

Just one $10-a-week raise will repay your investment in CREI training, and leave you a profit of $200 or more the very first year! All further raises are pure profit, and you'll be prepared for many more promotions and raises in the future!

Today, thousands of electronics hobbyists have an opportunity to turn their hobbies into profits. It's the "Age of Electronics!" Trained men are in crucial demand! You may be "outside" the electronics industries now, working on a job you enjoy far less than experimenting, building, transmitting, receiving, working for less money than is being paid to electronics engineering technicians. But your "true love" is electronics. Why not awaken to your opportunities—now!

ELECTRONICS IS SCREAMING FOR MEN LIKE YOU!

Here are just two of the high-level opportunities available from coast to coast:

"Just about four months have passed since I made my first recruiting trip to CREI. As a result of that visit Messrs. Kohs, Plante and Wenger are now members of the Laboratories and Mr. Kresge soon will be... we have some openings now and will have others..."—Bell Telephone Laboratories, Murray Hill, N. J.

"Two openings in our Field Service... aircraft electronics... starting salary is $380 and up...",—North American Aviation, Inc., Columbus, Ohio.

COUNTLESS POSITIONS MUST BE FILLED

And only trained men can fill them. You can get your share, if you take time now to gain that indispensable knowledge.

ALL YOU NEED IS ADVANCED TECHNICAL TRAINING

Sure you have some experience. But the fellows with only partial technical knowledge move slowly, or stand still, while you—the man with advanced technical training—plunge ahead in the golden world of electronics opportunities.

ACQUIRE NECESSARY TRAINING AT HOME

Use spare-time hobby hours for CREI Home Study as thousands of successful technicians have since 1927. Get concentrated training in minimum time, then step into a good job and enjoy good pay in the mushrooming electronics industry.

SEND FOR FREE BOOKLET. IT TELLS YOU HOW

How to gain career success in the tremendous electronics industries. It pinpoints opportunities which exist. By 1960, the electronics industries will do no less than $15 billion worth of business per year, not counting military orders. Take TV for example: There are about 39,000,000 TV sets and over 493 TV stations on the air. Color TV is pushing ahead furiously. There is but one field of maximum opportunity in this electronic age.

CREI TRAINS YOU IN MINIMUM TIME AT HOME

Thousands of men before you have benefited quickly from CREI Home Study training. Thousands of CREI graduates are now employed in industry here and abroad. Here is what they say:

"In this time of less than two years, I have almost doubled my salary and have gone from wireman, to engineering assistant, and now to junior engineer. I have CREI to thank."—Frank A. Eckert, 22 Clover Lane, Levittown, Pa.

MAIL THIS COUPON...TODAY!

To help us answer your request intelligently, please give the following information:

EMPLOYED BY

TYPE OF PRESENT WORK

SCHOOL BACKGROUND

ELECTRONICS EXPERIENCE

IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED

NAME

ADDRESS

CITY

STATE

ZONAL

Send booklet, "Your Future in the New World of Electronics" and course outlines.

FAMOUS FOR 30 YEARS

CREI is known and respected throughout the electronics world. Since 1927 we have trained thousands in the military, industry and government.

MAIL THIS COUPON...TODAY!

CAPITOL RADIO ENGINEERING INSTITUTE

ECPD Accredited Technical Institute Curricula—Founded in 1927

Send booklet, "Your Future in the New World of Electronics" and course outlines.

CHECK

FIELD OF INTEREST

GREATEST

TV Engineering Technology

Aeronautical Electronic Engineering Technology

Electronic Engineering Technology

Broadcast (AM, FM, TV) Engineering Technology

ECPD Accredited Technical Institute Curricula—Founded in 1927

Electronic Engineering Technology

Broadcast (AM, FM, TV) Engineering Technology

Television Engineering Technology

Aeronautical Electronic Engineering Technology

Name

Age

Street

City

State

Zone

Check: [ ] Home Study [ ] Residence School [ ] Korean Veteran

May, 1957

27

www.americanradiohistory.com
NOW! Get started with your own E-Z Tube Tester ROUTE...

Drug Stores, supermarkets, etc., are actually asking for them!

- work full or part time
- stock and sell new tubes
- requires little attention

Get in on the ground floor of this profitable new business!

ORDER DIRECT FROM FACTORY at lowest prices ever!

- Same accurate tester in successful use coast-to-coast.
- Tests over 350 different type of tubes.
- Rugged-made especially for DO-IT-YOURSELF trade.
- Automatically tests for shorts when tube is plugged into socket.
- One press of test button gives immediate GOOD-BAD reading on large 7" meter.
- 117 sockets, including 14 spare sockets, prevent obsolescence.
- Automatic stock control...automatic pricing.

Send 25¢ for COMPLETE SALES PLAN AND OPERATING MANUAL. Tells you all you have to know to start and build a successful Tube Tester business. All forms included.

FREE! E-Z Tube Tester catalog sheet on request

CALEX MANUFACTURING CO.
3815 Martin Court Seafood, N. Y.

Free Literature Roundup

An attractive color booklet contains some well-taken points on the question of using a turntable or a record changer in a hi-fi system. Write to Rek-O-Kut Co., 38-01 Queens Blvd., Long Island City 1, N. Y., for your copy.

Humorous and informative is a 32-page booklet entitled "Seven Villains of Tape Recording." Copies are available from OR Radio Industries, Inc., Shamrock Circle, Opelika, Ala.

Reprints of magazine articles dealing with the Goodmans' Acoustical Resistance Unit (ARU) are available from Rockbar Corp., 650 Halstead Ave., Mamaroneck, N. Y.
EXPERIMENTERS, HOBBYISTS, ENGINEERS!
You should have **VOLUME II** of the

RAYTHEON
TRANSISTOR
APPLICATIONS BOOK

only **50¢**

The new Raytheon Transistor Applications Book, Vol. II, is not just a collection of circuits, it contains complete construction information including wiring diagrams, illustrations and parts lists on a wide variety of new applications never before published. What's more, there's a section of installation and wiring hints on transistors, printed circuitry and a full section on basic transistor theory and circuit design.

If you experiment with transistors you can't afford to be without this great new book. Get it from your Raytheon Tube Supplier or send 50¢ for each book you want to Department V2.

RAYTHEON MANUFACTURING COMPANY
Receiving and Cathode Ray Tube Operations
Newton 58, Massachusetts

May, 1957
LEARN basic electricity electronics
THE EASY "PICTURE BOOK" WAY!

You don't need a degree to succeed in electronics. Now available... the fabulous ILLUSTRATED Training Course now used by the U. S. Navy!

You Learn by Pictures

Over 25,000 Navy trainees have already learned Basic Electricity and Basic Electronics this easy, "Picture Book" way! Now, for the first time, YOU can master the basics of Electricity and Electronics with this same "Learn-by-Pictures" training course! Over 1,700 simple, easy-to-understand drawings explain every section; these "teaching" pictures actually make up more than half the entire course! No other Basic Electricity or Basic Electronics course in America uses this revolutionary illustrative technique! You learn faster and easier than you'd dream possible!

A Complete Idea on Every Page

Here's how this easy, illustrated course works: every page covers one complete idea! There's at least one big illustration on that same page to explain it. What's more, an imaginary instructor stands figuratively at your elbow, doing "demonstrations" that make it even easier for you to understand. Then, at the end of every section, you'll find review pages that highlight the important topics you've just covered. You build a thorough, step-by-step knowledge at your own pace—as fast as you yourself want to go!

Everyday English—A Course Anyone Can Understand

Sponsored by the Navy to turn out trained technicians in record time, this modern course presents Basic Electricity and Basic Electronics in a simple way that everyone can grasp—regardless of previous education! Every phase is made instantly clear—explained in plain, down to earth English—with hundreds of easy-to-understand illustrations to help you!

10 Complete Volumes:
Volumes 1 and 2 of "Basic Electricity" cover DC components and circuits; Volumes 3 and 4 cover AC components and circuits; Volume 5 covers AC and DC motors and machinery. Volume 1 of "Basic Electronics" covers Diodes and Power Supplies. Vols. 2 and 3 cover Amplifiers and Oscillators. Vols. 4 and 5 cover Transmitters and Receivers.

Home Study Without Correspondence

This course is so different, so complete—there's no need for the usual letter writing, question and answer correspondence! Learn at home—at your own pace!

10 Day Examination—Money Back Guarantee

Send today for these exciting new training courses—yes risk nothing! When you receive the volumes, examine them in your own home for 10 full days. If, at the end of that time, you're not completely satisfied, simply return the books to us and we'll gladly refund your full purchase price! Total cost for either 5-volume course is only $10.00! In Canada, prices approximately 5% higher.

ORDER TODAY!

These books are sold by electronics parts jobbers and book stores. If YOUR dealer doesn't have these books, mail this coupon to us!

JOHN F. RIDER PUBLISHER, INC. 116 West 14th St., N.Y.C.

I have enclosed $ Please send me 

☐ 5-vol. Basic Electricity set @ $10 set
☐ 5-vol. Basic Electronics set @ $10 set
☐ Both sets. I understand I may return the books in 10 days and receive a complete refund of the full purchase price if I am not satisfied.

Name
Address
City & State

Always say you saw it in—POPULAR ELECTRONICS

McWatts
By CARL KOHLER

www.americanradiohistory.com
Outstanding Employment Opportunities Open to Central Graduates!

No matter what you're doing now... whether you've ever had previous technical experience or not, you can begin right now to prepare for a great career in these fascinating, rewarding fields!

Capitalize on the fact that Central's nationally recognized, proven training methods, top instructors and long record of educational achievement have put Central-trained men in high demand throughout America!... that Central's graduates are periodically interviewed and employed by many of the Country's foremost industrial giants and leading employers of electronics specialists. Hundreds of radio and TV stations look to Central as a reliable source for competent, thoroughly trained technicians and the nation's major airlines and aircraft manufacturers have hired hundreds of Central-trained technicians for important communications and electronics positions.

3 Proven Training Plans

1. HOME STUDY COURSE (with 9 kits of equipment)—Qualifies you for diploma, FCC license exam, and a variety of electronics jobs (or transfer into advanced resident training).

2. HOME STUDY—RESIDENT COURSE (with 9 kits of equipment)—Home study, followed by short period of resident training. Qualifies you for diploma, FCC license exam, and a wide variety of positions (or continue with advanced resident training). An ECPD-accredited engineering technician program.

3. FULL RESIDENT COURSE—Qualifies you for Associate of Science (A.S.) degree and top-pay employment opportunities as Electronics Engineering Technician. An ECPD-accredited engineering technician program. Part-time employment opportunities available for students while training.

May, 1957

How Central's "Progressive Plan" Will Pay Off for YOU!

Central's complete, accredited training is designed to get you the technical job you want... in the shortest possible time! Through Central's "Progressive Plan" of study, as you complete each phase of training your earning capacity goes higher! How far "up the ladder" you want to go is entirely up to you. A few short weeks of training prepares you for certain basic jobs. Then, with every additional phase of training you complete, you qualify for more advanced types of positions that command higher salaries. You can settle for any of a wide variety of well-paid, worthwhile jobs along the line... or you can use Central's complete training to advance right up to the top-level, top-pay positions! Don't limit yourself! Get the facts on Central's complete training. Mail the coupon today!

VETERANS Central offers courses approved under G.I. Bill

Mail Coupon for FREE BOOK

CENTRAL TECHNICAL INSTITUTE
Dept. A-57, 1644 Wyandotte St.
Kansas City 8, Missouri
Tell me more about how you can qualify me for a high-pay Electronics career.

Name
Address
City, State
Phone
County
Age
If Korean vet., give approx. discharge date

YOUR FUTURE IN ELECTRONICS

www.americanradiohistory.com
Why People Like GENIAC

"...beautiful simplicity ... good graded instructions."

| TECHNICIAN | "I am very happy to say I have derived many hours of entertainment as well as education from this instrument." | T/Sgt. W. B., USMC |
| ELECTRONICS AMATEUR | "I have purchased your kit and have become greatly interested in electrical brains. I want to thank you for the infinite amount of knowledge contained in this moderately priced kit." | W. P., Cleveland, Ohio |
| EXPERIMENTER | "I am enjoying the 'GENIAC' kit and have been trying to design new circuits in my spare time." | L. S. Fontana, Wisconsin |
| HOME STUDENT | "You have an ingenious design of beautiful simplicity accompanied by good graded instructions." | A. S., Cleveland, Ohio |

"...our son has found ... enjoyment and knowledge."

| COLLEGE STUDENT | "I am very delighted with my kit and we boys here at the dormitory at York College who are planning to become engineers are having a very interesting time assembling the various machines." | B. B., York, Nebraska |
| HIGH SCHOOL STUDENT | "Our son has found considerable enjoyment and knowledge working with this kit." | Mrs. S. S., Havertown, Pa. |
| FATHER AND SON TEAM | "My son has enjoyed your GENIAC and I feel that this kit is an ideal arrangement for giving anybody the basic ideas for the principles of computers." | P. M., Electrical Engineer and Instructor, L. A., California |

"...you have a fine teaching instrument."

| INTERNATIONAL EDUCATOR | "We believe GENIAC will serve a useful purpose as a training aid in our ICA technical assistance mission with the Turkish Ministry of Education in the field of technical education." | W. V., Program Chief |
| ELECTRICAL ENGINEER | "I am a former electrical engineer (now a physician) and I was delighted to read your instructions and see the way your apparatus is put together. I think you have a fine teaching instrument." | J. M., Baltimore, Md. |
| MATH DEPARTMENT HEAD | "I am interested in your 'GENIAC' kit both for my own school and for possible wider use in the city." | W. M., Chairman of Math Dept., Brooklyn, N. Y. |

Advanced Courses in Computer Operation

| DIGITAL COMPUTER COURSE | Shows how to set up and build computers and experiment with pulses, gates, storage, add, subtract, multiply, design circuits. Manuals, wiring diagrams and texts provide a complete introduction to theory and practice. | Course C-2 | $28.00 |
| ANALOG COMPUTER COURSE | Lists sources of materials parts, theory and practical instructions plus wiring diagrams and schematics for adding, multiplying, integrating and differentiating; gives practice in calculating scale factors, choice of time scales, machine equations and block diagrams. | Course C-3 | $28.00 |
| ELECTRONIC MEMORY COURSE | The course contains instructions for building relay memories, magnetic core memories and tube storage memories, with detailed descriptions of methods of storing information and automatically giving instructions to electronic devices. Suitable for all levels—particularly designed for people who have some knowledge of electronics. Including Texts: Course C-1 | | $28.00 |

ALL THREE COURSES TOGETHER $75.00, SAVING OF $9.00

Always say you saw it in—POPULAR ELECTRONICS

www.americanradiohistory.com
BUILD IT YOURSELF in a few hours!

Yes, you build any one of 33 exciting electric brain machines in just a few hours by following the clear-cut, step-by-step directions given in a thrilling booklet! No soldering required. GET WIRING beyond your skill! GENIAC is a genuine brain machine—not a toy. The only logic machine kit that not only adds, subtracts, etc., but presents the basic ideas of cybernetics, Boolean algebra, symbolic logic, automation, etc. So simple to construct that even a twelve-year-old can make a machine that will fascinate people with advanced scientific training! With the special circuitry of GENIAC, the Electric Brain Construction kit, you can compose tunes automatically. These new circuits were never available before!

OVER 400 COMPONENTS AND PARTS. Circuits operate on one flashlight battery, and the use of ingeniously designed parts makes building circuits one of the most fascinating things you've ever done! You set up problems in a variety of fields—and get your answers quicker than you can set them up! Play games with the machine—nim, tic-tac-toe, etc.—and pit your brain against its logic! Solve puzzles in a few seconds that would take you hours without the aid of the machine. You actually see how computing and problem-solving is analyzed with algebraic solutions transferred directly into circuit diagrams.

YOUR COST FOR GENIAC KIT: only $19.95 postpaid. The 1957 Model GENIAC KIT contains: (1) a complete 200-page text, “Minds and Machines”—a basic introduction to computers. (2) “How to Construct Electric Brains At Home”—a fully illustrated text book on basic computer design theory and circuits with specific instructions for building circuits. (3) Wiring Diagram Manual. A special booklet with full scale diagrams that you can tear out and place on your work bench for easy assembly. (4) Beginners' Manual. Starting from scratch, the manual adds extra experiments, thoroughly tested using GENIAC components to teach the basic symbols of electric circuits. (5) Over 400 components and parts.

So—mail the coupon for your GENIAC today! Your money back if not delighted!

Some Firms and Institutions that have ordered GENIAC:

<table>
<thead>
<tr>
<th>K1—Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>$19.95</td>
</tr>
</tbody>
</table>

(Add $1.00 W. of Miss. $2.00 Outside U. S.)

UP TO DATE?

Is your knowledge of these new technical fields rusty? Perhaps you never had time to study them but need to now. Write for free information about our new, modern, low-cost course. Work at your own speed at home. Check those that interest you.

PHYSICS
- High School Physics (Add $1.00 West of Mississippi or $2.00 Outside U. S.)
- Part 1—P1A
- Part 2—P1B
- College Physics (Add $1.00 West of Mississippi or $2.00 Outside U. S.)
- Part 1—P2A
- Part 2—P2B

MATHEMATICS
- Trigonometry
- Algebra
- Solid Geometry
- Calculus
- Statistics

ELECTRONICS
- Television P3A
- Radio P3B
- Radar—Theoretical P3C1
- Radar—Practical P3C2
- Musical Instruments P3D

CHEMISTRY
- High School College
- Analytic
- Qualitative
- Quantitative
- Organic
- Physical

BIOLOGY
- High School
- Human Biology
- Zoology
- Botany
- Genetics

PSYCHOLOGY
- Normal P51
- Child P52
- Abnormal P53
- Mental Hygiene P54
- Aptitude Test P55
- Rapid Reading P56
- Construction of Robots P57

PSYCHOLOGY
- Normal P51
- Child P52
- Abnormal P53
- Mental Hygiene P54
- Aptitude Test P55
- Rapid Reading P56
- Construction of Robots P57

ACOUSTICS
- Hi-Fi P4
- Analog Computer C3
- Digital Computer C2
- Memory Storage C1

OILERS GARFIELD CO., Dept. PE-47, 31 Broadway, New Haven, Conn.

Name ___________________________________________ Age ________ Occupation ____________________________

City ___________________________________________ Age ________ Occupation ____________________________

Zone __________ State __________________________

May, 1957
FREE CATALOG
SAVES YOU 50% on your TEST INSTRUMENT & HI-FI COSTS
50 KITS & WIRED MODELS to choose from!

FREE! CATALOG SAVES YOU 50% on your TEST INSTRUMENT & HI-FI COSTS
50 KITS & WIRED MODELS to choose from!

PERFORMANCE-PROVED by TV manufacturers, electronic schools and over 100,000 Servicemen. OVER 1 MILLION in use today!

YOU BUILD EICO KITS in ONE evening, but — they LAST a LIFETIME!

LATEST engineering • FINEST components • EASY instructions

EXCLUSIVE 5-WAY GUARANTEE on components, instructions, performance — and LIFETIME service and calibration!

Test radio, hearing aid, flashlight, photo-flash, electronic equipment batteries: BATTERY TESTER
#584 KIT $9.95 WIRED $12.95

Always say you saw it in—POPULAR ELECTRONICS
New DF Technique

For Small Boats

By ELIOT DRAKE

Aeronautical beacons aid seafarers

with or without a DF loop antenna

THIS COMING SUMMER more people than ever will be spending their weekends and holidays in boats. For many, it will be their first venture into unfamiliar surroundings. It follows that, after getting out on the water, numerous beginners will wonder how to find their way back.

The older mariners depended entirely on the magnetic compass. Within the past few decades, and particularly within the past five years, the use of radio direction finding (DF) equipment has become standard procedure. The novice boatsman, however, may not want to spend the money for a DF loop antenna. This article tells how you may approximate your position on the water by simply listening to aeronautical radio range stations.

Although radio range stations operating between 200 and 400 kc. are not generally used by navigators afloat, they are the simplest source of sea-going signposts to be found. No skill is required for observing radio range signals, and they are accurate even if you are in a small bouncing boat—something that cannot be said for the usual kind of radio bearings taken with DF equipment.

To use the aeronautical radio ranges for navigation, all you need is a receiver covering the band of frequencies from 200 to 400 kc. Radio range stations are generally on the air continuously, and the signal that you receive from any one of them depends upon the compass bearing between you and the station.

The range transmits two signals in the pattern of a four-leaf clover. As shown in the drawing, page 36, you will find that, if you are in the center of the upper left or lower right quadrant, you will only hear the code signal N (dash-dot). In the other two quadrants, you will hear the letter A (dot-dash). But when you are located on the lines that bisect the overlapping A and N patterns, you will hear a steady tone. Thus, you know that you are on the beam.

The airlines pilot "rides" this tone to find his base through clouds and darkness.

Actually, 16 different sectors are indi-
last at least one or two boating seasons.

Radio range stations have a positive means of identification. They are each assigned call letters which they periodically transmit in Morse code. These dot-and-dash call signs are transmitted very slowly and may be easily read and identified by a rank novice.

Representative patterns are shown in the map of the Sandy Hook and lower Long Island area. The caption accompanying this map further explains the use of the aeronautical radio range stations.

**Once you've learned** to poke your way around in poor visibility by using aeronautical range signals, the next logical step is to try loop-receiver direction find-

cated by a single range. This is also shown in the drawing above. However, you cannot find your position from observing a single radio range. By tuning in two or three radio range stations and determining in which sector of each range station pattern your boat lies, a fairly accurate position may be obtained. Then, at the very least, you can pilot the boat home by compass or direct it towards the nearest radio range course (steady tone) that will bring you safely to your destination.

**Radio range patterns** are identified in sectional aeronautical charts published by the United States Coast and Geodetic Survey. The price of a chart is only 25 cents, and since few changes are made each year, a small investment will probably

![Diagram of antenna pattern](image)

**Drawing** above shows division of antenna pattern from a radio range station into 16 parts, represented by intensity of the "A" and "N" signals. In actual practice, the beams are "warped" as shown in the map at right.

If your boat is suddenly surrounded by fog in position ○ on the map, you should first tune to 227 kc. to find station HEM, Mitchell Field, L. I. In this position, the A signal will be heard about twice as strong as the N signal. By then tuning to 248 kc. and identifying IDL, Idlewild Radio, the N signal will be heard with approximately twice the strength as the A signal. To verify the position further, tune to 341 kc. and identify EWR, Newark Radio; you should hear the N signal about twice as strong as the A signal.
Midwife to Dwarf Diodes

The birth of a semiconductor diode or transistor is a very delicate operation requiring utter cleanliness and skilled precision reminiscent of surgery. The whole new field of electronically active solids employs such delicate techniques that women, accustomed to the painstaking labor of needlepoint, are often their ablest practitioners.

Our pictures show tasks performed by these girls in the making of tiny silicon diodes, no bigger than a grain of rice. These midget diodes, manufactured at the Electronics Division of Hughes Aircraft Company, use silicon in place of germanium to gain greater heat resistance. This makes them suitable for many new applications in the field of industrial process control.

Silicon furnace (above) converts coarse nuggets into silicon ingots as the first step in diode-making. A controlled amount of impurity (1%) is added to the melt at 2640°F to provide conductor electrons within the solid structure.

Completed diodes are checked at right—both by eye and ear. An audio signal in the test device indicates the crystal orientation.

Crystals shown below under magnifier are sorted out for proper shape. Because they are "diced" from semi-circular wafers, some of them have rounded edges and must be rejected.

May, 1957
Space Message Expected

Provisions are now being made to receive the messages from space to be sent earthward from the artificial moon that will be launched later this year. Dr. John P. Hagen, Director of Project Vanguard, is shown below with a model of the satellite designed by scientists working under his direction at the Naval Research Laboratory in Washington, D. C. The instruments shown inside include telemetering equipment which will transmit radio signals to earth while the satellite courses through its orbit.

Horror in Brooklyn

In this age of imminent space travel and flying saucers, no one need be surprised on encountering a space monster on the quiet Brooklyn street pictured above. This department fails to understand the evident horror on the boy's face at this friendly meeting.

Rectifier Goes Flat

Flat selenium rectifiers, like the one shown above lying on the yardstick, may replace the customary larger stack pictured above it for comparison. The Radio Receptor Co. of Brooklyn imports the item.

Nosing Its Way 'Round

Grafting a 17-foot nose, simulating the front end of a Bomarc missile, onto a B-57 bomber (below) is a novel way of testing the guidance systems intended for eventual installation in the missiles. Testing under these simulated conditions saves not only money but also the most important element of research and development: time. Since test missiles seldom can be recovered, the time and money required to maintain expendable test missiles would be prohibitive. The grafted nose solves the problem.
"PIT STOP! Make a pit stop! Your left rear tire is almost done."

"Okay," radios the tired driver of speeding car No. 44 as he slows to broadside a turn and jams his car through racing traffic. "I'm coming in."

In the past, race drivers have always been plagued with the problem of how to secure accurate communication with their pit crew. Now, through the use of Citizens Band 465-mc. transceivers, both driver and crew can participate in exciting races with complete mutual understanding. No longer does a driver have to wear his tires to shreds before realizing it is time for a change. His crew chief in the pit can quickly spot such troubles through binoculars and radio a warning of potential danger.

On the other hand, drivers flying past the pit area at 110 miles an hour are in no position to advise their crews of impending needs—such as a pit stop in the next lap for gasoline. Radio enables the driver to alert his crew in plenty of time. An advance warning of action to come reduces the possibility of an excited crewman pouring water in the gas tank—a mistake which caused one car to lose a race last year.

The 4.1-mile track at Daytona Beach, (Continued on page 114)
Hams in Service Help Their Hobby

SCATTERED throughout the world are many friends and relatives of POP'tronics readers. They are members of the Armed Forces serving to protect our democracy. Although most of our contact with these airmen and soldiers must be through the mails, there is another method that has proven to be immensely valuable. It is the Military Affiliate Radio System, commonly referred to as MARS.

MARS is comprised of radio stations that operate in or near the usual radio amateur bands. They are mostly staffed by licensed radio hams who receive further training in message-handling procedures, equipment operation, etc., through these activities.

Two MARS networks are in existence. One of them is operated by U. S. Army personnel. The other is operated by men and women of the U. S. Air Force. Both have their headquarters in Washington, D. C. Although, as illustrated on these pages, the major portion of their messages concerns the morale and welfare of our troops, the military also believes that these networks can provide an additional number of traffic channels should they ever be needed.

The history of MARS is an impressive legend of cooperation between U. S. radio hams and the military. Reports indicate that MARS will soon expend considerable effort in teaching—or providing the facilities to teach—Novice ham radio. Follow our pages for more information.

Typical of the many MARS installations throughout the world is this one in Wiesbaden, West Germany. Airman First Class Ann Moody, center, is speaking to her mother in Kesar Falls, Maine. T/Sgt Rialto Cardinale operates station controls while Theresa lan none waits to talk to her parents.

Airman Harold Banks (at the right) requested the MARS station in Tokyo to relay an important message to his mother concerning the welfare of the entire family. MARS sent the message to Hawaii, then to the west coast, on to New Orleans, and finally delivered it less than 36 hours later. Personal messages are always handled with the greatest possible degree of discretion by MARS personnel.

40 POPULAR ELECTRONICS
Located in the New Kaijo building in Tokyo is the net control station for the Far East Air Force (FEAF). At the left, A/IC Leo Gonzalez, Jr., is checking net reports. Some messages of the MARS stations go by c.w., some by radiotelephone; and others by a system of radioteletype.

MARS Station A11BL is located at Tachikawa City, Japan, and is one of the foremost traffic-handling stations in the Far East. T/Sgt G. F. Doran is supervisor of this station, which is known as KA2FC in the radio amateur bands. On one occasion, by setting up a phone patch with a large hospital in San Francisco, A11BL was responsible for securing special serum for a stricken airman within 48 hours.

T/Sgt Cardinale (above), manager of the MARS station at Wiesbaden, Germany, adjusts one of the many transmitters at AJ3AIR. These transmitting units are powerful enough to reach any part of the world.

Station AJ3AAA (right), the net control station of the 12th Air Force Network, handles 2000 to 3000 messages each month while phone patches to relatives run around 120 a month. As in other stations shown, nearly all of the equipment is either surplus military or salvaged and repaired by station personnel.

May, 1957
Electronic Brain—Neurotic?

British scientists have designed the electronic brain above to include unusual human traits—forgetfulness, neuroticism and panic. Nicknamed Eucrates I, the "brain" learns from an electronic instructing computer. Continual successful accomplishments make Eucrates careless and then neurotic as it becomes unable to catch up. Finally it panics—until the electronic instructor comes to the rescue and smooths its muddled thinking. Eucrates will be used to study "neurotic" traits that might plague electronic computers.

What Is It?

Spotted on Lexington Avenue, in midtown New York, was this unusual antenna. There was no visible indication of what the driver expected to capture and the antenna itself gave no clue to its possible purpose. Aside from the incidental opinion that it looks something like a halo, we've been unable to figure out anything about it. Several photographs were taken by our staff to save this epic scene for posterity. Nevertheless our curiosity is still bothering us. We can't help wondering—what is this antenna and what is it supposed to do?

TV Keeps Dry Under Water

Businessmen can now conduct underwater salvage and offshore oil drilling operations, inspect spillways, dams, canals, irrigation systems, etc., without going near the water. A closed-circuit demonstration of the new underwater TV camera that makes all this possible was recently held in Hillsborough, Calif. (see photo below). The camera, designed by the engineering staff of HEC Corp., Redwood City, Calif., is housed in a watertight stainless steel cylinder. The lens looks out through a small window in one end of the cylinder. In addition to immediate viewing on the TV screen, the televised information can be recorded on tape and played back at a future date—underwater photography without film!

Skin Thermometer

A new skin thermometer (above), working on the principle of a temperature perceiving magnet in a constant magnetic field, is now being used for clinical diagnoses in Austria. The magnetic indicator, mounted on a thin silver plate, becomes more magnetic when subjected to rising temperatures. Placed on the skin, the thermometer immediately assumes its temperature, enabling quick, accurate readings.
Building the Big Ear

You can pick up voices a block away or even a jet in the next county—

THE FELLOW across the street was raking leaves. In my earphones the rake sounded like a road-scraping race in an echo chamber.

"Whisper something," I yelled at him, first turning down the gain on my black box for a second.

"You're nuts," he whispered, continuing his raking.

Then he looked up. "What kind of gadget you got there?" he blasted, putting down the rake. "What time did the saucer land?"

I'll admit I might have looked extra-terrestrial, standing there wearing a pair of earphones, holding a little black box, and aiming a blown-up take-off of a Gramophone horn. So I had to tell him about my "sound detector."

The first thing, I warned him, is that you don't yell at this device— you talk low. Dogs a quarter-mile away sound like they're in your own yard; voices that are just a murmur shape up into conversation; and the birds sound as if they're singing right in your ear. When you listen with the detector, sounds are picked up which otherwise would have flown right by, and you can recognize speech that was just noise before. In fact, a little listening gives you the feeling of bathing in a sea of sound.

"But what's it good for?" asked the man with the rake, a solid practical character by nature.

By ELBERT ROBBERSON

"Well, if you wanted to," I told him, "you could pick up a jet in the next county, or hear someone talking to you from a block away. Combine it with a megaphone, and you could talk with a person at a distance—like a swimmer, or somebody out in a canoe."

The leaf-raker began to get ideas. "You could listen for signals," he added, "or make sure the kids are okay. Is there much to building one?"

"Not much," I told him. "I put this one together in an afternoon, making it out of leftovers."

The parts of a sound detector are few— just a microphone, an amplifier (in a separate case), and a headset for listening.

To house the amplifier, use a 4"x5"x6" steel utility box. This may have a built-on chassis, or one can be added. Construction of the panel and chassis is shown in the photographs. Be sure that your cabinet is steel, not aluminum; steel provides shielding, which is always desirable in a high-gain amplifier.

The first step in wiring the unit is to install the "power," or d.c. wiring. Putting this wiring in first makes the subsequent insertion of components easier.

Then make up the battery cables and plugs, allowing about 10" scope on the wires. Note that one of the B battery plugs carries the resistor, R3, between the negative
Diagrams and parts list for sound detector.

