8 New Construction Projects

Intercom...Novice Beam...Signal Chaser...Crystal Set
Transistorized Timer...R/C Triplex...Receiver...Phono Player
Here it is!

the All-New

HAMMARLUND

HQ-100

COMMUNICATIONS RECEIVER

Keep up with the world—listen to radio programs from all countries—listen to the amateurs, ships, and many other interesting conversations. The whole wide world can be received like domestic stations on the brand-new Hammerlund HQ-100.

Variable selectivity permits you clear reception of even the most remote stations. Electrical bandspread tuning provides extra-accurate tuning in those crowded spots on the dial.

Many new and exciting features have been built into the new HQ-100. An amazing Auto-Response circuit automatically sets the audio characteristics for the very best performance on either communications or high-fidelity music.

This is not a reworked broadcast receiver, but a thoroughbred communications instrument made by the leading manufacturer of such receivers. See it and try it at your Hammarlund dealer.

Complete technical information and name of nearest dealer on request.

Ask for bulletin P-11

only

$169.00

*Telechron automatic clock-timer switch for warm-up operation, $10. extra

(Without Speaker)
BUILD THIS NEW FABULOUS MODULAR RADIO

Modular Construction eliminates use of individual resistors, capacitors and wiring.

Assemble this sensitive AC-DC Table Model Super Heterodyne Radio Receiver in less than 1/2 hour

NO WIRING
NO SPECIAL TOOLS
ONLY A SOLDERING IRON REQUIRED


You have read about the Navy's 'Project TinkerToy.' You have heard about 'Module' construction in military electronic applications.

This remarkable new pre-fab technique is now available to you — for the first time — in the first civilian product to feature both: PRINTED CIRCUITY and MODULAR COMPONENTS.

Here is an exciting opportunity to work with one of the latest developments in modern electronics and learn about the new, fabulous module technique.

In years to come, every radio, TV receiver, test instrument — in fact, every electronic device — will be modular constructed.

Be among the first to assemble a modular radio-broadcast receiver!

ACT NOW!
Send your check or money order...today! 10% required on C.O.D.

Use this convenient order form

R & D Electronic Laboratories Inc. Dept. PE-11
21-28 45th Road, L.I.C. 1, N.Y.

Send __ MODULAR RADIO KIT(S) at $17.50.

I enclose □ check; □ money order in the sum of $__________

□ in full payment — postage prepaid.

□ As 10% deposit for C.O.D. — I pay all charges.

NAME ___________________________
ADDRESS ___________________________
CITY _______ ZONE _______ STATE _______

All Parts Unconditionally Guaranteed

www.americanradiohistory.com
POPULAR ELECTRONICS

CONTENTS

FEATURE Articles and Electronic Developments
Electronic Election Battle .................................................................................. 39
See Who's on the Phone .................................................................................. 41
Tricked-up Cathode Rays Are "On the Beam" .................................................. 43
Drive-In Church Attracts Motorist Congregation ........................................... 51
Electronics on the Fishways ............................................................................. 60
Radar Tames the Wild Blue Yonder ................................................................. 74
Electronics Comes to Drive-In .......................................................................... 92

Electronic Build-It-Yourself Projects
The "Triad Terminator" .................................................................................... 47
Capacitor Duo-Decades for the Experimenter .................................................. 56
Transistor Experiment No. 12—Electronic Timer ............................................. 59
The "Economy" Signal Chaser .......................................................................... 63
Storing Small Components in the Workshop ................................................... 65
Handy Connections for Ferrite-Rod Loop Antennas ......................................... 65
Long-Wave DX'er—a Single-Tube Receiver ..................................................... 66
Progressive Crystal Receiver ............................................................................ 73
A Beam and Tower for the 15-Meter Novice .................................................... 78
R/C Triplex—Three Controls on One Channel ................................................. 86

AUDIO and Hi-Fi Features
The Hi-Fi Boost .................................................................................................. 53
What's New in Hi-Fi ......................................................................................... 70
Amplifierless Record Player ............................................................................ 80
Mixing It Up ....................................................................................................... 84

Miscellaneous Electronic News
Simplified Radar to Use "Wamoscope" ............................................................... 40
Electronic Alarm Guards Pools ......................................................................... 42
Live TV to S.A.? ................................................................................................. 42
TV Turned Traffic Cop ....................................................................................... 42
Unique Video Generator ................................................................................... 42
Chart Dials TV Troubles ................................................................................... 46
Fast/Slow TV Scanner ....................................................................................... 46
Computer Speeds Supplies .............................................................................. 46
Video Rig Checks Freight .................................................................................. 46
Bell Shakes Them Up ...................................................................................... 52
Gas with a Kick .................................................................................................. 52
Good-Bye Barnacles ......................................................................................... 52
TV Peeks from Sky ........................................................................................... 52
Auto Antenna Replacement .............................................................................. 72
Capacitors Use No Leads ................................................................................ 72
Pocket Size Tester ............................................................................................ 72
Robot Helicopter .............................................................................................. 72
Metal Monitor .................................................................................................... 92

(Also see page 6 for DEPARTMENTS)

© 1956 by Ziff-Davis Publishing Company. All rights reserved.
Average Net Paid Circulation 240,151

NOVEMBER 1956

VOL. 5—NUMBER 5
Publisher
OLIVER READ, W1ETI
Managing Editor
OLIVER P. FERRELL
Technical Editor
CHARLES S. TEPFER
Feature Editor
NORMAN EISENBERG
Associate Editors
HANS H. FANTEL
MARGARET MAGNA
Contributing Editors
H. B. BEHRENS, JR., E. GARNER, JR., H. S. BRIER, H. POLLACK, J. T. FRYE, R. P. TURNER
Art Editor
ALFONS J. REICH
Art and Drafting Dept.
FRANK SAYLES
J. A. GOLANIEK, WHIPLEY
W. K. VAHLSSING, J. A. ROTH
Advertising Director
L. L. OSEN
Advertising Manager
WILLIAM G. MIBOY
Midwest Adv. Manager
JIM WEAKLEY
Western Adv. Manager
JOHN E. PAYNE

ZIFF-DAVIS PUBLISHING COMPANY
W. B. ZIFF (1898-1953) FOUNDER
Also Publishers of RADIO & TELEVISION NEWS, POPULAR ELECTRONICS, and POPULAR MECHANICS
Editorial and Executive Offices
366 Madison Ave., New York 17, N. Y.
MU 7-8080
President
B. G. DAVIS
Vice-President
H. J. MORGANROTH
Vice-President
M. FROBLICH
Vice-Pres. & Circ. Dir.
M. MICHAELSON
Secretary-Treasurer
G. E. CARNEY
Art Director
AL GRUEN

BRANCH OFFICES
CHICAGO (1)
64 E. Lake St., AN 3-5200
LOS ANGELES (14)
215 W. 7th St. (Room 412)
Trinity 8043

SUBSCRIPTION SERVICE:
All communications concerning subscriptions should be addressed to Circulation Dept., Ziff-Davis Publishing Company, 366 Madison Ave., New York 17, N. Y. Include your old address as well as the new—enclosing if possible an address label from a recent issue of this magazine. Allow at least 6 weeks for change of address.

CONTRIBUTORS:
Contributions are welcomed to retain a copy of their manuscripts and illustrations. Contributions should be mailed to the editor, Ziff-Davis Publishing Company, 366 Madison Ave., New York 17, N. Y., and if their return is desired, the material must be accompanied by return postage. All manuscripts should be typed and will be handled with reasonable care, but this magazine assumes no responsibility for their safety. Any copy accepted is subject to whatever alterations and revisions are necessary to meet the requirements of this publication. Payment covers all rights and contributions will be paid at our own rate of acceptance. All photos and drawings will be returned if accompanied by a self-addressed, stamped envelope.

www.americanradiohistory.com
Train in Great Shops of COYNE for better jobs in

ELECTRICITY • TELEVISION

ELECTRONICS

RADIO—COLOR TV

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.

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, Dept. 86-71H

COYNE QUALITY

TELEVISION

RADIO—COLOR TV

Home Training at Unbelievably Low Cost

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—no 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 TELEVISION

Radio—Color TV

Home Training at Unbelievably Low Cost

Send Coupon for Free Book

and full details, including easy Payment Plan. No obligation, no salesman will call.

COYNE ELECTRICAL SCHOOL
500 S. Paulina St., Chicago 12, Ill., Dept. 86-71H

November, 1956

www.americanradiohistory.com
You can obtain fine music reproduction from your conventional phonograph with the

SHURE

"Twin Lever" Ceramic Phono Cartridge

The WC10 "Twin-Lever" Improvement Cartridge will dramatically improve the tone quality of your conventional home phonograph—will actually make it better than new! The low price of the "Twin-Lever" permits anyone to enjoy the luxury of faithful reproduction of recorded music.

This remarkable cartridge replaces practically all three-speed, plastic-cased cartridges, crystal or ceramic, turnover or single needle.

It is easily installed in any tone arm with standard 1/2" mounting centers. Needle replacement can be accomplished in seconds—without tools—with the cartridge in the arm.

MODEL WC10
List Price .......... $9.50
with two sapphire needles

MODEL WC10D
List Price .......... $34.00
with a 1-mil diamond and a 3-mil sapphire needle

SHURE
The Mark of Quality
IN ELECTRONICS SINCE 1925
SHURE BROTHERS, INC.
Microphones—Electronic Components
214 HARTFORD AVENUE * EVANSTON, ILLINOIS

DEPARTMENTS

Carl & Jerry .................. John T. Frye 10
Letters from Our Readers ............... 26
POP'tronics Bookshelf .............. 34
Transistor Topics ............. Lou Garner 57
Sound Impressions ............ 71
After Class .................. 76
The Transmitting Tower ........ Herb S. Brier 81
Tuning the Short-Wave Bands ... Hank Bennett 91
Tips and Techniques ............. 98
Tools and Gadgets ............ 102

COMING NEXT MONTH (DECEMBER)

(ON SALE NOVEMBER 20)

In accordance with our annual Christmas custom, there will be several projects for both adults and children: "A Child's Radio," "Electronic Tiddly-Winks," "Electronic Roulette," and "Electronic Harmonica." Also look for construction details on the "Economy" audio signal generator and a simple converter for long-wave DX'ing.

Other assorted subjects include: how the effect of an atomic bomb on huge population centers is "tested" with an elaborate computing system; the electronic "composer" and the two-ton monster that plays every imaginable musical instrument; how to listen to police calls; the purpose of a loudness control in hi-fi amplifiers.

IN THIS MONTH'S
RADIO & TELEVISION NEWS
(NOVEMBER)

The "Distributed Port" Loudspeaker Enclosure
All-Transistor Hi-Fi Amplifier
An Air Raid Alarm for Home Receivers
How to Choose a Tape
The "Electro-Tach"—An Electronic Tachometer

ALWAYS SAY YOU SAW IT IN—POPULAR ELECTRONICS
LOOKING FOR JOB SECURITY AND SUCCESS?

LET MY STUDENTS AND GRADUATES TELL YOU

ABOUT MY TRAINING -

$60 A WEEK IN SPARE TIME

I have the skill and know-how to do the work. I have a shop at home and have been working on radio and TV after working hours of my regular job. I average $50 a week for this part time work. RTTA training helped me in making extra money and giving me experience in the electronic field.

Harold Gimlen, Flint, Mich.

HAS OWN BUSINESS

I have a shop at home and have been working on radio. RTTA training increased my knowledge of TV circuits and showed me new, quicker methods of repairing.

Richard Hennis, Little Rock, Ark.

AIRCRAFT INSPECTOR

With RTTA training and through repairing radios and televisions for the right people at the right price, I was able to make the right contacts. I am now an Inspector for Douglas Aircraft at about $125 a week.

Hugh Maddox, Los Angeles, Calif.

ELECTRICAL TESTER

RTTA training has helped me understand TV and many variations of simple circuits. The course covers all subjects very clearly. I am now an Electrical Tester for Western Electric Co. at $83.42 a week.

Raymond Lapan, Burlington, N. C.

YOU, TOO, CAN GET A BETTER-PAYING JOB IN THE EVER-EXPANDING RADIO-TELEVISION-ELECTRONICS FIELD

Why limit yourself and your earnings because of your lack of training. Learn AT HOME in your SPARE TIME to be an electronic technician, television repairman, or studio technician. You don't need any experience whatsoever.