B1—1½-volt battery (Burgess 2F or equivalent)
B2—90-volt battery; two 45-volt units in series (Burgess XX20P1 or equivalent)
C1, C2—0.01-μfd., 400-volt tubular capacitor
C2—0.002-μfd., 400-volt tubular capacitor
C4, C5—8-μfd., 150-volt electrolytic capacitor
J1—Phono jack
J2—Headphone jack
PCI—Printed circuit (Centralab PC92)
PC2—Printed circuit (Erie 1407-01)
R1—1-megohm, ½-watt potentiometer
R2—6800-ohm, ½-watt resistor
R3—470-ohm, ½-watt resistor
R4—4700-ohm, ½-watt resistor
S1—D.p.s.t. switch, on R1
V1, V2—1S5 tube
V3—15S tube
V4—154 tube
1—5" x 9" x 4" utility case and chassis (Premier CA-1404 or equivalent)
3—Seven-pin miniature sockets
1—Two-terminal tie point
1—Crystal microphone replacement cartridge (Shure R7 or equivalent)
1—High-impedance headset

Terminal and the “dead” center terminal which is employed as a tie point. Voltage drop across this resistor is used for bias on the output amplifier tube.

The diagrams show two different makes of printed circuit, Centralab and Erie. In the model equipment, these were used to test the interchangeability of parts. If desired, the same combination of coupling circuits may be employed, but the unit will work as well (and buying parts will be simpler) if you stick to one or the other (or any equivalent) line of products. Just be careful to check the schematic of the coupling unit to make sure the wires are connected properly. For example, note the difference between the numbering of the two printed circuits illustrated. With these two
The chassis should be about 5" wide by 2" deep so that there will be room behind it in the cabinet for the batteries when the unit is assembled. Before cutting any holes, make sure that the potentiometer and phone jack will clear the vacuum tubes.

units, the order in which the wires are arranged from left to right is the same, circuitwise, although the numbers are different.

When the wiring is completed and checked, the tubes and batteries connected, and the headset plugged in J2, a rushing noise should be heard as R1 is turned to maximum clockwise. Now plug in the microphone, and you should be able to hear yourself breathe.

Until you are acquainted with the unit, speak softly! You may note that any tendency of the potentiometer R1 toward noise production will be amplified. Scratchy sounds produced when you operate this control do not necessarily indicate a defective potentiometer but rather are due to the high amplification.

Although the sound pickup with a "bare" microphone is very high, both loudness and intelligibility are greatly increased through the use of some means to concentrate available sound on the microphone.

An electric-heater bowl employed as a reflector will increase the response to sounds above a certain frequency, which depends upon the bowl diameter. "Highs" are greatly accented, and some directivity is obtained, which allows concentration on sound from the desired direction.

To use a heater as a reflector, remove the grill and screw out the heater element. The element has a left-hand thread, so turn it the opposite way that you would a light bulb to get it out. Remove the socket from the bowl, and cover the opening with a piece of cardboard or aluminum foil. Then move the microphone in toward the center of the bowl to find the point of maximum pickup. The diaphragm of the microphone should face the reflector.

The usual heater bowl falls off in sensitivity on sounds of less than 1000-cycle frequency, and has the most effect on higher pitched sounds. For instance, bird calls, children's voices, or other sounds rich in high frequencies are quite improved with such a reflector.

Best over-all response is obtained with an exponential horn. This device will gather in quite a volume of sound and cram it into the microphone, and will provide the best reproduction of low frequencies. The

May, 1957
An exponential horn, simply made with corrugated cardboard according to the layout at right, will give the best reproduction of low frequencies.

Stand the sides of the horn on the floor and tape the corners together, as shown below. Then draw the edges together, tacking with tape as you go.

When the horn is fully shaped, tape the microphone into place at end (see bottom photo) and wrap securely, covering all cracks with tape.

The exponential horn illustrated is very simply constructed out of packing-box corrugated cardboard. Four 30" squares are required. First lay out each of the four sides and cut them to shape with a sharp knife. Stand the sides on the floor and tape the corners together with masking tape. Then draw in the edges of the cardboard to meet, and spot-fasten with masking tape. When the sides are fully drawn in and secured, the horn will have the required exponential shape. Strips of tape can be run along the inside of the corner joints, and the outside fastenings augmented to make the horn rigid and secure.

Shape the neck of the horn so it butts against the face of the microphone. Then tape the microphone in place, covering all cracks and building up over the assembly with tape until a fairly rugged mounting is obtained. Inside the horn, apply tape where necessary to make the path into the microphone diaphragm smooth and unbroken.

To aim the horn, prop it up to point as desired, or secure a metal strip to the bottom at the center of balance.

With this horn, the most important improvement over a bare microphone—in addition to increased directivity and sensitivity—will be an important increase in sound intelligibility. For example, a plain microphone could pick up and greatly amplify the sound of distant voices, but the result might be just a babel. The horn will give the quality of "presence," and turn jumbled sounds into recognizable words.
THIS POWER SUPPLY can be used to increase a motor's speed and prevent excessive heating. Very simple to construct, it is designed primarily for small high-speed motors used on a.c. or d.c., such as the carving motor shown at the top of this page.

Both the selenium rectifier (SR1) and the capacitor (C1) can be obtained from your local dealer in electronic parts. Construct the base and uprights from ½” wood stock, and drill a ¼” hole in each of the upright pieces to pass the electric cord and wiring. The socket (SO1), capacitor and rectifier are then mounted and wired as shown in the diagrams.

Cut a protective shield from hardware cloth or wire screen (see photo above); then bend and fasten it with wood screws and washers. As an added safety measure, tape the exposed socket connections.

The d.c. supply must be used with motors drawing less than 0.5 ampere; those drawing more current will burn out the rectifier. It can only be employed with motors using d.c. or a.c./d.c.; motors using just a.c. will not work on the d.c. output of the rectifier.

May, 1957
PRACTICALLY everyone knows the "why" of crossover networks in quality sound reproduction. A speaker cone that will sashay in and out along the distance necessary to pump a fat, low sound into the room just can't move fast enough for the highs; and the perky jobs that will trill out the highs just can't move far enough and push enough air to manufacture large low notes. And, even in "wide-range" speakers, there is danger of the high notes being squeezed out of shape by the cone's low-note excursions. Hence, it is desirable to have more than one speaker.

If you connect bass and treble speakers to your amplifier, each unit will try to do part of the other's job, resulting in loss and all-around confusion. The use of two speakers calls for a crossover network, which is simply an automatic tone-sifter to switch the various tones to the speaker that can handle them.

Unfortunately, the "how" is not so clear, since most designs require coils of special values which the hi-fi fan must wind himself. However, there is a way to build a crossover unit without any meticulous measuring or winding.

Figure 1 shows how the crossover works; Fig. 2 shows the circuit. At the crossover frequency, both speakers are fed equally. Below this point, the woofer receives more power and the tweeter less, and vice versa, at the rate of 6 decibels per octave.

The two speakers should have the same impedance rating. If the rated impedance of the two speakers does not happen to match, consider the combination to have an impedance half-way between the two values.

To build your network, first decide on the crossover frequency. This will depend upon the frequency range of each of the speakers, and how much of the load you want each to carry. The point chosen should be in a frequency region which both speakers are able to reproduce, although it may be close to their response limit.

In Table 1, follow the proper speaker impedance column down to its intersection with the horizontal line corresponding to the desired crossover frequency. The figure at the intersection is the value of capacitance required for the crossover network. This may be made up by connecting different-value capacitors in parallel to give the desired sum. These capacitors may be low-voltage units. (Surplus bins are an excellent source of capacitors for this use.) Paper capacitors are preferred because they retain their rated value indefinitely.
while electrolytic capacitors tend to drop off or leak with age.

However, if it is necessary to use electrolytics, they will be perfectly satisfactory, as long as periodic tests are made to insuire that they have not gone bad. With electrolytics, it is necessary to connect two sections, back-to-back (positive-to-positive or negative-to-negative). Otherwise, they would pass current in one direction. Because of the series connection, the capacitance of each section used must be twice the total value desired.

Stock rolls of plastic-insulated #18 bell wire, available in hardware stores, can be used for the coil. These rolls commonly come packaged in 1-lb. and \( \frac{1}{4} \)-lb. rolls, constituting a ready-made air-core coil with tolerably low loss. The characteristics of several such packages have been measured, and found to be quite suitable for our purpose. The coils illustrated in this article had the following dimensions: 1-lb. roll—5" diameter, 1\( \frac{1}{2} \)" hole, 1" thickness; and \( \frac{1}{4} \)-lb. roll—3" diameter, 1\( \frac{1}{2} \)" hole, 1" thickness. Try to get wire made up in packages as close to these dimensions as possible.

Now go into Table II, following the same speaker impedance column down to the line marked by the previously chosen crossover frequency. At the intersection, the amount of wire required in the coil is

![Diagram](image-url)
which you listening to cause, and treble speaker by s/s winding the 1-lb. coil, Judge Then connect accommodating Fig. 2. Circuit for a two-way crossover network feeding separate woofer and tweeter.

![Diagram](image-url)

Fig. 2. Circuit for a two-way crossover network feeding separate woofer and tweeter.

shown in pounds. For example, a 1 1/4-lb. coil is required for a 4-ohm speaker to cross over at 500 cycles. This coil should consist of one 1-lb. coil, and a 1/4-lb. coil stacked on top, the two then being connected in series.

Stack the coils so that the direction of winding is the same for both coils, and make the series connection by joining the inside end of one coil with the outside end of the other. Connect the rest of the circuit to the remaining two free wires.

To obtain any of the odd values of weight which may be needed, stack 1-lb. and 1/4-lb. coils to arrive at the nearest quarter-pound in excess of the desired weight. Values of 1/4 lb. can then be obtained closely enough by simply removing half of a 1/4-lb. coil.

Then connect the capacitor and the coil in series across the amplifier output. The treble speaker is connected across the coil, and the bass across the capacitor. The amplifier output impedance tap should be set to the rated value for a single speaker because, in the series-parallel connection, this is the load the amplifier "sees."

**Judge the operation of the network by listening to any full-range music with which you are familiar.** If the woofer seems to be loafing, peel a little more off the coil. On the other hand, response can be pushed the other way by adding several turns. Not much change will be evident after small alterations—it takes at least 1/4 lb. for the difference to show up to any noticeable degree.

Suppose you want to use three speakers, which ordinarily calls for a three-way network. You can get out of the woods very simply by using a network such as has just been described, with the crossover at the frequency desired to separate bass and mid-range speakers. Then, connect another similar network in place of the mid-range speaker across the first network coil. The

![Diagram](image-url)

Fig. 3. Circuit for a three-way crossover network accommodating additional mid-range speaker.

second network should have the crossover frequency to separate the mid-range from the treble. The exact value in each case depends upon the speakers used. Connections are shown in Fig. 3.

Since the attenuation attained with these networks is smooth and gradual, a few cycles one way or the other make little difference—so don't bother splitting hairs. The main thing is to get the desired proportion of highs and lows into the appropriate speakers without humps or hollows. Your "hardware store" crossover network will do the job as well as many costing a great deal more money.
Eight-channel control a reality!
All-transistor receivers and a transistorized power pack, too!

"IF YOU CAN'T do three consecutive outside loops, you don't stand a chance in multi-control events," say the R/C model fliers. Inverted flight, true spins, snap rolls, and exotic stuff like "Cuban Eights" aren't too tough with standard radio equipment now on the market, but the outside loops separate the men from the boys. To old-timers, it must sound like the ultimate lie that one need know nothing about electronics to do these things. But the amazing truth is that the super multiple-channel R/C gear now used for these maneuvers is not complex and is easy to operate and maintain.

The R/C breakthrough came in 1956, brought about by the competitive interest of firms whose main line of business was electronics for the military, from target drones to guided missiles. Transistors made it possible, with a big assist from printed circuitry and lightweight components and relays.

Eight-Channel R/C. As this goes to press, at least two firms make eight-channel equipment, costing in the neighborhood of $200 for transmitter and receiver. Planes are being flown with radio-controlled ailerons, wheel brakes, wing flaps, full-scale type trimmable tails, and so on. CG Electronics, who took the lead in 1956 when its five-channel models won the Nationals, now has an eight-channel job almost ready for production. Orbit and Bramco have "eights" on the market.

The Bramco "Regent," for example, weighs only seven ounces (less than 10 with batteries) and measures only 3 1/2" x 2 1/2", including eight relays! It idles at 1/2 ma. and has a filament drain of only 10 ma. The single tube is a 1AG4 subminiature type with transistor amplification. This set operates on one subminiature penlite cell battery, and a 45-volt Mallory B battery that weighs 2 3/4 ounces. As on all "eights," several channels may be used simultaneously—so the problem is figuring out how to use all those controls. With
simultaneous control, the flier can operate the rudder while holding down the elevator, or controlling the ailerons.

Basically similar is the Orbit eight-channel receiver. This job weighs 9 ounces, has a filament drain of $\frac{33}{4}$ ma., operates on one penlite cell and one 30-volt hearing-aid battery. The Orbit transmitter stresses stability—all modern tone transmitters must be stable to avoid drifting of tone which could cause one or more receiver reeds to be inoperative. With this transmitter, there is no scrambling for the screwdriver when battery voltage drops and tones start drifting—while the plane flies merrily on. Current drain of the handheld Orbit transmitter is only 16 ma.

**Equipment for 465 Mc.** The sensation of the 1956 Trade Show was the single- and two-channel Babcock equipment on 465 mc. Revolutionary aspects of these radios compel their inclusion in any roundup of top achievements of the past year.

The Babcock 465-mc. receivers are fully transistorized. There are no tubes, not even a detector. One transmitter model serves both receivers—emitting one or two tones, depending on the receiver. Both tones can be sent simultaneously so that the flier can hold elevator and rudder at the same time. There is no reed bank; tones are filtered electronically to operate the proper relay. These relays are hermetically sealed.

The signal is picked up by two antennas, one a "J" antenna and the other a folded dipole, connected in series. The antenna base contains a crystal diode and capacitors which filter out the r.f. and pass on only the tone, or tones, to the receiver. Four stages of transistorized amplification are used, with an additional one or two transistors to operate the relay or relays.

Since these receivers have no tubes, no filament batteries are needed. Operators on the 465-mc. band know the handicap of high filament drain with the tubes required for that frequency, so the elimination of filament batteries is a milestone in the R/C hobby. Range is guaranteed at 600 feet on the ground, probably the equivalent of 1800 feet in the air. Actually, this is a conservative estimate for the range is adequate for all normal flying.

**Transistorized Power Supply.** A tiny but mighty gimmick developed in 1956 is the transistorized power supply for receivers. That’s right—for receivers. This power pack corresponds in function to the vibrator power supply used for transmitters, or to the vibrator power supply in the car radio.

The author has seen this amazing power supply, developed by the B and S Products Company, used with CG five-channel receivers. One penlite cell was the only source of current. The CG people have even been able to eliminate all radio batteries by using this power pack; the supply is taken from the actuator batteries which, of course, have to be carried anyway.

As this is written, other major suppliers are in the process of transistorizing their equipment. Names like Schmidt and Badeco are still to be heard from. Meanwhile, the cry is for nine and ten channels. Coast modeler Bob Bowen remarked: “Pretty soon we will be flying a couple of transistors, a tube, and an airplane built around an electric organ. Is there no end?”
Challenge and test the "brain power" of people you know—family, friends and party groups—with this neat little push-button box. It takes less than one evening to complete and will provide many hours of interest and amusement.

**CAN YOU DO BETTER?**

It seems as though someone is always contriving to place a measure on our powers of reasoning. Most of us have been exposed to the pencil and paper variety of IQ tests, quizzes, etc. But here's a new way to challenge the IQ, electronically. You can build your own surprisingly accurate intelligence tester in just a few hours from a transformer, buzzer and nine push-button switches.

As shown in the photographs and drawing, the secondary of the bell-ringing transformer is connected in series with the buzzer and the nine push buttons. These push buttons have s.p.d.t. contacts, and are so connected that the buzzer will sound when three preselected buttons are pushed at the same time.

The person being tested must discover which three buttons to push. Since intelligence involves the ability to discover relationships, the length of time required to find the right combination of push buttons is an indication of the intelligence of the person being tested.

**What's the Score?** A "gifted" person will realize immediately that a certain number of possible combinations exist, and will proceed to try them in orderly sequence. A less gifted person will try a few combinations at random, will probably not realize the large number of possible combinations, and may forget and try the same combinations more than once. As a result, he will require much more time to locate the right buttons.

Standards for grading the test, according to the length of time required to ring the
buzzer, might range from less than one minute (Genius) to over four minutes (Dull).

With nine push buttons to choose from, there are 84 possible three-button combinations, and the mathematical probability for hitting the magic three by pure chance is almost nil. Push buttons with s.p.d.t. contacts are used so that the machine cannot be "fooled" by someone pushing more than three buttons at once.

**Set the Combination.** The model is constructed in a 4½" x 6" x 8" metal cabinet. When wiring the push buttons, connection should be made to the normally closed contacts of all switches except the three that will be used to ring the buzzer.

**Mounted Variable Resistors for Experimenters**

Potentiometers and volume controls in experimental "breadboard" setups present a mounting problem. However, it's a pleasure to experiment when your potentiometers are mounted as shown here (top and underside views respectively). You can make quick solderless connections to the terminal lugs; and you can calibrate the home-made dial plates to suit yourself and your needs.

The construction is very simple. Jigsaw a 2¾"-diameter disc from ¾" composition board and glue it onto a ¾" section of 2¾"-O.D. cardboard tube; then cut a 2¾" disc from white drawing paper and glue it on top of the disc. Drill a hole through the center of the mount for the potentiometer. To mount the three medium-sized Fahnstock clips, drill three ½" holes through the top of the mount, directly in line with the ends of the lugs on the variable resistor, and mount the clips using 6-32 round-head brass screws. The ends of the resistor lugs are soldered directly to the ends of the screws to eliminate wiring.

—*Carl Dunant*
Double the value of your oscilloscope with this simple, easy-to-build unit

“ECONOMY”

By RICHARD GRAHAM

WE CAN ALL AGREE that the oscilloscope tells more about the operation of a piece of equipment than any other test instrument. But what do you do when you need more than just a picture? Suppose you want to know the actual peak voltage of the waveform under observation? The “Economy” oscilloscope calibrator can give you this information in a fraction of time, conveniently and accurately.

Price-wise, the construction cost of the calibrator shouldn't exceed $4.50 for the unit complete as shown. If you've invested in an oscilloscope, which probably cost upward of 10 times this amount, you're cheating yourself out of a large part of the utility and versatility inherent in the oscilloscope if you don't build the calibrator. Looking at it this way, you almost can't afford not to build it.

Basically, the calibrator is a device that will put out a standard a.c. voltage. This a.c. reference voltage is unaffected by variations in the 117-volt a.c. line voltage. Switching is provided in the calibrator to select either the waveform under observation or the standard voltage signal from the calibrator. Further provision is made so that any of three standard a.c. voltages can be obtained.

Construction. The oscilloscope calibrator is housed in a 5" x 4" x 3" aluminum utility box. Since nothing is critical in the layout or construction of the unit, any other size and shape box may be used. Preferably, the housing should be made of metal to act as shielding.

The heart of the calibrator is the one-watt neon lamp (NE1), the odd-shaped glass object you can see in the rear view photo. This is a standard one-watt type NE-30 neon lamp, which can be obtained at most electrical distributors, from which the screw base and internal resistor has

May, 1957

55
Follow the pictorial and schematic diagrams in putting the oscilloscope calibrator together. The parts list and a description of how the unit operates are given below.

**HOW IT WORKS**

The calibrator is an a.c. voltage regulator capable of supplying a constant, known voltage to the oscilloscope. The regulator utilizes a one-watt neon lamp (NEI) that will conduct whenever the voltage across the lamp exceeds its firing voltage, which is on the order of 60 volts. When the lamp "breaks down," it will start to conduct, but the voltage across the neon will remain constant. Thus, as the 60-cycle voltage waveform exceeds the firing voltage, the lamp begins to conduct, effectively clipping the voltage waveform to a maximum of 60 volts. It does this for both halves of the 60-cycle waveform, since the lamp will conduct equally well in either direction. The drawing above shows the regulating action.

To make the calibrator more versatile, a voltage divider is connected across the lamp. Potentiometer R2 is used to adjust the voltage across resistors R3 through R7 to exactly 50 volts peak-to-peak. The divider drops this to 10 and 0.5 volts peak-to-peak. These three standard voltages are usually adequate. Switch S2 selects the standard voltage to be fed to the oscilloscope, and switch S1 is used to feed either the calibrator output or the signal to be observed and measured to the oscilloscope input. Capacitors C1 and C2 isolate the oscilloscope input from the power line.
been removed and which has been mounted with the lead end up. Care must be used in removing the base from the lamp; since the brass screw base is very thin, however, only a pair of cutters is required.

If your radio parts distributor is well stocked, try and get a type NE-32 neon lamp. It has the same characteristics as the NE-30 except that the base is a double-contact bayonet base and does not include an internal resistor.

Mount the lamp in an electrolytic capacitor mounting clamp. To reduce the possibility of breaking the glass, first wrap the bulb with a few turns of tape. The clamp can then be tightened, remembering that it's a piece of glass we're clamping, not a piece of steel.

After the calibrator is completed and the wiring checked out, hook up the scope terminals on the calibrator to the vertical input terminals of your oscilloscope. Turn everything on, and place the calibrator switch in the cal position of switch S1. The oscilloscope can be adjusted until a waveform similar to that shown in the photo above (the top one) is seen. This indicates that the calibrator is working properly. Now all that is needed is to perform the calibration of the calibrator.

**Calibration.** The setup is shown in the drawing on page 114. A reasonably accurate a.c. voltmeter is required. Since the full a.c. line voltage will be across the potentiometer, some caution should be exercised. A small 10-amp. fuse is in series with the incoming line to prevent any serious short circuits.

Adjust the potentiometer until a reading of 17.7 volts is obtained on the a.c. voltmeter. This voltage reading corresponds to a peak-to-peak voltage of 50 volts used to calibrate the oscilloscope. Place switch S1 in the scope position. Adjust the oscilloscope vertical gain for a specific number of boxes on the face of the oscilloscope. Let's use ten boxes for our example.

Once this is done, do not touch the vertical gain setting for the remainder of the calibration procedure. Now place switch S1 in the cal position and the volts peak-to-peak switch in the 50-volt position. Adjust potentiometer R2 in the calibrator to produce the same ten boxes of deflection.

To check the accuracy of the voltage divider, set switch S2 to 50 volts peak-to-peak. Adjust the oscilloscope vertical gain to produce a deflection of ten boxes. Then set switch S2 to the 10-volt peak position. The deflection on the screen should now equal two boxes.

Similarly, to check the 0.5-volt peak-to-peak position, first set the switch S2 to the 10-volt peak-to-peak calibrating position and then adjust the os-

(Continued on page 114)
Crystal Diode Mount

This diagram mount for crystal diodes (above) allows all radio experimenters to make quick and correct connections to the diodes. The symbols ink-drawn on the mount show exactly how to connect to the diodes, and Fahnestock clips do away with continual bending and soldering of the leads.

The wood base in the photo measures about $3\frac{1}{2}" \times 1\frac{1}{2}" \times \frac{3}{8}"$. A piece of drawing paper is glued to top of base and four Size 15 (or larger) Fahnestock clips are mounted, in the positions shown, using $\frac{3}{8}"$ round-head wood screws. Solder the leads of the diodes to the clips (being careful not to overheat the diode leads), and bend the leads as shown.

—Art Trauffer

Make Tandem Transistors

To simplify assembly and wiring in direct-coupled transistor amplifiers, pairs of your favorite transistors can be taped and wired together. Thus, you can make your own tandem transistors using the units of your choice. Just tape two p-n-p transistors together, using $\frac{3}{8}"$ cellophane tape. Then bend back the emitter lead of one unit and the base lead of the second unit and solder the two ends together. For circuits and data on typical direct-coupled transistor amplifiers, see page 87 in the September, 1956, issue of Popular Electronics.

—Carl Dunant

2500-Cycle Multivibrator

This multivibrator consists of two transistors driven by a single penlite cell (1.5 or 3 volts). Although 2N43 units are shown, almost any other p-n-p transistor may be substituted. If the component values specified are used, the audio square wave should be 2500 cycles. Coupling capacitors C1 and C3 control the audio frequency if another is desired. The current drain is about 0.6 ma, and a penlite cell will last about 250 hours in continuous operation.

An important feature of this multivibrator is the peak-to-peak output voltage. It will equal 1.5 volts when the circuit is used with a 1.5-volt battery and 3.0 volts when the circuit is used with a 3.0-volt battery. This makes it very handy for calibrating or testing hi-fi equipment, oscilloscopes, voltmeters, etc.

—William A. Scism

A "Talking" Mike

Have you ever wondered how some of those stage magicians can second-guess questions from the audience? Well, one method is to use a crystal microphone as a part of their p.a. system. As you experimenters know, there are also crystal head-phones which are really nothing more than crystal microphones to start with.

The stage performer has his technicians arrange a switching circuit so that the mike can be put temporarily into the output of another low-power amplifier system from his "audience spotter." The latter speaks into his own mike when the stage microphone has been switched over to be an earphone, and in that way the stage performer knows what's going on.

The earphone can be heard within a range of two or three feet—not far enough for the audience to catch it, but plainly audible to the performer.

—Clyde D. Adams
STOP-AND-START driving is a well-known nuisance to motorists, and stop-and-start playing is equally annoying to radio users. "Intermittent operation" is a rather fancy phrase to describe such performance, but often the trouble-shooting procedures needed to locate the defective intermittent are pretty fancy themselves. The cure, however, is usually fairly simple, like replacing a tube or wiping a ground connection clean.

Locating intermittents buried deep inside a crowded chassis may well be a job for an experienced—and patient—technician or advanced hobbyist. However, many intermittents are caused by defects above and/or outside the chassis. So, if your gear recurrently drops in volume, or emits noises, try these remedies before really rolling up your sleeves or calling the repair shop.

**Line Cords and Grounds.** Start with the a.c. line cord and other cables such as the turntable leads and speaker wires. Are the conductors loose on the plug terminals or broken inside the cable insulation? In the case of radios and tuners, the antenna or ground chassis connections may be loose or corroded. Cracked antenna insulators, poor lead-in soldered joints and defective connection to the ground water pipe are common troubles (see drawing on p. 60). The lightning arrester can cause intermittent operation by internal leakage between its terminals. A good arrester should show a resistance of at least one megohm, when measured with the antenna lead-in disconnected so that possible antenna shorts to ground will not affect the ohmmeter reading.

Sometimes turning on a light or an ap-
pliance restores radio operation, in which case the trouble is likely to be in the antenna or ground circuits. The antenna may be shorting to ground through a dirt path between their respective chassis terminals. A perfectly good external ground to a water pipe may also contribute to this mysterious effect, due to the adventures that can befall the pipe. For example, building vibration may jar BX electrical cable in the walls or floor against the pipe, or the pipe may be serving as a ground for an appliance—or even a neighbor's radio. Try removing the ground altogether, or if a ground is necessary, run it to another pipe or to a long rod driven into the earth.

**Chassis Components.** The tuning capacitor of the radio or tuner sometimes causes intermittent crackling noises in the speaker. This is generally due to the accumulation of dust between the capacitor plates. To eliminate the noise, clean out the entire space between both sets of plates with a pipe cleaner. If the connection to the rotating plates is made by a wiper spring, make sure the wiper is clean and is bearing firmly against the shaft.

Tubes are a very common cause of intermittents. Checking them in a tube tester or tapping the tubes while they are in the set won't always show up the culprit, although checking them in the tester while they are still hot (wear a glove!) may show a "thermal" short or open. Look for glass tubes that are not lit, corroded tube pins, dirt between tube pins and between socket holes, dirty grid caps and loose cap connections, and partially seated tubes.

In a.c.-d.c. battery sets, a frequent cause of intermittent operation is low voltage due to weak batteries, or reduced line voltage resulting from heavy power demands when an air-conditioner or other large appliance is running or when the house lighting load is at a maximum. Low voltage causes the 1.4-volt oscillator tube to become unstable or inoperative. This tube type is very critical, especially as regards filament voltage.

Other causes of erratic operation or intermittent noise include defective speaker leads and connections; and loose tube shields, electrolytic capacitor cans, and transformers making poor contact with the chassis. Occasionally, a picture frame or a table ornament will vibrate audibly with a particular note from the speaker! – 30 –

**High-Speed Printer Teams Up with Digital Computer**

High-speed printer, shown at left, spells out results fast when it is hooked up to the output of a digital computer. Developed by Remington Rand, this device is capable of printing 600 lines and up to 78,000 characters per minute. What's more, it retains a record of the data fed to it by the computer. Typical uses of such a system would be furnishing quick weather forecasts, spotting market trends, providing inventories of supplies, estimating the financial status of a business, reckoning positions of stars, and furnishing stress analysis of moving parts.

POPULAR ELECTRONICS
HI-FI LISTENING usually runs strongly toward symphonic music. This doesn't mean that hi-fi fans are born music lovers. The reason is simply that a symphony orchestra is the richest source of varied sound—and sound is the substance of audio. But beyond its mere sound, music has meaning. Of all types of music, the symphony has perhaps the greatest range of emotional expression and therefore offers the widest field of exploration by listening. For your symphonic safari, the following handful of records would form a kind of road map of the tonal territory as it spreads over the past 200 years.

The Starting Spark. Symphonic music as we know it today started about the time of the American Revolution. It was then that composers like Haydn and Mozart settled the ground rules for symphonic composition: four separate movements, each different in tempo, together forming a balanced whole. The orchestras of the time were small—no heavy brass and not much percussion... mostly strings and woodwinds. But their smallness gave them agility which bigger groups could not match. It's something like an MG besting a Cadillac on sharp turns.

That's just what Mozart's music is like: pointed angles, darting lines, with an occasional detour into a slow stretch. Sample Mozart's Symphonies No. 39 and No. 41 as played by the New York Philharmonic under Bruno Walter on Columbia ML 5014. The strength and sparkle of their playing is matched by Columbia's sharp but full sound.

More edgy in tone and concept, but beautifully clear and precise, is Antal Dorati's Mercury recording (MG 50121) of Mozart's Linz Symphony with the charming Eine Kleine Nachtmusik (A Little Night Music) on the other side.

Titan in Tone. Extending the automotive parallel, Beethoven could be likened to a ten-ton truck making way among a flock of flivvers. For one thing, his orchestra sounds bigger and is bigger. Horns, trombones and kettledrums are scored with telling force. More important: Beethoven's musical ideas are "bigger," too. Gone are the finely pointed darts of Mozart; Beeth-

(Continued on page 116)

<table>
<thead>
<tr>
<th>RECORD</th>
<th>PERFORMERS</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Espana</td>
<td>Hollywood Bowl Symphony Orchestra Felix Slatkin, conductor</td>
<td>Spain inspired many composers to capture the passion and rhythmic fire of its mood and manner. This disc offers Ravel's famed Bolero and Alborada del Gracioso, Rimsky-Korsakov's Capriccio Espanol and excerpts from Albeniz' Iberia. These varied evocations of Spain are given a supercharged performance and a recording that suggests the clarity and brilliance of the Spanish moonday sun.</td>
</tr>
<tr>
<td>De Falla: Nites in the Gardens of Spain Epic LC 3305</td>
<td>L'Orchestre Lamoureux Jean Martinon, conductor Corinne Vozza, alto E. Del Pueyo, piano</td>
<td>More Spanish moods. De Falla weaves rich instrumental and vocal fabrics from folk rhythms and melodies. El Amor Brujo tells in exotic harmonies of a girl fearing the ghost of her dead lover until a new live one conquers the evil spirit. The &quot;Nights in the Gardens of Spain&quot; are apparently languorous and torpid, stirring with the undertone of excitement.</td>
</tr>
<tr>
<td>Les Baxter: Skins Capitol T-774</td>
<td>Les Baxter special percussion group</td>
<td>The art of music has always followed the medium through which it is expressed. Now that hi-fi is the main outlet for current musical invention, jazzman Baxter has devised an entertaining and ingenious arrangement of original compositions for a variety of drums to show off the musical and hi-fi possibilities of percussive sound. Fascinating—and technically superb.</td>
</tr>
<tr>
<td>Milhaud: Suite Provencale, Saudades do Brasil Capitol P-8358</td>
<td>Concert Arts Orchestra Milhaud, conductor</td>
<td>Engaging pieces by one of the foremost modern composers. Suite Provencale depicts the atmosphere of the composer's native southern France through arrangements of its old tunes. Saudades do Brasil does the same for South America, where Milhaud spent part of his life. In their sparkling orchestral guise, these simple folk tunes from two continents make highly rewarding hi-fi material, especially in Capitol's ultra-clean recording.</td>
</tr>
</tbody>
</table>

May, 1957
Sequential Neon Flasher Is Electronic Eye-Catcher

Attractive and inexpensive displays can be made from neon bulbs when they are connected as shown in the diagram at the right. The bulbs will go on and off in sequence.

As the first bulb fires, it charges the adjoining 0.47-µfd. capacitor to a level of about 60 volts. When the charging voltage to the second bulb is high enough to cause it to fire, it drops the voltage on the preceding bulb, thus turning it off. This procedure is repeated in sequence.

The cycling rate is determined by the values of the resistors, capacitors and battery voltage. Larger resistors and capacitors slow the rate. You'll find that power consumption for a four-bulb flasher (such as the one shown) is but a fraction of a milliampere.

—William A. Seism

Novel Microphone Utilizes Metal Faucet Connector

An inexpensive metal faucet connector for bath sprays provides the shield and housing for a handy, close-talking crystal microphone. The size and shape of this metal faucet connector is just right for the job, and you can buy it—or order it—from your hardware dealer or plumbing and heating dealer. Ask for a "Dumaco #A-4088 Bath Spray Bulb" (Durst Manufacturing Company, 409 Lafayette St., New York 3, N. Y.).

Force-fit an Amphenol 75-PC1M chassis unit into the small end (hose end) of the faucet connector. To do this, enlarge the opening slightly and twist the Amphenol chassis unit in as far as it will go. Then lay a block of wood on the chassis unit and drive the unit in further.

Now remove the cover on the large end of the faucet connector. Pull out the rubber interior using a pair of pliers and a small screwdriver.

For the mike unit, the writer used a Primo R-200 crystal earphone (Lafayette Radio #MS-111, or Radio Shack Corp., Boston, #R-9021). These sensitive and economical crystal earphones make quite good microphones, but any other crystal or high-impedance magnetic earphone or mike unit can be used instead, provided that it fits into the housing.

Screw off the ear-insert of the crystal earphone and tape the mike unit to the rubber piece that you pulled out of the faucet connector. Be sure that the opening in the rubber piece fits around the opening in the mike unit. Clip off the mike unit leads to a length of about 3", and solder one lead directly to the interior of the metal housing near the chassis unit. Then solder the other lead into the center contact of the chassis unit.

Cut a 1½"-diameter disc from very-fine-mesh brass strainer screen and lay the screen inside the cover of the faucet connector. Now put the mike together and push the cover on the housing, using a little dab of solder here and there, if necessary, to hold the cover to the housing securely.

—Art Trauffer
Building the "Vokar" Superhet

Special kit makes the construction of this transistor receiver simplicity itself

This HANDY LITTLE SUPERHET will find ready acceptance in every room of the home. Since it uses transistors and is powered by a self-contained battery of only four inexpensive flashlight cells, upkeep is very low—and there is no dangling power cord to confine it to the outlet. While this set was not designed specifically as a portable, it is small enough and light enough to go along with you on a picnic or a trip to the beach, or anywhere within the normal service area of a broadcast station—without an antenna.

No attempt has been made to miniaturize the setup. Instead, easily available parts were used throughout the receiver, and sufficient space was allowed to wire them into place without burning your fingers.

Construction. The entire receiver fits nicely into a midget table model radio cabinet. All components with the exception of the antenna coil, ganged tuning capacitor ($C_{1a}/C_{1b}$), and volume control ($R_{19}$), are mounted on a $3\frac{1}{2}'' \times 6\frac{3}{4}'' \times \frac{3}{8}''$ perforated Bakelite board. A rectangular cutout measuring approximately $2\frac{3}{4}'' \times 1''$ is made in one corner of the board to accept the frame of the speaker.

The dial consists of a series of shallow holes in a $180^\circ$ arc, filled with white paint. This does away with the task of calibration and gives the cabinet front a modernistic appearance.

A simple bracket of rigid aluminum alloy holds the tuning capacitor and the volume control; the particular bracket used by the author was cut from the side of a discarded aluminum box. The antenna coil, $L_1$, is permanently mounted in the plastic case in which it is purchased, and the case

HOW IT WORKS

This six-transistor receiver was designed around the Vokar 5000 i.f. kit, which supplies the tiny but efficient oscillator coil and miniature input, interstage, and output i.f. transformers. These transformers, plus one of Lafayette Radio’s new flat ferrite antenna coils (MS-308), give the receiver adequate sensitivity for local reception without the use of an external antenna. Push-pull class-B CK-722’s ($TR_4$ and $TR_5$) feeding an efficient 4" speaker provide sufficient audio output.

The remainder of the lineup features a 2N136 ($TR_1$) as converter in the circuit specified by the manufacturer, a pair of 2N112’s ($TR_2$ and $TR_3$) as i.f. amplifiers, and a CK-722 ($TR_6$) driver to push the output stage. A germanium crystal diode ($CRI$) occupies the detector position and, at the same time, develops the automatic gain control current which is applied to the first i.f. amplifier.
is then cemented to the inside top surface of the wooden cabinet.

Location of the majority of the parts can be easily seen in the photos. Layout is not especially critical, so no point-by-point wiring instructions are given. The rear portion of the specified ganged tuning capacitor is the oscillator section.

When wiring the receiver, leave as much space as possible under the speaker side of the board, so that there will be sufficient clearance for the four type “C” flashlight cells. These cells are held in place by a Bakelite strip and two vertical brass rods cut from 6-32 threaded stock.

**Aligning I.F. Amplifier.** Anyone familiar with aligning vacuum-tube superhets will find aligning a transistor set a little annoying. Three fundamentals must be kept in mind: (1) you should begin the align-

![Schematic Diagram]

The schematic diagram will show you how to wire the superhet. Parts used are listed above.

64

POPULAR ELECTRONICS
ment at the detector ($T_3$) and work back to the converter ($L_1$); (2) if the two i.f. transistors ($TR_2$ and $TR_3$) are removed from their sockets at any time, be sure to replace each of them in the particular socket it occupied at the time of the alignment (changing transistors, or replacing them with others of the same type, will generally call for a complete realignment); and (3) adjusting the tuning of the output circuit of a transistor will have an effect on the tuning of the input circuit.

Using an r.f. signal generator with a very low output impedance such as the Heathkit LG-1, feed a modulated 455-kc. signal across the output winding (pins 1 and 3) of the last i.f. transformer, $T_3$. The ground side of the signal generator should be clipped to the ground side of the receiver circuit. Feed the "hot" side of the signal generator through a good quality 0.001-$\mu$fd. mica capacitor to the junction of $CR_1$ and pin 3 of $T_3$. Adjust the slug at the top of $T_3$ for maximum loudness of tone in the speaker.

Now, apply the modulated signal to pin 3 of $T_2$. Adjust the slug in $T_3$ for maximum loudness of tone in the speaker. Adjusting $T_2$ will detune $T_3$, so juggle $T_2$ and $T_3$ for maximum loudness.*

Turn the power switch off, insert $TR_2$ in its socket, then turn the power switch on again. Now, apply the modulated 455-kc. signal through the 0.001-$\mu$fd. capacitor to the base of $TR_2$. Adjust $T_1$ and then touch up $T_2$ and $T_3$.

Turn off the power switch and insert $TR_1$ in its socket. Momentarily disconnect $C_2$ from the secondary winding of $L_1$, and short-circuit the plates of $C_{1b}$ to disable the oscillator. Turn the power on, and apply a very weak (5 to 10 $\mu$V.) modulated 455-kc. signal through the 0.001-$\mu$fd. capacitor to the base of $TR_1$. With this signal applied, go over the adjustments of $T_1$, $T_2$ and $T_3$ at least once or twice to make sure all three are in alignment. Then reconnect $C_2$ to the secondary of $L_1$ and remove the short circuit from $C_{1b}$.

**Aligning the Oscillator.** Since the receiver is to be tuned over the broadcast band, the oscillator must tune from 1005

*Check $TR_3$ at this point to make sure it isn't oscillating. To do this, disconnect $R_5$ momentarily from $CR_1$ and connect a VTVM (set at its lowest range) across the volume control. With no signal applied to the base of $TR_3$, the meter reading should be zero, and varying the tuning slug in $T_2$ or $T_3$ should have no effect whatsoever on the reading. In the event that $TR_3$ oscillates, or if the adjustment of $T_2$ and $T_3$ is critical in your setup, neutralize $TR_3$ by using a small capacitor and a resistor in series between pin 6 of $T_3$ and the base of $TR_3$. Vokar recommends a 6-$\mu$fd. capacitor and a 4700-ohm resistor for this purpose. When check is completed, reconnect $R_5$ to $CR_1$, and realign $T_2$ and $T_3$ in the manner previously described.

May, 1957
Loop antenna is mounted in a plastic box attached to top of wooden cabinet on the inside. Batteries are taped together and soldered in series to provide a 6-volt power supply; they are visible in the lower right-hand corner of the cabinet.

to 2055 kc. Turn the power off, and turn the plates of the ganged tuning capacitor (C1a/C1b) to where they are fully meshed. Using a grid-dipper, adjust the slug in the oscillator coil, L2, for a dip at 1000 kc. Change grid-dipper coils, turn the plates of the tuning capacitor fully out, and adjust the trimmer on C1b for a dip at approximately 2055 kc. Go back and readjust the slug in L2 at 1000 kc, with the tuning capacitor plates fully meshed. Then touch up the trimmer on C1b at 2055 kc, with the tuning capacitor plates fully unmeshed.

Final adjustment of the oscillator range should be made with the receiver turned on. To do this, lay a wire from the “hot” output side of a modulated signal generator, at approximately an inch or so from the “hot” side of antenna coil L1. Set the signal generator at 550 kc, and, with the plates of C1 turned full in, adjust the slug in L2 until the signal generator tone is heard in the speaker. Now, turn the plates of the receiver tuning capacitor full out, set the signal generator at 1600 kc, and adjust the trimmer on C1b until the tone is heard in the speaker. Then adjust the trimmer on C1a for maximum loudness of tone at about 1400 kc. Set the signal generator at 1400 kc, turn the receiver tuning knob until the tone is heard in the speaker, and adjust C1a.

You should now be able to pick up the local broadcast stations on your receiver. Tune in a moderately weak one near the center of the band, and go over the adjustment of the slugs in T1, T2 and T3, for maximum loudness of reception from the speaker.

Vokar now has two more kits available using this circuit. Kit No. TC-6 contains not only the i.f. transformers, but tuning capacitor and bypass capacitors as well. Kit No. TC-6T has all of the above plus the transistors needed to make the receiver work.

The Editors

POSSIBLE TROUBLES—and CURES

No Reception. If you have this kind of trouble, turn off the receiver at once. Make sure all transistors are in the proper sockets—it’s easy to forget and insert them in their sockets in the wrong direction. The red dot on the transistor identifies the collector lead. Check all wiring and alignment of the i.f. amplifier. Then check the tuning capacitor to make sure one of the rotor plates is not bent and rubbing against a stator. Make sure the battery is wired in with the proper polarity. If the polarity has been accidentally reversed, you may need a whole new set of transistors.

Motorboating. If low-frequency oscillation or motorboating occurs, check C13 and C15 to make sure that they are wired in with the proper polarity. If they are, check the capacitance of these two units, or replace each in turn with a spare capacitor of the same ratings. Do the same for C7. Also check the condition of the battery. Make sure the two audio transformers, T4 and T5, are wired in the circuit according to the color code.

Squealing. First make the checks given under “Motorboating.” Squealing may have at least two other causes, however: (1) oscillation in the i.f. amplifier; or (2) superregeneration in the oscillator portion of the converter. In the latter case, squealing will probably be noticeable only near the high-frequency end of the broadcast band. The second i.f. stage may require neutralization, or a slightly different value of C5 or R6 may be needed in the first i.f. amplifier stage. However, don’t alter the value of these components until after you are positive that this stage is oscillating.

If squealing develops only near the high end of the broadcast band, it is probably due to excessive feedback in the converter. If you have a second 2N136, try it at TR1. A 2N113 may also be used here if you happen to have one at hand. As a last resort, try various values of capacitance across pins 4 and 6 of the oscillator coil. Alternatively, try various values of capacitance across R3. Either of these two expedients will shift the tuning range of the oscillator.

Distortion. If you obtain distorted reception, check all possible combinations of the three CK-722 transistors in the output stage. Actually, the two output transistors should be as closely matched as possible for minimum distortion. Try increasing or decreasing the value of R15 slightly.

Distortion which is developed in the detector stage may be due to a poor diode, CR1, or to a defective coupling capacitor at C12. Also, make sure that C12 is wired in the circuit with its positive lead connected to the center terminal of the volume control.

66

POPULAR ELECTRONICS
Sea-going computers, color television, and other advanced electronic devices for providing and recording information form "Subsea Control," a futuristic nerve center for the "Fisherman," a boat projected by the Evinrude Motors Div., Outboard Marine Corp., Milwaukee, Wis.

The Subsea Control was conceived and designed by Oliver Read, Publisher of POPULAR ELECTRONICS and RADIO & TV NEWS, and by Norman Eisenberg, Feature Editor of POPULAR ELECTRONICS. The model—in-stalled in the striking circular Evinrude boat—has been seen by thousands at boat shows across the nation.

Subsea Control would present a continuous flow of valuable audio and visual information that could remove much of the guesswork from fishing, navigation, and underwater studies. As shown in the photo (above, right), the operator would have before him radar and sonar indicators, color television screen, compass rose, depth-sounding recorders, glow-type graph indicators, loudspeaker, a 16-segment navigation-direction channel indicator, and test meters. The data provided by this array would furnish, in effect, a complete "sound-movie" of the world beneath the waves, supplemented by valuable statistical data.

The boat itself (above, left) designed by Brooks Stevens, Milwaukee industrial designer, features twin engines, powered steering comparable to that of a twin-screw ocean liner, complete maneuverability, and a parasol-type canopy that can be folded—when not in use—against the radar mast projecting from the center.

Twenty-Year Battery

The tiny device held by the girl at left is actually a 95-volt battery with a projected shelf life of 20 years. Developed by G.E., it is designed for high voltage-to-volume requirements and long storage or standby service. It employs a solid electrolyte, is cylindrical, axial-leded, measures 3 1/4" long by 0.335" in diameter, and weighs 0.15 ounce. Uses include: charging capacitors for "one-shot" or intermittent applications; bias supply for high-impedance circuits such as those utilizing neon lamps or photomultiplier tubes; and furnishing low currents to circuits employing electrometer tubes or ionization devices. Price is $12.50. Further details are available from the Specialty Electronic Components Department, General Electric Company, West Genesee St., Auburn, N. Y.
WHAT DO YOU DO when one of your household appliances goes “haywire”? If you’re an oriental potentate, you simply clap your hands and nod in the direction of the offending item. If you’re a billionaire, you probably tell your secretary . . . who tells your business manager . . . who informs your chief maintenance engineer . . . who either (a) sends an electrician to fix it or (b) calls an outside repair firm to pick up the item. But if you’re neither of these, chances are you’ll try to fix it yourself. And, if you do, you’ll find the Eico Model 540 REDI-TESTER a useful aid.

THE MODEL 540

Like most of the instruments manufactured by the Electronic Instrument Company (Eico, 84 Withers St., Brooklyn 11, N. Y.), the Model 540 REDI-TESTER is available either as a “do-it-yourself” kit ($12.95) or as a factory-wired unit ($15.95). You can use it to check line voltages, circuits for leakage, resistance, currents, and battery voltages.

The Model 540 is a multi-range instrument with voltage ranges of 0-7.5, 0-15, 0-150 and 0-300 volts, a current range of 0-15 amperes, and a 0-1000 ohm direct-reading resistance range. Using a 3½” meter, it has a deep-etched brushed aluminum panel and is fitted into a black Bakelite case measuring 3¾” x 6½” x 3½”. Total weight of the instrument, including its batteries (used for ohmmeter checks) is only 3½ lbs. A pair of test leads is included.

Putting It Together. One of the first things you’ll notice when you open the kit is that two instruction manuals are provided. One is a conventional instruction booklet, as is often furnished with any test instrument . . . it gives the basic specifications of the instrument and tells how to use it in typical applications. The other is a large “fold-out” instruction sheet which
gives step-by-step assembly instructions and includes pictorial diagrams.

Take special pains when soldering around the meter... its clear plastic case can be damaged by excessive heat... and meters are expensive! You'll also find it a good practice to check each wiring step twice. Check before you install a wire or part to make sure you understand the step and that you are using the right part. Check after each step to make sure you haven't erred... it's easier to correct a mistake during wiring than after all work is done.

Special Features. The Model 540 REDI-TESTER is designed especially for home appliance and automotive servicing. It is not a general-purpose multimeter for electronics work. However, in its intended application, it is hard to beat. For one thing, all voltage and current ranges are a.c./d.c.—not a.c. or d.c.; it measures both alternating and direct voltages (and currents) with the same range selector setting, the same test leads, and using the same jacks. So you don't have to worry about the type of voltage you're measuring or, if it's d.c., about its polarity.

The instrument permits direct reading of power line voltages in two ranges, 0-150 and 0-300 volts, by means of an attached line cord and plug. When plugged into a power receptacle, up to 15 amperes may be drawn from a built-in, panel-mounted outlet, with power consumption indicated on a 0-1.5 kw. scale. "Good-Bad" scale indica-

Final assembly of the Model KT-20 multimeter.

Lafayette KT-20 "Semi-Kit" Multimeter

Comment. If you're an auto mechanic, electrician, building maintenance man, or appliance repairman, you'll be able to use the Model 540 REDI-TESTER in all your work. And even if you're none of these—just an ordinary householder with a small touch of the "do-it-yourself" attitude, you'll find it pleasant to have around.

There is only one criticism we could make... replacing the batteries might be a chore, since the cells are individually wired in series. If care isn't taken to avoid overheating during this operation, battery life could be shortened considerably. We would prefer "clip" type mounting.

THE KT-20 "SEMI-KIT"

If you asked a dozen electronics technicians or radio-TV servicemen what they considered to be the second most important test instrument in their laboratories,
chances are that you'd get at least two—and perhaps as many as a dozen—different answers. Some would feel that the signal generator was the second most important... others would favor the oscilloscope... and still others might lean towards the tube tester. But if you asked the same people what they considered to be the most important test instrument, there's a good chance that all twelve would agree on the volt-ohm-milliammeter—or multimeter.

There are many good multimeters available to the electronics worker, both as kits and as factory-assembled and tested instruments. But this month we will review a unique approach to electronic kit design—the Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) Model KT-20 multimeter "Semi-Kit." It assembles into a multirange volt-ohm-milliammeter with a d.c. sensitivity of 20,000 ohms per volt and an a.c. sensitivity of 5000 ohms per volt.

You may wonder what we mean by the expression "ohms per volt." This is a measure of the sensitivity of a multimeter or voltmeter and indicates the number of ohms of input resistance for each volt in each range. For example, with a rating of 20,000 ohms/volt, the instrument has an input resistance of 20,000 X 10 or 200,000 ohms on the 10-volt range. Similarly, on the 50-volt range, it has an input resistance of 20,000 X 50 or 1,000,000 ohms.

**Putting It Together.** There seems to be a surprising scarcity of parts when you first open the KT-20 kit. Actually, this multimeter has just as many components as any multirange test instrument. The apparent lack of parts is due to the fact that the kit is partially pre-assembled... hence the name "Semi-Kit."

The meter movement, ohmmeter rheostat and knob, selector switch and knob, tip jacks, a.c. rectifier, and resistor terminal boards are already in place on the instrument's front panel. Part of the wiring, including the majority of the connections to the selector switch, is already completed. And the test leads are already assembled! Your job, then, is to mount the meter multiplier and shunt resistors, and to assemble and install the battery mounting board.* Finally, you connect a few short leads.

If you've wired compact radios, hearing aids, or other miniature equipment, you shouldn't have any trouble assembling the KT-20 multimeter in a single evening. On the other hand, if your assembly experience has been confined to larger equipment, or if you're a beginner... you may find it best to spread out the work over several evenings, or even to devote an entire weekend to the project. Wiring in "tight places" can be tedious unless you've had some experience.

**Special Features.** The assembled KT-20 multimeter provides a.c. and d.c. voltage ranges of 0-10, 0-50, 0-250, and 0-1000 volts. *(Continued on page 119)*

* There is an optional construction step. A small adjustable calibration resistor is furnished with the kit. As normally assembled, the instrument has an accuracy of ±5%. However, if you want greater accuracy, you can install and adjust this resistor to give an accuracy of ±2%. Since this increase in accuracy is negligible for most practical work, the resistor was omitted from the test model shown in the photographs.
YOU CAN SAVE your back as well as your buck and get fresh worm-bait with no digging and no great expense by using one of the electronic "Worm-Turners" described here. A worm-turner warms the worms—in fact it makes things so hot for them that they quit their earthy diggings and sidle right to the surface where you can snake out an eager hand and scoop 'em up at will. The ladies giggle, the worms wriggle—and you'll have all the fish-bait you'll need.

Before you conclude that your POP'tronics staff has blown its collective cork, take a look at the photos and diagrams shown here. You'll admit there's a new angle for an old angler, and if you'll pardon our puns, you'll see that it's more fun and a lot easier to dig these simple circuits than to break soil as a preface to summer fishing.

All you need is a lawn and a 115-volt a.c. power source. When current from this source passes through a ground probe, the worms in the area of the probe will crawl CAUTION

Do not attempt to modify either of these circuits. If wired according to the schematics, they will provide adequate protection from the LETHAL 117-volt a.c. household line.

Let electronics flush them out of the ground to the surface. It is assumed that the worms experience a mild shock caused by the IR (voltage) drop in the earth. Regardless of the reason, this method will bring worms to the surface in a jiffy.

WORM-TURNER NO. 1
By R. Wayne Crawford

The safety factor is the biggest problem involved in the use of house current. One side of the a.c. line is "hot" to ground. Obviously, if this side of the line were grounded directly, the house fuses would blow. The circuit used here limits the current flow through the probes. The entire unit is built in a 3" x 3" x 5" wooden box; wood was used in this case because of its insulating properties.

When the d.p.s.t. switch is in the "off" position, both sides of the a.c. line are open. The purpose of the 10-watt lamp bulbs is to limit the current through the "Worm-Turner" No. 1 in action. Probes (two are used) are inserted into the earth. The a.c. energy they shoot into the ground causes worms to rise.
ground probes. The neon lamp lights when the switch is in the “on” position, indicating that the probes are “hot.” Use of a lamp in series with each line eliminates the problem of trying to identify the “hot” line.

The probes can be constructed from any fairly stiff, thin, metal rod. The writer used two wire coat hangers with the enamel sanded off. Each probe should be about 15" long. One end of each probe should be filed to a point and a 90° bend in the rod. Wrap this section well with rubber tape. It will serve as a handle for forcing the probe into the ground.

A standard a.c. plug and receptacle may be used to attach the wires from the probes to the unit. Connect the unit to the power source with a rubber-covered line cord. A long cord will give you greater freedom of movement about the lawn.

To use this worm-turner, push the probes into the ground to a depth of a foot with the two probes approximately three feet apart. Turn the switch to the “on” position. If the moisture content of the earth is about average, one of the lamps should light. Within a few minutes the worms will start crawling out of the ground in the area of the “hot” probe. When you find that no more worms are crawling to the surface, turn the unit off and move the probes to another location. Don’t take any chances by moving the probes when the unit is turned on.

If the earth is exceptionally dry, water a section of the lawn before starting. The current flow will now be greater between the two probes and, since the lamps are in series, it may be necessary to use larger wattage lamps to obtain satisfactory results.

WORM-TURNER NO. 2

By J. E. Pugh, Jr.

Worm-Turner No. 2 also depends on a surge of a.c. through the ground to jolt the worms to the surface. Details on its construction may be seen in the accompanying photos and diagram.

All parts fit nicely in a 3” x 5” x 7” aluminum box, but they should be located with care as they must be closely spaced. The transformer is centered in the box for good balance when the unit is carried. The lamp sockets should be made of Bakelite and isolation transformer. Note carrying handle and “push-to-test” button.
their mounting bases must be shortened to about 1/4" thick to provide space for shock mounting. Clip two rubber washers, 3/8" to 1/8" thick, on each mounting screw for this purpose. Use flexible wire such as test prod wire for connecting chassis parts between the two halves of the case. These wires should be long enough to permit the case to be opened if the lamps ever need to be replaced.

The probes are made of 3/8"-diameter rods about 2 feet long. Fit the upper end of each probe into an inexpensive file handle and then attach the wire (about 10' of test prod wire) near the handle. After this, tape the rod with rubber tape near the handle to lessen the chance of shock. The photo shows the probes both before and after being taped. The end opposite the handle is ground down to a point to make it easy to push into the earth.

When SI is closed, line voltage (117 volts a.c.) is applied to isolation transformer T1, which in turn supplies 117 volts to output receptacle S01. The two parallel lamps in series with the load will indicate if the probes become accidentally connected together, and under such conditions they place a limit on the maximum current through the transformer. This current is permitted to be somewhat above the transformer rating since excessive loading will ordinarily be only momentary.

In addition to the above, the smaller lamp is used to indicate that the probes are functioning properly. During normal operation, the load current is sufficient to cause the 25-watt lamp alone to glow with a medium brightness, but it is not great enough to light both lamps. Thus, switch S2 is provided so that the 75-watt lamp can be switched out of the circuit for testing.

To use, push the probes into the earth 5' to 10' apart. Throw switch SI on and then press test switch S2. The 25-watt lamp should glow dimly, indicating that the system is working. Wait a few moments and then start picking up the worms. As with Worm-Turner No. 1, if the earth is very dry, it may help to spray it with water before inserting probes.
WHEN THE anguished tones of the Elvis Presley recording suddenly faded from the speaker in my workshack, I knew company was coming—most likely with the usual pot of coffee and a consuming curiosity. Calmly, I made a few last adjustments on my latest electronic triumph and awaited the judgment committee of one.

It took her exactly three minutes and twenty seconds to turn off the record player in the music room, stop in the kitchen and suspicion flooded her face. "How do you know it won't go berserk—like some of those other nutty R/C nightmares you turned loose?"

"Impossible!" I chuckled. "I've checked (Continued on page 98)"

Competitive Meet next week," I said casually. "When they see this baby—"

"First plane I ever saw without wings."

"It's a whirlybird type—you know, helicopter." I ran a fond hand over its smooth fuselage. "Whole thing only weighs twenty pounds, including the modified, aluminum-cast lawn-mower engine which powers it. It carries a quart tank of a special fuel, which I got from the kids who run the hot-rod strip on the edge of town, and it can stay airborne for almost an hour, according to my calculations."

"How do you steer it?" she asked.

"With R/C control of these adjustable blades on the larger rotor." I smiled into my coffee. "My tone control system modifications—somewhat along the line of what would be conventional elevator-control—are something a notch below sheer genius! According to my schematics, this baby'll—"

"You keep saying 'according to your plans.'" she said skeptically. "That means you haven't actually flown this misbegotten gizmo yet." An expression of mingled worry for the coffee, walk from the house to my workshack and knock on the door.

"Couldn't stand any more of that male Banshee's adenoidal wailing, eh?" I said, admitting the wife into my private sanctum of scientific puttering. "Why you bought those absurd recordings is completely beyond—"

"It happens," she said coldly, "I like his singing."

"If that's singing, let's go down to the dog pound and hear some group stuff some time," I snickered. "I've heard better tonality from Air Alert Sirens and I—"

"What in the world is that?" She pointed to my newly built project on the floor.

"Oh, that happens to be the little marvel which is only going to walk off with all the awards when my R/C Plane Club holds its Competitive Meet next week," I said casually. "When they see this baby—"

"First plane I ever saw without wings."

"It's a whirlybird type—you know, helicopter." I ran a fond hand over its smooth fuselage. "Whole thing only weighs twenty pounds, including the modified, aluminum-cast lawn-mower engine which powers it. It carries a quart tank of a special fuel, which I got from the kids who run the hot-rod strip on the edge of town, and it can stay airborne for almost an hour, according to my calculations."

"How do you steer it?" she asked.

"With R/C control of these adjustable blades on the larger rotor." I smiled into my coffee. "My tone control system modifications—somewhat along the line of what would be conventional elevator-control—are something a notch below sheer genius! According to my schematics, this baby'll—"

"You keep saying 'according to your plans.'" she said skeptically. "That means you haven't actually flown this misbegotten gizmo yet." An expression of mingled worry for the coffee, walk from the house to my workshack and knock on the door.

"Couldn't stand any more of that male Banshee's adenoidal wailing, eh?" I said, admitting the wife into my private sanctum of scientific puttering. "Why you bought those absurd recordings is completely beyond—"

"It happens," she said coldly, "I like his singing."

"If that's singing, let's go down to the dog pound and hear some group stuff some time," I snickered. "I've heard better tonality from Air Alert Sirens and I—"

"What in the world is that?" She pointed to my newly built project on the floor.

"Oh, that happens to be the little marvel which is only going to walk off with all the awards when my R/C Plane Club holds its

POPULAR ELECTRONICS
Playing a prized old record on today's wide-range hi-fi equipment can be fun, but—

Should it Hiss? Should it Rumble?

A FRIEND heard that we had a hi-fi system second to none, and decided to bring over some of his old, treasured 78-rpm records. He had been told that hi-fi could practically bring Caruso back to life. We started one of the ancient discs, and there followed a combination hiss-static effect that all but masked the great tenor's tones. "If that's hi-fi," said our friend, "I'm going back to my old model phonograph. I never heard any of that noise before!"

Those who have tried to play old records on new hi-fi systems have probably had a similar experience. The reason for it is simple. High fidelity, with its wide frequency response, does bring out the brilliance of high-pitched musical tones. But—at the same time—it reproduces record surface noise much more than a limited frequency range or "lo-fi" phono ever did. And there is plenty of noise on the older shellac recordings—caused by the manner in which they were made, the material of which they were made, and the type of heavy and often blunted pickups which were employed during playback when those records were new.

Still, many listeners own quite a collection of such discs. The question facing them is how to use their new hi-fi systems to hear the music on those records but not the accompanying noise.

What Is Scratch? What we call "scratch" is not a single tone, but a mixture of tones of varying intensity and pitch. The only sure thing about "scratch" is that it consists mostly of high frequencies. Hi-fi equipment, noted for its ability to reproduce musical overtones, will reproduce the high-frequency noise spectrum as well.

Now, at the other end of the frequency band are the low-frequency noises, caused chiefly by rumble from an imperfect record changer. In "lo-fi" systems using less expensive amplifiers, this rumble may go unnoticed because the amplifier and/or speaker is incapable of reproducing it. With better equipment, however, the rumble becomes a nuisance, especially during quieter passages of music.

Even when the rumble is so low-pitched that you can't hear it, it can still add distortion to the music. The speaker cone may vibrate very slowly, due to the rumble signal, while the regular program material is being superimposed on it. As a result, certain musical notes are reproduced by a distended speaker cone, causing subtle distortion which can give rise to "listener fatigue."

Tone Controls and Noise. Ideally, it would be nice if we could filter out the noises without filtering out any of the music along with them. Practically, this is not possible. Although we can design circuits to get rid of any frequency or group of frequencies, those circuits have no way of knowing whether they are blocking out musical tones or extraneous scratch and rumble.

The next best thing would be to eliminate as much of the objectionable noise and as little of the program content as possible. The graph on the next page shows why this cannot be done with conventional tone controls. It's true that rotating the treble tone control counterclockwise will get rid of the surface noise, but at the same time, it will cut down on the brilliance of musical overtones. Much of the color of the violins, triangles and flutes will disappear.

Nearly all tone controls have a slow rate of attenuation. In other words, to get a

May, 1957
substantial decrease in intensity of tones at around 10,000 cycles, the control is so arranged that some decrease of intensity is already taking place at frequencies as low as 1000 or 2000 cycles. This is an ideal arrangement where tone controls are being used to compensate for the differences in room furnishing, loudspeakers, etc., for anything other than a gradual change of response would sound artificial. But when surface noise is the problem, tone controls just don't act as "steeply" as they should.

The same situation applies to the bass tone control which might, at first glance, seem like the way to combat turntable rumble. Again, the rumble will be eliminated or reduced, but so will the sonorous tones of the bass fiddles and the thundering crash of the kettle drums.

**Filters Cut Sharply.** There are two basic differences between filters and tone controls. The former circuits have relatively flat or uniform response up to a given frequency, known as the cutoff point in the case of low-frequency rumble filters. As a result, most of the program content (which occupies the middle frequencies primarily) is retained in its entirety, while the extremely high noise and low rumble frequencies are rapidly and substantially blocked out. The graph illustrates the expected action of a pair of filters and illustrates how much program content would be lost if the same thing were attempted using conventional tone controls.

Actually, in the case of old 78-rpm recordings, there was very little program content above 5000 cycles in the first place, so practically nothing is lost by introducing such filters except the scratch itself.