After you finish my Radio-FM Television Course or FM-Television Course you can have, if you want it, two weeks of laboratory training at my associate resident school in New York City—AT NO EXTRA COST.

If you have had previous radio and television experience you can take my practical TV Studio Technician Course to qualify for a good-paying job in a TV studio.

Write to me today and let me show you how you can begin now to put yourself on the road to a better future.

VETERANS!

My school fully approved to train veterans under the GI Bill. Don't lose your school benefits by waiting too long. Write discharge date on coupon.

Radio-Television Training Association

52 EAST 19th STREET • NEW YORK 3, N. Y.

Licensed by the State of New York • Approved for Veteran Training

November, 1956

L. C. Lane, B.S., M.A.,
President, Radio-Television Training Association, Executive Director, Pierce School of Radio & Television.

ABOUT MY EQUIPMENT

YOU GET ALL THIS EQUIPMENT

- COMBINATION VOLTMETER
- AMMETER-OHMMEET
- AT-77 SIGNAL GENERATOR
- WIRE TELEPHONE TRANSCEIVER
- C.W. TELEPHONE TRANSMITTER

"... a money making little gem."
I have completed kit #66 and was amazed at how it works. I showed it to a friend of mine and he asked me to sell it up for one of the prizes in his social club was having. That sure is a money making little gem.

John Fernandez, Fresno, Calif.

"We get excellent pictures...
I would like to compliment you on an excellent and complete course. We get excellent pictures on my TV set from W5FE (Syracuse, N.Y., approximately 110 miles away. The set is working good and I have had to replace only three tubes since I assembled it two years ago.

Larry M. Stafford, Kingston, Ont., Canada

"... very good reception...
I have really enjoyed the course and have come a long way in TV servicing. I am getting very good reception on my TV station considering that the nearest VHF station is 120 miles.

J. W. Hamilton, Jr., Henderson, Texas

MAIL THIS COUPON TODAY!

Mr. Leonard C. Lane, President
Radio-Television Training Association
Dept. PE-11C, 52 East 19th Street, New York 3, N. Y.

Dear Mr. Lane: Send me your FREE BOOK, FREE SAMPLE LESSON, and FREE film that will show me how I can make TOP MONEY IN TELEVISION. I understand I am under no obligation.

(Please Print Clearly)

Name ____________________________ Age __________

Address __________________________

City ____________________________ Zone ______ State ______

[ ] Radio-FM TV Technician Course
[ ] FM TV Technician Course
[ ] TV Studio Technician Course

Write discharge date (if interested)


www.americanradiohistory.com
you get the most for your money when you build
ALLIED’S own knight-kits

* You get maximum value for your kit dollar
* You get premium quality parts
* You get advanced design and top performance
* You get exclusive new features
* You get easiest-to-follow instructions for assured success in the finished equipment

BUY WITH CONFIDENCE FROM THE PIONEERS IN ELECTRONIC KITS

Fascinating knight-kit

**TRANSISTOR RADIO KIT**

Model S-765 only $4.35

- Experiment with the marvel of transistors!
- Printed circuit mounting board simplifies assembling. Just 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., 2 lbs.

Model S-765. Net only $4.35

- S-266. Accessory kit: 4000 ohm double headphones and all parts for outdoor antenna. Net $3.15

Fascinating knight-kit

**SPACE-SPANNER**

**BANDSWITCHING RECEIVER KIT**

Model S-243 only $15.95

- All-new 2-hand receiver, easy to build—a great value. Bandswitch selects thrilling short wave, including amateur, aircraft, police and marine radio (6 to 38 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. 7 x 10 1/4 x 6", for 110-120 v, 50-60 cycle AC or DC. Shpg. wt., 4 3/4 lbs.

Model S-243. Net only $15.95

- S-247. Matching cabinet for above $2.90

Fascinating knight-kit

**TWO-WAY INTERCOM SYSTEM KIT**

Model S-295 only $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 babysitting. In "closed" position, Remote remains private, but can be called and can originate calls. High-gain 2-stage amplifier and 4" PM speakers. With tubes and 50-ft. cable. (Up to 200-ft. may be added.) Each unit 43 1/4 x 6 1/2 x 4 3/4", antique white finish. For AC or DC. Easy to assemble. 7 lbs.

S-295. Net only $14.75

Fascinating knight-kit

**10-IN-1 LAB KIT**

Model S-265 only $12.65

- Instructive, fascinating! Enables you to build any one of 10 circuits: Broadcast receiver for headphone reception; Phone Oscillator to play records through any radio; Phone Amplifier; Code Practice Oscillator; Signal Tracer; Electronic Timer; Relay, etc. Includes tubes, all parts, instructions (less photo-tube and socket, and headphone). Ready to build. For 110-120 V., 50-60 cy. AC. 10 lbs.

Model S-265. Net only $12.65

- J-112. Headphone for above $1.85
- C-100. Antenna Kit for above $1.85

IDEAL KIT FOR THE HAM

Model S-255 only $43.75

- Knight-kit 50-WATT CW TRANSMITTER KIT

Compact, value-packed, low-power rig. 50 watts input to 807; 6AG7 oscillator takes crystal or VFO; bandswitching covers 80, 40, 20, 15, 11-10 meters; pi matching network eliminates separate antenna tuner; clean cathode keying of oscillator and final; excellent TVI suppression; meter reads plate or grid of final. With all parts, tubes, wire, solder and instructions (less key and crystal), 8 1/4 x 11 1/4 x 8 3/4", 18 lbs.

Model S-255. Net only $43.75

Always say you saw it in—POPULAR ELECTRONICS
YOU BUILD THE BEST AND SAVE MORE WITH knight-kits

**knight-kit**

**VTVM KIT with printed circuit board**
Model F-125
$24.95

Easy to build. Reads peak-to-peak, 15,000 ohms. Balanced-bridge push-pull circuit; 4½" meter, 200 microamp. Ranges: AC peak-to-peak volts, 0-4, 14-40, 140-400, 1,400-4000; DC rms v. and DC v., 0-1.5-5-15-50-150-500-1500; ohms, 0-1000-10K-100K, 1-10-100-1000, 0-20,000 mega. DB scale; direct-reading DB scale; polarity reversing switch. Ready to build. 7½ x 5½ x 4½", 6 lbs.
Model F-125. Not only... $24.95
F-125. High Voltage Probe. $4.75
F-127. High Frequency Probe. $3.45

**knight-kit**

**20,000 OHM/VOLT VOM**
Model F-140
$29.50

Low cost 32-range VOM. Features 4½" 50-microammeter; 1% precision multiplier; 2% accuracy full-scale deflection. Ranges: AC, DC and output volts, 0-2, 5-10, 50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg; DC ma, 0-1-10; DC amps, 0-1/10; Decibels, -20 to +63 (6 ranges). Black bakelite case, 6½ x 5½ x 3½". Ready to build. 5½ lbs.
Model F-140. Not only... $29.50

**knight-kit**

**'IN CIRCUIT' CAPACITY CHECKER KIT**
Model F-119 only $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, ready to build. 3 lbs.
Model F-119. Not only... $12.50

**FREE 356-PAGE 1957 CATALOG**

It's your money-saving guide to everything in Electronics, featuring more than 25 other KNIGHT-KITS, including Test Instruments, Hobbyist Kits and Amateur Kits. Send for it!
Eeeeeelectricity!

Carl was just arriving home after spending a short week-end vacation with an aunt and uncle in Chicago. He burst in the front door; yelled, "Hi, Dad"; planted an awkward kiss on the bridge of his mother's nose; and sailed right out on the back door, across the yards, and into the basement laboratory of his neighbor and best friend, Jerry Bishop.

Jerry was there all right, and he was just as glad to see his pal as Carl was to see him; but it was against the Code of Boyhood to show their feelings. Jerry hardly looked up as he grunted a greeting. To tell the truth, though, he was pretty busy trying to strap a squirming, wriggling something into the concave side of a short section of gutter trough. It kept slithering through the rubber gloves he was wearing.

"Holy cow, Jer, what is that thing?" Carl demanded. "Is it a snake?"

"Of course not, stupid. It's an eel that my uncle in the Navy sent me from South America. I want to make some tests on it. Put on that other pair of rubber gloves and help me fasten it in this trough."

"Not on your life!" Carl said emphatically as he backed toward the door. "I wouldn't touch that snaky-looking thing with a ten-foot pole, let alone my hands. Why on earth would your uncle send you something like that? Has he sprung his hatch?"

"Certainly not. This is not just an ordinary eel. In fact, it's not really an eel at all. Strictly speaking, it's an electric fish. My uncle says if I'm going to be an electronics engineer I should know about all forms of electricity; and electric fishes have been stirring electrons for thousands of years. Pictures of them appear in Egyptian tombs and they are mentioned in Aristotle's Historia Animalium. In addition to this so-called electric eel, there are five other fishes with shocking power: the torpedo or electric ray, the electric catfish, the star-gazer, the numb-fish, and the elephant-snout fish."

NEVER MIND the lecture, Professor," Carl said impatiently. "Just tell me..."
NOW in YOUR OWN HOME!

LEARN AUTOMATION ELECTRONICS

TELEVISION RADIO • ELECTRONICS

FASTER and EASIER with the aid of DTI EXCLUSIVE TRAINING FEATURES

OPPORTUNITIES ARE GROWING

The vast Electronics field is growing fast! It is calling for skilled technicians to step into good jobs paying real money. These are interesting positions—in plants ... TV studios ... laboratories ... offices ... radio stations ... plus equally wonderful opportunities for starting a profitable full time or part time sales and service business of your own.

Electronics offers a real future! With over 400 TV stations on the air, with more than 30 million TV sets in use, with so many opportunities opening up in Radio Broadcasting, Communications, Instrumentation, Military Electronics and the newer field of Automation Electronics, the need for skilled personnel is increasing.

But to make progress in this fast-moving field you need real KNOW-HOW—the kind you get from an industrial training program—the kind you get from DeVRY TECHNICAL INSTITUTE.

Yes, you get the benefit of a program geared to the needs of industry, and backed by our 25 years of experience in helping men prepare for good jobs or their own business.

EMPLOYMENT SERVICE

DTI's efficient Employment Service is ready to help you make your start in the field when you complete the training. Over the past 25 years, we have built up hundreds of contacts with employers of electronic specialists. You even get valuable advice on starting and operating your own business.

MILITARY SERVICE

If you are subject to military service, we have important information for you.

MAIL COUPON FOR DETAILS!

DeVRY TECHNICAL INSTITUTE
4141 Belmont Ave., Chicago 41, Ill. Dept. PE-11-M

Please give me a copy of "89 Ways to Earn Money In Television Radio-Electronics," together with facts about the opportunity fields I have checked below.

- TELEVISION
- COMMUNICATIONS
- RADIO
- NUCLEAR INSTRUMENTATION
- AUTOMATION ELECTRONICS

Name: ___________________________ Age: __________
Street: ___________________________ Apt: __________
City: ___________________________ Zone: __________

1021 A DeVry's training is available in Canada.

November, 1956
Perfect Pair...

RAYTHEON

CK722 and CK768 TRANSISTORS

You won't find a better performing, easier to use, less expensive combination than these two, top-quality Raytheon Transistors.

The CK768 is specially designed for RF application with the Raytheon CK722 for audio circuits. They pair up perfectly. Yet the CK722 costs but $0.99, the CK768 only $1.50—$2.49 for the best transistor combination that money can buy. Available from stock through your Raytheon Tube Supplier.

Get the Raytheon TRANSISTOR APPLICATIONS BOOK
116 pages - over 50 practical circuits - using low cost Raytheon Transistors. For your copy send 50c to Raytheon, Dept. P7.

Carl & Jerry (Continued from page 10)

what you are trying to do with old Squirmy there."

"I want to strap him in this rubber-lined trough so I can find out something about the electric charge he emits. The rubber lining will prevent his being short-circuited by the metal trough. When I get him fastened down, I'll slide these little tin-foil strips underneath his body at different points to pick off the charge he emits. Then, by using the 'scope and the VTVM, I'll know if he has a.c. or d.c. wiring and how much voltage he puts out."

"You mean you don't have any idea what to expect? And are you wearing those rubber gloves because you don't want to touch the slimy thing or because you're afraid of being shocked?"

"To answer the last first, I'm wearing them cause I don't want to be shocked. A full-grown electric eel can put out a jolting five-hundred volts that can stun a horse or paralyze a man. Since eight feet is about as long as they get, and since this one is nearly five feet long, I'd guess he was full grown. He acts fully charged, too. An adult eel that puts out only three hundred volts is either sick or simply not letting himself go. Even a baby eel can deliver around 120 volts—as much voltage as there is in the a.c. house line."

"How do you know all this? You been boning up at the library?"

"Yes, and I got a lot more information..."

... Jerry was trying to strap a squirming, wriggling something into the short section of gutter trough, but it kept slithering through his rubber gloves...
HERE'S HOW YOU CAN MAKE BIG MONEY IN ENGINEERING!

Because of the critical engineering shortage you don't have to be a graduate engineer to win lifetime success.

Pick up a newspaper. Turn to Help Wanted. Look as far as "E." The paper's black with big ads offering big pay for engineers. It's the country's most critical shortage — and one that isn't going to be overcome for many long years.

You're not an engineer, you say. You don't even have a college degree.

O.K.

If you've got brains, if you've got ambition, if you've got the sheer determination to work and be somebody — you can win a secure place in engineering.

Each year, I.C.S. prepares thousands of men just like you for a lifetime career in engineering. In just a few short months, many begin a fast move upward with positions as engineering aides, and with healthy boosts in pay.

How about you? Tired of the treadmill you're on? Take the first big step to success by sending in that I.C.S. coupon now. In your spare time, working at your own pace, you can ready yourself for a really big job — in a lot less time than you may think!

Send Coupon Now... Get Three Books Free!

These books free if you act now!

1. "How to Succeed" — a gold mine of career tips
2. Big catalog outlining opportunities in the field of your choice
3. Sample lesson text (math) showing clear, step-by-step I.C.S. method

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 15622X, SCRANTON 9, PENNA.**

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

**AVIATION**

- Aeronautical Engineering Jr.
- Aircraft & Engine Mechanic

**BUSINESS**

- Accounting
- Bookkeeping and Accounting

**CIVIL, STRUCTURAL ENGINEERING**

- Civil Engineering
- Construction Engineering
- Highway Engineering
- Reading Structural Blueprints

**DEGREE PROGRAMS**

- Degree in Business Administration
- Degree in Business Correspondence
- Degree in Business Management

**MECHANICAL AND SHOP**

- Gas, Electric & Gasoline Driving
- Heat Treatment
- Metal Fabrication
- Industrial Engineering
- Industrial Instrumentation
- Machine Design
- Machine Tool Design

**MISCELLANEOUS**

- Aeronautics
- Aeronautical
- Aeronautical Drafting
- Aeronautical Engineering
- Aeronautical Drafting
- Aeronautical Engineering
- Aeronautical Drafting
- Aeronautical Drafting
- Aeronautical Engineering
- Aeronautical Drafting

**TEXTILE**

- Loom Weaving
- Industrial Engineering
- Industrial Instrumentation
- Machine Design

**TELEVISION**

- Television Technician

**RAILROAD**

- Air Brake Equipment
- Car Inspecting
- Diesel Engineering
- Electric Engineering
- Steam and Diesel Power

**STEWART'S CONSULTING ENGINEER**

- Consulting Engineer
- Consulting Engineer
- Consulting Engineer
- Consulting Engineer
- Consulting Engineer
- Consulting Engineer
- Consulting Engineer
- Consulting Engineer
- Consulting Engineer
- Consulting Engineer

**CIVIL, STRUCTURAL ENGINEERING**

- Civil Engineering
- Construction Engineering
- Highway Engineering
- Reading Structural Blueprints
- Sanitary Engineering
- Structural Engineering
- Surveying and Mapping

**DRAFTING**

- Aircraft Drafting
- Architectural Drafting
- Electrical Drafting
- Mechanical Drafting

**RADIO, TELEVISION**

- Radio and Television
- Radio and Television
- Radio and Television
- Radio and Television
- Radio and Television

**HIGH SCHOOL**

- Mathematics
- Try Sports
- Try Sports
- Try Sports

**OCCUPATIONAL**

- Auto Body Rebuilding
- Auto Electrician
- Auto Body Rebuilding
- Auto Electrician
- Auto Body Rebuilding
- Auto Electrician
- Auto Body Rebuilding
- Auto Electrician

**INFORMATION**

- Books on Individual Subject:
- Books on Individual Subject:
- Books on Individual Subject:
- Books on Individual Subject:
- Books on Individual Subject:
- Books on Individual Subject:
- Books on Individual Subject:
- Books on Individual Subject:

**RESUME**

- Send me information on:
- Send me information on:
- Send me information on:
- Send me information on:
- Send me information on:
- Send me information on:
- Send me information on:
- Send me information on:

November, 1956

---

Canadian residents send coupon to International Correspondence Schools, Canadian, Ltd., Montreal, Canada. Special tuition rates to members of the U. S. Armed Forces.
What's new in magnetic recording

"Scotch" Brand Magnetic Tape has been played thousands of times with perfect results. However, for maximum performance throughout the years, these simple suggestions on tape storage will prove of benefit:

1. Avoid storing unboxed reels of tape. Original box provides protection from dust and damage.

2. Reels of tape should be loosely wound and stored on edge or laying flat on individual shelves. Stacking many reels one on top of the other should be avoided.

3. If tape is subject to extreme temperatures, allow the tape to return to room temperature before running on machine.

4. Tape should be stored in a room with relative humidity maintained between 40 and 60%. If the relative humidity is subject to large variations, magnetic tape can be safely stored in a sealed metal can. Occasional use of the tape improves storage characteristics by releasing strains.

Do you record symphony concerts, operas, news events? Then, for true economy, "Scotch" Brand Extra-Play Magnetic Tape 190 is the tape for you. With 50% more tape wound on a standard size reel, amazing Extra-Play Tape lets you record even longer radio programs and home celebrations with pauses for reel changeover reduced to a minimum.

**JUST ONE of the many advantages of "Scotch" Brand Magnetic Tape . . . it's "dry" lubricated to prolong recording head life. The only magnetic tape on the market with patented silicone lubrication, "Scotch" Brand glides smoothly over the head to end high frequency flutter caused by sticking and squealing. No wonder it's the favorite brand of recording engineers.**

**NEW PLASTIC LEADER AND TIMING TAPES! 50% stronger than paper leader . . . takes both ball point and pencil writing . . . has special anti-static coating . . . carries new convenient timing markers. Ask your dealer for it.**

The term "Scotch" and the plaid design are registered trademarks for Magnetic Tape made in U.S.A. by MINNESOTA MINING AND MFG. CO., St. Paul 6, Minn. Export Sales Office: 99 Park Avenue, New York 16, N. Y. © 3M Co. 1956

---

Carl & Jerry (Continued from page 12)

from a story that appeared in the June-July, 1956, edition of a storage battery house organ called Exide Topics that my uncle sent me. What I want to do right now is to double-check on some of the statements in that story.

"Looks like you've got Old Squirmy pretty well trussed up; so let's start double-checking," Carl suggested.

"Okay," Jerry agreed. "First let's see if this eel is a.c. or d.c. According to the eel experts, the electrical discharge he puts out is a series of rapid direct-current discharges in the form of short-duration pulses sent out at a rate of about four hundred per second. But these pulses are of such short duration, about two-thousandths of a second, that the actual wattage output of an adult electric eel is only about forty watts."

**THEN SUPPOSE we hook Buster here to a forty-watt bulb," Carl suggested.**

"He's no good for lighting bulbs," Jerry explained. "Those pulses are too short to overcome the thermal lag of an incandescent bulb filament. Voltage has to be applied to such a filament for about one-fiftieth of a second before it begins to glow, and one of these pulses only lasts about one-tenth that long. But he could light a neon bulb, and I'm sure he'll make some interesting traces on our 'scope. I've got an idea about how to check his polarity, too. We'll simply run his output into this 0.5-microfarad capacitor and let him charge it up with his pulsating voltage. Then our VTVM connected across it will show his peak voltage and polarity."

As he talked, Jerry slipped one tin-foil electrode beneath the tail of the eel and another beneath the center of his body. Leads from the electrodes went to the capacitor, and the VTVM was connected to read the voltage charging this capacitor.

"Three-hundred-and-fifty volts!" Carl announced; "and the way the pointer swings proves that Old Squirmy's tail is the negative pole of his battery and the front part of him is the positive pole."

"Watch the meter while I slide this front electrode back and forth," Jerry suggested. "I want to find where the front end of his generator actually is."

This method soon showed that the maximum voltage, four hundred and eighty volts, was obtained when the negative electrode was at the eel's tail and the positive electrode was at a point about a foot back from his head.

"That squares with what the books say," (Continued on page 18)

Always say you saw it in—POPULAR ELECTRONICS

---

www.americanradiohistory.com
How to Pass

FCC
COMMERCIAL
License Exams

Get your FCC License
Quickly!

We Guarantee to train you until you receive Your FCC License

Get all 3 FREE

CLEVELAND INSTITUTE Training results in success with commercial FCC examinations—easily—and quickly. Here’s Proof:

<table>
<thead>
<tr>
<th>Name and Address</th>
<th>License</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walter E. Eggers, Pacific Grove</td>
<td>1st</td>
<td>12 weeks</td>
</tr>
<tr>
<td>Paul Reichert, West Salem, Ohio</td>
<td>2nd</td>
<td>10 weeks</td>
</tr>
<tr>
<td>Harold Phipps, LaPorte, Indiana</td>
<td>1st</td>
<td>28 weeks</td>
</tr>
<tr>
<td>John H. Johnson, Boise City, Idaho</td>
<td>2nd</td>
<td>12 weeks</td>
</tr>
<tr>
<td>James Faint, Johnstown, Pa</td>
<td>26 weeks</td>
<td></td>
</tr>
</tbody>
</table>

(Names and addresses of trainees in your area sent on request)

Cleveland Institute training results in job offers like these:

Radio Operators & Technicians
American Airlines has openings for radio operators and radio mechanics. Operators start at $334.33 per month. Radio mechanics' salary up to $1,99 per hour. Periodic increases with opportunity for advancement. Many company benefits.

Electronics Technicians
Convair Electronics Department: Radio and Radar Mechanics. Electronics Technicians and Junior Engineers are wanted for a special program on fire control development and installation. Beginning rate: $385 and up.

And our trainees get good jobs

Electronics Technician
"I am now employed by the Collins Radio Company as a Lab Technician. (This job was listed in your bulletin.) I have used the information gathered from your course in so many ways and I know that my training with Cleveland Institute helped me a great deal to obtain the job."

Charles D. Sindelar, Cedar Rapids, Iowa

Cleveland Institute of Radio Electronics
4900 Euclid Bldg. Desk PE-18 Cleveland 3, Ohio

November, 1956

MAIL COUPON TODAY

Cleveland Institute of Radio Electronics
Desk PE-18, 4900 Euclid Ave., Cleveland 3, O.

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
New! A MACHINE THAT COMPOSES MUSIC

COMPUTES, "REASONS" PLAYS GAMES

GENIAC ELECTRIC BRAIN

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 . . . no 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 tasks you've ever done! You set up problems in a variety of fields—and get your answers almost 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 1956 Model GENIAC KIT contains: (1) a complete 200-page text, "Minds and Machines"—a basic introduction to computers. (2) "How to Construct Electrical 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 to ease assembly. (4) Beginners' Manual. Starting from scratch, the manual adds fifteen 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!

K1—Only
$19.95
Postpaid

New! CIRCLE-O-PHONIC SOUND SYSTEM

A revolutionary new sound system which can increase the effectiveness of conventional amplifying and loudspeaking units over several hundred percent has been developed by our engineers. This patented speaker hookup rotates the loudspeaker at fixed speeds distributing the sound in a complete circle. No distortion, echo, or microphone feedback. In actual demonstrations, one 25 Watt speaker covered the entire Ebbetts Field Grandstands and in acoustically dead nightclubs, one CIRCLE-O-PHONIC speaker took the place of 23 individual loudspeakers mounted around the room. If you need special stereophonic effects with CIRCLE-O-PHONIC sound, you will want to read "EXPERIMENTS WITH CIRCLE-O-PHONIC SOUND." Postpaid...