Commercial record scratch filters usually have three or more settings (including a "flat response" setting). This means that the new, better grade recordings can be played "wide open," while older discs can be reproduced with just a slight amount of filtering to remove that edge of hiss. The very old "collector's items" can be played with maximum filtering to cut out all the old scratch and noise.

Similarly, rumble filters have several settings to take care of different degrees of rumble. The idea is to use the least amount of filtering necessary for pleasant reproduction in both cases. Starting on page 77 you will find complete details on how to build a combination rumble-and-scratch filter which can be easily installed in your hi-fi system.
INCLUDING a combination record-scratch and turntable-rumble filter in your hi-fi system provides you with a double guarantee. It means that you can enjoy your old records with a minimum of noise. It also means that you'll be able to enjoy your present records when they reach old age, or when your record player begins to rumble and you're not yet ready to replace it with a new one.

Many commercially available preamplifier-control units have these filters already built in. But older or less costly equipment may not. Actually, it is a lot easier to include an "outboard" type of filter, such as the one to be described, than to try to design one into an existing circuit.

This unit can be used between any preamp and any power amplifier. The output of the preamp will be connected to the input of the filter, and the output of the filter plugs right into the input of the power amplifier. If you have an all-in-one preamp-amplifier combination, that's no problem either, as will be shown later.

**How Much Filtering?** Quite a bit of experimenting with old and new records was required to decide on the cutoff frequencies for the scratch filter portion of this circuit. We finally decided that two settings of filtering other than the normally flat response setting would do the trick. The first cutoff was set at 8000 cycles, and is intended for use with somewhat older microgroove recordings that are beginning to develop a definite "hiss." The second setting starts "cutting out" frequencies at about 4000 cycles and is intended for old 78-rpm recordings which have quite a bit of scratch and noise.

The rate of cut was designed to be 12 decibels per octave. This means that at the 4000-cycle setting of the scratch filter response will be relatively flat up to 4000 cycles, whereas 8000-cycle noise will be reduced by a ratio of 4 to 1, with even higher frequencies reduced still further. This "rate of cut" is about twice that possible with regular tone controls whose action is much more gradual.

As for the rumble frequency filter, the two cutoff points selected are 50 cycles and 100 cycles, with the rate of cut about 10 db per octave. The first "cut" position is for very low frequency tunable rumble troubles, whereas the extreme 100-cycle setting will get rid of higher frequency rumble troubles as well as some 60-cycle power line hum which may possibly be present in your system.

**Building the Filter.** The entire unit is built into an aluminum two-piece case which, when completed, acts as a complete

---

**HOW IT WORKS**

**Scratch Filtering.** At low frequencies, the chokes offer very low impedance as compared to the 82,000-ohm load resistor ($R_1$). Conversely, the 500-µfd. capacitor ($C_2$) has very high impedance across the load, and consequently causes no shunting action. The result is that full input voltage is developed across the load resistor. At 10,000 cycles, the choke acts like a series impedance of about 200,000 ohms, and the combined parallel impedance of the 82,000-ohm resistor and the 500-µfd. capacitor (whose impedance to high frequencies is low) is now reduced to about 20,000 ohms. By voltage divider action, then, only about 1/10th of the 10-ke. input signal is available at the output. This corresponds to a reduction of 20 db at this particular frequency.

**Rumble Filtering.** At high frequencies, the two 0.01-µfd. capacitors ($C_4$ and $C_6$) act as a short circuit. The entire signal is developed across the 110,000-ohm effective load (two 220,000-ohm resistors in parallel). At 20 cycles, for example, each capacitor has a series impedance of about 800,000 ohms, and again—by voltage-divider action—the output voltage is about 1/25th of the total. It corresponds to a reduction of about 28 db at this particular frequency.
Pictorial diagram above details relationship of parts used in the filter. Note that leads on chokes CH1 and CH2 are colored, and must be wired according to instructions. Below are the schematic diagram, table of frequency cutoff action for different switch settings, and parts list. Switches are shown at 100-cps and 4000-cps cutoff positions. All ground points, including shield of output cable, should be returned to connection at ground on J1.

<table>
<thead>
<tr>
<th>SWITCH POSITIONS</th>
<th>RUMBLE(S2)</th>
<th>SCRATCH(S1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FLAT</td>
<td>FLAT</td>
</tr>
<tr>
<td>2</td>
<td>500√</td>
<td>8000√</td>
</tr>
<tr>
<td>3</td>
<td>100√</td>
<td>4000√</td>
</tr>
</tbody>
</table>

C1—220-μf, ceramic capacitor (Centralab BC220)
C2—500-μf, ceramic capacitor (Centralab BC501)
C3, C5—0.02 μf, tubular capacitor (Cornell-Dubilier 2S2)
C4, C6—0.01-μf, tubular capacitor (Cornell-Dubilier 4S1)
CH1, CH2—1.5-hy., 10-ma. choke (Merit C-2973)
1—Phono jack (RETMA standard type, non-insulated)
P1—Phono tip plug (RETMA standard type)
R1—82,000-ohm, 1/2-watt resistor
R2, R3—220,000-ohm, 1/2-watt resistor
S1, S2—Double-pole, triple-throw lever switch (Centralab 1452)
J1—3" x 4" x 5" aluminum chassis-case

shield for the circuit, preventing any hum pickup from power supply transformers located on nearby equipment.

Lever-type switches were selected because of their professional appearance and because the settings can be spotted easily from your armchair across the room. The orientation of these switches is such that flat response is achieved with both switch knobs all the way down. The rumble switch is mounted to the left of the scratch switch (since we normally think of low frequencies as being at the left of the audio scale and high frequencies at the right). Check the pictorial diagram for the exact position of the switch contacts, shown in the "flat" position, before mounting.

The only metal cutting necessary involves...
Inside view of filter, with wiring completed, is shown at right. Lever switches are mounted on front panel. Chokes CH1 and CH2 are mounted on left inside panel. Unit is to be connected between preamp and power amp. It requires no power. With both switches in "flat" positions, signal is fed through directly. For instructions on using filter with complete or "single-chassis" amplifier, see drawing and text below.

A few small round holes and narrow slots for the two lever switches. Each switch requires two round 7/16" holes spaced 13/16" apart with a 1/4" x 3/16" slot centered vertically between the two mounting holes. As the aluminum of the chassis recommended in the parts list is quite soft, the slot was made by drilling a 7/16" starting hole at each end of the intended slot area and carefully cutting the slot between the end holes, using an ordinary coping saw.

The phone input jack requires two 7/16" holes spaced 13/16" apart and an 11/32" hole centered between them. A 3/4" clearance hole for the output cable and four 7/16" holes for mounting CH1 and CH2 completes the metal work.

**Wiring Tips.** Capacitors C1, C2, C5 and C6 can all be pre-wired to their respective switches before assembly. One end of C3, C4, R1, R2 and R3 can also be wired to the switches before installation, reducing the number of wiring steps after all the parts are installed in the case.

You will note from the schematic diagram that CH1 and CH2 are actually wired in series. The chokes are color-coded and this coding should be strictly observed in order to get the full 3 henrys from a series combination. Start with the red lead of CH1 wired to point 1 of S1a. The blue lead of CH1 and the red lead of CH2 are then joined together and wired to point 2 of S1a. Finally, the blue lead of CH2 is wired to point 3 of S1a. Keep all unshielded leads as short as possible, and be certain that only a single chassis ground is made—using the "ground" side of the input jack J1 for this purpose.

Assemble the two parts of the case together using the self-tapping screws supplied. Mark the settings of the switch positions on the front panel. The markings for the rumble filter switch, reading from bottom to top, are "flat," "50 cps" and "100 cps." Scratch filter switch markings, reading from bottom up, are "flat," "8 kc." and "4 kc."

**Installation and Use.** Connect the output cable from your preamp to the input jack of the filter. The output cable of the filter is then connected to the input jack of your power amplifier. If you have a combination preamp-amplifier, the best place to "tap into" the circuit is at the ungrounded end of the main volume control, as shown in the partial schematic on this page.

On quality FM broadcast programs, you will want to leave both switches in the flat position; on weak signals, however, setting the scratch filter to 8 kc. will often dispense with some of the FM hiss associated with weak reception. For AM broadcasting, we found that the 4-kr. setting gets rid of a lot of static, and since this type of transmission is limited to a maximum range of about 5000 cycles, practically no program content is lost. As for your record collection, each record will require its own best setting, which can be determined by experimentation. A good idea might be a notation on the jacket or record album as to the most pleasing settings to be used.

The rumble filter setting will depend upon the quality of your turntable or record changer. Remember to set it back to "flat," however, when listening to radio, unless the radio station's turntable has some rumble, too—which has been known to happen!
THE NEW MICRO-BATTERIES

IN JANUARY of this year, American newspapers carried a startling, almost incredible story: atomic energy had at last been tamed! The man in the street would soon be able to carry a tiny nuclear power plant in his pocket with absolute safety—a power plant which would operate his transistor radio, hearing aid, emergency receiver, and even his wrist-watch. Despite its cough-drop size and the absence of massive shielding, the danger from radiation would be less than from an ordinary radium-dial clock.

As so often occurs, public misinterpretation of the newspaper stories conjured up all kinds of fantastic visions—visions which are just as improbable today as they were fifty years ago. Let's try to clear up some of these foggy notions about the atomic battery and other microcells.

At this moment, a nuclear battery is producing usable electrical energy in the laboratories of a well-known American watch manufacturer, Elgin National Watch Co., Elgin, Ill. This cell is indeed no larger than a cough drop, is as safe as a house key to carry, has a life of about five years, and actually obtains its energy indirectly from atomic fission.

Atomic Energy. When most radioactive substances disintegrate, three types of emissions are given off: alpha particles which are heavy, positively charged bundles consisting of two protons and two neutrons; beta "rays" which are really free high-speed electrons; and gamma rays which are extremely high frequency electromagnetic waves. The chief danger to human tissue from atomic radiation lies in the latter.

Gamma rays have great penetrating power. Beta and alpha particles, on the other hand, are not as hazardous because they cannot penetrate much below the upper layers of the skin. Thus, it is the gamma radiation which makes necessary the elaborate precautions taken in the Nautilus and in atomic plants to protect the personnel against tissue damage. It also accounts for the fact that the only pocket-sized nuclear power plants are those in science-fiction stories!

In 1947, a new element called promethium was discovered in the waste products of ordinary spontaneous uranium fission. Chemists dutifully studied its structure, catalogued it as element 61 in the periodic table of elements, tagged it as one of the "rare earths" falling between element 60 (neodymium) and element 62 (samarium) on the chart and then promptly forgot it. Almost 10 years later, practical-minded engineers casting about for a safe source of

Fingers loom large in comparison with the fully shielded atomic battery at left. It is just about cough-drop size. Without its external metal shield, the battery is no bigger than a shirt button (far left).
Promethium—a new atomic element—has made the nuclear battery possible. The cross-section drawings at right show the structure of the battery and how it works. Directly below is a life performance curve of the atomic cell.

Atomic energy re-discovered promethium and immediately pounced upon it as the possible answer to their problems.

Promethium 147 has several interesting properties. When it decays, it emits beta particles in profusion but virtually no gamma or alpha radiations. Furthermore, it has a useful half-life of more than 2½ years and so represents a potential long-term power source if its beta rays can be utilized.

Beta radiations are elusive; they are difficult to capture and use in the direct production of energy. But, reasoned the inventors, why not make the conversion a two-step process? The beta particles could release their energy in another form—even if this form were still not usable—and then the secondary energy could be changed into a practical product.

Thus, the new atomic battery was born. The cough-drop nuclear cell is the result of this line of research.

**Nuclear Battery.** As the drawings above show, the cell is built in three layers. In the center is a wafer consisting of promethium 147 atoms and some phosphor material. The latter is a crystalline substance which gives off flashes of bright light when bombarded by electrons. Your television receiver picture tube screen has a phosphor coating of this type. The two outer wafers of the sandwich are miniature silicon photo-cells. As the brilliant scintillations of the embedded phosphor in the center wafer impinge upon the silicon cells, the "atomic light" is converted into electrical energy.

The life graph of the nuclear battery provides the story of its performance. When first made, a single atomic cell will provide approximately 40 microamperes of electric current at about one volt of potential, the equivalent of 40 microwatts of electrical power. When you consider that an ordinary small desk lamp uses a million times this amount of power while in operation, all visions of atom-powered automobiles and washing machines in the very near future immediately collapse. With a bang!

Due to the decay rate of promethium 147, the available current falls off to 30 microamperes at the end of one year, to 20 microamperes at the end of the half-life period of 2½ years, and finally to 10 microamperes after five years. Any equipment that will

(Continued on page 118)

**Indium cells,** which are intended for use with electronic wrist-watches, show promise of things to come in the chemical battery field. One of them has about half the surface area of a copper penny.
Tuning the Short-Wave Bands

with Hank Bennett

In tuning across any of the various short-wave bands, the average listener may hear some rather unusual musical or animal-like sounds. These strange sounds, which may be repeated a number of times, are from one to ten seconds in length with a few seconds of “dead time” in between. They represent the interval signal identification of various s.w. stations. Such signals are used quite often just preceding the sign-on time of a station—to enable listeners in foreign lands to tune in, at times for test purposes, and frequently between programs—when there would otherwise be short periods of “dead air time.” An IS helps DX’ers to identify readily the country in which a particular station is located.

Some countries have one common interval signal for all of their s.w. transmitters while several stations in a certain country may each have its own identifying signal. The signals of some countries are played on instruments that are native to that country or surrounding territory. Bird calls are often heard from stations in the Pacific. One of the most unusual interval signals heard by your Editor was the amusing cackle-call of “Woody Woodpecker,” used by a station in Colombia; this one has not been heard recently and may no longer be in use.

(Continued on page 108)

Thomas Green, Pueblo, Colorado, at the dials of his National NC-173 receiver. For boosting weak signals, he uses a “Select-O-Jet” and “Q-5’er.”

Colorful and interesting verification issued by Radio Monte Carlo. The 7349-kc. frequency shown is no longer in use; you can find them on 7140 kc.

INTERVAL SIGNALS

Australia—Radio Australia features a music box playing “Waltzing Matilda” for five minutes preceding transmissions. The programs open with the chimes of the Melbourne post office clock and the laugh of the native kookaburra bird.

British Honduras—Belize, on 3300 kc., uses a recording of “Greensleeves.”

Canada—First four notes of the National Anthem, “O Canada.”

Egypt—Camel bells.

England—Bow (church) bells. The chimes of “Big Ben” are also frequently heard.

Germany—Deutsche Welle, Cologne, plays a motif from Beethoven’s “Fidelio” on the celesta.

Greece—A folk song played on a native flute and sheep bells.

India—A melody of 8 seconds duration with 10 seconds between playings. Instruments used include a violin, viole, cello, and tambura.

Italy—One of the very few stations in areas other than the Pacific to employ a bird call, Radio Rome can be noted with its bird-chirp IS. The type of bird is not known and may be any of several.

New Zealand—Call of the native bell bird at 5-second intervals.
LITTLE has been said in recent Transmitting Towers about the 144 to 148 mc. (2-meter) amateur band; so let’s discuss it now. Many of the remarks will apply specifically to Novice operators, because the 145 to 147 mc. segment of the band is open to Novice operators, but the general discussion should be helpful to the General Class operator as well.

Probably the first thing that a Novice notes about the 145-mc. Novice band is that it is the only band on which he can operate phone. The next thing that impresses him is the width of the band. Its 2000 kc. is 40 times as wide as either the 3.7- or 7.15-mc. bands and eight times the combined width of the other three Novice bands. Obviously, interference is not a major problem on 2 meters. A third feature of the band is the modest size of the antenna required, a 1/2-wave one for the center of the band being only 38" long.

Undoubtedly, the big disadvantage to 2 meters in the eyes of many amateurs is its limited range. The reliable range of a typical, low-power, 2-meter station equipped with a simple, non-directional antenna in an average location will be between 10 and 20 miles. Substituting a small beam antenna for the non-directional one will probably double this range. Still better antennas, higher power, and very sensitive receiving equipment will push it out to 100 miles or so.

Compared to the distances that are covered regularly on the lower frequency bands, these distances are not very great. However, they can be covered 24 hours a day, 365 days a year. In addition, there are frequently special atmospheric conditions, especially in the warmer months of the year, that make it possible to work 500 miles or more, even with simple equipment. For the record, contacts of 1000 miles or so are not unknown on 2 meters, although they certainly cannot be called everyday occurrences.

The truth is that the thrill of working a new state a couple hundred miles away on 2 meters is just as great as spanning an ocean on 15 meters. However, not all ama-
HELP US OBTAIN OUR HAM LICENSES

In this section of the Transmitting Tower, the names of prospective amateurs requesting help and encouragement in obtaining their licenses are listed. To have your name listed, write to Herb S. Brier, WSEGQ, % POPULAR ELECTRONICS, 366 Madison Ave., New York 17, N.Y. Please print your name and address clearly.

Names are grouped geographically by amateur call areas.

**K1/W1 CALL AREA**

RoY L. LaDuke, 378 Blackstone St., Providence, R.I. (Code and theory)
William Cashman, Jr. (14), 59 Willow St., Reading, Mass. (Code)
Sam Lipson, 1 Kensington Hts., Worcester 2, Mass. (Code and theory)
Fred Foley, 21 Elmwood St., Worcester 2, Mass. (Code and theory)

**K1/W2 CALL AREA**

Frederick Mason, 111 Park Ave., New York 28, N.Y. (Code)
Jack Kilroy (14), 59 Valley View Terrace, Poplar Lake, N. J. Phone: MO 8-0682. (Code and theory)
Bernard Greenberg, 2628 E. 29th St., Brooklyn 26, N. Y. (Code)
D. W. Brown, 34 Edgar St., Buffalo 7, N. Y. (Code and theory)
Edward Domchuk, 77-05 26th St., New Hyde Park, N.Y. (Code and theory)
Richard Palmler, Seneca Blvd., Hector, N. Y. (Code, theory and regulations)
Charles Fennig, Marie Rd., Valley Cottage, N.Y. (Code)
Weilacher Calhoun (10), 39 W. 100th St., New York 25, N. Y. (Code and theory)
Alfred Mastarrigo (16), 105 Villa Rd., Pearl River 7, N. Y. (Code)
Michael Dinan, 104 W. 92nd St., New York 23, N. Y. (Code)
Robert Tucker, Box 408, Eastport, L. I., N. Y. (Theory)
George Yahwak, Jr., 119 North St., Auburn, N.Y. (Code and theory)
Ben Zobel, 133-03 120th Ave., S. Ozone Park, N.Y. (Code)
Sandy Johnson (15), 1/2 W. J. Handlen, Rockaway, N. J. (Code)
Dan Granoff, 73-31 187th St., Flushing 66, N. Y. (Code and theory)
Robert Kubiak (14), Box 146, Florida, N. Y. (Code and theory)
Robert Thomas, 1651 Boston Row, N. Y. Phone: L11-9-6928 (Code)
Joe E. Calzaretta, 2122 Haring St., Brooklyn 29, N. Y. (General Class theory)

**K3/W3 CALL AREA**

Samuel Passafiume, 1062 Farragut St., Pittsburgh 6, Pa. (Code and theory)
Thomas C. Miller, 120 Center St., Milton, Pa. (Code and theory)
Eddie Hensel, 1139 Third Ave., New Kensington, Pa. (General Class theory)
Eugene Robinson, 101 S. Pittsburgh St., S. Connellsville, Pa. (Theory)
Jack and Fl Fl Wilson, 1005 Greentree Rd., Hillside Heights, Newark, Del. (Code and theory)
Joseph Pears, 126 Tree St., Philadelphia 48, Pa. (Code)
Cari Reinhart, 149 Skyport Dr., Dravosburg, Pa. (Code and theory)
John Hamilton (14), 1541 Crescent Ave., Lancaster, Pa. (Code)
Jerry Dickman, 6545 Darlington Rd., Pittsburgh 17, Pa. (Code and theory)
Stephen Rosen (15), 5427 Eighth St., N.W., Washington 11, D. C. Phone: RA 3-7448. (Theory)

**K4/W4 CALL AREA**

George Stone (15), Route 3, Lafayette, Tenn. (Theory)
Paul Kelly, 629 Jessamine, West Palm Beach, Fla.
Paul Hancock, P.O. Box 4543, Harkers Island, N. C. (Code and theory)
Kenneth Harrison, P.O. Box 237, Bogart, Ga.
Bill B. Purdie, 143 Clarmount Ave., Hampton, Va. Phone: NEWport News 4-4177.
Wally Miller, Jr., Route 4, Lafayette, Tenn. Phone: North 8-3916. (Code and theory)
Joe Cooper (15), 315 Garden Lane, Chickasaw, Ala. Phone: HE 8-1188
Milton Ware (15), 324 Third St., Chickasaw, Ala. Phone: HE 3-4449.
Winfred Routh, Rt. #1, Franklinville, N. C. (Code and theory)
Bobby Sutton, Rt. 3, Box 671, Kinston, N. C. (Code and theory)
David Matthews, Jr., Route #1, Turkey, N. C. (Code and theory)
Robert Blumenkranz (13), 8927 Emerson Ave., Miami Beach, Fla.

**K5/W5 CALL AREA**

Randon Reaves, 8722 Lupton Lane, Houston, Tex. (Code and theory)
Elvis Link, 3712-5800 W. Montgomery Rd., Houston 18, Tex. (Code and theory)
Gary Allums (16), 209 Rush St., Bossier City, La. Phone: 3-5514. (Code and theory)

**K6/W6 CALL AREA**

Dick Schmicter (14), 2745 Glenn Ave., Los Angeles 23, Calif. (Code and theory)
Lester Shaw, 115 S. Flower Ave., Brea, Calif. (Code)
Mike Nagy, 1243 Colma Rd., San Bernardino, Calif. (Code)
George Drysdale, 4435 Josie Ave., Lakewood 8, Calif. Phone: GA 9-6919. (Code and theory)
Michael Gnau, 10 Saturn St., San Francisco 14, Calif. (Code and theory)
Forrest Myers, 947 Cascade Rd., San Landro, Calif.
Roddon Wight (15), 250 N. McDaw, Susanville, Calif. Phone: 6627. (Code)

**K7/W7 CALL AREA**

Paul N. Hamilton, 19350 S.W. Blanton, Aloha, Ore. (Code and theory)
Wilbur C. Young, 8114 S.E. Mill, Portland 16, Ore.
Robert K. Gierke (15), Box 8220, Talbot Rd., Edmonds, Wash. Phone: GReenwood 4610. (Code)
Marcus Dilley, Tieton, Wash. (Code and theory)
Billy A. Blair, Box 87, Richmond, Utah. (Theory)

**K8/W8 CALL AREA**

George S. Lee, 1451 Sunset Rd., Mayfield Hts. 24, Ohio
Wesley Rishel, 2100 Revely, Lakewood 7, Ohio. (Code and theory)
Richard Hansz, 11306 Arden, Livonia, Mich. (Code and theory)
Joseph Pousak, 17815 Clark St., Riverview, Mich. (Code and theory)
James Everly (13), 340 Blaine Ave., Marion, Ohio. (Code and theory)
Lance Lyman, 6739 Usner Rd., Olmsted Falls, Ohio. (Code and theory)
Steve McShane (14), 12830 Wilmette, Detroit 13, Mich.
William Mark Boyd (16). 112 Poplar St., Bluefield, W. Va. (Wants pen pals; will answer all letters)

Gilman Huckins. 3333 Buckle St., Saginaw, Mich. (Code and theory)

William J. Harvanec. 3816 W. 128th St., Cleveland 11. Ohio. Phone: OR 1-8301. (Code and theory)

David D. Phoenix Jr.. 3351 E. 147th St., Cleveland 28. Ohio. (Code)

Richard R. Six.. 501 Holley St., St. Albans, W. Va. (Code and theory)

K9/W3 CALL AREA

Bruno Wizolek (11). Chicago, Ill. Phone: PE 6-9449. (Code)

John Swanson (14). 14201 S. Dearborn. Chicago 27. Ill. (Code and theory)

Gary Keener. R. R. #2, Union City, Ind. (Code and theory)

John L. Robinson (14). 1228 W. Farwell, Chicago, Ill. Phone: RO 1-1376. (General Class theory)

Stephen Latuszek. 58 Robertson Ave., Lake Zurich, Ill. (Code and theory)

Fred W. Riehle. 1018 E. 6th St., New Albany, Ind. (Code and theory)

Vernon G. Packard. 3323-A Center St., Milwaukee, Wis. (Code and theory)

Dallas Bjella. 303 Boston St., Syracuse, Ind. (Code and theory)

Danny L. Lee. 713 Sexton St., Aurora, Ill. (Code and theory)

Richard Kroeis. 2413 Bate St., Racine, Wis. (Code)

Gilbert Russell (14). 1322 N. New York Ave., Peoria, Ill. (Code and theory)

Harry J. Ledyga. 746 E. Phillips St., South Bend 19. Ind. Phone: AT-81350.

Peter Treml. 733 Ids St., Menasha, Wis. (Code and theory)


K0/WO CALL AREA

Vernon R. Beck (15). 5769 Madison Ave. N.E., Minneapolis, Minn. (Code and theory)

Maynard B. Wiemers, Gilmore City, Iowa. (Code and theory)

Gerald Schoenhofen. 3237 Fifth Ave. S., Minneapolis 8, Minn. (Code, theory and regulations)

Bobby Zehnder. R.R. 1, Milford, Iowa. (Code and theory)

David Gilchrist (13). 77 Fenno Rd., Riverdale, Iowa. (Code, theory, and class code)

Robert Lee (16). 112 Beatty St., Coffeyville, Kans. (Code. theory and selection of equipment)

Jerry Earson (14). 636 Parrow, Moberly, Mo. (Code)

Stephen Steven (13). 4612 W. 72nd St., Prairie Village, Kans. (Code)

Mildred Pett. R.R. 1, Marion, Kans. (Code)

David Bell. 2013 S. Locust, Pittsburgh, Kans. Phone: 3275. (Code)

Bruce Becker. 4443 Denn, Kansas City, Mo. (Code)

Dale E. Gabrielson (15). 707 S. Fifth St., Virginia, Minn.

VE AND OTHERS

Peter Arthur (14). R. R. 2, Simcoe, Ont., Canada. (Theory)

Dunmold Growestie (14). Chester, N. S. Canada.

To help prospective amateurs obtain their Novice licenses, the Radio-Electronics-Television Manufacturers Association offers a set of code records (recorded at a speed of 33 1/2 rpm) and a Novice Theory Course for about $10.00, post-paid. The complete course or more information on it is available from RETMA. 1721 DeSales St., N.W., Washington 6, D. C.

May, 1957

The "CONELRAD" Model CA Monitor makes it easy for you to comply with the regulations requiring amateurs to cease operation during a CONELRAD Radio Alert. Connected to the voice-coil circuit of any standard broadcast receiver, its built-in warning light will glow or an external warning device will be activated when an Alert is broadcast. For complete data on this unit, contact The Walter Ash Radio Company, 1125 Pine St., St. Louis 1, Mo.

station will cost considerably more. However, compared to a typical, low-frequency Novice installation, the difference in cost is much less. A few figures may be helpful.

As anyone who reads the News and Views section of the Transmitting Tower can attest, a very popular Novice combination is a Johnson Adventurer transmitter and a Hallicrafters S-38D receiver. Adding a crystal or two and a telephone key makes the basic equipment cost about $110.00, to which must be added the cost of the antenna installation. Many Novices spend more than this amount for their receivers alone, and some get by for less. Nevertheless, $110.00 is certainly a fair figure on which to base a comparison.

A typical, low-power, 2-meter station consists of a 15- or 20-watt phone transmitter and a converter to extend the tuning range of the regular station receiver to cover the 144-mc. band. Checking the cost of three commercially available amateur transmitters shows a price range of approximately $75.00 to $100.00 for the transmitter, complete with tubes, crystal, and power supply. A microphone will add another few dollars to the cost.

The preferred receiving method is to use a 2-meter converter in conjunction with a regular communications receiver. It gives excellent results, because it combines all the good features of the regular receiver

(Continued on page 121)
Adapter Connects "Tiny Plug" to Standard Phone Jack

You can make a simple adapter that will connect a "tiny plug" (Lafayette MS-283) to a standard phone jack in a jiffy. Just obtain a metal can at least 1 in diameter having a friction lid (such as a bouillon cube can), and saw it off to a length of 3/4". Drill or punch a 5/8" hole in the bottom center of the can. Then twist an Amphenol 75-MCIF phone plug into this hole and solder the plug to the bottom of the can.

Drill four small holes for a "tiny jack" (Lafayette MS-284) in the lid of the can; the two outside mounting holes are 3/8" in diameter, but the two center holes should be about 5/8" in diameter to prevent shorting of the plug's prongs. Mount the "tiny jack" to the inside of the lid. Now solder a short flexible insulated lead from the center electrode of the phone plug to one lug on the "tiny jack," and solder another lead from the rim of the plug to the remaining lug on the jack. The completed adapter can be covered with Mystik tape, as shown in the photo, to improve its appearance.

Telephone Line Antenna Provides Excellent Reception

A simple crystal radio receiver connected to a telephone pickup for an antenna and a good ground will give amazing reception. Making a direct connection to the phone line is strictly forbidden for obvious reasons, but use of a capacity pickup for receiving short-wave or AM broadcast signals is both acceptable and effective.

Shown in the photo at left is an attractive pickup which provides storage space for a small directory or note pad. It is made from a 7" x 12" piece of aluminum about 1/16" thick (the metal sheet should be at least as large as the base of the phone). Notch the two corners on one side and bend the adjacent edges down. File a curved notch in the front edge for access to the directory. Small pieces of felt cemented to the edges of the flanges at the corners serve as protective feet. A machine screw, hex nut, and a battery nut installed in a hole in one of the flanges make a binding post for attaching a wire.

Receivers with series antenna capacitors usually perform better with the telephone pickup if the capacitors are shorted.

Chassis-Drilling Hint

Drilling a hole in a steel chassis, after parts have been assembled on it and wired, is generally a hazardous process. The chips are likely to fall almost anywhere and cause short circuits. A good way to avoid such difficulties is to place a small Alnico magnet on the chassis as close as possible to the hole being drilled, as shown in the diagram at left. The magnet will attract and hold the chips as they are cut out by the drill. If you're working in close quarters, where there isn't any space for the magnet, try magnetizing the drill instead.

—Frank H. Tooker

—Art Trauffer

—Serge L. Krauss

POPULAR ELECTRONICS
IS YOUR HEAD ON STRAIGHT?

SHOOTING trouble in the head may sound a bit radical, but it's a simple and effective way of curing most tape recorder complaints. Like the phono pickups discussed last month (POPULAR ELECTRONICS, April, 1957, page 66), tape recording and playback heads are also afflicted by minor ills, chiefly "bad posture" and "dandruff." For this reason, make sure your heads are (1) straight, and (2) clean.

Problems may come to a head when there is a screw loose somewhere. In that case, the head forgets which end is up and leans over a little to one side. Such a coyly tilted head can't take a forthright tone. Both in recording and playback, it muffles the bright tingle and clouds up the sparkling clarity that is the pride and joy of hi-fi tape fans. To retain the full advantage of wide-range tape recording, the head must always be proudly erect at strictly right angles to the direction of tape travel. In other words, as the tape travels sideways, the head posture must be straight up and down.

Up on the Angles. You can improvise your own test of head alignment by simply carefully skewing the tape (first in one direction, then in the other) as it runs past the head (see photo, above right). If the music brightens up with added highs as you deflect the tape, you know that your head is on crooked. But that's nothing that a small screwdriver won't fix. Adjustment screws are provided for this purpose.

For this test, you can't use tape recorded on your own machine—because the error in recording cancels the error in playback. Result: you still don't know whether or not your head needs fixing. For a valid test, you must use "pre-recorded" tape made on a perfectly aligned "professional" machine. Pre-recorded tape from reputable

May, 1957
Magnet gap in recording head must make close contact with tape and lie athwart the direction of tape travel at precisely a right angle.

High frequency response drops rapidly as a result of either head misalignment (above) or poor contact between head and tape (below), as shown in tests by Minnesota Mining & Mfg. Co.

Make Your Own Professional-Looking Dial Plates

A professional-looking dial plate can be made from a strip of flashing copper and a few dial decals. Cut the copper strip to the desired size, flatten it, and then polish the best side to a bright finish. Rinse the plate well, dry it, and give it two coats of clear plastic spray to prevent it from tarnishing.