CIRCLE-O-PHONIC LOUDSPEAKER
Sound spreads at an even intensity throughout the entire enclosure.

K1—Only
$49.95

Some Firms and Institutions that have ordered GENIAC:

Allis-Chalmers
Remington-Rand
International
Business
Machines
Wheeling Mfg. Co.
Manuel Missionary
College
Walter V. Clarke
Associates
Barnard College
Westinghouse
Electric
Philips
Laboratories
General
Assurance
Co. of America
Lafayette Radio
Rohr Aircraft Co.
Albert Einstein
Medical College
Naval Research
Laboratories
Los Angeles
Public Schools
Kansas State
University
Duke University
Coral Gables
Bell Telephone
Laboratories

OLIVER GARFIELD COMPANY
126 Lexington Avenue, New York 16, New York

Always say you saw it in—POPULAR ELECTRONICS
LEARN HOW TO BUILD COMPUTERS!

ELECTRONIC MEMORY COURSE

An essential part of every computer is the memory—a storage device for retaining bits (binary digits) of information. The ELECTRONIC MEMORY course contains instructions for building relay memories, magnetic core “Matrix” memories and “SEAC” tube memories, with detailed descriptions of over 15 different methods of storing information and automatically giving instructions to electronic devices now in use. The booklets, texts and manuals are a complete course in this fascinating subject. Suitable for all levels—particularly designed for people who have some knowledge of electronics but want to know specific details of electronic computers for professional reasons. Complete question answering service. The memory “Matrix” can be expanded to any desired degree and can be used in conjunction with the digital computer kit as an outside memory store. Price of course with all instructions and training manuals, texts, etc., postpaid. ...................... C1- $22.00

DIGITAL COMPUTER COURSE

Have you ever wanted to build a small digital computing device? One that reproduces in miniature what computers like ENIAC, SEAC, BIZMAC, etc., do on a large scale? Our DIGITAL COMPUTER course shows how to set up and build computers and experiment with pulses, storage, gates, flip flops, adding, subtracting, multiplying and applications of Boolean Algebra to circuit design. You get an introduction to programming. More important, you learn how and where to buy computer parts to build your own computers. Manuals, wiring diagrams and texts provide a complete introduction to theory and practice of DIGITAL COMPUTERS clearly explained. We have a complete question answering service. This is the finest and only DIGITAL COMPUTER course on the market, postpaid. ...................... C2- $28.00

ANALOG COMPUTER COURSE

ANALOG COMPUTERS are widely used in engineering and scientific research to duplicate actual physical conditions and to integrate and differentiate directly. Our ANALOG COMPUTERS course lists sources of materials, parts, theory and practical instructions, plus wiring diagrams and schematics for adding, multiplying, integrating and differentiating specific experiments, give practice in calculating scale factors, choice of time scales, machine equation and block diagrams, phase inverting amplifiers, use of parallel inputs, solution of simple differential equation. We show you how you can build computers at home. Texts discuss theory and design of computer elements, network and operational amplifiers, multiplication and function generation. This is your best and only comprehensive introduction to ANALOG COMPUTERS. Each course is a complete introduction to the subject with all necessary instructional material and parts. Course. Manuals, postpaid. ...................... C3- $28.00

New! WRIST RADIO weighs 2.5 oz.

All-transistor wrist radio receiver

A broadcast band all-transistor wrist radio has been designed with r-f reflex circuit to provide good selectivity and sensitivity. Three transistors are used which require 4.5 ma. total battery current and five button-size mercury cells last up to 100 hours. The receiver features a 2-stage transformer-coupled audio amplifier and a no-whistle regenerative circuit. A high quality hearing aid receiver allows for private listening. Printed circuitry is used throughout. Band coverage is 550 to 1600 kc. Its small size (2 ¾ in. long, 1 ¾ in. wide and ¾ in. thick) and weight (2.5 oz. with batteries) make it well suited for wearing on the wrist or in a shirt pocket. Completely assembled with all batteries. Postpaid ...................... R1 $29.95

Order Now!

Oliver Garfield Co., Dept. PE-116
126 Lexington Avenue
New York 16, New York

Please send me:

□ R1 $29.95 Postpaid
□ 20.95 West of Mississippi
□ 21.85 Outside U.S.
□ 21.00 Postpaid
□ 49.95 F.O.B. N. Y.
□ 135.00 F.O.B. N. Y.
□ 22.00 Postpaid
□ 28.00 Postpaid
□ 28.00 Postpaid
□ 29.95 Postpaid

Check, Cash or Money Order is enclosed. My name and address are attached. DEALER INQUIRIES INVITED

OLIVER GARFIELD COMPANY
126 Lexington Avenue, New York 16, New York

November, 1956

www.americanradiohistory.com
New Altec 342A Amplifier with the "input-matcher" feature

**Typical Specification**
- **Input Sensitivity:** 110 db
- **Input Impedance:** Nominal 150,000 ohms
- **Source Impedance:** 30, 90, 250, 750, 500/600 with 4665 plug-in transformer
- **Load Impedance:** 4, 8, 16 ohms and 70 v line
- **Output Impedance:** Less than 20% of nominal load impedance
- **Noise Level:** Equivalent input noise—123 db, output noise—13 db
- **Controls:** 4 mixer controls, 1 master volume control, 1 each bass (treble equalizer control), all controllable composition
- **Power Supply:** 117 volts, 60 cps, 110 watts
- **External Power:** 117 volt 50 cycle power transformer
- **Available:** Of chassis
- **Tubes:** 3—12AX7, 1—6CD7, 7—6L6G, 1—5666B
- **Dimensions:** 7½" H, 19½" W, 8½" D overall
- **Color:** Green
- **Weight:** 22 lbs
- **Accessories:** 4665 plug-in transformer, 12217 assembly plug-in phone equalizer, 12210 assembly rack mounting assembly, Canon XL-1-12 straight cord plug.

The new Altec 20 watt public address amplifier is truly outstanding in its flexibility of function. Pick any combination of four inputs, plug in the convenient "input-matcher" for each source and the Altec 342A amplifier is matched to your exact circuit needs. In minutes the 342A can be input-matched to any high or low impedance microphone, crystal or magnetic phone pickup, tuner or tape recorder merely plug in the proper "input-matcher.

The 342A has individual volume controls for each of four inputs, a master volume control and separate bass and treble tone controls. DC operation of the heaters of the input tubes insures hum-free performance and eliminates the need for tube selection. The quality, reliability and amazing flexibility of the new Altec 342A amplifier make it ideal for every public address use either permanent or portable.

**The Altec 342A Amplifier**

**ALTEC HIGH FIDELITY**

Dept. 11-P
356 Santa Monica Blvd., Beverly Hills, Calif.
161 Smith Avenue, New York 13, New York

Carl & Jerry (Continued from page 14)

Jerry reported, "According to them, all of the critter's vital organs are in the front fifth of his body, and the rest is made up of 'electric tissue.'"

"Whatever that is."

"It's a flabby whitish jelly composed of 92% water. This stuff is organized into three pairs of electric organs. The eel can use one pair for a major discharge, one pair for a medium-size whammy, and the third pair for a small shock. Each organ is made up of smaller units separated by another kind of tissue that acts like the insulating separators in a storage battery. The electricity is actually produced in these smaller units. Each one produces about one-tenth of a volt. Somehow, in some way, the creature is able to connect these units in series to produce the high voltage discharges. But how he can throw thousands of 'switches' on and off several hundred times a second in perfect unison is still a mystery."

Jerry CONNECTED the leads from the electrodes to the horizontal input terminals of his 'scope and adjusted the linear sweep until he had two of the voltage spikes visible on the screen. Since the frequency of the eel's output was irregular, this pattern was not easy to hold, but a sweep frequency of around 200 cycles per second displayed two complete pulses. Once again this proved the books were right when they said that the eel put out about 400 discharges per second.

"For the rest of our experimenting," Jerry mused, "we should have the eel swimming freely about. Wonder where we can manage that? He's too big for a washtub."

Jerry and Carl looked deep into each other's eyes and saw the same thought. "Okay," Jerry said, "but you'll have to go ahead and make sure the coast is clear. Mom is deathly afraid of this thing, and if she saw us sneaking it into the bathroom, she would never set foot in there again."

Jerry gathered Old Squirm, still strapped to the length of gutter trough, under his arm and cautiously followed Carl up the basement stairs. Jerry's mother, fortunately, was busy talking on the telephone and never noticed the boys tiptoeing past the door on their way to the second floor. Safely inside the bathroom, Carl started quietly filling the tub with water while Jerry made another trip to the laboratory for other equipment he wanted. When the tub was two-thirds full, the eel was released inside it. He seemed to enjoy his freedom and went slithering around on
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.

November, 1956
IN HI-FI SPEAKERS
Linthrop SETS
THE PACE AT
AMAZINGLY LOW PRICES!

6.8 OZ. ALNICO V
MAGNETS, 6.4 OHM
ALL MODELS

ORDER DIRECT
6" $8.95
8" $10.85
12" $13.95

POSTPAID and
TAX PAID

MINIMUM DISTORTION
FOR MAXIMUM LISTENING PLEASURE

AND NOW . . . THE LOW COST
Linthrop TWIN EXTENSION SPEAKER

BRING GLORIOUS
SOUND TO YOUR
• KITCHEN
• BEDROOM
• BASEMENT
• DINING ROOM
• PATIO
• REC. ROOM

MUSIC, SPORTS,
DRAMATIC SHOWS
ANYWHERE IN
YOUR HOME OR
COTTAGE AT
LOW, LOW COST!

ONLY
$23.95
COMPLETE!

Carl & Jerry (Continued from page 18)

the bottom of the tub in graceful coils. Jerry separated the earpieces of a pair of headphones and handed one to Carl.

"Listen," he said, as he dipped the metal-tipped ends of the headphone cord in the water. Clearly heard in the phones was a static-like noise. When the eel was quiet, this noise subsided; but as soon as it started to move, the noise returned.

"Any time he is moving," Jerry explained, "the electric eel gives off a series of weak discharges. These serve two purposes: first, they warn enemies to keep their distance; and secondly, they form a kind of radar that enables the eel—which is virtually blind when it is adult—to seek out its prey."

"WAIT A MINUTE!" Carl interrupted. "I'm not so dumb that I don't know a radar system consists of a receiver as well as a transmitter. I'll admit Old Squirmy has a dan-dan-dandy low-frequency transmitter: but where's his receiver?"

"He's got one all right, according to the books," Jerry replied. When one eel in a tank discharges, all the other eels come to the spot, apparently to horn in on the result. Obviously they know when one of their fellows is trying to stun something and can judge very nicely where the current is coming from. But now let's see if we can prove this with the eel-caller I've built up. It's a blocking oscillator that produces sharp spikes of voltage over a frequency range which is adjustable from about 500 to 2000 cycles per second. The output of the oscillator drives an output tube so as to produce pulses of very respectable amplitude across these two electrodes. Let's place the electrodes in the water at this end of the tub and see if we can sweet-talk him into coming over."

Carl did as he was told, and Jerry began varying the frequency of the blocking oscillator. As a certain frequency was reached, the eel on the bottom of the tub began to stir and swim directly to the electrodes. When they were transferred to the opposite end of the tub, he immediately moved toward them.

"Old Squirmy's receiving frequency seems to be around 800 cycles per second," Jerry announced.

"Say! That thing really puts the come-hither on him," Carl said enthusiastically. "We ought to patent it."

"We're a little too late," Jerry told him. "Eel hunters in South America are already using earphones to locate electric fish and then are employing eel-callers something like this one to lure them into..."
BUILD 16 RADIO CIRCUITS AT HOME only $19.95

with the New Improved PROGRESSIVE RADIO "EDU-KIT"

A Practical Home Radio Course

NOW! FREE TOOLS WITH "EDU-KIT"

WHAT THE "EDU-KIT" OFFERS YOU

The "EDU-KIT" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. You will learn radio theory, construction, servicing and trouble-shooting, using regular schematics, how to service and trouble-shoot radios. You will work with the latest developments in Printed Circuitry as well as the latest improvement in Printed Circuit Signal Injector.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice the Progressive Signal Tracer, the Progressive Signal Injector, the Progressive Radio, the Printed Circuits, the Printed Circuit Signal Injector and the accompanying instructional materials.

You will receive training for the Novice, Technician and General Class of F.C.C. Radio Amateurs. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tester and other units, using the Progressive Course Work, while learning how to operate from them. You will receive a complete course in the Progressive Signal Tracer, the Progressive Signal Injector, the Progressive Radio, the Printed Circuits, the Printed Circuit Signal Injector and the accompanying instructional materials. You will receive training for the Novice, Technician and General Class of F.C.C. Radio Amateurs. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tester and other units, using the Progressive Course Work, while learning how to operate from them.

Absolutely no previous knowledge of radio or science is required. The "EDU-KIT" is the product of many years of teaching experience. The "EDU-KIT" will give you a basic education in Electronics and Radio, worth many times the complete price of $19.95. This offer is not to be outdone for the same price of the entire kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in electronics or not, you can learn radio for a future hobby. A professional manner; Instructive, attractive lessons, in a future hobby. A professional manner; Instructive, attractive lessons, and you will earn your money back for your course at a wise investment. I have learned more from your courses than I did from an expensive course.

PROGRESSIVE TEACHING METHOD

The Progressive Radio-EDU-KIT is the foremost educational radio kit in the world. Each kit is designed and constructed, with the kits in the "EDU-KIT" are the most modern educational principles of "Learning by Doing." Therefore, you construct, learn and build many of the latest and most advanced electronic circuits. The kit is designed to provide an easy-to-learn, thorough and interesting background in radio theory. You build by examining the various radio parts of the "EDU-KIT." You then learn the function, theory and wiring of these parts. Then you build a simple radio, with this first set you have a solid foundation in radio construction, everything you have been learning. You will be able to build a more advanced radio, learn more advanced theory and practice repairs in a future hobby. Then you will be able to build a more advanced radio, learn more advanced theory and practice repairs in a future hobby. Then you will be able to build a more advanced radio, learn more advanced theory and practice repairs in a future hobby.

The "EDU-KIT" is complete

You will receive all parts and instructional necessary to build 16 different radio and electronics kits, each guaranteed to operate. Our kits contain tubes, sockets, variable, electrolytic and paper electrolytic capacitors, resistors, diodes, transistors, coils, hardware, tubing, punched metal chassis, printed circuit material, etc.

In addition, you receive Printed Circuit schematic material, Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electronic 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 F.C.C. Type Questions and the Radio Amateur License training. You will also receive lessons for service work, the Progressive Signal Tracer and the Progressive Signal Injector, a Metal Fidelity Guide and Quiz Book. You receive all parts, tools, instructions, etc., which will take several years to learn.

FREE EXTRAS

• SET OF TOOLS & RADIO & ELECTRONIC TESTER
• ELECTRIC SOLDERING IRON & TESTER INSTRUCTION MANUAL
• HIGH FIDELITY GUIDE & QUIZES TELEVISION BOOK & MEMBERSHIP IN RADIO-TV CLUB CONSULTATION SERVICE
• No Knowledge of Radio Necessary
• No Additional Parts or Tools Needed
• Excellent Background for TV

FREE Hi-Fi, Radio & TV Servicing Manuals on request (see coupon below)

SERVICING LESSONS

You will learn trouble-shooting and servicing of a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and faults of troubles in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and thereby free them of tedious servicing. You will have earned your money back for your course at a wise investment. I have learned more from your courses than I did from an expensive course.

FROM OUR MAIL BAG

Ben Velper, P. O. Box 21, Rapids City, Utah: "The EDU-Kits are wonderful. Here I am sending you the question and also the answers for them. I have been in Radio for the last seven years, but I lacked to work with Radio Kits, and like to build Radio Testing Equipment. I can't believe how these kits work. I have used the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Mound Ave, Huntington, W. Va.: "I was dropped on my head and that such a bargain can be had at such a low price. I have had a very interesting experience. I have tested many radios and phonographs. My friends are very interested and I will take this with me."

Our large printing company, which has been doing this for years, and they say it is the best trouble if there is any to be found.

PRINTED CIRCUITRY

At no increase in price the "EDU-KIT" now includes Printed Circuitry. You will build a Printed Circuit Signal Injector, a Printed Circuit Signal Tracer and a Printed Circuit Tracer and a Printed Circuit Tracer and a Printed Circuit Tracer. You will find that the Printed Circuitry is the best for many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV kits.

A Printed Circuit is a special insulated chassis on which has been deposited a conductive material, which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

REG. U.S. PAT. OFF.

November, 1956

Progressive "EDU-Kits" INC.
497 Union Ave., Room 525D, Brooklyn 11, N. Y.

[Handwritten notes and signatures]

Name
Address

WORTH $5.00

UNCONDITIONAL MONEY-BACK GUARANTEE

ORDER DIRECT FROM AD
RECEIVE FREE BONUS RESISTOR KIT WORTH $3.00

☐ Send "EDU-Kit" Postpaid. I enclose full payment of $19.95.
☐ Send "EDU-Kit" C.O.D. I will pay $19.95 plus postage and C.O.D. charges.
☐ Send me FREE additional information describing "EDU-Kit." Include FREE valuable Hi-Fi, Radio and TV Servicing Literature. (Outside U.S.A. — No C.O.D.'s. Check on U.S. bank or Inter'l M.O. "EDU-Kit" for 105-125 V. AC/DC $26.95; 210-250 V. AC/DC $32.45.)

Name
Address

www.americanradiohistory.com
Carl & Jerry (Continued from page 20)

their traps. But to get back to his built-in radar, by means of it the electric eel can move straight toward his prey and can detect a variation of just a few inches. What’s more, he can tell instantly if his prey is moving and can make allowances for that movement."

"YOU KNOW," Carl mused, "that’s all pretty wonderful when you stop to think about it. Here we think of electricity itself as being quite modern, but that ugly creature resting there on the bottom of the tub and his ancestors have been using electricity for thousands of years. What’s more, they’ve been using it in ways that we think of as being ultra-modern. Since electric eels talk to each other by means of their electric discharges, we must admit that they are equipped with wireless telephones. Those same discharges are employed as a compact, efficient, and highly effective weapon to secure food and to combat enemies. Finally, the lowly eel has been quietly using radar—which we did not discover until the last war—for countless centuries. It kind of makes you wonder if man—in spite of all his scientific development and progress—is so doggone smart as he thinks he is, doesn’t it?"

"It certainly does," Jerry agreed, "and I think my uncle had something like that in mind when he sent me the eel and told me to study it. When we work with electricity that is man-produced by batteries and generators and so on, we sort of take it for granted and forget how magic it really is, but when you see electricity being generated within the living tissue of a live creature such as this, all the wonder and mystery of it sweeps over you, and you are glad that you intend to make a lifetime study of it."

In a single speaker, Norelco has created an unusually efficient sound radiator. These twin-cone speakers incorporate a small cone for reproducing high frequencies and a large cone for lower frequencies. Both cones operate in conjunction from a single voice coil—producing balanced sensitivity and uniform sound for all ranges. Arrangement of both cones reflect and diffuse the sound while moving in phase to provide even sound distribution.

A deep air gap within a homogeneous magnetic field provides unusually large movement of the voice coil resulting in distortion-free reproduction over the entire frequency range. Impedance does not diminish with higher frequencies and volume is practically constant throughout the whole audible range.

Send today for your catalog on Norelco *FRS Twin-Cone Speakers. It contains specification data, sound distribution curves, frequency characteristics on these speakers as well as the new Norelco Speaker Enclosures.
Another great advance in HOME STUDY TRAINING. Let National Schools, of Los Angeles, a practical Technical Resident Trade School for over 50 years, train you at home by Shop-Method, for today's unlimited opportunities in ALL 8 BRANCHES of the Television, Electronics, Radio Industry.

Check all you receive in One Master Course at One Low Tuition:
1. Television — Including Color TV
2. Radio — FM and AM
3. Industrial Electronics
4. Sound Recording and Hi-Fidelity
5. Preparation for FCC License
6. Automation
7. Radio and Sonor
8. Communications

ALL OF THIS MODERN, NEWEST, PRACTICAL EQUIPMENT IS YOURS TO KEEP!
- Parts to build a modern TV set, including 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.
- Professional Multimeter
- These are a MUST for all technicians.

YOU DO MANY PRACTICAL JOBS. You do servicing, circuit analysis and many other down-to-earth experiments. You build a modern TV set from the ground up... with equipment kits we give you, including a new large screen picture tube and professional Multimeter, at no additional charge.

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 GRADUATE ADVISORY SERVICE, TOO.

L. J. ROSENKRANZ
President of NATIONAL SCHOOLS

This Master-Shop Method course is completely up-to-date. Here in Los Angeles, the TV and Electronics center of the world, we are able to keep in constant touch with the industries latest developments. As a student, you will quickly master all phases of your trade in your spare time. Your earning power will grow with every lesson. Just as thousands of National Schools graduates do every day, you can handle servicing, manufacturing, repairing, hundreds of other jobs, or make good money in your own business. SECURE YOUR FUTURE—NOW SEND COUPON BELOW.

IN THESE MODERN TV STUDIOS, SHOPS AND LABORATORIES, your Shop Method Home Study Course was developed by experienced instructors and engineers. What an advantage that is to you at home—each lesson is tested, proved, easy to understand. You can master the most up-to-date projects, such as color TV set repair, printed circuits—every lesson is prepared for the F.C.C. License and Industrial Electronics without taking a special course. TAKE YOUR FIRST STEP NOW TO A TOP-PAY JOB IN TV, ELECTRONICS, RADIO. SEND COUPON BELOW TODAY.

NATIONAL SCHOOLS
4000 S. FIGUEROA ST., LOS ANGELES 37, CALIF.
187 N. LA SALLE ST., CHICAGO 1, ILL.
IN CANADA: 811 W. Hastings St., Vancouver, B. C.

FREE!
Fully illustrated "CAREER" BOOK in TV, Radio, Electronics. AND actual Sample Lesson—yours at no cost, no obligation. SEND COUPON NOW—TODAY!

NATIONAL SCHOOLS
TECHNICAL TRADE TRAINING SINCE 1905
Los Angeles, California

GET FAST SERVICE—MAIL NOW TO OFFICE NEAREST YOU
NATIONAL SCHOOLS, Dept. D, 187 N. LA SALLE ST.
4000 S. FIGUEROA ST., LOS ANGELES 37, CALIF.
CHICAGO 1, ILL.

VETERANS: Give Date of Discharge.

NAME _______________________________
ADDRESS _______________________________
CITY __________________________________
ZONE STATE ___________________________

November, 1956

23
ATTENTION!

RADIO CO.
OFFERS THE BEST MULTIMETER VALUES ON THE MARKET TODAY...
World Famous "FUJI"

ELECTRONIC TEST EQUIPMENT

MODEL LP-3 POCKET TESTER
An attractive Black Bakelite cabinet.
Response: 170µA
AC Volt.: 10v 50v 250v 500v 1000v
(500v A/V200000)
DC Volt.: 10v 50v 250v 1000v
(250µA V/40000)
DC Current: 250µA 10mA 250mA
Resistance: 0~1MΩ 0~10KΩ
Decibels: -20db~+22db
(at AC 10v Range)
+20dB~+56dB
(at AC 50v Range)
(OdB~6.775v~000Ω)

$7.95

Almo RADIO CO.
509 ARCH ST., PHILA., PA.
CAMD., N.J., ATL. CITY, N.J., SOUTHAMPTON, PA., WILM., DEL., SALESYM., IDE.

SEND FOR THE 1957 ALLIED CATALOG
Features the world's largest selection of systems and components.
Shows you how to choose a custom Hi-Fi music system for your home.
At no more than the cost of an ordinary photograph.
Tells you what to look for and how to save money.
Offers dozens of complete systems and hundreds of individual units, including the
famous money-saving Hi-Fi Knights.
For everything in Hi-Fi and Electronics, get the
FREE 1957 Allied Catalog.