When the plastic has dried, lay out and apply the dial and lettering decals carefully, then put the plate aside for about 24 hours to allow the decals to dry thoroughly. At the end of this time, cut the necessary dial-center and mounting holes, and give the plate a second coat of plastic spray.

Dials can be made in a strip, as shown in the photo, or individually, as preferred or as necessity dictates. Small brass escutcheon pins, available from almost any hardware store, may be used to affix the dial plate neatly to a wooden hi-fi or receiver cabinet.

—B. W. Blachford

POPULAR ELECTRONICS
BELIEVE IT OR NOT, there are still some individuals who haven't fully accepted the transistor as a practical electronic device—who still look on it as a "laboratory curiosity." But not children! In 1956, REMCO, a large toy manufacturer, sold over 500,000 transistor radio kits through toy outlets. These kits retailed in the range of $7.00 to $10.00. If the interest in scientific toys is at all indicative of our young people's inclinations, we won't have to worry about any future "shortage" of engineers.

Readers' Circuits. Last month we featured a transistorized audio preamplifier and mixer . . . in response to a number of requests from hi-fi and audio enthusiasts. We've also received a good number of requests from another group . . . the hams. So here's a circuit for you fellows . . .

Stanley F. Kadron, W3WTV, of 3609 Latham Road, Baltimore 7, Md., proposes a simple c.w. monitor. In case you're not a ham and wonder what a "monitor" does, it's simply a device for listening to your own transmitter. In the case of a radio-telephone transmitter, a simple tuned circuit and crystal detector makes a fine monitor. But in the case of a c.w. transmitter, something is needed to convert the r.f. signal into an audible tone. In a receiver, the BFO (beat frequency oscillator) does this job.

Stanley's approach is to use a transistorized audio oscillator which, in turn, is powered by an r.f. signal picked up from the transmitter. Whenever a signal ("dot" or "dash") is transmitted, the oscillator operates.

The p-n-p transistor, TR1, is connected as a simple audio oscillator, with feedback provided by the center-tapped primary winding of audio transformer T1. Operating power is supplied by the r.f. signal picked up by the antenna, rectified by crystal diode CR1, and filtered by the r.f. choke (RFC1) and capacitor C3. Frequency of operation is determined by tuning capacitor C1, across T1's tapped coil.

Construction and wiring are non-critical. T1 can be practically any audio transformer with a 4000 to 10,000 center-tapped wind-
lowed by a three-stage resistance-capacity-coupled transistorized audio amplifier. In operation, r.f. signals picked up by the antenna are selected by tuned circuit L1-C1 and detected by a crystal diode (CR1). The resulting audio signal is amplified by transistors TR1, TR2, and TR3, with the final output signal driving a pair of magnetic headphones.

Standard components are used throughout. L1 is a Ferri-Loopstick, CR1 a standard crystal diode such as a 1N48 or 1N34, and the r.f. choke (RFC1) a 2.5-mhy. unit. The capacitors may be paper, mica, or ceramic; the two resistors are ½-watt carbon units. B1 is a three-volt battery made up by connecting two No. 7 cells in series. Moderate (1000-ohm to 4000-ohm) impedance magnetic headphones may be used.

According to Mike, the antenna is not especially critical...he indicates that he has had good results using only a 3' "whip" antenna.

With the values specified, reception is limited to a portion of the AM broadcast band, depending on the value of C1. You select the desired station by adjusting L1's iron core. If you would like to tune the entire band, you might replace C1 with a 365-µfd. tuning capacitor...an Argonne Type AR-94 would be a suitable choice.

The Tetrode Transistor. The junction tetrode transistor, not as well known as the popular triode transistor, has potential applications in many fields but particularly in high-frequency communications. The tetrode is very similar to a junction triode...with but one change. An additional connection is made to the base electrode, just opposite the "conventional" lead connection. In use, d.c. voltages of opposite polarity are applied to the two base connections.

The diagram at the right shows two resistance-coupled single-stage amplifiers. A triode circuit is given at (A)...a tetrode circuit at (B). In both circuits, C1 is the input coupling capacitor, C2 the output capacitor; R1 is the base bias resistor, R2 the collector load resistor; base bias current is supplied by B1, collector bias by B2. Circuit (B) differs only by the addition of the second base bias battery, B3, and its associated resistor R3. The second base connection is identified as B0. Voltage polarities shown are for n-p-n transistors.

In operation, the effect of the reversed bias on the second base lead is to reduce the effective conducting path between emitter and collector, forcing conduction to take place in the immediate vicinity of B0's lead connection. This reduces the power rating of the transistor and, at the same time, lowers the transistor's inter-electrode capacity and base resistance. The net result is to increase the upper frequency limit of the transistor at the expense of a reduced power rating.

Thus, tetrode transistors may be used at much higher frequencies than conventional (Continued on page 120)
HEATHKITS... are fun to build, and you save by dealing directly with the manufacturer!

It's easy to follow simple step-by-step directions with large pictorial diagrams as your guide. You save labor costs and get more real quality for less money. Your greatest dollar value in fine kit-form equipment.

BUDGET YOUR PURCHASE...

We invite you to take advantage of the HEATH TIME PAYMENT PLAN on any order amounting to $90 or more. Just 10% down, and the balance in twelve easy monthly payments. Write for complete details.

Largest selling VTVM in the world!
... etched circuit board

HEATHKIT VACUUM TUBE VOLTMETER KIT

Sensitivity and reliability are combined in the V-7A. It features 1% precision resistors, large 4½" panel meter, and etched circuit boards. AC (RMS) and DC voltage ranges are 0-1.5, 5, 15, 50, 150, 500 and 1500. Peak-to-peak AC ranges are 0-4, 14, 40, 140, 400, 1400 and 4000 volts. Ohm-meter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K and X1 megohm.

MODEL V-7A
$24.50
Ship. Wt. 7 lbs.
$2.45 Own., $2.06 h.3.

New improved...
full 5" size
... etched circuit for only

$42.50
Ship. Wt. 21 lbs.
$4.25 Own., $3.97 M.0.

HEATHKIT 5" PUSH-PULL OSCILLOSCOPE KIT

This new and improved oscilloscope sells for less than the previous model. You can have a full 5" oscilloscope at the remarkably low price of only $42.50. The OM-2 provides wider vertical frequency response, extended sweep generator coverage, and increased stability. Vertical channel is essentially flat to over 1 MC, and down only 6 DB at 1.5 MC. Amplifiers are push pull, and modern etched circuits are employed in critical parts of the circuit. A 5BP1 cathode ray tube is used. The scope features external or internal sweep and sync, one volt peak-to-peak reference voltage, three-position step attenuated input, adjustable spot shape control, and many other "extras."

Compact, portable...
a favorite in the home
and in the service shop

HEATHKIT
HANDITESTER KIT

Measures AC or DC voltage at 0-10, 50, 300, 1000, and 5000 volts. Direct current ranges are 0-100MA and 0-1000MA. Ohmmeter ranges are 0-3000 and 0-300,000 ohms. Sensitivity is 1000 ohms/volt. Features small size and rugged construction in sleek black bakelite case.

MODEL M-1
$14.50
Ship. Wt. 1 lb.
$1.15 Own., $1.22 M.O.

HEATH COMPANY • BENTON HARBOR 10, MICH.
A Subsidiary of Daystrom, Incorporated

May, 1957

www.americanradiohistory.com
HEATHKIT NEW MODEL
CW TRANSMITTER KIT

Here is a straight-CW transmitter that is one of the most efficient rigs available today. It is ideal for the novice, and even for the advanced-class CW operator. This 50 watt transmitter employs a 6DQ6A final amplifier, a 6CL6 oscillator, and a 5U4GB rectifier. It features one-knob band switching to cover 80, 40, 20, 15, 11 and 10 meters. It is designed for crystal excitation, but may be excited by an external VFO. A pi network output circuit is employed to match antenna impedances between 50 and 1000 ohms. If you appreciate a good signal on the CW bands, this is the transmitter for you!

POPULAR WITH SERVICEMEN
HEATHKIT
RF SIGNAL GENERATOR KIT

Produces RF signals from 160 KC to 110 MC on fundamentals on 5 bands, and covers 110 MC to 220 MC on calibrated harmonics. Output may be pure RF, RF modulated at 400 CPS, or audio at 400 CPS. Prealigned coils eliminate the need for calibration after completion.

FULL SET OF COILS INCLUDED WITH KIT
HEATHKIT GRID DIP METER KIT

An instrument of many uses for the ham, experimenter, or serviceman. Useful in locating parasitics, neutralizing, determining resonant frequencies, etc. Covers 2 MC to 250 MC with prewound coils. Use to beat against unknown frequency, or as absorption-type wavemeter.
EASY TO BUILD
...A "LEARN-BY-DOING" EXPERIENCE
HEATHKIT BROADCAST BAND
RECEIVER KIT
You need no previous experience to build this table-model radio. It covers 550 KC to 1620 KC and features good sensitivity and selectivity. A 5½" speaker is employed, along with high-gain miniature tubes and a new rod-type antenna. The power supply is transformer-operated. The kind of a set you will want to show off to your family and friends. Construction is simple. You "learn by doing" as the project moves along.


MODEL BR-2
$18.95
incl. Fed.
Excise Tax
Shpg. Wt. 10 lbs.

MODEL CR-1
$7.95
incl. Fed.
Excise Tax
Shpg. Wt. 3 lbs.
$5.80 DWN.,
$5.67 MO.

REAL HI-FI PERFORMANCE
AT MINIMUM COST
HEATHKIT 7-WATT
AMPLIFIER KIT
This 7-watt amplifier is more limited in power than other Heathkit models, but still qualifies for high fidelity, and its capabilities exceed those of many so called "high fidelity," phonograph amplifiers. Using a tapped-screen output transformer, the model A-7D provides a frequency response of ± 1½ DB from 20 to 20,000 CPS. Total distortion is held to surprisingly low level. The output stage is push-pull, and separate bass and treble tone controls are provided.
Model A-7E: Similar to the A-7D except that a 12SL7 tube has been added for preamplification. Features two inputs, RIAA compensation, and extra gain. $20.35, incl. Fed. Excise Tax, $2.04 dwn., $1.71 mo.

MODEL A-7D
$17.95
incl. Fed.
Excise Tax
$1.80 DWN.,
$1.51 MO.
Shpg. Wt. 10 lbs.

FOR AMATEUR OR PROFESSIONAL
PHOTOGRAPHERS
HEATHKIT
ENLARGER
TIMER KIT
This is an easy-to-build device for use by photographers in controlling their enlarger. It covers the range of 0 to 1 minute with a continuously variable control. Handles up to 350 watts. Timing cycle controlled electronically for maximum accuracy.

MODEL ET-1
$11.50
Shpg. Wt. 3 lbs.
$1.15 DWN.,
$0.97 MO.

HEATH COMPANY • BENTON HARBOR 10, MICH.
A Subsidiary of Daystrom, Incorporated

May, 1957
NEW EDGE-LIGHTED TUNING DIAL FOR IMPROVED READABILITY

HEATHKIT HIGH FIDELITY FM TUNER KIT

This FM tuner can provide real hi-fi performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature compensated oscillator, AGC, broad-banded IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A ratio detector is employed for high efficiency, and all transformers are prealigned, as is the front end tuning unit. A new feature is the edge-lighted dial for improved readability, and a new dial cord arrangement for easier tuning. Matches the models WA-P2 and BC-1. Easy to build.

MODEL FM-3A
$25.95
Incl. Fed. Excise Tax (with cabinet)
Shpg. Wt. 7 lbs.

MODEL BC-1
$25.95
Incl. Fed. Excise Tax (with cabinet)
Shpg. Wt. 8 lbs.

NEW EDGE-LIGHTED TUNING DIAL MATCHES MODEL FM-3A

HEATHKIT BROADBAND AM TUNER KIT

The BC-1 was designed especially for high fidelity applications. It features a low-distortion detector, broad band IF's, and other characteristics essential to usefulness in hi-fi. Sensitivity and selectivity are excellent, and audio response is within ±1 DB from 20 CPS to 2 KC, with 5 DB of pre-emphasis at 10 KC to compensate for station rolloff. 6 DB signal to noise ratio at 2.5 UV. Covers 550 to 1600 KC. RF and IF coils are prealigned, and the power supply is built in. Features AVC, 2 outputs, and 2 antenna inputs. Tuning dial is edge-lighted for high readability.

MODEL A-9B
$35.90
Shpg. Wt. 23 lbs.
$35.95 DWN., $2.98 MO.

FULL 20 WATTS FOR PA OR HOME APPLICATIONS

HEATHKIT 20-WATT AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installation, but used extensively for public address applications. True high-fidelity performance with frequency response of ±1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

HEATH COMPANY • BENTON HARBOR 10, MICH.
A Subsidiary of Daystrom, Incorporated

Always say you saw it in—POPULAR ELECTRONICS
FEATURES GOOD LOOKS AND HIGH PERFORMANCE

HEATHKIT HIGH FIDELITY SPEAKER SYSTEM KIT

The model SS-1 covers 50 to 12,000 CPS within ±5 DB, and can fulfill your present needs, and still provide for the future. It uses two Jensen speakers and has a cross-over frequency of 1600 CPS. The speaker system is rated at 25 watts, and the impedance is 16 ohms. The enclosure is a ducted-port bass reflex type and is most attractively styled. It is easy to build and can be finished in light or dark stain to suit your taste.

MODEL SS-1
$39.95
$4.00 DWN., $3.36 M0.
Shpg. Wt. 30 lbs.

ATTRACTIVE STYLING MATCHES MODEL SS-1
HEATHKIT HIGH FIDELITY RANGE EXTENDING SPEAKER SYSTEM KIT

The SS-1B is designed especially for use with the model SS-1. It consists of a 15" woofer and a compression-type super tweeter to add additional frequency coverage at both ends of the spectrum. Cross-over frequencies are 600, 1600, and 4000 CPS. Together, the two speaker systems provide output from 35 to 16,000 CPS within ±5 DB. The kit is easy to assemble with precut and predrilled wood parts. Power rating is 35 watts, and impedance is 16 ohms.

MODEL SS-1B
$99.95
$10.00 DWN., $8.40 M0.
Shpg. Wt. 80 lbs.

Free 1957 CATALOG

Our new 56-page 1957 catalog describes more than 75 different kit models for experimenters, hams, students, engineers, industrial laboratories, etc. Send for your free copy now!

HOW TO ORDER

It's simple — just identify the kit you desire by its model number and send your order to the address listed below. Or, if you would rather budget your purchase, send for details of the Heath Time Payment Plan!

ORDER BLANK

HEATH COMPANY • BENTON HARBOR 10, MICH.
A Subsidiary of Daystrom, Incorporated

Name
Address
City, Zone, State

Quantity Item Model No. Price

Enclosed find □ check □ money order for
□ Parcel Post □ Express □ Freight □ Best Way

POSTAGE

On parcel post orders include postage for weight shown. Orders from Canada and APO's must include full remittance. NOTE: All prices subject to change without notice.

SHIPPING WEIGHT

80 lbs.

TOTAL

May, 1957
WHAT'S THE PE ANSWER?

ANOMALOUS PROPAGATION

In an old issue of RADIO magazine (now discontinued), I saw the term "anomalous propagation." Then I saw it again in a book on radar that was written in 1946. My latest books contain no information on this term. What does it mean? ROY MacDONALD San Diego, Calif.

The phrase "anomalous propagation" appears to have originated during World War II. Both American and British scientists referred to it as "anomalous propagation" when their radars performed beyond their expectations. Present-day radars are able to distinguish between unusual effects that troubled early radar investigators. Most scientists would agree that "anomalous propagation" was really another word for freak radar conditions due to the weather.

Radar signals will sometimes travel extraordinarily long distances if a particular type of meteorological inversion exists. In your location, it is not unusual for radars to pick up airplanes twice as far away as theory predicts. In 1943-45, this would have been referred to as an "anomalous propagation" effect. We now know that it is due to the high-level subsidence in your usual high pressure area. Or, in other words, it is due to a layer of very dry, warm air over a surface layer of cool, moist air. Such an inversion "guides" the radio waves over longer distances than radars usually cover.

WHAT IS A "PICOFARAD"?

The British magazines use the abbreviation "pf" in rating capacitors. Is this something new? STANLEY SMITH New York, N. Y.

No; "pf," or "picofarad," is used in Europe in place of the American μfd., or micromicrofarad. They also use the μfd., or microfarad, but see no reason to add confusion when the value of the capacitor becomes very small. Although "pf" has been introduced several times in the United States, it has never caught on, or been accepted by the Radio-Electronics-Television Manufacturers Association.

CROSSOVER NETWORK THEORY

With reference to your article on crossover networks (January, 1957) I am confused over the matter of impedance matching. In the circuit shown on page 72 of that issue, if the voice coil of each speaker is 8 ohms, should the 4-, 8-, or 16-ohm terminals of the amplifier be used?

On the other hand, if the 6-decibel series circuit shown on page 71 is used with 8-ohm voice coils, which output terminals of the amplifier should be used?

Also, if the 12-decibel circuits are used, are the capacitance and inductance values the same as in the 6-db circuits?

Z. D. HARDING Los Angeles, Calif.

Do not confuse "6 db" and "12 db" with impedance ratings. The former apply only to the rate of signal attenuation at the crossover frequency. The 4-, 8-, and 16-ohm figures refer to the impedances of speaker voice coils and amplifier output terminals. These should always match as closely as possible, regardless of the type of crossover network used.

Quite possibly, part of your misunderstanding may stem from the well-known rule of loads in parallel and in series. It is perfectly true, for example, that two 8-ohm speakers in parallel present a total impedance of 4 ohms. Connected in series, they present an impedance of 16 ohms. When they are used with crossover networks, however, this rule doesn't apply in the same way, because the reactances—set up by the capacitors and coils employed—add their own impedance effects to each speaker line. As a result, the entire speaker system may be connected to the same amplifier terminal as would be used for only one speaker without a crossover network. In other words, if 8-ohm speakers are used, with a crossover network, connect to the 8-ohm terminal on the amplifier.

The values of coils and capacitors are slightly different in a 12-db network than in the 6-db network. To find the 12-db value, multiply the value of the coil used in the 6-db circuit by 1.41; then divide the value of the capacitor by 1.41.
$100,000 INVENTORY SALE!

NEW! COMPLETELY WIRED!
6-TRANSISTOR RADIO

POCKET SIZE SUPERHERET
REGULAR PRICE $58.00, only

$34.88

Exclusive! Outstanding ALL-TRANSISTOR pocket-size superhet radio with all transistors fully wired, tunable and controllable directly from the printed circuit. Super, top-notch craftsmanship, unusual sensitivity and selectivity. COMPLETELY WIRED, ready to play, with built-in ferrite antenna, microphone, speaker. Transistorized, sharply tuned H-F transformer coupled to push-pull transistor output for maximum power! Built on Single 9 volt mercury battery (64 extra). Finger-tip tuning, with sub-mini 2-gang variable condenser, separate controls. Superb!

60 TUBULAR CONDENSERS. 60 types, 0.0005 to 0.05 mf to 1100v, Wt. lbs. Reg. $12.50.

70 RESISTORS. Insulated 18c. A-B, etc. 8 ohms to 10 meg. $1 each, 16 for $8. Reg. $1.50.

45 STANDARD MINIATURE 1/2" & HS PLATES.

50 TERMINAL STRIPS and boards; 15 types, 1 to 20 screw cap leads, Wt. 1 lb, Reg. $5.

100 RADIO PARTS including resistors, condensers, lamp bases, etc. Wt. 2 lbs, Reg. $6.50.

70 MICA CONDENSERS.

50 PRINTED CIRCUITS.

EMERSON TUNER, Hi-Q, permeability 6000, 0.01 m. Reg. $12.50.

2 SPRAGUE WHITE AND 2-1/2" PLATE CAPACITORS.

25 SPRAGUE BLACK BEAUTIES, molded condensers. 0.001 to 0.1 mf, 1100v. Wt. 1 lb, Reg. $8.50.

30 POWER RESISTORS.

8 CONNEXION WIRE, random, stranded wire, 0.020 to 0.1100v. Wt. 2 lbs, Reg. $1.50.

World's Smallest Speaker

Only 1 1/4" sq. For transistor radios, etc. 1 oz. magnet, 4 or 10 ohm v.e. available. Wt. Reg. $5.50.

2 TRANSISTOR LOOPSTICKS. 1115 & 1117. For use with, or as part of, your tube radio, for best selectivity & sensit. Wt. 1 lb, Reg. $3.

30 PRECISION RESISTORS. WW & cartfilm, 20 values. $1 each. Wt. 1 lb, Reg. $2.50.

10 USE SADDLES. 4-prong, Transistor & printed circuit, dup. 5 or 10c each, as desired. Wt. 1 lb, Reg. $1.

15 TRIMMERS. assd. values, mini type. Reg. $1.25 each.

2 CONTACT CONTROLS. Single, 2 stage, Duplex, Wt. 1 lb, Reg. $1.50.

25 CONTROL DIODES, 1N21, 1N22. ASSTD. Wt. 5 lbs, Reg. $10.

20 PRINTED CIRCUITS. Assd. values, 0.0001 to 5000 microfarad. Wt. 1 lb, Reg. $5.

3 AC-DC CHOKES. 600 ohms, 75 ma. For battery power supply, push-pull output stage, etc. Wt. 9 lbs. Reg. $1 each.

10 TRANSISTOR TUBE, electrical, plastic, friction, rubber. For push-pull or isol. Wt. 9 lbs, Reg. $3.

MINI-METER BUYER! 1/4" round, charton. Various Hi-Q needles, Wt. 9 lbs. Reg. $10 to 1000 each, Reg. $5.

40 MINIATURE CONDENSERS. 1/2" miniature printed circuit types; Condensers, Spares.

40 MINIATURE RESISTORS in 18 values, 10 ohms to 10 meg. Wt. 1 lbs, Reg. $5.

25 SPRAGUE BLACK BEAUTIES, molded condensers. 0.001 to 0.1 mf, 1100v. Wt. 1 lb, Reg. $8.50.

24 SPRAGUE WHITE AB, tube fil., 50 to 1500 ohms. Wt. 2 lbs, Reg. $10.

25 SPRAGUE BLACK BEAUTIES, molded condensers. 0.001 to 0.1 mf, 1100v. Wt. 1 lbs, Reg. $5.

25 SPRAGUE BLACK BEAUTIES, molded condensers. 0.001 to 0.1 mf, 1100v. Wt. 1 lbs, Reg. $5.

8,000-ohm Dynamic Phone


FREE! ANY $1 ITEM IN THIS AD FREE
WITH ANY $10 ORDER!

WRITE TODAY FOR OUR FREE
8-PAGE SPRING FLYER
of EXCLUSIVE BARGAIN AND BONUS ITEMS!

SUPER SOLAR BATTERY

Outfitters formed 1899 many times never wears out! 2-1/4" x 1-1/2" molded case w/off grid windup a must for all sun battery uses. Plug-in type.

$2.98

MONEY BACK GUARANTEE

ANY SIZE ORDER ENROLLS YOU IN OUR CREDIT-BONUS PLAN

ORDER BY "BLACK TYPE" HEADLINES i.e. "ONE MINI-METER BUY, $1"
Send check or MO including sufficient postage; excess returned. C.O.D. orders, 25% down, Rated, net 30 days.

MONEY-BACK GUARANTEE OF SATISFACTION

/worldfamousdollargifts.com

131-133 Everett Ave.
Chelsea, Mass.

May, 1957
Hellishcopter
(Continued from page 74)

this baby out so thoroughly—both electronically and mechanically—that only a windstorm could make it act erratically!"

"I envy you your confidence," she said.
"You'll see," I promised, picking up the rather large model and carrying it outdoors. "Why, even a mor—uh . . . even you could fly this little gem! And to show you how sure I really am, I'll let you have the pleasure of piloting its test flight!"

CAREFULLY placing the helicopter on the lawn, I set about starting the modified mower motor. A moment later, it exploded into action and I stepped out of the range of the three-foot-long rotor-blades which began slashing efficiently in a blurred orbit above the helicopter. I hurried over to the wife. She clutched the transmitter unit nervously, her eyes held to the helicopter with anxious fascination.

"It's running in neutral now," I told her.
"Punch that button marked Up."

She did and the pint-sized whirlybird slowly, smoothly rose from the ground. Two feet . . . five feet . . . eight feet . . . higher and higher it climbed, revolving in a circle as it ascended, the rotors screaming noisily. "Now, correct that revolving motion—punch the Forward button," I shouted. "It can't be tilted. That's a perfect forward position!"

She jabbed the button, desperately, and the little whirlybird began slowly flying across the yard.

"See!" I yelled. "It goes just like the real thing!"

"Here, you take it!" she screeched nervously, holding out the transmitter unit to me. "I—don't w-want to r-run it a-again! Take it!" Without warning, she all but threw the transmitter at me. I grabbed it, missed, and the unit smashed to the ground. Frantically, I snatched it up.

It rattled ominously.

"Why did you do that?" I yelped. "I think you've busted something!" Gently, I shook the unit again. It rattled all right.

"Look at the gizmo!" she screamed.

Above us, the helicopter suddenly shot upwards about thirty feet, tilted to the starboard and shot off across the rooftops. Twice, before it flew out of sight, I saw it drop to within three feet of the ground, whip around in crazy maneuvers, and then steadily climb back into the sky. Now its clatter was fading into the distance. We stared, horrified, as it zoomed behind a row of trees several back yards away.

"I knew it! I knew it!" wailed the wife.
"I just knew it would happen! Every time (Continued on page 102)
Below Is A Partial List—Send For FREE Complete List and Order Form

**STANDARD LINE**

**TUBES**

- INDIVIDUALLY BOXED!
- GUARANTEED ONE YEAR!
- FACTORY BOXED • FACTORY IRREGULARS
- NEW JAN SURPLUS • EQUIPMENT TUBES

 Always 1000 Types in Stock

FREE POSTAGE! On All Orders Shipped in U.S. Territories and A.P.O.'s. Send 25c for handling on orders under $5.00. Please send appros. postage on Canadian and foreign orders. Excess will be refunded.

**Trade-In TVs**

Please Specify Console or Table Model When Ordering.

**FREE** 16" TV SET with every receiving tube order of $200.00 or more!

**FREE!**

**TWO SET COUPLER WITH EVERY TUBE ORDER OF $8.50 OR MORE!!**

Remember — You Buy Quality When You Buy Standard. Quality Never Shouts — It Always Whispers

May, 1957

Stanard Line ELECTRIC COMPANY

432 Harrison Avenue, Harrison, N. J. — Phone: Humboldt 4-4997
LAFAYETTE

6 TRANSISTOR SUPERHET RECEIVER KIT GIVES SUPERB PERFORMANCE . . . INCOMPARABLE VALUE

- 100% SUBMINIATURE PARTS—NO COMPROMISES!
- LABORATORY DESIGNED—SENSITIVE, SELECTIVE, STABLE!
- CLASS B PUSH-PULL AMPLIFICATION—PLENTY OF POWER!

Lafayette is proud to present its 6 Transistor Superhet Receiver Kit KT-110. This kit represents the utmost in sensitivity, selectivity and stability. You'll be elated at its superior commercial quality! You'll be elated with its surprising performance! The circuit uses 3 high frequency RF Transistors, 3 dependent audio Transistors and Crystal Diode and features a specially matched set of 2 LP'S, Oscillator, Superhet, Class B Push-Pull Audio Amplification, and Transformer Coupling in audio and output stages. Special care has been taken in the design for exact impedance matching throughout to effect maximum transfer of power. Has efficient 2 ½" speaker, and delivers back for private listening. Complete with all parts, transformers, pre-punched chassis, battery and easy-to-follow step-by-step instructions. 9" x 3 ½" x 1 ½". Shpg. wt., 3 lbs.

KT-110—Complete KT-110 Kit—Less Case..........................Net 33.50
MS-339—Sturdy, attractive brown leather case with carrying strap for KT-110 Net 2.95
MS-279—Sensitve matching earphone...............................................Net 2.39

4 AND 6 TRANSISTOR RADIO KITS FOR SPEAKER AND EARPHONE OPERATION

- FOR GROUP AND PRIVATE LISTENING
- ONLY 6" WIDE X 3 ½" HIGH X 1 ½" DEEP

Completely self-contained, subminiaturized portable operates a miniature earphone for individual listening. Uses ultra-subminiature "Poly-Vari-Core" miniature tube. Output is fed to speaker or earphone. Extremely sensitive, stable and selective over entire broadcast band. Requires no outside antenna or ground connection. Kit supplied complete with transistors, all parts, drilled chassis, battery, and instructions with wiring diagram. Shpg. wt., 2 lbs.

KT-94—4 Transistor Kit as above Net 19.95
MS-311—Leather Carrying Case.............................................Net 1.95
KT-260—Super Dynamic Earphone...........................................Net 3.95
MS-278—Economy Earphone................................................Net 1.95

2 TRANSISTOR CLASS B PUSH-PULL OUTPUT SPACE KIT WITH SPEAKER SELF-CONTAINED IN HANDSOME PLASTIC CASE

Converts KT-94 into a 4-transistor home radio with speaker. Complete Kit with 2 transistors, 3 transformers, 3/4" FM speaker, pre-punched chassis, battery, case and instructions. KT-96—Shpg. wt., 1 lb. ........................................Net 11.50

FM-AM TUNER KIT

Basic FM-AM Tuner
having outstanding specifications and delivering astonishing performance — all at a budget price in easi
ly assembled kit form.

34.95

- ACF DEFEAT CIRCUIT WITH FRONT PANEL CONTROL
- FOSTER-SHELEY DISCRIMINATOR CIRCUIT
- GROUNDED GRID TRIODE AMPLIFIER
- 20-20,000 CPS RESPONSE

Choose this 7 tube compact high-fidelity FM-AM tuner whose characteristic features are found in units costing many times as much, and whose performance is unheard of at this low price. There are two front panel controls, a function control for AM, FM, PHONO, TV and a tuning/ACF defeat control. Features Armstrong FM circuit with limiter and Foster-Seeley discriminator, Simplified tuning with slide-rule dial and flywheel counter-weighted mechanism, high impedance phono input and high impedance audio output.

SPECIFICATIONS

FREQUENCY RANGE: FM 88-108MC, AM 530-1550 KC.
ANTENNA INPUT: FM: 300 ohms, AM Ferrite loopstick and high impedance external antenna.
DISTORTION: Less than 5% at rated output.
FREQUENCY RESPONSE: FM .5 db 20 to 20,000 cps, AM ± 3 db 20 to 5000 cps. SENSITIVITY: FM 5 UV for 59 db quieting, AM, Loop sensitivity 60 UV/minute.
SELECTIVITY: FM: 200 KC bandwidth, 6 db down; 376 KC FM discriminator peak-to-peak separation, AM: 0 KC bandwidth, 5 db down. IMAGE REJECTION: 30 db minimum.
HUM LEVEL: 60 db below 100-50 modulation.
TUBE COMPLEMENT: 212-AF, 1-6865, 1-866, 2-6UG, 1-6545 plus selenium rectifier. SIZE: 5 ¼" x 9 ½" x 9 ½" deep (approx. knobs not included). WEIGHT: 30 watts. For 110-120V 60 cycles AC. Attractive etched copper-plated and lacquered finish. Less metal case, Shpg. wt., 9 lbs.

KT-100A—Metal cage for above, Shpg. wt., 3 lbs. .... Net 34.95
ML-100—Metal case for above, Shpg. wt., 3 lbs. .... 5.00

LAFAYETTE SIGNAL GENERATOR

COMPLETELY WIRED AND TESTED! ACCURACY AND QUALITY GUARANTEED!

22.50

- FREQUENCY 120KC to 260MC!
- 120KC to 120MC ON FUNDAMENTALS!
- 30 DAY TRIAL PERIOD! FULL REFUND IF YOU ARE NOT SATISFIED FOR ANY REASON

Completely wired and tested instrument. Do not confuse with kits sold in the same price range. Has the quality and accuracy of instruments selling for 3 to 4 times as much. Six operating ranges: 120KC to 320KC, 320KC to 1000KC, 1KC to 3.2MC, 3.2MC to 30MC, 30MC to 90MC, 90MC to 1MC. All on fundamentals — calibrated harmonics from 120MC to 260MC. Switch between internal modulation at 400 cps or any external source at other frequencies. Switchable volume control. Use as below 120MC or forjt. outputs are unmodulated RF, modulated RF and 400 cps audio. RF output is in excess of 10,000 micro volts. Jacks are provided for high or low RF output. Highly stable special circuit design. Fine adjustable RF control. AF output 2-5 volts, input 4 volts, across 1 megohm. 5 inch etched dial plate — protected by clear plastic bezel. Common AF terminals for KEY-NOT and INT-OUT. INT-AF output eliminates need for special connectors. Gray metal case — carrying handle — complete with leads, fine cord and plug. For 115-220V, 60-60 cycle AC. Shpg. wt., 8 lbs.