ALLIED RADIO
America's Hi-Fi Center

ALLIED RADIO CORP., Dept. JJ-116
100 N. Western Ave., Chicago 80, Ill.
□ Send FREE 1957 ALLIED Catalog.

Name
Address
City Zone State

* simple installation

Another reason why today's fastest selling high fidelity record changer is

Collaro

* Simple Installation —

the pre-wired audio cable and the power cord with standard plugs eliminate need for making solder connections.
Pre-cut mounting board available.

ROCKBAR CORPORATION
650 Haistead Avenue, Mamaroneck, N.Y.

For other features and new popular price, see your hi-fi dealer or write Dept. FL-18

Always say you saw it in—POPULAR ELECTRONICS
Thousands of Central-Trained Engineering Technicians
Now in Permanent HIGH-PAY ELECTRONICS CAREERS!

YOU, TOO, can enjoy the
financial security and rewarding opportuni-
ties now open in

ELECTRONICS
TELEVISION - RADIO

- AM-FM-TV Technician
- Automation Technician
- Electronics Inspector
- Field Service Engineer
- Research and Development Assistant
- Technical Writer (or Illustrator)

The jobs listed above as well as scores of others . . . are available right now in the fascinating field of Electronics. Naturally, the pick of these jobs go to the best-trained men. The quality of your training and, the caliber of the school where you receive it are two of the most important items considered by employees of electronics specialists. Proof of the excellence of Central's training is demonstrated almost daily by requests for job interviews from some of the country's foremost industrial giants . . . from leading radio and TV stations . . . and from the nation's major airlines. All want fully qualified engineering technicians . . . and they know Central can provide them!

Central's
"Progressive
Plan"
Trains You in
Shortest Possible Time!

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 for 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 for those qualified to continue with advanced resident training. An ECPD-accredited engineering technician program.

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

VETERANS! Central offers courses approved under the
G.I. Bill.

Mail Coupon for
FREE BOOK

November, 1956

Your future in
ELECTRONICS

C. L. Foster, President, Central Technical Institute. Mr. Foster is one of the nation's best known technical institute educators.

Central Technical Institute
Dept. 116, 1644 Wyandotte
Kansas City 8, Mo.

Please give me the facts that will get me into a high-pay electronics career.

Name

Address

City, State

Age

Phone

If Korean veteran, give approximate discharge date.

www.americanradiohistory.com
LETTERS
FROM OUR READERS

Wanted: Parabolic Dishes
- I am looking for a parabolic dish or horn to be used with a speaker or microphone similar to those used on sound trucks. I used to be able to get them for about $10, but now have no luck. Have any of your readers seen some in other cities?
  
  FRANCIS FOSSA
  Nashua, N. H.

The editors of POP'tronics are also scouting around for one of those war surplus dishes. Carl and Jerry located one for their May 1956 story installment, but they're not telling anyone where they found it. How about it, guys, have you seen or heard of any parabolic dishes lately?

Must Meet FCC Standards
- I would like to obtain a diagram to build a transceiver such as the Vocaline (June and August issues) Citizens band Model JRC-400.

  (name withheld)

We cannot stress too strongly that all radio transmitters used for two-way voice communications must meet FCC standards. In the case of radio amateurs, we are sure you are aware that they must pass strict examinations. Citizens band equipment must be approved by the FCC laboratories—constructing your own is impractical.

Twinkling Xmas Tree
- In your December 1954 issue, you featured a twinkling tree which interested me greatly. I constructed one from plastic in six sections. It is 30" high. The neon bulbs are cemented in notches filed in the upper edges of the limbs. All wires are carried to the base of the tree where war-surplus
8 reasons why the world's most respected name in communications is Hallicrafters

model S-38D $49.95
Wonderful starting point for the new amateur or short-wave listener. Same meticulous engineering found in all Hallicrafters equipment—at down to earth prices. Coverage: standard broadcast from 540-1650 kc. plus 3 short wave bands from 1650 kc. to 32 Mc.

model S-53A $89.95
Has easy-read overseas dial with international stations indicated. Electrical bandspread and logging scale. Complete with 5 in. speaker, headphone jacks plus phono-jack. Two stages of i.f. Coverage: standard broadcast from 540-1630 kc. plus four SW bands over 2.5—31 and 48—54.5 Mc.

model S-85, S-86 $119.95
A superb receiver that pulls them in on 10, 11, 15, 20, 40 and 80 meter amateur bands. Over 1000° calibrated bandspread gives better selectivity on large easy-to-read dial. Features separate tuning condenser and built-in PM 5” speaker. Coverage: Broadcast band 540-1680 kc. plus three S/W bands 1680 kc.—31 Mc. S-85 AC, S-86 AC-DC.

model S-94, S-95 $59.95
Advanced models that bring in emergency radio, police and fire calls. Newly engineered FM chassis provides low frequency drift and low noise figure. Modern styling with simplified control gives easy operating. Coverage: S-94—30 to 50 Mc; S-95—152 to 173 Mc.

model SX-99 $149.95
The best at its price with all features demanded by DX enthusiast. Has “S” meter, separate bandspread tuning condenser, crystal filter and antenna trimmer. Easy-read dial has over 1000° calibrated bandspread through 10, 11, 15, 20, 40, and 80 meter amateur bands. Coverage: standard broadcast 540-1680 kc. plus three Short-Wave bands 1680 kc-54 Mc.

model S-102, S-106 $59.95
The only inexpensive complete receivers for 2 and 6 meter bands. New models with all of Hallicrafters famous engineering. Have 7 tubes with rectifiers, built-in 5” PM speaker, low frequency drift, compact bandspread design, phone jacks. Coverage: S-102—143 to 149 Mc. in 2 meter band; S-106—49 to 55 Mc. in 6 meter band.

model SX-104, SX-105 $89.95
Two new high frequency crystal controlled/tunable receivers at low cost. First time available on single band receiver. Ideal for monitoring government, marine, fire, police and other emergency frequencies. Coverage: SX-104—30 to 50 Mc.; SX-105—152 to 173 Mc.

THE NEW ONE
THAT'S ON THE
DRAWING BOARD
TODAY!

where the best ideas in communications are born!

Export Sales: Philips Export Co.
100 E. 42nd St., New York 17, N.Y.
NEW SPEAKER MODELS WITH A FREQUENCY RESPONSE FOR EVERY APPLICATION

MID RANGE EXTENDED TWEETER WOOFER COAXIAL

FABULOUS "G" SERIES SOUND REPRODUCERS

Are ideal for single or multiple installations, additions in Hi Fi systems or for binaural applications. Their fabulous features of superb range, response and overall perfection of performance—and unbelievable low price—makes Utah's new "G" series your best buy in Hi Fi. The incomparable, precision combination of molded, seamless cones permanently welded with indestructable adhesive to rugged, 8 oz. voice coils powered by oriented grain Alnico V magnets, assures you of full power handling capacities.

See the FABULOUS "G" at your dealers today.

From the beginning, Utah's "G" Series has been a step above the rest. The high frequency model is perfect for adding that extra sparkle to the most demanding systems. The mid-range model is ideal for bridging to a high frequency module. The woofer, with its unobtrusive design, is a must for front of house installations. Coaxial units are available in 3" and 4" models. The 3" units are economical and can be used for front of house use or in small home theater systems.

High Frequency Model GT5F
List Price $8.75

Mid Range Model GMBJ
List Price $13.80

Woofer Model G15P
List Price $42.65

Coaxial Model G12J3
List Price $39.75

FABULOUS "G" SERIES SOUND REPRODUCERS

Are ideal for single or multiple installations, additions in Hi Fi systems or for binaural applications. Their fabulous features of superb range, response and overall perfection of performance—and unbelievable low price—makes Utah’s new “G” series your best buy in Hi Fi. The incomparable, precision combination of molded, seamless cones permanently welded with indestructable adhesive to rugged, 8 oz. voice coils powered by oriented grain Alnico V magnets, assures you of full power handling capacities.

Write for complete Fabulous “G” Catalog and technical folder.

UTAH RADIO PRODUCTS CORP.
HUNTINGTON, INDIANA

Export Dept. Rocke International, N. Y. C.

Letters (Continued from page 26)

0.5-ufd. capacitors are employed to control the twinkling frequency.

R. J. Norton
Everett, Wash.

Many thanks for remembering to send in the photo of your Xmas tree. Other readers interested in duplicating this tree can obtain the plans from our back issue department. Each back issue costs only 30 cents.

Comments on August/September

- Thanks for the story in your August issue on tape correspondence. This QSL card is my own idea. How do you like it? I am using a DeJur model TK820, dual speed, and a Shure 51 microphone.

Art Rubin
355 Summit Ave.
Cedarhurst, N. Y.

- Your August issue was one of the best yet. I particularly liked the article on memory devices.

O. Relling
Oceanside, N. Y.

Many thanks, Otto, for your note. Readers that missed the August issue will soon see the memory device article reprinted in SCIENCE DIGEST.

- Just finished the series by Lou Garner on printed circuits. It was excellent! Please continue the series with more on methods using silk screens and photographic techniques.

John York
Fishkill, N. Y.

- Congratulations on McIntyre’s dual control system in your September issue (page 63). It was just the thing I was looking for. I appreciated the well-written description.

Lee Aubrick, WIRDV
Hartford, Conn.

- Specifically liked the issue devoted to electrets (August, page 85).

Doug Mosher
Portland, Ore.

More Help for Mr. Grenier

- To make faded tube numbers reappear (see request by Gerard Grenier, August issue, page 28), I would suggest melting some black carbon with candle wax, then pouring it over the spot on the (Continued on page 32)

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. Kohn, Plante and Wengler are now members of the Laboratories and Mr. Krege 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.

COUNTERLESS 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 fellow 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 1980, 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 34,000,000 TV sets and over 425 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.

FAMOUS FOR 29 YEARS

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

MAIL THIS COUPON . . . TODAY!

CAPITOL RADIO ENGINEERING INSTITUTE

Accredited Technical Institute Curriculum—Founded in 1927
3224 16th St., N.W., Dept. 1211-C Washington 10, D. C.

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

CHECK BOX

☐ Practical Radio Electronics Engineering
☐ Practical Television Engineering
☐ Practical Aeronautical Electronics Engineering

IN WHAT BRANCH OF ELECTRONICS ARE YOU MOST INTERESTED:

☐ BROADCAST RADIO ENGINEERING (AM, FM, TV)
☐ PRACTICAL AERONAUTICAL ELECTRONICS ENGINEERING

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!

MAIL THIS COUPON . . . TODAY!
Lafayette engineers have designed this fascinating 4-transistor superhet receiver kit in a unique and interesting form. It is, by itself, a completely self-contained, pocket-sized personal portable set which operates as a miniature audio receiver so you can hear, by plugging into the KT-96 kit listed below, it is instantly converted to a full 6-transistor home radio, complete with speaker for the entire family to enjoy.

The set is completely miniaturized and utilizes the new, radically different Argonne "Poly-Vari-Can" ultra miniature 2-gang variable condenser. You will be delighted with the truly subminiature parts, from the variable which measures only 1/16" square x 1/32" deep, to the tiny 11/16" long electrolytics. The chassis measures only 4" L x 3.5/16" W x 1" D. You'll be amazed at its performance. Circuit features are easy to follow, 4 transistors (2 high frequency and 2 audio type) plus a germanium diode, 2 I.F., stages and built-in high gain ferrite core and antenna. The result is a sensitive, stable and selective set covering the entire broadcast band. Requires no outside antenna or ground connection. The kit is furnished complete with transistors and all parts, including battery and chassis already drilled and punched. The earpiece and carrying case are accessory items, not supplied. All necessary pictorial and circuit diagrams are furnished with simple, easy-to-follow instructions. Shpg. wt., 1 lb.

**KT-96 Kit**

**Net** 19.95

**MS-311 LEATHER CARRYING CASE**

**Net** 1.95

**MS-260 Super power dynamic earpiece**

**Net** 3.95

**MS-278 Economy earpiece**

**Net** 1.95

---

**2-TRANSISTOR CLASS B PUSH PULL OUTPUT STAGE KIT WITH SPEAKER SELF-CONTAINED IN BEAUTIFUL PLASTIC CASE:**

- **CONVERTS 4-TRANSISTOR KIT INTO A 6-TRANSISTOR HOME RADIO WITH SPEAKER**

Add a completely transistorized push-pull audio stage to your 4 transistor receiver. Complete stage including speaker and case measures only 3 1/2" H x 2 3/4" W x 3/4" D. Plug right into your 4 transistor kit above. Converts your 4 transistor set to a 6 transistor plus dial audio receiver. Performance equal or superior to commercially wired sets selling at more than twice the price. Kit includes 2 transistors, 2 transformers, 2.5" FM speaker, pre-panched chassis, speaker case to hold entire stage, battery, hardware, instructions and diagrams. Shpg. wt., 1 lb.

**KT-96**

**Net** 11.50

---

**FM-AM TUNER KIT**

**Basic FM-AM Tuna**

having outstanding specifications and delivering astonishing performance — all at a budget price in easily assembled kit form.

- **AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL**
- **FOSTER-SEELEY 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, PROTO, TV and a tuning/AF 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 88.1-108MC, AM, 530-1550 KC. **ANTENNA INPUT:** FM, 300 ohms. AM, ferrite loopstick and impedance external antenna. **DISTORTION:** Less than 1% 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 90 db quieting, AM, Loop sensitivity 80 UV/meter. **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down; 375 KC FM discriminator peak to peak separation, AM, 8 KC bandwidth, 6 db down. **IMAGE REJECTION:** 50 db minimum. **HUM LEVEL:** 40 db below 100% modulation. **TUBE COMPLEMENT:** 2-12ATT, 1-12AX7, 1-12AU7, 2-6AS6, 1-6AL5 plus selenium rectifier. **SIZE:** 5 1/2" high x 9 1/2" wide x 1 1/2" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V 60 cycles AC. Attractive etched copper-plated and lacquered finish. Less met case.

**Shpg. wt., 9 lbs.**

**KT-100**

**ML-100...Metal cage for above. Shpg. wt., 3 lbs.**

**5.00**

**LAFAYETTE SIGNAL GENERATOR**

**COMPLETELY WIRED AND TESTED! ACCURACY AND QUALITY GUARANTEED!**

**22.50**

- **FREQUENCY 120KC to 200MC**

**120KC to 120MC ON FUNDAMENTALS!**

**30 DAY TRIAL PERIOD! FULL REFUND IF YOU ARE NOT SATISFIED FOR ANY REASON!**

Complete wiring and tested instrument. Do not confuse with kits sold in the same price range. Has the quality and accuracy of instruments costing many times as much. Six overlapping ranges — 120KC to 320KC, 320KC to 1000KC, 1000KC to 3MM, 3MM to 11MC, 11MC to 38MC, 37MC to 130MC — all on fundamentals — calibrated harmonics from 120MC to 200MC. Switch between internal modulation at 400 cps or any external source at other frequencies. 400 cps signal can be used separately. Outputs are unmodulated RF, modulated RF and 400 cps audio. RF output is in excess of 100,000 micro volts. Jacks are provided for high or low RF output. Highly stable special circuit design. Fast adjust RF control. AF output 2-3 volts, input 4 volts, across 1 megohm.

2-inch etched dial plate — protected by electrostatic shield. Common AF terminals for EXT-MOD input and INT-AF output eliminates need for special connections in the case — carrying handle — complete with leuda, line cord and plug. For 110-120V. 60-60 cycle A.C. Shpg. wt., 8 lbs.

**LSG-10 — Signal Generator**

**22.50**

**100 SIXTH AVE. NEW YORK, N. Y.**

**PHILADELPHIA, 50 S. 13TH STREET; BOSTON 10, MASS., 1120 Federal St.; BROOKLYN 38, N. Y., 546 E. Fordham Rd.; NEWARK 2, N. J., 24 Central Ave. Include postage with order.
3 TRANSISTOR HI-FI PREAMPLIFIER KIT


KT-117 — Complete Kit. . . Net 18.45

5 TRANSISTOR PUSH PULL AMPLIFIER KIT

transistor amplifier for phones-microphones—inverser — excellent for the experimenter-student—or any one desiring high quality push pull amplifier. U's use new C.E. 2N189 and 2N186A transistor. Inverse feed back for reduction of distortion. Transistor coupled driver and output stages. Complete with panelled chassis, knobs, transistors, all parts and detailed instructions and diagrams.

KT-106 — 5 ohm output. . . . Net 22.95
KT-105 — 6 ohm output. . . . Net 22.95

TRANSPORT CODE PRACTICE OSCILLATOR KIT

For those interested in mastering the international code, an audio tone oscillator is especially suited. The circuit of this transistor type feedback oscillator has the simplicity of the code signal, the signal strength of the vacuum tube, and requires only two penlite cells for months of service. It may be used with transmitting equipment, or with a code practice receiver. Complete with all parts (transistors, Forward Key, Earphones, Condensers, Masonite Board, etc.) and schematic diagram.

KT-72 — Cannon EC-1 — Single Headset . . . . . Net 2.99
KT-73 — Cannon EC-1 — Double Headset. . . . . Net 1.39

2 TRANSISTOR RADIO KIT

Packed into a 2½"x3 1/4"x1 1/4" plastic case. This two transistor plus crystal diode radio kit offers many surprises. Utilizing a receiver-tune detector circuit with transistor coupled driver and output stages provides high sensitivity and selectivity. Pulls in distant stations with ease. Optional single earphone. The kit comes complete with two transistors, crystal diode, battery, earphone, tools, instruction sheets including schematic and instructions.

KT-84 — Complete Kit, less earphone. . . . . Net 10.95
MS-260 — New Super Power Dynamic Earphone. . . . . . . . . Net 2.50

NEW POCKET AC-DC VOM MULTITESTER 2,000 ohm per Volt on AC & DC

You've always wanted a portable Pocket Voltmeter, but they were too expensive. Here is the Lafayette model, completely wired, and costing less than a dollar! This VOM has a sensitivity of 2000 ohms per volt on both AC and DC. Single selector switch. 3" x 1 1/2" x 6 1/4". Net 3.95.

New! Lafayette Radio Mail Order Center ——

November, 1956
KITS! KITS!
HERSHEL'S KITS ACCLAIMED BEST!

ALL KITS CONTAIN THE FINEST ASSORTMENTS. OVER 10,000 SOLD!

30 Tube Sockets
2½-lbs of HARDWARE
15 ROTARY SWITCHES
10 Electrolytic Condensers
40 Radio & TV KNOBS
40 BY-PASS Condensers
60 Carbon RESISTORS
60 MICA Condensers
100 SET SCREWS
8 IN2 XTAI DIODES
50 Ceramic Condensers
15 Variable Condensers (A and Mica)
50 RF CHOKEs
20 POWER RESISTORS
1 Phone Motor 115 Vac.
50 TERMINAL STRIPS
200 ft. HOOK-UP WIRE
1 TRANS. 6.3V-110 Vac.
5 Melissier Plug-In COILs
5 PILOT PANEL LITES
50 FUSES 3AG UP
1 Meter Rectifier O-1MA.
1 IGN. COIL 3V-15,000 VSEC.
25-Fl. Phone-Mike Cable
3 Selenium RECTIFERS (65 MA. 110V.)
1 PHOTO Electric CELL

10 STRAIN INSULATORS
1 TELEGRAPH KEY
5 MICRO SWITCHES
75-Fl. 300 OHM TV LEAD-INS
25 TV STAND OFFS
24 SHOCK MOUNTS
1 PHONO XTAI with NEEDLE
1 PIX TUBE BRIGHTENER
3 Condensers (500 MMFD 20,000 Volts)
100 Ft. of SPAGHETTI
1 RCA Flyback Trans.
10 BATHTUB Condensers
10 GRAIN WHEAT LAMPS
5 RADIO-PHONO CHASSIS
4 LOOP ANTENNAS (RADIO)
1 PHANTOM ANTENNA A-62
100 SPRINGS (RADIO-PHONO)
5 RADIO NOISE FILTERS
25-Fl. RG-58/U COAXIAL CABLE WITH PLUGS
2 Powerful ALNICO 5 Magnets

All New MYSTERY PACKAGE of ELECTRONIC PARTS

OIL CONDENSER $1.65
ARC'S COMMAND TRANSMITTER $8.95

TERMS: Cash with order or 25% DOWN—BALANCE C.O.D.
ALL PRICES NET F.O.B. DETROIT MINIMUM ORDER $2.00

Letters (Continued from page 28)

Best method is to apply full strength household ammonia to the tube. This will generally bring the numbers up.

F. R. COLEMAN
Victory, W. Va.

Once again, many thanks to all readers suggesting ideas on how to bring up invisible tube numbers. Other methods were printed on page 30 of the October issue.

Building P.E. Projects

This photo shows most of the construction projects that I have built from the pages of P.E. I had a real "ball" building them. There are eight in all, counting the extra metal locator, field strength meter, and R/C battery rejuvenator that are not shown. In the photo (from left to right) are the Lorenz transmitter, headphone adapter, battery eliminator, thyatron experiments and metal locator.

DON BOGGS
Manhattan Beach, Calif.

Medium-Wave DX

I have been reading the letters about long-wave DX and thought some readers might be interested in medium-wave (broadcast-band) DX. Some of my best loggings include: LRA, PAR, CB138, BED2, CM8B, WNEW, WWVA, WINS, WCAU, CMQ, PRE8, and WGMG.

I use an Edystone 740 receiver and a 33' antenna. I would like to hear from other readers about their DX.

EDDIE W. BURY
81 Penlon Hall Lane
Cleckheaton, Yorkshire
England

Thank you, Eddie, for your interesting letter. Although POP'tronics does not publish a column on medium-wave DX, we do recommend that you contact the Newark News Radio Club, 210 Market St., Newark 1, N. J., about its bulletins on broadcast-band (as we call it in the states) DX.

Always say you saw it in—POPULAR ELECTRONICS
QUALITY INSTRUMENTS BY EMC

Save More...Service Better

A COMPLETE "ECONOMY-LINE"
WITH HIGH-PRICED FEATURES.

Advanced production techniques and extensive quality controls assure you of a high quality, reliable instrument at the lowest possible price...compare and you'll agree—it's smart to buy EMC.

VOLOMETER—EMC Model 102
Durable molded bakelite case, pocket size. Features 800 micro amperes D'arsonval-type meter, 3½ inch plastic meter, accurate to within 2%. Three AC current ranges—and the same zero adjustment for both resistance ranges.
$35.90 wired & tested $12.50 kit form

VOLOMETER—EMC Model 104
This precision-engineered instrument features a 4½ inch, 50 micromperme meter, with alnico magnet...with 3 AC current ranges to 3 amms and three resistance ranges to 20 megohms.
$26.95 wired & tested $19.25 kit form

MUTUAL CONDUCTANCE
TUBE TESTER—EMC Model 206P
One of the finest pieces of tube testing equipment at a price comparing favorably with emission-type testers. This completely flexible model using lever-type switches offers extremely accurate results with ease of operation.
$83.50 (hand rubbed carrying case)

VACUUM TUBE VOLTMETER—EMC Model 106
Specially designed for field alignment of TV and radio sets. Uses 1½ precision resistors for voltage multipliers. 5 db ranges. Full scale deflection of 1½ volts for both AC-DC volts. Housed in compact portable bakelite case. Size 4½" x 5½" x 2½". Net weight 3 lbs.
$35.00 wired and tested $23.90 kit form

TUBE TESTER and REJUVENATOR—EMC Model 209
Miniaturized instrument gives fast, absolutely accurate checks for tube quality, shorts, leakages, continuity, and opens on all modern and future tubes...uses standard emission test for quick readings on modern, 3½ plastic meter. $38.50 in hand rubbed carrying case.
$35.90 (hammertone metal case) $25.90 kit form

WIDE BAND OSCILLOSCOPE FOR COLOR AND MONOCHROME TV
EMC Model 601
EMC Model 601 oscilloscope gives you the highest quality features ever found in this price field. Exclusive features: full 5 mc bandwidth for color TV servicing—push-pull vertical amplifier, 02 volt per inch sensitivity—5 UP1-5 scope tube—60 cycle phasing control—DC positioning controls eliminates overshooting and bounce—built-in peak-to-peak calibration reference—2-step compensated attenuator input—multivibrator sweep, from 15 cycles to over 75 kilocycles.
$117.90 wired and tested $70.90 kit form

Write today for FREE illustrated catalog and technical information on the EMC economy line.