LSG-10—Signal Generator ................................................22.50

LAFAYETTE Radio

165-08 Liberty Ave.
JAMAICA 33 N.

100 SIXTH AVE. NEW YORK, N.Y.

PIONEER, N. J., 119 W. St.
RITCHIE MFG. CO., 80 Federal St.
BROOKLYN 58, N. Y., 542 E. Fordham Rd.
NEWARK 7, N. J., 3-26 Central Ave.
Include postage with order.

American Radio History

Always say we saw it in—POPULAR ELECTRONICS
3 TRANSISTOR HI-FI PREAmPLIFIER KIT


5 TRANSISTOR PUSH PULL AMPLIFIER KIT

A 1/4 WATT CLASS B PUSH-PULL OUTPUT

NEW 5 TRANSISTOR AUDIO AMPLIFIER FOR PHONOS-MICROPHONES—UNIVERSAL—EXCELLENT FOR THE EXPERIMENTER—STUDENT—OR ANY ONE DESIRING TO FABRICATE HIS OWN GOOD TRANSISTORIZED AMPLIFIER


KT-184—3.2 ohm output. Net 22.95.
KT-185—5 ohm output. Net 22.95.

TRANSISTOR CODE PRACTICE OSCILLATOR KIT

For those interested in mastering the international code, an audio tone oscillator is enclosed in this kit. This is a high frequency oscillator which can be used to practice code. It may be used in the classroom or at home. It is easily constructed. Includes schematic diagram.


2 TRANSISTOR POCKET RADIO KIT

Packed into a 2¼"x1¼"x1½" plastic case. New Two Transistor plus crystal diode radio kit offers many surprises: utilizes a regenerative detector circuit with transformer coupling. Excellent sensitivity. Ranges: 2000-12,000 kHz. Includes detailed instructions. Size: 4 1/4" x 2 1/2" x 1". Net 11.95.

KT-188A—Complete kit less earphone. Net 10.95.


NEW POCKET AC-DC VOM MULTITEMETER

2,000 ohm per Volt on AC & DC

COMPLETELY WIRE—NOT A KIT

Accurate VOM with a sensitivity of 2000 ohms per volt on both AC and DC. Single selector switch. 3" 160 amp. meter. Scales: DC Volts: 0-10-50-100-1000; AC Volts: 0-10-50-100-1000; Ohms: 0-10k, 0-1 kohms; DC Current: 600 ma and 500 ma; Decibel: 20 to -22; ±20 to ±60; Capacity: 250 mmf to 2 mfd and .001 to 1 mfd. Heavy plastic panel, metal knobs, and molded case, Size: 4 1/4" x 3 1/2" x 1/2".

With batteries and test leads. Shpg. wt. 4 lbs. RW-27A. 8.95.

LAFAYETTE CATALOG

FREE! LAFAYETTE CATALOG

3 TRANSISTOR SUPERHET POCKET RADIO KIT

A TRUE POCKET SUPERHET RECEIVER—NO EXTERNAL ANTENNAS

A remarkable sensitive, super-selective pocket superhet receiver with astonishing performance over the complete broadcast band. Uses 2 high-frequency and one audio transistor plus efficient diode detector and features 2 specially matched IF transformers for maximum power transfer. The components are housed in a finished injection molded plastic case.

The receiver's appearance enhanced by attractive maroon and silver station dial. Sensitivity built-in superhet antenna eliminates need for external antennas. A designer's dream in a true pocket superhet receiver! Complete with all parts, transistors, instructions, parts, etc. and easy to follow step-by-step instructions. 4 1/4" x 2 1/4" x 1 1/8". Shpg. wt. 1 lb.


1 AND 2 TRANSISTOR POCKET RADIO KITS

ONE TRANSISTOR POCKET RADIO KIT—KT-97

• IDEAL FOR STUDENTS, HOBBY-ISTS AND EXPERIMENTERS

• PRE-PUNCHED CHASSIS FOR ADD-ON-MENT TO 2 TRANSISTOR KIT

KT-97—Complete 2 Transistor Kit, less earphone. Net 9.75.

20,000 OHMS PER VOLT MULTITEMETER SEMI KIT

A new kind of kit—the difficult work is already done—you just wire it in and mount the battery holder to complete the unit. A fine high sensitivity (20,000 ohms per volt) AC instrument employing a 3" 40 microammeter movement. Has 4 DC voltage, 4 AC voltage, 3 DC current, 3 resistance and 2 ohm ranges. Complete with test leads and detailed instructions.

KT-20-KIT. Net 11.95.

SPECIALS!

Mail Order Center --------

NEW! Mail Order Center --------

ELECTRONIC CATALOG PACKED WITH MONEY SAVERS

Packed with the largest selection of Electronic, Radio and TV, Parts, and equipment. PA, Hi-Fi, systems, tubes, antennas, Transistor Kits, parts and components. Test Equipment now housed in one kit. Books, Microphones, drafting equipment, Binoculars, Telescopes, All Radio, TV and Ham supplies. ALL AT GREAT SAVINGS.—Get the economy-minded engineer, hobbyist, technician. CHUCK FULL OF BUYS! SEND FOR YOUR FREE COPY TODAY!
Dear Leo,

This is a letter of gratitude and appreciation. I want to thank you and your fine staff for manufacturing the little Globe Chief Transmitter. In my opinion the Chief is the finest transmitter that a novice can buy. It is undoubtedly the best transmitter under $100 that can be bought, and I think the Chief out performs transmitters in higher price ranges.

I have basis for my belief, Leo. In only one month and sixteen days, I have worked 43 states, three VE's, one VP7, and a 60. This is proof enough that the Chief is a great little transmitter. If every ham knew how good the Chief is and what kind of results I have obtained from it, you would be flooded with orders for the little fine transmitter. There are about 17 hams in Tifton, and they are all impressed with the Globe Chief I own. I, with the Chief, have worked twice as many states in one month as these hams in a year. As you are reading this letter, Leo, you are probably thinking, "This guy must stay on the air 8 hours a day to rack up so many states in a short time." Well, Leo, that seems to be what everybody thinks, but the truth is, I remain on the air for an average of 7 hours a week, about an hour a day, sometimes less than that. And, Leo, I'm just an average operator. I'm not a speed king with a key, I don't use a bug, and I don't use a fancy antenna. I owe everything I've accomplished to the Chief. It just goes to show what fine results can be obtained by using the Chief. In closing, let me say this, I will own WRL products for the rest of my ham career and I will always be assured that I will own the best.

Sincerely,
Bob Patrick KN4MGL
Box 330
Tifton, Georgia

And you can own the WRL "Chief"

Only $5.00 per mo.
or $49.95 Cash

Completely Wired:
$64.95 Cash


For Complete Information:
WORLD RADIO LABORATORIES
The World's Largest Distributor of Amateur Radio Equip.
3415 W. Broadway Council Bluffs, Iowa
PHONE 2-0277

---

Hellishcopter (Continued from page 98)

you start fooling around with these darned R/C—"

"WHO DROPPED THE TRANSMITTER?" I snapped savagely. "Come on, we've got to chase that baby and try to figure a way to catch it before—"

SOMEBODY — or something — screamed quite distinctly about half a block away. It was enough to curdle one's blood, that scream . . . especially if one happened to be responsible for letting a helicopter with three-foot-long blades loose in the neighborhood. Breaking into a gallop, I wondered how many years I'd get and if the wife would wait for me.

Suddenly the whirlybird appeared — chopping furiously across an empty lot, about ten feet off the ground — and veered sharply to port. I tried to head it off, but it climbed — just as I leaped, hoping to grab a pontoon — and chattered past me. Before I landed on my aching back I caught one short glimpse of a large and scrappy tomatoclinging to a pontoon, his yellow eyes blazing with madness. I hoped he accounted for the unholy scream.

"It went into Mrs. Millar's place!" babbled the wife, helping me to my feet. "Did you see that cat riding—"

"Saw it!" I agreed, and sprinted at a dead limp into the Millar yard. Ahead, I could hear the rise and fall of the mower-engine, its pitch changing. It's too much to hope for power failure, I thought, as I raced through a small vegetable garden, vaulted a fence and continued through somebody's roses, ignoring my wounds. That baby's good for another forty minutes, and when I think of the damage she can do in forty minutes . . .

I turned off the thought.

Again, suddenly, chillingly, somebody screamed with terror. I emerged into a back yard to see a matronly woman, her face blanched and twisted with fright, staring into the air. Twenty feet above her, flying in a wide circle and trailing a clothesline with several flapping items on it, was the errant helicopter — its motor snarling and coughing with almost vicious glee.

"Don't be alarmed, lady!" I gulped. "I'll try to—"

Just then she buried her head in her arms and mercifully passed out.

THE WHIRLYBIRD now widened its circle and I saw that it went by the limbs of a tall apple tree in the next yard with regularity. A desperate, unlikely idea popped into my mind. I streaked for the apple tree and began clambering up it. The helicopter passed twice before I made it to the limb
THE FINEST AND MOST COMPLETE LINE OF
Transistor Coils & I.F. Transformers

All loops described below have a secondary which is overcoupled for maximum gain stability with a variation in output load. Designed to match an input impedance of approximately 600 ohms.

These loops also make excellent antenna coils for conventional vacuum tube receivers. They offer better signal pickup and increased selectivity over ordinary air loops.

SUBMINIATURE ANTENNA LOOPS

An adjustable antenna coil with a high Q ferrite core. May be used with any variable condenser having a maximum capacity between 250 & 450 mmf.

Manufactured under XTRAN patents of and by Automatic Manufacturing Corp.

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Freq. Range</th>
<th>Tuning Cond.</th>
<th>Impedance</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2041</td>
<td>455 KC 25K-600 Ohms</td>
<td>Input</td>
<td>$2.85</td>
<td></td>
</tr>
<tr>
<td>2042</td>
<td>455 KC 25K-1000 Ohms</td>
<td>Output</td>
<td>$2.85</td>
<td></td>
</tr>
</tbody>
</table>

SUBMINIATURE

To our knowledge the 9-C1 and 9-C2 are the smallest I.F. transformers in existence. All technical specifications for the 2041 and 2042 apply respectively to the 9-C1 and 9-C2.

Dimensions: 9/16" sq. x 9/16" high.

Manufactured under XTRAN patents of and by Automatic Manufacturing Corp.

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Freq. Range</th>
<th>Tuning Cond.</th>
<th>Impedance</th>
<th>Use</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>9-C1</td>
<td>455 KC 25K-600 Ohms</td>
<td>Input</td>
<td>Use</td>
<td>$3.50</td>
<td></td>
</tr>
<tr>
<td>9-C2</td>
<td>455 KC 25K-1000 Ohms</td>
<td>Output</td>
<td>Use</td>
<td>$3.50</td>
<td></td>
</tr>
</tbody>
</table>

UNSHIELDED MINIATURE OSC.

These coils are designed for use in a converter circuit using only one oscillator for both the oscillator and mixer.

Dimensions: 9/16" x 1 1/4" long.

Manufactured under XTRAN patents of and by Automatic Manufacturing Corp.

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Max. Capacity</th>
<th>Freq. Range</th>
<th>Use</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>365 mmf.</td>
<td>455 KC</td>
<td>Occ.</td>
<td>$1.00</td>
</tr>
<tr>
<td>2020</td>
<td>78-100 mmf.</td>
<td>455 KC</td>
<td>Occ.</td>
<td>$1.00</td>
</tr>
</tbody>
</table>

SHIELDED SUBMINIATURE OSC.

The 2021 oscillator coil is a subminiature shielded version of the #2022 described above. Identical in size to our 9-C1 and 9-C2 I.F. transformers. Designed for use with a condenser having a maximum capacity of approximately 100 mmf. (Miller #2110). 9/16" sq. x 9/16" high.

Manufactured under XTRAN patents of and by Automatic Manufacturing Corp.

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Max. Capacity</th>
<th>Tuning Cond.</th>
<th>I.F.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>100</td>
<td>455 KC</td>
<td>Osc.</td>
<td>$2.50</td>
</tr>
</tbody>
</table>

ATTENTION CANADIANS!

ELECTRO SONIC

ELECTRO SONIC SUPPLY CO. LTD., Dept. TM-1, 543 Yonge St., Toronto 5, Canada
FREE Rush Catalog No. 571 to all leading radio and television parts distributors

J. W. MILLER COMPANY

5917 South Main Street * Los Angeles 3, Calif.
Crested Butte, Colorado | Atlas Redtie, Ltd., Toronto 10, Ont., Canada

103
Can you think faster than this Machine?

GENIAC set up to do a problem in check valve research

Be careful before you answer. GENIAC the first electrical brain construction kit is equipped to play Tic-tac-toe, cipher and anagram codes, add, subtract, multiply and divide. Solving problems in a variety of ciphers—actuarial, police and device, scientific problems transformed directly into circuit diagrams. You create from over 400 specially designed and manufactured components a machine that solves problems faster than you can express them.

MAIL THIS COUPON

SCIENCE KITS Dept. PE-572, Oliver Garfield Company 126 Lexington Avenue, New York 16, N. Y.
Please send me:
1 GENIAC Electric Brain Construction Kit and Manual.
$19.95 (East of Mississippi)
$20.95 (Elsewhere in United States)
$21.95 (Outside the United States)
Returnable in seven days for full refund if not satisfied.
I enclose $... in full payment.

Always say you saw it in—POPULAR ELECTRONICS
Uniform high quality and longer life are reasons why Burgess batteries are standard equipment in many complex electronic machines of our age. These same qualities, plus engineering know-how, fit Burgess batteries into everyday industrial applications. Illustrated are just a few of Burgess battery applications. Call on Burgess today!
your present speaker in a

KARLSON
TRANSUDER

CAN GIVE YOU
10x THE
EFFICIENCY!
✓ 2x the dispersion!
✓ 2 more octaves bass!
✓ Flatter response - Less distortion!
✓ Unexcelled transient response!

TIPS and
TECHNIQUES

SHOELACE SPAGHETTI

Pieces of ordinary shoelace may be used as spaghetti for insulating connecting wires inside motors. The coils and wiring are doped with insulating varnish on finishing each job so the lace is satisfactory. It can also be used for insulating splices and soldered connections, as shown here. After slipping the laces over the wires, a coat of varnish finishes the job. —K. M.

COVERING TABLE RADIO CABINETS

Self-adhesive plastic material may be used to dress up an old cabinet. Before applying, smooth out the scratches with emery paper or fine sandpaper, and remove dirt or grease with soap and water or kitchen scouring powder. Be careful when cleaning the front of the cabinet, or

KARLSON ASSOCIATES INC.
Dept. PE, 1610 Neck Rd. Bklyn. 29, N.Y.

IN EASY-TO-ASSEMBLE
KITS from $18.60
to $57 net.
Also assembled models from $26.70 to $174.

SHOELACE SPAGHETTI

Pieces of ordinary shoelace may be used as spaghetti for insulating connecting wires inside motors. The coils and wiring are doped with insulating varnish on finishing each job so the lace is satisfactory. It can also be used for insulating splices and soldered connections, as shown here. After slipping the laces over the wires, a coat of varnish finishes the job. —K. M.

COVERING TABLE RADIO CABINETS

Self-adhesive plastic material may be used to dress up an old cabinet. Before applying, smooth out the scratches with emery paper or fine sandpaper, and remove dirt or grease with soap and water or kitchen scouring powder. Be careful when cleaning the front of the cabinet, or
any other part of the cabinet not to be covered with the plastic material, as some of the older or cheaper cabinets have a color coating which dissolves and comes off when washed with soap and warm water, or cleaned with scouring powder. —A. T.

LOUDSPEAKER RATTLE

Loudspeaker rattle is often due to warped cones or to the voice coil rubbing the magnet pole piece. These difficulties can sometimes be eliminated or reduced in smaller speakers by slightly distorting the speaker rim. To do this, place enough washers under one or more of the speaker mounting screws to throw the speaker rim out of true. It is also sometimes effective to place slight pressure on a portion of the cone, after the proper area has been located, by lightly pressing the cone with the fingers at various points until the rattle is a minimum. Be careful not to rupture the cone. It may be brittle in older sets. The pressure can be maintained by sticking a small wad of masking tape on the desired cone area, the wad being formed with the adhesive surface on the outside. When the set is installed in the cabinet, the wad will be pinched between the cone and the wire mesh grill covering the speaker opening on the cabinet. Too thick a wad will puncture the cone. When

speaker rattle is due to a tear in the cone, the edges of the tear can be held together by transparent cellophane tape. —E.F.C.

TRANSISTOR PULLER

Transistors in their sockets are often hard to reach using only the fingers. This job can be made easy with the tool shown in the photograph. Simply obtain a large pair of tweezers—about 6" long—and wrap a single layer of rubber tape around the end of each blade. A short length of rubber sleeving can be used instead.

This rubber tip for the blade will not only provide a good surface for gripping the transistor but it will help prevent scraping the type numbers off the case. To use the tool, hold the transistor by its side or top depending on the layout of the nearby parts.

—J.E.P.
Tuning the Short-Wave Bands

(Continued from page 82)

There are too many interval signals for s.w. stations the world over to include them all in this column, but a complete list can be obtained from the World Radio Handbook, available for $2.00 from Gilfer Associates, P. O. Box 239, Grand Central Station, New York 17, N. Y. Some of the more common ones that can be heard are featured on page 82. If you would like to know the interval signal of any particular country or station, send me a card.

Current Reports

The following is a resume of the latest reports that have been received. Please remember that these reports were correct at time of compilation; frequencies and schedules often change with little or no notice. All times shown are Eastern Standard, using the 24-hour system.

Andorra—Radio Andorra, 5979 kc., is being heard in the Eastern USA in late afternoon with a variety of musical programs but no English. This station broadcasts mainly to Spain, Portugal, France, Switzerland, Italy, and North Africa. The IS is a low-pitched gong. (26)

Argentina—LRA, R. Del Estadio, 9690 kc., Buenos Aires, has an English session at 2330-0000, Monday thru Friday. It features L.A. music, commentaries, and closes with a late news bulletin. (RH, TC)

Australia—New frequency changes from Radio Australia are as follows: to N.Z. & South Pacific Islands at 2229-0415 on 11,710 kc. (replaces 11,740 kc.); to the British Isles & Europe at 0245-0359 on 11,710 kc. (replaces 11,740 kc.); to Eastern N. A. at 0714-0845 on 11,810 kc. (replaces 11,770 kc.); and to South, S.E., & S.W. Asia at 1500-1700 on 15,315 kc. (replaces 15,160 kc.). The Western N. A. xmsn remains unchanged and is heard daily at 1015-1115 on VLC11, 11,770 kc. The DX program is heard Sundays at 0630 on 11,810 kc., to Eastern N. A., and at 1100 on 11,770 kc. to Western N. A. (61, 82)

Brazil—Radio Sociedade de Bahia, Salvador, is operating new stations on 11,875 kc., heard at 1400-2100 but usually covered by jamming after 1730, and on 15,125 kc. at 0600-1100. (100)

Radio Jornal do Comercio, Recife, currently features English programs as follows: “About Brazil,” broadcast at 2005 Mondays thru Saturdays; and “Brazil Calling,” at 1630 Sundays. They can be heard on ZYK2, 6095 kc., ZYK32, 11,825 kc., and ZYK33, 15,145 kc. (54, 66)

Bulgaria—Radio Sofia is again operating in English on 9700 and 7670 kc. at 2115-2215 and 2300-2330. While not directed to N.A., it is well heard. (JG, 187, 208)

China—Radio Peking is being reported on 15,060 kc. at 1800 and on 15,350 kc. at 0940 and 1840, in language xmsn. It can be tuned on 17,745 kc. at 2155 s/on, 2200 news, 2215-2230

**KITS! KITS!**

**HERSHEL'S KITS ACCLAIMED BEST**

**ALL KITS CONTAIN THE FINEST ASSORTMENTS. OVER 10,000 SOLD!**

**30 TUBE SOCKETS**
0.75 each at HARDWARE

**15 ROTARY SWITCHES**

**10 ELECTRICAL CONDENSERS**

**40 RADIO & TV KNOBS**

**40 BY-PASS CONDENSORS**

**60 CARBON RESISTORS**

**60 MICA CONDENSERS**

**100 SET SCREWS**

**8 IN 22 XTAL DIODES**

**50 CERAMIC CONDENSERS**

**15 VARIABLE CONDENSERS (Air and Mica)**

**50 RF CHOKEs**

**30 POWER RESISTORS**

**1 PHONE 115 Vac.**

**10 TERMINAL STRIPS**

**200 Ft. HOOK-UP WIRE**

**5 TRANS 6.3V/110 Vac.**

**5 MICROPHONE PLUG-IN COILS**

**5 PILOT PANEL LITES**

**50 FUSES 3AG UP**

**1 METER RECTIFIER O-10MA.**

**1 IGN. COIL 28V. 15,000 V.E.C.**

**25 Ft. Phone-Mike Cable**

**1 SELENIUM RECTIFIERS (150 MA. 110V.)**

**1 6V-30 amp. SOLENOID**

**10 STRAIN INSULATORS**

**1 TELEGRAPH KEY**

**5 MICRO SWITCHES**

**75 Ft. 300 OHM TV LOAD IN**

**25 TV STAND OFFS**

**24 SHOCK MOUNTS**

**1 PHONO XTAL with NEEDLE**

**24 Modular and DRIVER TRANSFORMERS**

**100 ASSORTED CRYSTALS**

**24 MODULATION TRANSFORMERS**

**GE Radiotron Oil CONDENSER 95'***

**3 RCA Oil CONDENSERS**

**4 Loop ANTENNAS**

**1 PHANTOM ANTENNA 4-52**

**3 Photographers - Mechanics**

**1 Wooden box - Made of hard worke**

**MATERIALS**

**SWING CHUTE BAG**

**CARRYING ALL-PURPOSE CASE**

**PHOTO ELECTRIC CELL**

**SWING CHUTE BAG**

**ALL-PURPOSE FIL TRANSFORMERS**

**TUNING UNITS**

**OIL CONDENSER**

**ALL-PURCHASE FIL TRANSFORMERS**

**GE Radiotron Oil CONDENSER**

**MODULATION**

**DRIVER TRANSFORMERS**

**ALL-PURCHASE FIL TRANSFORMERS**

**OIL CONDENSER**

**NEW BATTERY**

**OF ELECTRONIC PARTS**

**100 ASSORTED CRYSTALS**

**74.50-117.50 MHz.**

**24 MODULATION TRANSFORMERS**

**5 PHANTOM ANTENNAS**

**36 LOOP ANTENNAS**

**24 MODULATION TRANSFORMERS**

**ALL-PURCHASE FIL TRANSFORMERS**

**NEW BATTERY**

**36 LOOP ANTENNAS**

**ALL-PURCHASE FIL TRANSFORMERS**

**NEW BATTERY**

**36 LOOP ANTENNAS**

**ALL-PURCHASE FIL TRANSFORMERS**

**NEW BATTERY**

**36 LOOP ANTENNAS**

**ALL-PURCHASE FIL TRANSFORMERS**

**NEW BATTERY**

**36 LOOP ANTENNAS**

**ALL-PURCHASE FIL TRANSFORMERS**

**NEW BATTERY**

**36 LOOP ANTENNAS**

Contents and price are subject to change without notice. Minimum order $5.00

**Worth $35.00**

**OUR PRICE ONLY**

**$2.95**

**IT'S ANOTHER THRILLING HERESHEL SURPRISE**

**18 POUNDS OF BRAND NEW USEABLE GOVT. SUPPLIES. PERFECT GIFT FOR HAMS, ETC.**

**Always say you saw it in — POPULAR ELECTRONICS**
s/off with Chinese music and English anmts. This latter period is dual to 15,080, 11,650, and 11,960 kc. (GA, 26, 184)

Cook Islands—ZLIZA, R. Pareotonga, Raretonga, can still be noted on 5850 kc. on Wednesdays at 2215-0000. With QRM (7)

Cuba—Reloj de Cuba is operating on 5085 kc. (heard at 1730-0600) and 11,750 kc. (heard at 1300-0600) with various musical programs and Spanish language. COCO, Havana, 9350 kc., has returned to the air after a long absence and is noted on the east coast at 0700 s/on and in the west around 2300. (DK, 7, 25, 54, 59, 100, 158)

Czechoslovakia—Radio Prague has English to N.A. at 1930-2000, 2200-2300, and 0000-0030 on 6170, 6105, 6055, and 5955 kc. (GA, 176)

Ecuador—New stations noted include: Radio Equinoccial, Ibarra, 5543 kc. (1900-2300); La Voz del Norte, Ibarra, 5902 kc. (1900-2300); Radio Sangi de Ibarra (7), Ibarra, 6210 kc. (1900-2300). A previous unidentified xmt on 4600 kc. is Radio Atalaya, Guayaquil. Other unidentified stations are noted on 4490, 4695, 4700, 4755, 4775, 4870, and 5202 kc. Except for HCJB, none of the stations in this country seem to give call letters but they do announce by station name. Any help in identifying the unknowns will be appreciated. (100)

Egypt—Radio Cairo has an English program on 9475 kc. at 1330-1400. An English newscast can be heard on 9730 kc. at 1530-1540 with a commentary to 1555. (11, 26, 124, 127)

England—The BBC has "Music For Dancing," Sundays at 1615-1700 on 17,700 kc. On Fridays at 1600, they present a program of light music on the same channel. (156)

Formosa—BEC27, Taipeh, 7200 kc., may have a new 1000-watt xmt in use now as the signal is excellent on the west coast with AFRS programs. This is scheduled Saturdays and Sundays only. ID is AFRS, Taiwan. (7)

France—The only English xmsn from Paris is on 7240 kc. at 0900-1600 to England. Paris is also noted on 15,400 kc. in French at 1500-1530 to French Africa, and on 17,650 kc. in French to Canada at 1230-1245 (Mondays-Fridays only). (116, 108)

Gold Coast—The Gold Coast B/C Service, Accra, is being well heard in the east on 3366

English Newscasts

Here is a compilation of a few stations that carry English newscasts daily. Although there are many others, these are probably the easiest to hear. (149)

Argentina—LRA1, Buenos Aires, 9690 kc.; news & commentary at 2330; news at 2350.

Canada—CKNX, on 11,945 kc. at 2200; on 11,705 kc. at 2030 with news at 2000.

England—BBC news at 0100 on 9600 kc. and at 2145 on 15,070 kc.

French Equatorial Africa—From Brazzaville on 11,970, 9730, and 9620 kc. at 2150.

Japan—Radio Japan has news at 0000 on JOA4, 11,705 kc., and JOB20, 9525 kc.

USSR—From Moscow at 2000 on 11,760 and 11,870 kc., and at 2200 on 11,840 kc.

Madison Electronics

Invites You To Write For More Detailed Information

On The New Line Of Quality

High Fidelity Kits

FEATURING A NEW PREAMP THAT DEFIES LISTENING AND LABORATORY COMPARISON

PREAMPS * POWERAMPS * SPEAKERS

MADISON ELECTRONICS, INC.
22 Rasedale Ave., Madison, N. J.

May, 1957
GEARED AC MOTOR
* 50-v. 60-c. Will run on 115-v.
with 60 to 150-v. built in series with motor. Gear ratio 324 to 1.
SALE $1.00

HIGH FREQUENCY RECEIVER
1 and 6 Band-Battery Operated
Brand new. Reality 2 receivers in 1. Use as tuner for auto radio or operate as head-phone battery. Portable. Size 6 x 6 x 3.5. Cost Govt. over $100. SALE $46.50

HIGH VOLTAGE PLATE TRANSFORMER
* Hermetically sealed, top grade unit. 115-v. primary, tapped. Secondary 7500-v. center tapped. 80 MA. Size 8" x 7" x 10". Wt. 40 lbs. Cost Govt. over $25. SALE $9.95 FOB

99c... KITS... 99c
Your Choice-Prepaid in U.S.A.
* 11 Potentiometers. Good values.... $0.99
* 26 Resistors: To 10,000 ohms.... $0.99
* 5 Vacuum Tubes.... $0.99
* 14 Capacitors. Typical tapped. Size 1/2" x 1/2".... $0.99
* 16 Tube Sockets. Size 7/8" x 7/8".... $0.99
* 1 Surprise Package. Minimum $8.99. SALE $9.95

DM-42 DYNAMOTOR (New)
* Hams and field engineers ideal for mobile transmitters and test gear. Input 12-v DC. Output 513, 10-000, and 8,000 W. 2A to 250 MA on high voltage. Size 7 x 7 x 11. Wt. 10 lbs. Cost Govt. $97.50. SALE $9.91 FOB

GEAR REDUCTION MOTOR
* Multiple gear ball bearing motor with enclosed 22-to-1 reduction gear box. High torque. 10 to 200 rpm output, reversible. Runs on 6 or 12-v DC or 110 AC through series resistors. Many uses. Cost 930. SALE $4.97 Ppd.

LEARN CODE!
Let RCA Train You for a Lifetime Career in
TELEVISION ADVANCED, ELECTRONICS
Resident classes, day and evening. Resident class begins September 20th, October 1st, November 26th, and February 25, 1958. Free graduate placement service. Approved for Veterans. Send for free catalog now.

LESTER E. RABINOWITZ, INC.
A Service of Radio Corporation of America
850 West 4th St., New York 14, N. Y.

NEW THIS YEAR!
Special 16-page section on HOW TO SELL YOUR PICTURES FOR CASH!

You'll profit from this money-making guide to the photo market — newspapers, calendars, and greeting card firms, trade journals and magazines interested in buying your photographs.

Just one of the big, extra features in the 1957 PHOTOGRAPHY DIRECTORY. Buy your copy today — only $1.00. On sale now at newsstands.

1957 PHOTOGRAPHY DIRECTORY

$1.00

B & Y GUIDE

Buying Guide
Most Complete Handbook of Photographic products

Details on exciting new products from all over the world

SPECIAL SECTION: WHERE TO SELL YOUR PICTURES
A MONEY-MAKING GUIDE TO PHOTO MARKETS

Compiled by the editors of POPULAR ELECTRONICS

OVER 5,000 LISTINGS 1,000 ILLUSTRATED
ILLUSTRATED LISTINGS
LATEST MODELS
LATEST PRICES
PLUS: DIRECTORY OF PHOTO SCHOOLS

Always say you saw it in—POPULAR ELECTRONICS

SPECIAL OF THE MONTH!

DC MILLIAMETER
* Brand new genuine Weston 0.1 MA basic meter. 18.0 MV full scale with external precision multiplier. In square metal case with test lead. Size 3 1/2" x 2 1/2". Cost Govt. over $5.50 SALE $3.49 Ppd.

ELECTRONIC SPECIALS
Last Minute Items — New Surplus
Dynamator, 25-v. to 200-v. $5.95 FOB
Aerom Tube, 954 or 955, Govt. $3.04 Ppd.
Chrome 3" Reel, 15 to 25-v AC or DC, SALE $1.99 Ppd.
Rings, Heater, 300-150 T-W. $1.97 Ppd.
Solenoid Air Valve, 115-v. 60-c. $3.79 Ppd.
ARC-5 Transmitter, 3 to 4 MC. $1.75 FOB
Surplus Atomizer. $1.50 SALE $1.25 FOB
ORDER FROM AD or write for new FREE CATALOG 1000s items at tremendous savings. We pay Frt. except where FOB.

SURPLUS CENTER
843 "O" St., LINCOLN, NEBRASKA

www.americanradiohistory.com
SHORT-WAVE ABBREVIATIONS
AFRS—Armed Forces Radio Service
Ann.—Announcement
BBC—British Broadcasting Corporation
c.w.—Code
Eng.—English
ID—Identification, identity
JS—Interval signal
kc.—Kilicycle(s)
L.A.—Latin America(s)
N.A.—North America(s)
QRM—Interference
R.—Radio
s/on—Sign-on
s/off—Sign-off
w.—Watts power
xmn—Transmission from station
xmt.—Transmitter used by station

6090 to 6200 kc. and is heard from 1900 to 2300 s/off; HRN, La Voz de Honduras, is now on 5960 kc. and is heard at 0700-0800 and 1900-2300; HROW, R. Montserrat, has moved back to 5880 kc. and is heard at 0700-0800 and 1900-2300. The above three are in Tegucigalpa. HRVW, La Voz de Centro America, San Pedro Sula, has moved from 5867 to 5972 kc. and is heard at 0700-0800 and 1900-2300. HRVW verified promptly by airmail. (100)

Hungary—Radio Budapest is again operating in English to N.A. daily at 1930-2000 and 2300-2330 on 11,910, 9833, and 7220 kc. The program features news, commentaries and music. (BH, JS, 192, 262, 208)

India—While this country currently has no programs beamed to N.A. All-India Radio, Delhi, can be noted on 17,795 kc. with English to S.E. Asia at 0830-0840, (news at 0830-0840). This xmn is parallel on 21,580 kc. It can be

May, 1957

"It smokes up, you say?"
Save on Everything in Kits, Hi-Fi, Electronics
Send for the leading Buying Guide to the world's largest stocks of Electronic equipment, including the great line of Knight-Kits, Hi-Fi equipment, recorders, TV accessories, Ham gear, P.A. test instruments, parts, tubes, tools and Books—all at lowest prices. Write for your FREE copy today.

ALLIED'S 1957 ELECTRONIC SUPPLY GUIDE

356 PAGES packed with value

ALLIED RADIO

ALLIED RADIO CORP., Dept. 79-E7
100 N. Western Ave., Chicago 80, Ill.

Send FREE 356-Page 1957 ALLIED Catalog

Name
Address
City
Zone
State

SEND ORDER TO:

ASSEMBLE YOUR OWN:

WALKIE-TALKIE RADIOPHONE

for as little as

$6.98 plus accessories

Specifications: 1 to 5 mile range with 18-inch antenna and much more with directional beam antenna. Tunes from 144 to 148 mc. High level amplitude modulation. Silver plated tank circuit and many other exclusive features assure maximum efficiency and long battery life. Fully portable—no external connections over needed. Meets FCC requirements for general class amateur license. No minimum age requirement.

The following components are all you need to assemble a complete walkie-talkie as illustrated. Factory wired and tested transmitter chassis complete with special dual tube $6.98

High output carbon mike $1.49

Miniature mike transformer $0.98

Powerful alnico magnet headphone $1.25

Strong 16 gauge aluminum case (8"x5"x2") with all holes punched, battery compartment, battery switch plus all hardware and fittings including 18" antenna $3.98

Uses standard batteries available at your local radio store.

All components except tubes guaranteed for one year. Include 5% for postage. COD's require $2.00 deposit.

SPECIAL: Limited quantity, brand new Western Electric telephone handsets $6.98

Receiver impedance matching transformer for using handsets with walkie-talkie $0.98

All orders immediately acknowledged

SPRINGFIELD ENTERPRISES

Box SAE
Springfield Gardens 13, N. Y.

tuned on its xmsns to Great Britain at 1930* 2045 on 9615 kc., and at 1445-1545 on 11,705 or 9850 kc. (33, 208)

Jamaica—ZQI, Radio Jamaica, Kingston, is often noted on 4950 kc. along the eastern seaboard at 1800-2000 with music, news, commercials, and frequent ID's. They have English news at 1930. Tune carefully for this if you aren't along the east coast; it has been reported from all over the U.S. (47, 184)

Japan—JOB2O, Tokyo, 9525 kc., is noted at good level in South American beam at 0400 s/on. Spanish is heard until 0415, Portuguese until 0430. (25)

Lithuania—if you can read c.w., here is a chance to log a rare country. LYG, Kaunas,

has a c.w. xmsn most evenings on 5940 and 8502 kc. A report to them was QSL'ed promptly with a prepared card. (167)

Luxembourg—Radio Luxembourg, 6090 kc., is currently being noted in the east on Sundays at 1500-1900 with no QRM. Programs are beamed to England. They feature "Top Twenty Tunes" from 1800 to 1900 complete with commercials. On other days, this xmsn is badly QRM'ed after 1700 by 4VB. Radio Commerce, Haiti. Another xmsn is heard around 0230 with an excellent signal and musical programs. Anmts are in Flemish. (WJ, 62, 208)

Mozambique—Lourenco Marques is often reported from 9630 to 9638 kc., although a letter from the station states that they are on 9624 kc. The "Cactus Club" can be heard

Always say you saw it in—POPULAR ELECTRONICS

SHORT-WAVE CONTRIBUTORS

George Altman, Jr. (GA) Norwich, Ohio
David Crookett (DC) Winston-Salem, N. C.
Tom Conner (TC) Ashland, Ore.
James Gere (JG) Oswego Village, N. Y.
Bill Hansen (Bf) Chicago, Ill.
Ronald Hehn (RH) Bozeman, Mont.
Don Kenny (DK) Pacific Palisades, Calif.
Walter Mayttichorius (WM) Ashland, Ohio
Jaco Schanker (JS) Brooklyn, N. Y.
David Wahlin (DW) Kenmore, N. Y.
Bill Flynn (BF) Berkeley, Calif.
Chuck Maxant (CM) Baldwin, N. Y.
Floyd Backus (FB) Richmond, Va.
Bob Knowles (BS) San Diego, Calif.
William J. Currell (WC) Toronto, Ont.
Jerry Saval (JS) Revere, Mass.
R. D. Kimpton (DK) Cobourg, Ont.
Jim Cumbie (JC) Sherman, Texas
Grady Ferguson (GF) Covington, N. C.
John Beaver (JB) Pueblo, Colo.
Jim Lathem (JL) Hemstead, N. Y.
Frank Langenexer (FL) Hollywood, Calif.
John Mann (M) Montreal, Ont.
Tom Thompson (TT) Saginaw, Mich.
Howard Kass (HK) Brooklyn, N. Y.
B. A. Conkin (BC) Fairlington, Conn.
I. Art Russell (IA) San Diego, Calif.
Camilo Castillo (CM) Panama City, Panama.
Roy Bugden (RB) Fort Lauderdale, Fla.
Arthur Teal (AT) Chester, Conn.
Robert Schwartz (RS) Brooklyn, N. Y.
Albert K. Saylor (AS) Queens, Va.
Walter Meaux (WM) Nashville, Tenn.
Tommy Kneitel (TK) Rego Park, N. Y.
Silas Dunn (SD) Little Rock, Ark.
Steven Buehner (SB) Bayside, N. Y.
Philip Danley (PD) Miney, Pa.
Danny Ferguson (DF) Columbia, S. C.
David Tabaczek (DT) Auburn, N. Y.
Christopher Bennion (CB) Riverside, Conn.
at 2300-2355 with music and commercials. (26, 28, 158)

Netherlands — Radio Netherlands, Hilversum, is easily heard in the south on 9590 kc. In the L.A. beam at 1630-1800. On Sundays they have the "Happy Station Program" to the U.S. & Canada at 2130-2300 on 9590 and 11,950 kc. Alternate frequencies are 15,426, 15,365, and 6025 kc. (DW, 54, 156, 152, 173)


Poland — Radio Warszaw is heard well on 6010 kc. in English to N.A. at 2130-2200 and 0030-0100, with news and music. It is dual to 9525 kc. but not heard well there until the late evening. It is also noted on 17,800 and 15,120 kc. at 0600-0630 with English news and music. (JG, 104, 153)

Rumania — Radio Bucharest is being noted on 11,937 and 9570 at 2200-2330 and 2300-0000 in English to N.A. Music, news and tests make up the program. (DC)

Surinam — There will be a new s.w. outlet in Paramaribo on 11,590 kc. which may be in the Commercial Service. Further details are requested. (623)

Tanganyika — Dar-Es-Salaam now has a morning xmsn audible in the U.S. at 2230-0000. (100)

Tangier — The Voice of Tangier, Br. P.O. Box 219, Tangier, operates as follows: at 0200-0230 and 0600-0900 on 7230 kc.; at 1330-1430 on 9444 kc.; at 0300-0500, 1200-1330, 1430-1530, and 1530-1815 on 9485 kc. IBRA Radio operates in English daily at 1615-1645 and on Mondays, Tuesdays, Wednesdays & Fridays at 1300-1315 on 11,515 and 8935 kc. (82)

United States — The Voice of Maritime Labor, New York, is still being noted on Sundays only at 1120-1135 with a program of interest to shippers & seamen. It is heard on 15,700, 15,850, and 18,850 kc. (104)

Venezuela — YVFK, Radio Rumpos, Caracas, 4970 kc., is heard at 1800-2230 with an English program, "Supper Club," at 1800-1900. Other programs are in Spanish. Another all-Spanish xmsn is noted over YVMQ, Radio Barquisimeto, Barquisimeto, 4990 kc., at 1915-2230. (83, 116)

YVLD, Valencia, is readable on the west coast at 2230/close. (7)

Yugoslavia — Radio Belgrade has an excellent signal in N.A. xmsn of news and features at 1715-1730 on 8100 kc. (104, 208)

NOW! Take the "Headache" Out of TV Trouble Shooting

Amazing Handbook Helps You Accurately

Pin Point TV TROUBLES

IN 10 MINUTES

SAVES TIME . . .

MAKES YOU MORE VALUABLE!

Now for the first time—a practical procedure for spotting the cause of trouble in any TV set—FAST! Overcomes the most difficult, most time-consuming TV trouble shooting problems. Here's no guesswork! Quick, simple tests tell you which of 5 TV set sections help you locate the exact trouble spot at once, from as many as 700 possibilities. Not a book for the "tinkerer" or home owner TV serviceman to save time and money. The hours and aggravation it can save you on a single servicing job more than pays for this amazing handbook. Helps you make more money as an expert speedy TV trouble-shooter!

NEEDED BY EVERY TV SERVICEMAN

"Pinpoint TV Troubles in 10 Minutes" is one of the most valuable "tools" you can carry on a servicing call. Amazingly practical. Over 300 spiral bound fast reference pages with 50 time-saving Check Charts cover dozens of important diagrams and charts; electrical explanations of circuits and designs. Fits easily into your tool kit for handy on-the-job reference. Prepared and backed by the famous Coyne Electrical School.

COYNE ELECTRICAL SCHOOL

May, 1957

www.americanradiohistory.com
Florida, recently served as the testing ground for an experimental installation of radio communication between pit crew and stock car race driver. The car was a Chevrolet racing sedan owned by Al Hobbs of Gibsonburg, Ohio. A Vocaline transceiver was bracketed on the transmission hump inside thick slabs of sponge rubber—no internal changes of the transceiver were necessary. A floor switch, on the car's floorboard, controls an externally mounted solenoid over the "Push-to-Talk" switch, and the standard crystal microphone is solidly taped to the sedan's gearshift lever under the steering wheel, only twelve inches from the driver's lips.

Mr. Hobbs' racing stock car is driven by his 22-year-old son, Chuck, who competes in NASCAR (National Association Stock Car Automobile Races) sanctioned races throughout the southern United States. They plan on extending the benefits of radio communication to other stock and modified racing cars of the Hobbs team if this initial installation proves successful. Perhaps in the not too distant future such radio communication will become standard procedure on the stock car racing track.

—William Carroll

Oscilloscope Calibrator

(Continued from page 57)

cilloscope gain for ten boxes of deflection. When switch S2 is placed in the 0.5-volt peak-to-peak position, the deflection should be one-half box if the divider is accurate.

During actual use of the calibrator, the unit is left connected to the vertical input of the oscilloscope and the signal waveforms under observation are fed into the input terminals of the calibrator. With the switch S1 in the scope position, the oscilloscope input terminals are merely transferred to the input terminals of the calibrator.

Using the Calibrator. To measure the voltage of a waveform being fed into the oscilloscope, use a reverse procedure to
LEARN HOW TO BUILD:

- Your Own AM Hi-Fi Tuner
- Thermistor Fire Alarm
- Electronic Gardening Gadgets
- A Device That Kills TV Commercials
- Electronic Toys
- Geiger Counter
- Transistorized Light Meter
- Your Own Lie Detector
- PLUS DOZENS OF OTHER HANDY, EXCITING ELECTRONIC DEVICES

BUY YOUR COPY OF THE ELECTRONIC EXPERIMENTER’S HANDBOOK

ON SALE NOW
AT YOUR FAVORITE NEWSSTAND! PRICE: $1.00

ZIFF-DAVIS PUBLISHING COMPANY. 366 MADISON AVENUE, NEW YORK 17, N. Y.
that of the calibration just described. To measure a peak-to-peak voltage, first calibrate the screen of the oscilloscope in terms of volts with the calibrator. This is done by placing switch 81 in the cal. position. Then set switch 82 to one of the voltage settings on the calibrator. For our discussion, let's use the 10-volt position.

Adjust the vertical gain of the oscilloscope to produce a signal of a specific number of boxes on its face. If you make the calibrator signal ten boxes high, then each box on the oscilloscope face will represent one volt. If you adjust the oscilloscope vertical gain so that a 10-volt calibrator output is only one box high, then ten boxes on the oscilloscope face will represent one hundred volts. Thus, it can readily be seen that the three ranges included in the calibrator will cover any voltage normally encountered with the oscilloscope.

Sound Impressions

(Continued from page 61)

ven throws music at you in massive chunks that can emotionally bowl you over if you listen attentively.

Try his Seventh Symphony as recorded on Angel 35330 by Otto Klemperer conducting the Philharmonia Orchestra. This performance carries the composer's moods from the depths of tragic utterance and loneliness to flights of wild exuberance. Pervading the whole is the driving, almost compulsive sense of urgency that represents the joining of Beethoven's own personality to the rhythmical quality of the music. This is one piece that doesn't ask you to listen; it tells you to. The disc itself proclaims the music with tremendous dynamic range and convincing acoustics. Musically and technically, this is a big and full record. A giant speaks.

Lush Rapture. By the time of the Civil War, composers had learned some tricks that later won this period the name of "the romantic era." Slick harmonies slithered from key to key, giving you that aching, longing kind of feeling that makes music "sweet." Orchestration changed: instead of having choirs like strings, brass, and woodwinds always together like platoons on the parade ground, the romantic composers often let single instruments murmur mysteriously, wail plaintively, or sing out triumphantly against their massed companions.

Tchaikowskii blended these tricks into deeply personal and genuinely felt music of compelling sweep and passion. Even at first hearing, his music carries you along in an avalanche of rich-hued sound. West-
minster’s version of his Fifth Symphony (XWN 18355) is the unbelievable ultimate in vibrant hi-fi, and conductor Rodzinski wrings out music for the last drop of blood. Play it loud, and it’ll wring you, too.

Brahms, contemporary with Tschaikowski, had the same harmonic and orchestral tools to work with. Yet he disdained emotional rampage and used the new musical devices for more austere and contained expression. Try his Fourth Symphony as done by the Vienna Philharmonic under Kubelik on London LL 1485. Its beauties don’t jump at you, but they’ll come out after a few playings.

Bridge to Present. In Gustav Mahler’s music, we find a bridge from the past to our own time. Still richly melodious in the old tradition, his music already throbs with the nervous tension of modern life. He uses a huge orchestra to build cunning “sound effects” ranging from hushed and breathless whispers to strident caricature or majestic climax.

Mahler’s First Symphony, played under Rodzinski on Westminster XWN 18014 or under Bruno Walter on Columbia 55L-218, is a rich lode for your musical digging and tailor-made for audio.

Here and Now. Much of today’s music is frankly experimental and often falls harshly on ears unused to dissonance. Yet there are some living composers with a knack for making modernism inviting even to novice listeners. Full-fledged sympho-

---

Out of high school just 2 years ago, this young man has already started a fascinating, highly rewarding career in electronics engineering. No matter whether you are now 18 years old—or 28—a 26-month Embry-Riddle education will prepare you for a quick start in this lucrative professional field.

Electronics Engineering Design course concentrates on essential technical studies and practical projects. With the aid of top flight Embry-Riddle instructors you’ll master many absorbing fundamentals—Microwaves and Radar, Servomechanisms, Industrial Electronics and Television, to mention a few of the subjects.

The demand for trained engineers is greater than the supply—and will be for years! So take the first step now—mail this coupon. And remember, study and play in Miami’s perfect year-round climate is stimulating and exciting.

---

May, 1952
ideal for the beginner who wants to enter electronic field

explanations in simple language exactly how radio tubes work; how radio signals are transmitted and received; how sound is amplified; how to convert old radios into useful electronic equipment; how to read diagrams and follow them! actually shows you step by step how to build your own hi-fi transistor radio, intercom, record player ... many other "do it yourself" projects. written by popular mechanics electronics editor lothar stern. saves you many dollars—at the same time training you in the fascinating, profitable world of electronics. each coupon for no risk ten-day free reading trial. send no money now—after 10 days either return the book and mark bill "canceled" or send only $2.96 plus 50c shipping. or send $2.95 now and we pay postage. same return privilege.

name

address

city

state

send only $2.00

606 e. ontario st. chicago 11, illinois

really works—for life!
guaranteed to work for your lifetime: uses no tubes. battery or electrical plug required. never runs you smaller than a pack of cigarettes! neverDriven long local radio sta-
tions most anytime anyway

without extra antenna. unam-
phonics, crystal set diode hi-q
tuner—billion speaker. fully
assembled. includes radio tube,
battery, coil, crystal, diode, mini-
aturantenna. send $2.95 before 10th day of 10-day free

reading trial. send complete ready to listen—nothing extra to

buy. f-e-e. aerial kit included free for distant stations. available only from

midway company dept. wpl-s kearney, nebr.

low cost home training course for beginners & advanced craftsmen

learn skills and secrets of fine woodworking and tool use. professionally pre-
pared shop method training tells and shows how. covers everything. easy to master.

interstate training service dept. f-99 portland 13, oregon

your f. c. c. license

guaranteed preparation.

get your license by the easy emig method—passed at your speed—study times at your convenience.

write now for free information

emig school of electronics

4902 sunset blvd. hollywood 27, Calif.

always say you saw it in—popular electronics

After Class (Continued from page 81)
rocks and missiles or deep-space meteorological survey gear. At 200° below 0°F, the cell has a little better output than at room temperature. Used in conjunction with telemetering equipment, it could provide power for years for units dropped into remote polar regions or used in oceanographic studies. It is believed that the cost of promethium—which is now prohibitive commercially—will soon be reduced by the current expansion program in the atomic energy field.

**Indium Cell.** What of other microcells? One of the more recent and promising developments in the chemical (rather than atomic) battery fields is the indium cell. Indium, a relatively rare metal, has shown itself to be excellent battery material when properly combined with other chemicals. The indium cell shown below is characterized by high reliability, long life, zero leakage over the period of its entire life, and the absence of swelling or other dimensional changes. It provides about 1.15 volts compared to 1.35 volts for the mercury cell and has a capacity of approximately 120 milliampere-hours, enough energy to operate a #47 panel lamp for about three-quarters of an hour. Thus, the small cells now in production, intended for use with electronic wrist-watches, have a capacity per unit volume which is at least 125% that of comparable mercury cells.

—Continued—

Kit Builder's Korner

(Continued from page 70)

It has d.c. current ranges of 0-100 microamperes and 0-250 milliamperes. Two db scales are calibrated: -20 to +10 db, and -8 to +22 db. Finally, ohmmeter ranges of 0-5000, 0-50,000 and 0-5,000,000 ohms are provided.

The most interesting feature of the kit is the fact that it is partially assembled. Much of the difficult work is already completed, thus simplifying considerably the final assembly of the instrument. You'll also like the use of a small clip for the ohmmeter batteries.

Comment. The instrument assembles without difficulty, works nicely, seems fairly rugged, and has ample accuracy for most practical work. The meter face is large,
Your copies of Popular Electronics are valuable! Keep them neat...clean... ready for instant reference!

Now you can keep a year's copies of POPULAR ELECTRONICS in a rich-looking leatherette file that makes it easy to locate any issue for ready reference.

Specially designed for POPULAR ELECTRONICS, this handy file—with its distinctive, washable blue Kivar cover and 16-carat gold leaf lettering—not only looks good but keeps every issue neat, clean and orderly.

So don't risk tearing and soiling your copies of POPULAR ELECTRONICS—always a ready source of valuable information. Order several of these POPULAR ELECTRONICS volume files today. They are $2.50 each, postpaid—3 for $7.00, or 6 for $13.00. Satisfaction guaranteed, or your money back. Order direct from:

JESSE JONES BOX CORP., DEPT. PE
Box 5120, Philadelphia 41, Pa.
(Established 1843)

$13.95 radio kit by Packard-Bell
AN AMAZING VALUE, IN
CHOICE OF CLEAR PLASTIC OR IVORY CABINET

The famed Packard-Bell 6R1 in an exciting new kit perfect for student instruction in electronics. Powerful 5-tube superheterodyne circuit. Everything included: tubes, wiring diagrams, complete parts layout sheets. $13.95*, plus $1.50 for postage and handling. Add 4% tax in Calif. Write for free illustrated catalog on other kits.

ELECTRONIC KITS SUPPLY CO.
Dept. PE-5, 1727 Glendale Blvd., Los Angeles 26, Calif.

YOUR COPIES OF POPULAR ELECTRONICS ARE VALUABLE!

Keep them neat... clean...

Ready for INSTANT REFERENCE!

---

calibrations are fairly easy to read, and the knife-edge pointer permits readings with good accuracy. Thus, the KT-20 is a valuable instrument and represents a good buy, whether purchased in kit form or as a factory-assembled instrument.

Our personal preference would be for an additional current range or two. This is not especially critical, but more current ranges would be handy for some types of work. In addition, the ohmmeter batteries used, though of standard types, might not be available in all localities... again, our personal preference would be for standard penlite cells in place of the shorter version used.

---

Transistor Topics
(Continued from page 90)

triodes. Commercially available units have operating frequencies up to 250 megacycles. Currently, junction tetrode transistors are available from General Electric, Germanium Products, and Texas Instruments.

Your columnist has just completed the design, construction and test of an FM "wireless microphone" using a single G.E. junction tetrode transistor and operating at approximately 100 megacycles. With a six-volt battery, the unit could be picked up at 15 to 20 feet from a low-sensitivity table model FM receiver using the oscillator's coil radiation alone... no antenna!

The second base connection in the tetrode can be used for signal insertion if necessary. For example, one r.f. signal can be applied to the "conventional" base lead, another signal to the second lead, and the tetrode used as a mixer or converter.

New Manual. General Electric has issued a new Transistor Manual. A 64-page booklet, it includes information on basic semiconductor theory, transistor specifications and body outlines, definitions, and a good selection of circuits. It sells for fifty cents (50¢) and is available through all

---

Allied Radio's "10-Circuit Transistor Lab Kit."

Always say you saw it in—POPULAR ELECTRONICS

www.americanradiohistory.com
Merco's low-cost all-transistor radio receiver.

G.E. distributors... or direct from General Electric Company, Semiconductor Products, Dept. TT, Electronics Park, Syracuse, New York. Our advice? Get a copy as soon as you can!

**Product News.** How small can you get? It looks like someone asked a popular hearing-aid manufacturer this question. Sono-tone has introduced a hearing aid which occupies only three-tenths of a cubic inch, yet contains three transistors and 87 subminiature components... plus a battery!

Sylvania has reduced the price of its 2N229 transistor to seventy-five cents (75¢). An n-p-n type, the 2N229 is intended for audio applications. The manufacturer has issued an interesting four-page booklet which includes basic data on the transistor as well as three suggested circuits.

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill., has introduced a "10-Circuit Transistor Lab Kit." Your columnist hasn't had a chance to examine this item, but it sounds like an interesting kit.

Merco Recording Company, Inc., 147-33 231st St., Springfield Gardens 13, L. I., N. Y., has announced an all-transistor radio which is priced at less than thirty dollars, including battery. The set features a nine-volt battery with a 700-hour life and has a 4" loudspeaker.

Well, fellows, that's all for now. See you next month...
敏感和售价为$42.50准备就绪，用于操作，并作为一套$29.75。

对于那些愿意分开接收器，而不是一个转换器的人来说，可用的设备是几种。这包括了Hallicrafters S-102，售价$39.95。它在可比性能上相对可操作在2米到那个S-38D在更低频段。

从所有这些数字来看，可以理解到的，如果它是在一个2米上是不吓人地使用，你可能会注意到，一个好产品的稍微增加的成本的发射机被投资在了在调节设备，因为实际上所有2米的交流都是被做在电话上。另外，在这一点上，也是值得提及的，这个稍微更低功率的2米的发射机对比到一个典型的，初学者c.w.发射机是小得多重要。150瓦在"2"将会做为一个好一个50瓦在更低的频率。

38'-long，1/4''-diameter的杆，剪在一半并在中心通过一个50到75 ohm传输线上或者一个38'折叠二极管与300-ohm馈线，如在书目"How To Become a Radio Amateur,"这是一个满意的天线对于很多接触。然而，这种改进被从一个甚至一个小的能制作一个可使用而非常挑剔的天线。一个可以被购买的，一个小数或者构造过的从数据在Radio Amateur's Handbook中，增加了你有效的传输设备电力输出的接收器，以提高10到20倍，并且仍然是比许多电视天线更小的。

在以上的讨论中，某些商业设备是被提及的。任何业余伙伴的目录将会列出其他那些简单地使用2米的商用设备。自己建造的设备也是工作得很好的。一个完全的2米的发射机是在书目"How To Become a Radio Amateur."中被描述的。数据在2米的发射机，天线和转换器，和2米的信号是被传播的，是可以在下面的v.h.f.章节中的Handbook。

结论：2米的发射机不是对于所有的业余爱好者，任何多于15-meter c.w.或75-meter的电话的。一般来说，它是最适合于向着大城市的居民，那些电话操作和谁生活或者在或者近的在较大的城市——那样是会不够的。很难保持在工作的范围没有取决于特别的条件来敷设的正常范围的这个带。2米的发射机也有足够多的，来提供那个需要，无论他的位置，他更感兴趣的是在试验接收器和设备而不是在建立联系。

新闻和观点

关于在2月里，1957的，Transmitting Tower在获得一个WAS（Worked All States）证书的报告中，有——POPULAR ELECTRONICS.

总是说你看见它——POPULAR ELECTRONICS

www.americanradiohistory.com
mitting proof of 2-way contact with each of the 48 states to the American Radio Relay League, Inc. F. E. "Ed" Handy, W1BDI, ARRL Communications Manager, adds a suggestion. Too many applicants fail to receive their certificates on the first attempt because of insufficient evidence. Usually, they submit 48 cards, but they accidentally include two cards from one state and none at all from another. Ed suggests preparing a list of the states in alphabetical order and filing your QSL (confirmation) cards in the same manner for easy cross-checking. ARRL absolutely will not issue a WAS certificate without written proof of each claimed contact, although a District of Columbia contact counts as a contact with Maryland.

Dave, KN2VJO, now employs the NC-33 he formerly used as his SWL receiver as a CON- ELRAD monitor by tuning it to a local broadcast station while he is on the air. If his keying has sounded rather bad lately, he asks: "Ever try to send code while listening to Elvis?"

Gerald, KN4LXT, operates a Globe Chief 90 running 85 watts on 40 and 15 meters into a 40-meter folded dipole. In 45 days on the air, he has worked 26 states in all call areas, including five KN6's on 40 meters. He also raised some foreign DX, but his nervousness prevented him from making the contacts. Before getting his Novice license, KN4LXT had a 76% return on SWL cards to amateurs!

Larry, KN4JNM, uses an AT1 transmitter and a Space Spanner receiver, with a Windom antenna about 30' high. In a month on 80 meters, he has worked 29 states and one VE call area, with all but one state confirmed. Best DX is Nevada. Gil, WN1NZY, got on the air last September with a home-built 25-watt rig, full of bugs. New York was his best DX. Now, he has a Globe Chief running 75 watts. His antenna is a folded dipole, his receiver an S-83A with a Q-Multiplier added, which helps when interference is bad. Gil operates every morning between 2:30 and 4:00 a.m. and he has 20 states worked. Eddie, WN3JYM, (17), has worked 24 states, confirmed, in six weeks of operation on 40 meters. He uses a Globe Chief transmitter running 75 watts, and his receiver is a Heathkit AR23 with Q-Multiplier, although he used a Space Spanner for a few weeks with good results. Eddie suggests that many Novices could study proper operating procedures with profit. He offers to help anyone obtain his license between looking for 6's and 7's.

Buddy, KN4KQI, uses an AT1 transmitter, feeding a 66' doublet, and an HQ-128X receiver. In five months on the air, he worked 19 states on 40 meters. He now has his 15-meter beam finished and will undoubtedly be on 15 by the time you read this. Mike, KN2VXE, works 40 meters only, because his surplus BC-455B receiver tunes only that.

* Speaking of the Q-Multiplier, it seems that the 7-henry, 15-ma. filter choke, CH1, used in the power supply in my article entitled "Use a Q-Multiplier" (Populor Electrons, May, 1956), is hard to locate in dealers' stocks. Any small filter choke of 7 henrys or more inductance and a current rating of 40 or 50 ma. may be substituted for it.

---

### BUILD YOUR OWN AMATEUR TRANSMITTER!

... FROM ONE OF THESE 3 FEATURE-PACKED KITS!

- **"RANGER"** Kit... $214.50 Net
  Wired... $293.00 Net

- **"ADVENTURER"** Kit... $54.95 Net

- **"VALIANT"** Kit... $349.50 Net
  Wired... $439.50 Net

---

**May, 1957**

---

*E. F. Johnson Company*

3006 Second Ave., S. W., Wayzata, Minnesota

Please send me a copy of your most recent amateur catalog.

Name: ____________________________

Address: __________________________

City: ____________________________ State: __________________________

---

www.americanradiohistory.com
Shrinks Hemorrhoids
New Way Without Surgery

Science Finds Healing Substance That Relieves Pain—Shrinks Hemorrhoids

For the first time science has found a new healing substance with the astonishing ability to shrink hemorrhoids and to relieve pain—without surgery.

In case after case, while gently relieving pain, actual reduction (shrinkage) took place.

Most amazing of all—results were so thorough that sufferers made astonishing statements like "Piles have ceased to be a problem!"

The secret is a new healing substance (Blo-Dyne*) —discovery of a world-famous research institute.

This substance is now available in suppository or ointment form under the name Preparation H*. Ask for it at all drug counters—money back guarantee.


Make Sure, Safe Insulated Electrical Connections

With the New
Super Champ Hand Tool

The One Tool for All Wire Sizes used in Home Wiring, Appliances, Automobiles.

CUTS Wire—STRIPS Wire sizes 22-210
CRIMPERS Solderless Terminals and Connectors

Without solder or tape for use with small connections—SHEARS Bolts and screws without damaging threads—no filing or hack sawing.

Order Direct—Use Coupon

Name: ___________________________ Phone: ___________________________
Address: ___________________________ 

City Zone State

Pen-Ohio Dist. Co., 2631 N. Main St., Dayton 5, Ohio

New Magic Radio Walkie Talkie!

Your own Pocket Size Radio Station!

Broadcasts to Any Home or Car Radio with Out Wires or Connections!

No contact necessary.

- Simple to use.
- No wires or connections.
- Operates on any ordinary radio.
- No contact necessary.

Send $2.50 for instructions and to try your new Power Radiophone System.

American Radio History

Elec. Technicians are in Demand

Trained Men are Needed Now!

In just 18 months you can complete Electronic Technician training to enter this ever-growing industry.

Day or evening classes. Opportunity for employment in local industry. Approved for Korean Veterans.

Terms beginning July, September, January, April

Indianapolis Electronic School

312 E. Washington St. Indianapolis 4, Indiana

Electronic Technicians are in Demand

Always say you saw it in—Popular Electronics
BUY THE WORLD'S MOST COMPLETE HI-FI GUIDE

Compiled by the Editors of Popular Electronics

164 PAGES!
Nine Big Chapters on:

- WHY AND HOW HI-FI
- TUNERS
- TAPE AND TAPE RECORDERS
- RECORD PLAYERS AND CHANGERS
- TONE ARMS, CARTRIDGES AND NEEDLES
- PREAMPLIFIERS AND AMPLIFIERS
- LOUDSPEAKERS
- SPEAKER ENCLOSURES
- SAVING MONEY IN HI-FI

Also included in this new Hi-Fi Guide is a helpful YEARBOOK SECTION covering all the latest trends in high fidelity. This "book within a book" lists the nation's outstanding Hi-Fi records and artists, all FM stations, and contains a complete calendar of 1957 Hi-Fi Shows, plus a directory of Hi-Fi literature available free!

BE SURE TO BUY YOUR COPY!

NOW ON SALE AT ALL NEWSSTANDS AND RADIO PARTS DEALERS!

Price: 75c

May, 1957
SALE ON TRANSISTOR RADIO KITS!!
TRANSISTOR RADIO KITS FEATURING
11½" min. speaker—matching transformer sub-min. volume control—modern dual circuit mini-volume control size sets. Give us 4½—inches of volume—all stations. Regularly $24.95. 19.95

10,000 OHM PLATE RELAYS—D.P.S.T. $9.95
6.0 INCH HI-GAIN IAMPONES $9.95
VOKER KIT OF D.F.S. & OSCILLATOR COIL $3.79
PHILMORE TRANSISTOR RADIO KITS 12.95
SUPEREX TRANSISTOR RADIO KITS 5.95
10-element contrast outdoor TV antenna—Was $8.05. 2.69
6-element indoor antenna—Was $8.05. 2.69
Baseplate and all cable VHF—Was $12.05. 4.95

GROVE ELECTRONIC SUPPLY CO.
4103 W. BELMONT AVENUE CHICAGO 41, ILL.
Include postage with order—Send for 1957 catalog.

EXPERIMENTERS—AMATEURS—HOBBYISTS
We are reducing a large inventory of brand new vacuum tubes and this get-acquainted offer is limited to the stocks on hand. 15 different electronic parts required. FREE SEND FOR FCC FORM 505 Garage Door Radio Control Transmitter & Receiver. Kits Available. ESSCO TELEMETRY Receiver—4-Tube Simple Transmitter. 5.0 INCH H.P. 1650 mtw. 100 AMPLIFIER Bases. 2-Tube Receiver—R/C Transmitter. SCHOOL LANGUAGE-TRANSMITTER. 300 Base Bases. 150 Bases. 275 tubes. 350 tubes. 3.95. Drilled Bases Wall Box, Res., Cond., SIGMA Relay, $9.95

SIGMA 4F RELAY: 6.000 mcm, $3.85; 6 Reed Relay 1.65
24V Battery Charger Kit $4.95; wired.$3.50
R & C BOOKS: Model Control 51; Radio Control 61; Handbook 2.25
CRYSTALS: 27,255 mc. Paragraph 25c. 3.25
METERS: 150 micro. 3.95; 250 micro. 3.25; 3.95
RELAY CONTROLLER UNITS: 2-Amp. 2H. Thermal Relay Strip, Heating Element, Hi Z Audio, Mini-Return U Magnets, New Lamp, Resistors, Condensers, only 99 TUBES XFG1, RK61, 344, 245, 1604, 644—Transistors $9.95
350 OHM Resistor. 4.54; 2V 22.75; 4.25; 22.75
RELAYS, 100 each 2 Ma DC or 110V AC SPD 50¢; 5ST-FS: 85¢ Flip-Flops 100 V AC. Range 5000 to 100000 per min. 25¢ to 2.00 capsules.
3325-2 CANAL ST.
NEW YORK 13, N. Y.

LAFAYETTE SPECIAL
R/C TRANSFER
Completely assembled—tested and guaranteed R/C transmitter. Includes tube and 27.255 mc. Crystal. 4¾" x 4¾" x 2½". Approx. 1 mile. Shelf. $8.05. Less batteries. F-249

19.95 LAFAYETTE SPECIAL

YOKE KIT OF D.F.S. & OSCILLATOR COIL $3.79
PHILMORE TRANSISTOR RADIO KITS 12.95
SUPEREX TRANSISTOR RADIO KITS 5.95
10-element contrast outdoor TV antenna—Was $8.05. 2.69
6-element indoor antenna—Was $8.05. 2.69
Baseplate and all cable VHF—Was $12.05. 4.95

GROVE ELECTRONIC SUPPLY CO.
4103 W. BELMONT AVENUE CHICAGO 41, ILL.
Include postage with order—Send for 1957 catalog.

JOE PALMER
1440 LAS SALINAS WAY SACRAMENTO, CALIFORNIA

RADIO CONTROL HEADQUARTERS
For model airplanes, boats, cars, etc. FREE CATALOG 15P. No operator's license required. FREE SEND FOR FCC FORM 505 Garage Door Radio Control Receiver & Transmitting sets. Kits Available. 172 pg RADIO CONTROL HANDBOOK. THE "NEW LOOK" and reflector. License required. Was $6.95 $2.69

R/C TELEMETRY Receiver—4-Tube Transmitter. 300 Base Bases. 150 Bases. 275 tubes. 350 tubes. 3.95. Drilled Bases Wall Box, Res., Cond., SIGMA Relay, $9.95

SIGMA 4F RELAY: 6.000 mcm, $3.85; 6 Reed Relay 1.65
24V Battery Charger Kit $4.95; wired.$3.50
R & C BOOKS: Model Control 51; Radio Control 61; Handbook 2.25
CRYSTALS: 27,255 mc. Paragraph 25c. 3.25
METERS: 150 micro. 3.95; 250 micro. 3.25; 3.95
RELAY CONTROLLER UNITS: 2-Amp. 2H. Thermal Relay Strip, Heating Element, Hi Z Audio, Mini-Return U Magnets, New Lamp, Resistors, Condensers, only 99 TUBES XFG1, RK61, 344, 245, 1604, 644—Transistors $9.95
350 OHM Resistor. 4.54; 2V 22.75; 4.25; 22.75
RELAYS, 100 each 2 Ma DC or 110V AC SPD 50¢; 5ST-FS: 85¢ Flip-Flops 100 V AC. Range 5000 to 100000 per min. 25¢ to 2.00 capsules.
3325-2 CANAL ST.
NEW YORK 13, N. Y.

LAFAYETTE SPECIAL
R/C RECEIVER
Completely wired and assembled. 1½" x 1½" x 3½". Operate on 117 ± 2 volts A.C. or D.C. in the industry. Two tubes, O.S. radio control rom. $24.95

NEW TV PICTURE TUBES
featuring SENSATIONAL NEW ARC PREVENTIVE BASE
Any No. 21" Glass Tube—$22.95
Any No. 17" Glass Tube—$18.95
Add $4.00 for Aluminized—Write for Prices on Other Sizes—One Year Guarantee—Licensed by RCA—No Dut Required—Shipped Via Railway Express—F.O.B. N.Y.C.—25% Dep. on C.O.D.'s

CLIFFORD SALES CO., INC.
172 Greenwich St., New York, N. Y. — CO. 7-6221

EDLIE for TOP VALUES AC VOLTMETERS

7.95

LAFAYETTE SPECIAL
R/C RECEIVER
Completely wired and assembled. 1½" x 1½" x 3½". Operate on 117 ± 2 volts A.C. or D.C. in the industry. Two tubes, O.S. radio control rom. $24.95

NEW TV PICTURE TUBES
featuring SENSATIONAL NEW ARC PREVENTIVE BASE
Any No. 21" Glass Tube—$22.95
Any No. 17" Glass Tube—$18.95
Add $4.00 for Aluminized—Write for Prices on Other Sizes—One Year Guarantee—Licensed by RCA—No Dut Required—Shipped Via Railway Express—F.O.B. N.Y.C.—25% Dep. on C.O.D.'s

CLIFFORD SALES CO., INC.
172 Greenwich St., New York, N. Y. — CO. 7-6221

EDLIE for TOP VALUES AC VOLTMETERS

7.95
BLUE RIBBON RADIO CONTROL KITS

The highest quality radio control kits at the lowest prices in the industry. From the R/C supplier selected by Dr. Walter A. Good for his Dual Proportional units. Prices begin at $7.95. Write for free catalog 57-4.E.

ACE RADIO CONTROL
Box 301
Higginsville, Missouri

MAGNETIC GUITAR MICROPHONE

Complete with Individual Tone and Volume Controls
High impedance contact mike specially designed for use with guitar. Easily mounted under strings without special attachments. While in mounted position, mike can be raised or lowered easily on rod to create varying tone effects. With 8 ft. cable and standard phone plug. Ship. wt. 2 lb.
PAJE .......... Net 9.95

FOR SALE

WALKIE-Talkie chassis $6.98. See our display ad in this issue. Springfield Enterprises.

CITIZEN'S band radio plans for building your own receiver and information on transmitter design, FCC requirements, etc. plus special type on approved transceivers. All for $1.00. Springfield Enterprises, Box 54-E5, Springfield Gardens 13, N. Y.

DIAGRAMS for repairing radio $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-PE, Hartford 1, Conn.

WALKIE-TALKIE: Build wireless portable radio for less than $10.00. Plans for variable frequency and crystal control types. Only $5.00 for both, including assembly photographs. Springfield Enterprises, Box 54-E5, Springfield Gardens 13, N. Y.

TRANSISTOR devices, walkie-talkies, VHF AM-FM portable radios, wirelessikes, etc. at wholesale prices direct from our factory. Free literature. Springfield Enterprises, Box 54-E5, Springfield Gardens 13, N. Y.

TUBES-TV, Radio, Transmitting And Industrial Types At Sensibly Low Prices. New, Guaranteed. 1st Quality Top Name Brands Only. Write For Free Catalog or Call Walker 5-7000. Barry Electronics Corp., 512 Broadway, New York 12, N. Y.


COMPLETE Television sets $11.95. Jones TV, 1115 Rambler Avenue, Pottstown, Pa.

"TEST 'Ur Own" Radio and TV tube testers. Total investment in tester, all accessories, and tubes, $400. These units in drug and food stores net 12% per month. Can finance with small down payment. If really interested in complete details, call John Poier-Jordan 3-2706. General Electronic Research, P.O. Box 94, Port Atkinson, Wis.

WORLD'S smallest wrist radio. Transistors, mercury batteries, earset, case, expansion strap, etc. Illustrated instructions. Complete kit only $12.95. Without earset—$9.95. Perry, 23 Knickerbocker Drive, Newark, Delaware.

TRANSFORMERS—115V: 6V@15A—$4.00 each and 115V: 1V@100A—$2.50 each. Remit with order. Dur- son Company, 10616 National, L.A.-34, Calif. Ship- ments postpaid.


2 WAY Wrist Radio with auxiliary long distance booster. Complete diagrams and instructions $1.25. C. Carrier Co., 734-15th St., N.W., Washington 5, D. C.


TELEPHONE Extension in your car. Answer your home telephone by radio from your car. Complete diagrams and instructions $1.25. C. Carrier Co., 734-15th St., N. W., Washington 5, D. C.


SUPERSENSITIVE, Single Transistor radio circuits and construction book: sun powered, miniatures, etc. All new data! Send $1.00 to T. R. Electronics, 1465 Freeport Road, Pittsburgh 27, Pennsylvania.


ELECTRIC Guitars, amplifiers, wholesale, free catalog, Carvin Pes, Covina, Calif.

WANTED

CASH Paid! Sell your surplus electronic tubes. Want unused, clean transmitting, special purpose, receiving, TV types, magnetrons, kilowatts, broadcast, etc. Also want military & commercial lab test and communications gear. We swap too, for tubes or choice equipment. Send specific details in first letter. For a fair deal write, wire or telephone: Barry, 512 Broadway, New York 12, N. Y. Walker 5-7000.

CYLINDER and old disc phonographs. Edison, Con- queror, Idelia, and Oratorio models. Berliner Gramo- phones and Zono-o-phones, Columbia cylinder Graph- phones, and Coin-operated cylinder Phonos. Want old catalogues and literature on early phones prior to 1919. Will pay cash or trade old h-f components. POPULAR ELECTRONICS, Box 50.

WANTED: Used Citizens band mobile 2-way Radio. 16 or 12 watt RP power output or more. John J. Strouhal, Hungerford, Texas.

BUSINESS OPPORTUNITIES

TO $100.00 Weekly. Sparetime, Home Operated Mail- order business. Successful "Beginner's" Plan. Every- thing Supplied. Lynn, 10420-E National, Los Angeles 34.

VENDING Machines—No Selling. Operate a route of coin machines and earn amazing profits. 32-page cat- alog free. Parkway Machine Corporation, Dept. 12, 715 Ensor St., Baltimore 2, Md.

May, 1957
INVENTIONS WANTED


HELP WANTED

HIGH Paying Jobs: Foreign, U.S.A. All trades. Travel paid. Information Application forms. Write Dept. 21M National, 1020 Broad, Newark, N. J.

INSTRUCTION

LEARN While Asleep! Complete Instructions $2.00 Guaranteed. Research Association, Box 610-PE, Omaha, Nebraska.

ENGINEERING Degrees earned by home study. (Residential Courses also available.) Pacing International University, Box 27274-D, Hollywood 27, California.

TRANSISTOR Workshop. Write for details! Transit, Box 15-06, Alden Manor, New York.

DON'T Cry if you have code trouble. Shortcut methods. A plain, simple fantasy. We teach the association method approved the world over. Novice course, basic instruction plus practice material to 8 WPM, $5.95. Advanced course, practice material 9 to 11 WPM, $4.95. Combined—$9.95. Magnetic recording tape, 7-1/2 dual track, 3/4 IPS. Tapedcode, Box 31-B, Longhorne, Penn.


PLASTICS


ADVERTISER'S INDEX

<table>
<thead>
<tr>
<th>ADVERTISER</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ace Radio Control</td>
<td>127</td>
</tr>
<tr>
<td>Air Waves Electronics Co.</td>
<td>122</td>
</tr>
<tr>
<td>Allied Radio Corp.</td>
<td>8, 9, 22</td>
</tr>
<tr>
<td>Allegro Electronics Co.</td>
<td>22</td>
</tr>
<tr>
<td>Bailey Technical Schools</td>
<td>24</td>
</tr>
<tr>
<td>Beckman Instruments, Inc.</td>
<td>122</td>
</tr>
<tr>
<td>Beckman Instruments, Inc.</td>
<td>122</td>
</tr>
<tr>
<td>Burgess Battery Co.</td>
<td>105</td>
</tr>
<tr>
<td>Cashert</td>
<td>104</td>
</tr>
<tr>
<td>Cessna Manufacturing Co.</td>
<td>29</td>
</tr>
<tr>
<td>Capitol Radio Engineering Institute</td>
<td>15</td>
</tr>
<tr>
<td>Central Technical Institute</td>
<td>9, 113</td>
</tr>
<tr>
<td>Cleveland Institute of Radio Electronics</td>
<td>24</td>
</tr>
<tr>
<td>Clifford Sales Co.</td>
<td>125</td>
</tr>
<tr>
<td>Clay Electrical School</td>
<td>9, 113</td>
</tr>
<tr>
<td>Devry Technical Institute</td>
<td>11</td>
</tr>
<tr>
<td>Dresser</td>
<td>116</td>
</tr>
<tr>
<td>Duff Deere Company, Inc.</td>
<td>14</td>
</tr>
<tr>
<td>Edith Electronics</td>
<td>126</td>
</tr>
<tr>
<td>Electronic Experimenters Handbook</td>
<td>11</td>
</tr>
<tr>
<td>Electronic Instrument Co., Inc. (EICO)</td>
<td>12</td>
</tr>
<tr>
<td>Ershol &amp; Co.</td>
<td>16</td>
</tr>
<tr>
<td>Electric Appliance Co.</td>
<td>26</td>
</tr>
<tr>
<td>Electronic Measurements Corp.</td>
<td>16</td>
</tr>
<tr>
<td>Electronic Specialty Supply</td>
<td>104</td>
</tr>
<tr>
<td>Echo Sonic Supply Co., Ltd.</td>
<td>103</td>
</tr>
<tr>
<td>Electro-Stafford Record Co.</td>
<td>122</td>
</tr>
<tr>
<td>Embry-Riddle School of Aviation</td>
<td>110</td>
</tr>
<tr>
<td>Ewing School of Electronics</td>
<td>105</td>
</tr>
<tr>
<td>Fair Radio Sales</td>
<td>104</td>
</tr>
<tr>
<td>General Sales Corp.</td>
<td>105</td>
</tr>
<tr>
<td>General Electric Co.</td>
<td>23, 33, 104</td>
</tr>
<tr>
<td>Groom Products, Inc.</td>
<td>106</td>
</tr>
<tr>
<td>Groves Technical School of Electronics</td>
<td>129</td>
</tr>
<tr>
<td>Groves Technical School of Electronics</td>
<td>106</td>
</tr>
<tr>
<td>Grove Electronic Supply Co.</td>
<td>129</td>
</tr>
<tr>
<td>Gyde Electronics</td>
<td>126</td>
</tr>
<tr>
<td>Hawking Co., P. E.</td>
<td>122</td>
</tr>
<tr>
<td>Heshel Manufacturing Co.</td>
<td>11</td>
</tr>
<tr>
<td>Hershell Radio Co.</td>
<td>105</td>
</tr>
<tr>
<td>Hi-Fidelity Guide and Yearbook</td>
<td>125</td>
</tr>
<tr>
<td>Indiana Technical College</td>
<td>116</td>
</tr>
<tr>
<td>Indianapolis Technical College</td>
<td>116</td>
</tr>
<tr>
<td>International Correspondence School</td>
<td>116</td>
</tr>
<tr>
<td>International Correspondence Schools</td>
<td>116</td>
</tr>
<tr>
<td>Interstate Training Service</td>
<td>116</td>
</tr>
<tr>
<td>Johnson Co., E. F.</td>
<td>107</td>
</tr>
</tbody>
</table>

HIGH FIDELITY

"DIAMOND Needles", $8.95, when we retip your sapphire with finest diamond. Send needle only. Packard Radio, 67 Littlefield St., Pawtucket, R. I.

HI-FI twin reflex enclosure kits. New table model design permits optimum performance with four to six inch speakers. $10.05. Custom Design, Box 43, Waverly, Iowa.

DISLISTED of "HI" HI-Fi Prices? Unusual discounts on all high fidelity requirements. Write now. Key Electronics Co., 120 Liberty, New York 6, N. Y.

TAPE RECORDERS


TAPE RECORDERS, Tape, Unusual Values, Free Catalog. Dresser, 69-02F, 174 St., Flushing 65, N. Y.

STEREOPHONIC, Monaural Recorded Tapes, Recording Tape, Accessories. Write, Efsco Sales Company, West Hempstead, N. Y.

REPAIRS & SERVICING

"KITS assembled and wired: Construction from magazine article. Expert workmanship. Estimates. C. Spinner, Box 102, Massapequa Park, N. Y."

ALL Type kits expertly wired and tested including all ham gear. Satisfaction assured. McSwan, Box 1101, Culver City, Calif.

BOATS

NEW! "How to Build Your Own Fiberglass Boats" and "How to Make Old Boats New with Fiberglass." Send 10¢, Castolite, Marine Division, Dept. EM-115, Woodstock, Illinois.

MISCELLANEOUS

SONGPOEMS and Lyrics Wanted! Mail to: Tin Pan Alley, Inc., 1650 Broadway, New York 19, N. Y.

ADVERTISER

PAGE NO.

<table>
<thead>
<tr>
<th>ADVERTISER</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakelite &amp; Associates, Inc.</td>
<td>106</td>
</tr>
<tr>
<td>Belo &amp; Co.</td>
<td>129</td>
</tr>
<tr>
<td>Lafayette Radio</td>
<td>7, 100, 101, 126, 127</td>
</tr>
<tr>
<td>Ben &amp; Jerry Ice Cream</td>
<td>97</td>
</tr>
<tr>
<td>Madison Electronics</td>
<td>109</td>
</tr>
<tr>
<td>Microwave Company</td>
<td>117</td>
</tr>
<tr>
<td>Miller Company, J. W.</td>
<td>103</td>
</tr>
<tr>
<td>Miller, Gustave</td>
<td>100</td>
</tr>
<tr>
<td>Most Electronics Distributing Co., Inc.</td>
<td>130, 3rd &amp; 4th Covers</td>
</tr>
<tr>
<td>National Company</td>
<td>107</td>
</tr>
<tr>
<td>National School</td>
<td>107</td>
</tr>
<tr>
<td>National American Philips Co., Inc.</td>
<td>10</td>
</tr>
<tr>
<td>Pacific States University</td>
<td>129</td>
</tr>
<tr>
<td>Pace, Jo</td>
<td>129</td>
</tr>
<tr>
<td>PensOhio Distributing Co.</td>
<td>124</td>
</tr>
<tr>
<td>Philadelphia Wireless Technical Institute</td>
<td>116</td>
</tr>
<tr>
<td>Popular Mechanics Press</td>
<td>118</td>
</tr>
<tr>
<td>Popular Photography Directory</td>
<td>118</td>
</tr>
<tr>
<td>Port Arthur College</td>
<td>105</td>
</tr>
<tr>
<td>Precision Radiation Instruments, Inc.</td>
<td>114</td>
</tr>
<tr>
<td>Progressive &quot;Edu-Kits,&quot; Inc.</td>
<td>21</td>
</tr>
<tr>
<td>Quality Electronics</td>
<td>129</td>
</tr>
<tr>
<td>RCA Institutes, Inc.</td>
<td>23, 110</td>
</tr>
<tr>
<td>Raytheon Manufacturing Co.</td>
<td>25</td>
</tr>
<tr>
<td>Rca &amp; Uniaval</td>
<td>25</td>
</tr>
<tr>
<td>Researcher, The</td>
<td>122</td>
</tr>
<tr>
<td>Rider, Publisher, John E.</td>
<td>26</td>
</tr>
<tr>
<td>Rinehart &amp; Co., Inc.</td>
<td>12</td>
</tr>
<tr>
<td>Warner Corporation</td>
<td>12</td>
</tr>
<tr>
<td>Sams &amp; Co., Inc., Howard W.</td>
<td>111</td>
</tr>
<tr>
<td>Sperry Electronic Supply Co.</td>
<td>68</td>
</tr>
<tr>
<td>Springfield Enterprises</td>
<td>112</td>
</tr>
<tr>
<td>Stanburn Radio &amp; Electronic Co.</td>
<td>105</td>
</tr>
<tr>
<td>Standard Line Electronic Company</td>
<td>105</td>
</tr>
<tr>
<td>Syntax Electronics</td>
<td>110</td>
</tr>
<tr>
<td>Surplus Center</td>
<td>110</td>
</tr>
<tr>
<td>TAB</td>
<td>129</td>
</tr>
<tr>
<td>tube Mart, The</td>
<td>107</td>
</tr>
<tr>
<td>Uncle Sam Talking Picture</td>
<td>105</td>
</tr>
<tr>
<td>Valparaiso Technical Institute</td>
<td>130</td>
</tr>
<tr>
<td>Varia Corporation</td>
<td>129</td>
</tr>
<tr>
<td>Video Electric Company</td>
<td>98</td>
</tr>
<tr>
<td>Vidmar Radio</td>
<td>116, 124</td>
</tr>
<tr>
<td>Whistlein Pharmaco Co.</td>
<td>124</td>
</tr>
<tr>
<td>World Radio Laboratories</td>
<td>103</td>
</tr>
</tbody>
</table>

Always say you saw it in—POPULAR ELECTRONICS
college graduates get ahead faster!  

And....

Kester TV-Radio Solder Kit consists of "Resin-Five" Flux-Core Solder, with an activated Resin Flux that does a perfect job on all metals. Of course, our "Resin-Five" Flux is non-corrosive and non-conductive. Also available on 1 lb. spools — see your dealer.

FREE—Kester's 16 page booklet "Soldering Simplified" for your copy today.

KESTER SOLDER COMPANY 4275 Wrightwood Avenue, Chicago 39, Illinois

WANT A BETTER JOB: BECOME AN ELECTRONIC ENGINEER

CODE RECORD WITH INSTRUCTION BOOKLET 7" 45 RPM CRYSTALS 27,355 Mc. Petersen 29A 3.95

Good Trade-In Allowance on your Receivers-Transmitters or Instruments. Send for our flyer on Transistor Kits & Parts.

SPERA ELECTRONICS SUPPLY 37-10 33RD ST. LONG ISLAND CITY, N.Y.

$59 ELECTRONIC FLASH! 400 II SHAWLITE $5520

Assembly & ready to work! Not a Kit! Latest feature, SUPER CIRCUIT BREAKER, prevents overloading then $2.39, job lot AC & Batteries all in one unit, powerful, compact. Gold Finish, Heavy Duty RAW 200+. Recycles 2 cells includes 608/312/325/mfd/450w Flash controls. Batteries not included. Two (2) 240V.... $10

PHOTOFLASH SLAVE "PF" APRIL 57 COMPLETELY BUILT READY TO INSTALL $20 KESTER BUILD KIT FORM 654 "TAB" PHOTO ELECTRONIC FLASH BOOK $50 ILLINOIS PHOTOFLASH HANDBOOK $50

"TAB" SPECIALIZES USBUILD HI-FI KITS!

FOR THE BEST DEAL C "TAB" B4 BUY HI-FI!

NEW IMPROVED "TAB" HI-FI SPEAKERS!

"TAB" FINEST HI-FI RECORDING TAPE 12"—Reel to Reel—Per Reel $1.45 and on Money Back Guarantee

FERRO-SHEEN!!

TUBES "TAB" GUARANTEED

TUBES "TAB" TESTED

KITs! KITS! KITS!

"TAB" QUAL-KITS ARE EASIEST!

TERM: Money Bank Gld. (not of this bank only). 52 ml. Order P.O.B. N.Y. 67. Add $1.00 for C.O.D. 25% Dep. Prices shown are subject to change.

"TAB" WRITE & CATALOG AT OUR 12TH YEAR IN BUSINESS

111th Street., New York 6, N.Y.
Superior's New Model 670-A

A Combination VOLT-OHM MILLIAMMETER PLUS CAPACITY, REACTANCE, INDUCTANCE AND DECIBEL MEASUREMENTS.

SPECIFICATIONS:
- D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
- A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
- OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
- D.C. CURRENT: 0 to 1.5/15 Ma. to 0 to 1.5/15 Amps
- RESISTANCE: 0 to 1,000/100,000 Ohms to 0 to 10 Megohms
- CAPACITY: 0.01 to 1 Mfd. to 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers)
- REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
- INDUCTANCE: 15 to 7 Henrys, 7 to 7,000 Henrys
- DECIBELS: -6 to +18, +14 to +48, +24 to +58

ADDED FEATURE: Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged crinkle-finished steel cabinet complete with test leads and operating instructions.

Superior's New Model 770-A

The FIRST POCKET-SIZED VOLT-OHM MILLIAMMETER

USING THE NEW "FULL-VIEW" METER.

71% MORE SCALE AREA!!

Yes, although our new PULL-VIEW D'Aronval type meter occupies exactly the same space used by the older standard 2½" Meters, it provides 71% more scale area. As a result all calibrations are printed in large easy-to-read type and for the first time it is now possible to obtain measurements instead of approximations on a popular priced pocket-sized V.O.M.

- 8 A.C. VOLTAGE RANGES: 0-15/30/150/300/150/300/150/300 Volts
- 8 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1,500/7,500 Volts
- 2 RESISTANCE RANGES: 0-15/30 Ohms 0-1 Megohm
- 3 D.C. CURRENT RANGES: 0-15/150 Ma. 0-1.5 Amps
- 3 DECIBEL RANGES: -6 db to +18 db, +14 db to +48 db

FEATURES
- Compact—measures 3¼" x 5½" x 2¼"
- Uses "Full View" 2½" accurate D'Aronval type meter. Housed in round-cornered, molded case. Beautiful black electrochemical finish.
- Depressed letters filled with permanent white. Insures long-life even when handled roughly.

Model 770A comes complete with self-contained batteries, test leads and operating instructions.

Superior's New Model TV-50

GENOMETER

7 SIGNAL GENERATORS IN ONE! R. F. Signal Generator for A.M. • R. F. Signal Generator for F.M. • Audio Frequency Generator • Bar Generator • Cross Hatch Generator • Color Dot Pattern Generator • Marker Generator

R. F. SIGNAL GENERATOR: Provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. • VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 900 cycle sine-wave audio, the Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. • BAR GENERATOR: Projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 8 to 16 horizontal bars or 7 to 20 vertical bars. • CROSS HATCH GENERATOR: Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect. • DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence. • MARKER GENERATOR: The following markers are provided: 189 Kc. 282.5 Kc. 456 Kc. 600 Kc. 1,000 Kc. 1,400 Kc. 1,600 Kc. 2,000 Kc. 2,500 Kc. 3,079 Kc. 4.5 Mc., 5 Mc., 10.7 Mc. (1079 Kc. is the color burst frequency)

MODEL TV-50 comes absolutely complete with shielded leads and operating instructions. Only

SHIPped ON APPROVAL
NO MONEY WITH ORDER — NO C. O. D.

SEE FOLLOWING PAGE FOR COMPLETE DETAILS

MOSS ELECTRONICS DISTRIBUTING CO., INC. • DEPT. D-337 3849 TENTH AVENUE, NEW YORK 34, N.Y.

PRINTED IN U.S.A. POPULAR ELECTRONICS

www.americanradiohistory.com
**CONDENSER BRIDGE**

with a range of 0.0001 Microfarad to 1000 Microfarads

(Measures power factor and leakage too.)

**RESISTANCE BRIDGE**

with a range of 100 ohms to 5 megohms.

**SIGNAL TRACER**

which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it is a part or circuit defect.

**TV ANTENNA TESTER**

The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

**Specifications**

**CAPACITY BRIDGE SECTION**

4 Ranges: 0.0001 Microfarad to .003 Microfarad; .001 Microfarad to .005 Microfarad; .005 Microfarads to 20 Microfarads to 1000 Microfarads. This section will also locate shorts, and leakage up to 20 megohms. And finally, this section will measure the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

**RESISTANCE BRIDGE SECTION**

2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms. Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the RC combination is part of an RC bank.)

As Design Engineers, we the undersigned would like to say that the Model 76 is in our opinion the best combination unit of its kind we have been privileged to design. Although it is comparatively a low-priced tester, it will, after you become acquainted with its multiple services, be your most frequently used instrument.

S. LITT
L. MELENKELVITZ

MOSS ELECTRONIC DISTRIBUTING CO., INC.
DEPT. D-337 3849 TENTH AVENUE, NEW YORK 34, N.Y.

Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. It is further understood that should I fail to make payments when due, the full unpaid balance shall become immediately due and payable.

- Model TW-11...Total Price $47.50
  $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- Model TV-12...Total Price $72.50
  $22.50 within 10 days. Balance $10.00 monthly for 5 months.
- Model 670-A...Total Price $28.40
  $7.40 within 10 days. Balance $3.50 monthly for 6 months.

- Model TV-50...Total Price $47.50
  $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- Model 76...Total Price $26.95
  $6.95 within 10 days Balance $5.00 monthly for 4 months.
- Model 770-A...Total Price $15.85
  $3.85 within 10 days. Balance $4.00 monthly for 3 months.

Name ____________________________
Address __________________________
City ____________________________ Zone State ____________________________

ALL PRICES NET, F.O.B., N.Y.C.

$26.95

**SHIPPED ON APPROVAL**

**NO MONEY WITH ORDER - NO C.O.D.**

We invite you to read before you buy any of the models described on this page, the preceding page and the following page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rates.

**NO INTEREST OR FINANCE CHARGES ADDED!**

If not completely satisfied, you are privileged to return the Tester to us, recelong any further obligation.

**SEE OTHER SIDE**

CUT OUT AND MAIL TODAY!
**Superior's New Model TV-12**

**TRANS-CONDUCTANCE TUBE TESTER**

**TESTING TUBES**
- EMPLOYS IMPROVED TRANS-CONDUCTANCE CIRCUIT. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.
- NEW LINE VOLTAGE ADJUSTING SYSTEM. A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.
- SAFETY BUTTON — protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.
- NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY. Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

**TESTING TRANSISTORS**
A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale. The Model TV-12 will accommodate all transistors including NPN's, PNP's, Photo and Tetrododes, whether made of Germanium or Silicon, either point contact or junction contact types.

Model TV-12 housed in handsome rugged portable cabinet sells for only $72.50

**Superior's new Model TW-11. STANDARD PROFESSIONAL TUBE TESTER**

- Tests all tubes, including 4, 5, 6, 7, Octal, Lock-in, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minors, Proximity fuse types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TW-11 as any of the pins may be placed in the neutral position when necessary.
- The Model TW-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
- Free-moving built-in roll chart provides complete data for all tubes. All tube listings printed in large easy-to-read type.

- NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphone tubes or noise due to faulty elements and loose internal connections.

**EXTRAORDINARY FEATURE**
- SEPARATE SCALE FOR LOW-CURRENT TUBES — Previously, on emission type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

The Model TW-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover. $47.50

**SHIPPED ON APPROVAL NO MONEY WITH ORDER — NO C.O.D.**

**FIRST CLASS**
Permit No. 61430
New York, N.Y.

**BUSINESS REPLY CARD**
No Postage Stamp Necessary if Mailed in the U. S.

POSTAGE WILL BE PAID BY —

MOSS ELECTRONIC DIST. CO., INC.
3849 TENTH AVENUE
NEW YORK 34, N.Y.

We invite you to try before you buy any of the models described on this and the preceding page, if after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time-payment schedule details.)

NO INTEREST OR FINANCE CHARGES ADDED!
If not completely satisfied, you are privileged to return the Tester in the original carton at our expense. No further obligation.

SEE OTHER SIDE
CUT OUT AND MAIL TODAY!