RF—AF CRYSTAL MAKER
TV Bar-Generator—EMC Model 700
The popular 700 has three extra features—bar generator for TV adjustment with a variable number of bars available for horizontal or vertical alignment. Complete coverage from 18 cycles to 108 megacycles on fundamentals.
$55.90 wired and tested

Yes, send me a complete catalog of all EMC Instruments plus full information about the EMC "Profit" Plan for jobbers.

NAME

OCCUPATION

COMPANY

STREET

CITY       STATE

www.americanradiohistory.com
Save at Esco

Parts Kits: Buy in Kit Form and Save $$

Many of these kits may be purchased for less than any single item alone. Convenience of having parts at hand saves you time and money. All new useful parts. No dogs. All popular brand make. Your word-of-mouth advertising makes our business. Satisfaction Guaranteed or money refunded. Illustrated are kits like those you receive.

A. KIT Power Resistors
$2.99
Navy power resistor kit. 50 of various values from 10-150,000 ohm 25 to 200 watts. Check when the 100,000 ohm 200 watt bleeder would cost separately. Ship. wt. 1 lb.

B. KIT Variable Condensers
$2.99
10 new popular replacement variables from one to five gang. Ship. wt. 9 lbs.

C. KIT Midget Variables
$2.99
Includes 10 assd. variables such as 100 mfd. 100 mcfd. 245 mfd. dual 33 mfd. also 2, 15, 35, 50 and 100 mfd. All midline types. Ship. wt. 3 lbs.

D. KIT Paper Tubular Condensers
$2.99
50 popular sizes including plastic and metal eneased from .001 mfd. to 1 mfd. 660 V. and cut by pass. Poular brands, no freak types or sizes. Ship. wt. 3 lbs.

E. KIT Tube Sockets
$2.99
829, 852, Steatite, XU-4 Pin, Acorn, miniature, octal, loctal, wafer, and molded types. A whole of a buy. 50 in all. Ship. wt. 3 lbs.

F. KIT Radio Knobs
100
$2.99
100 various knobs for radio & television. Push on. set screw, pointer, audio, red, brown, black and white. All for reg. ¼ inch shaft. Ship. wt. 3 lbs.

G. KIT Wafer Switches
$2.99
25 assorted bakelite and steatite insulated single & multi-gang types for band change and other circuits. Ship. wt. 4 lbs.

H. KIT Rheostats & Potentiometers
$2.99
25 assorted replacement, regular & midget types. Ship. wt. 4 lbs.

I. KIT Mounting Hardware
$2.99
100 pcs. various terminal strips of screw & solder types. Ship. wt. 3 lbs.

J. KIT Coil Kit
$2.99
50 pcs. Contains RCA TV IF's, Osc. HV, osc. RF choke, antenna, & IF coils. Ship. wt. 3 lbs.

K. KIT Insulators
$2.99
50 pcs. Includes aircraft strain, antenna, feed thru, stand off, and mounting types. All low loss. Ship. wt. 6 lbs.

L. KIT—RF IF
$2.99
Contains 25 ass'd. IF, RF, OSC, antenna, and a $5.75 Maxon wave trapper. Ship. wt. 4 lbs.

M. KIT Lamp Bulb Replacement
$2.99
100 bulbs of radio, flash-light, and automobile types. 2.5 to 12 V. Popular types. Ship. wt. 2 lbs.

N. KIT Fuses
$2.99
100 popular assd. cartridge fuses including 70 amp. type for the mobile installations. Ship. wt. 3 lbs.

O. KIT Television Yokes
$2.99
3 assorted replacement yokes. Ship. wt. 4 lbs.

P. KIT Hook Up Wire
$2.99
Over 7 lbs. or 1000' of various cut lengths hook up wire all ready stripped at each end and tinned for easy soldering. A real time saver. Multi colors to give the professional look. Ship. wt. 5 lbs.

Q. KIT Electrolytic Caps
$2.99

R. KIT Oil Bath Tub Cond.
$2.99
25 ass'd. bathtubs by pass condensers for that rugged service construction. Ship. wt. 5 lbs.

S. KIT Box of 50 Crystals
$2.99
Assorted. Many for bam bands. Ship. wt. 3 lbs.

T. KIT Carbon Brushes
$2.99
Over 100 assorted new dynamotor and motor brushes, most with spring & bronze lead. Ship. wt. 3 lbs.

Christmas Special!! ALL 20 KITS $49.95

Save money and give the gift that will keep any radio man busy for hours going thru this treasure house of parts that will be the envy of his fellows. Over a $1,000 inventory. Remember, this is all picked, useful, new merchandise. All sold to satisfy or money refunded.
Butterfly — 8 stator 7 rotor for 300-1000 Mc. Ship. wt. 3 lbs. Price...$3.95

Co-axial relay— 12 V. or 24 V. operated & can be connected for 6 V. operation with mg. plate. Size 4 3/4 x 5 1/2 x 2 1/4”. Ship. wt. 2 lbs. Price $1.25 ea.

Miniature pump. Ideal for aeration of aquariums, labs, etc. with strainer. Ship. wt 1 lb. Price $1.00 ea.

Remote tuning head for CW Receiver or other equip. 2:1 gain ratio. Ship. wt. 2 lbs. Price...79c ea.

Field Telephone Case. Ideal for portable equipment or replacement. New canvas or leather choice. Ship. wt. 3 lbs. Price $79c ea.

Wood varnished instrument case for precision instruments. Size 20” x 9” x 4 1/4”. Sh. wt. 7 lbs. Price...$1.75 ea.

1 RPM Haydon Timer Motor. Ship. wt. 1 lb. 24 V. AC 79c. 110 V. AC...$1.49

4 MFD— 600 V. Capacitor. Oil type. Ship. wt. 1 lb. Price...79c ea.

Push button control C30/ARC-5. Ship. wt. 2 lbs. Price...79c ea.

Shock mounts. Lord 1179A/U. Ship. wt. 3 lbs. Set of four. Price...79c

Thermometer— 40° to 110°F. Mount element thru wall for outside temp. Ship. wt. 4 lbs. Price...$3.50 ea.

Cam operated switch. Six individual SP switches with roller type push buttons. Ship. wt. 2 lbs. Price 79c ea.

Wood varnished instrument case for precision instruments. Size 20” x 9” x 4 1/4”. Sh. wt. 7 lbs. Price...$1.75 ea.

AS 27/ARN-5 110-335 Mc. Antenna. Ship. wt. 54 lbs. boxed. Price...$1.25

TEST SET EE-1 NEW—$19.50

A test set for aircraft containing AC & DC volt, ohms, meter, tachometer, pressure gauge & test gauge cords & tools. In aluminum suitcase type case that opens forming sloping 2 sec. panel. Ideal for your test bench applications. Cost hundreds of dollars but yours in original evaporated shipping container for only $19.50. Ship. wt. 27 lbs.

AN-148A Antenna

150-180 Mc. Ship. wt. 8 lbs. Price...$2.79 ea.

Dual 1. mfd. 4500 V. Cap. GE Pyranol type. Ship. wt. 2 lbs. Price...$1.79 ea.

RBM 6 V. 35 Amp. Contact Relay. Ship. wt. 1 lb. Price...79c ea.

2 mfd. 5000 V. Oil Capacitor. Ship. wt. 2 lbs. Price...$1.79 ea.

1.2 mfd. 15,000 GE Pyranol Capacitor. Ship. wt. 9 lbs. Price...$3.75 ea.

Power Supply Kit

$2.99

Components include power transformer, dual 12 henry choke, two 4 mfd. 600 V. oil condensers, rectifier tube & socket, and hook up wire. Use usual power supply circuits for full wave 250 V. 160 Ma. DC or half wave 600 V. 150 Ma. DC supplies. Ship. wt. 30 lbs. All for $2.99

Test Set EE-1

$19.50

A test set for aircraft containing AC & DC volt, ohms, meter, tachometer, pressure gauge & test gauge cords & tools. In aluminum suitcase type case that opens forming sloping 2 sec. panel. Ideal for your test bench applications. Cost hundreds of dollars but yours in original evaporated shipping container for only $19.50. Ship. wt. 27 lbs.

Remit shipping charge and instructions with all orders. Otherwise order will be shipped express collect. All items guaranteed to your satisfaction or money refunded if returned prepaid within 10 days of receipt.

ESSE Bargain Box

ESSE

Golf Car Motor $4.50

New 1 1/2 HP battery operated motor for building up your golf car or other use. Operates from 12 to 24 V. with speed to 6000 RPM. Measures 4 1/4" dia. x 9" long, 5/8" shaft. Wt. 11 1/2 lbs. Ship. wt. 13 lbs.

OAV-1 Test Signal Generator $19.95

This signal generator was used to provide a test signal of constant frequency for operation and alignment of the commercial Co-axial Coils from the Co-axial Coils type receivers. The generator covers the range between 150-220 megacycles. A combination of square and ramp wave form of the listed square wave output is obtained at frequencies of 1, 10, 100, and 1000 cycles, depending on the position of the Freq. mod. Pulse switch. A 15 mc. signal is also provided by a second pulse switch. Power is supplied by internal 115 V., 60 cycle AC supply connected to shore by cord provided. Wt. of unit 62 lbs. Brand new with instruction book. Price...$19.95

Annunciator Panel $2.95

Contains four sensitive coils which drop announcing plate on energizing. Contains also 8 phone jacks for use on switchboard, door systems, etc. Panel size 7 1/4" x 2 1/2". Ship. wt. 3 lbs. New.

1 KW Plate Transformer $17.50

Arma IV. Plate transformer for the construction of that 1 KW. Rig. Two CT 400 V. windings may be series connected for 800 V. Size 9 1/2" x 9" x 8". Ship. wt. 100 lbs. New Navy surplus. Price...$17.50 ea.

Power Supply Kit

$2.99

Components include power transformer, dual 12 henry choke, two 4 mfd. 600 V. oil condensers, rectifier tube & socket, and hook up wire. Use usual power supply circuits for full wave 250 V. 160 Ma. DC or half wave 600 V. 150 Ma. DC supplies. Ship. wt. 30 lbs. All for $2.99

ESSE

Golf Car Motor $4.50

New 1 1/2 HP battery operated motor for building up your golf car or other use. Operates from 12 to 24 V. with speed to 6000 RPM. Measures 4 1/4" dia. x 9" long, 5/8" shaft. Wt. 11 1/2 lbs. Ship. wt. 13 lbs.

OAV-1 Test Signal Generator $19.95

This signal generator was used to provide a test signal of constant frequency for operation and alignment of the commercial Co-axial Coils from the Co-axial Coils type receivers. The generator covers the range between 150-220 megacycles. A combination of square and ramp wave form of the listed square wave output is obtained at frequencies of 1, 10, 100, and 1000 cycles, depending on the position of the Freq. mod. Pulse switch. A 15 mc. signal is also provided by a second pulse switch. Power is supplied by internal 115 V., 60 cycle AC supply connected to shore by cord provided. Wt. of unit 62 lbs. Brand new with instruction book. Price...$19.95

Annunciator Panel $2.95

Contains four sensitive coils which drop announcing plate on energizing. Contains also 8 phone jacks for use on switchboard, door systems, etc. Panel size 7 1/4" x 2 1/2". Ship. wt. 3 lbs. New.

1 KW Plate Transformer $17.50

Arma IV. Plate transformer for the construction of that 1 KW. Rig. Two CT 400 V. windings may be series connected for 800 V. Size 9 1/2" x 9" x 8". Ship. wt. 100 lbs. New Navy surplus. Price...$17.50 ea.

Power Supply Kit

$2.99

Components include power transformer, dual 12 henry choke, two 4 mfd. 600 V. oil condensers, rectifier tube & socket, and hook up wire. Use usual power supply circuits for full wave 250 V. 160 Ma. DC or half wave 600 V. 150 Ma. DC supplies. Ship. wt. 30 lbs. All for $2.99

Tube Checker...Dynamic Mutual Cond. $22.50 ea.

Here is a real buy on a portable dynamic mutual condenser tube checker built for the Signal Corp., by leading mfgs. Checks most of latest tubes including TV types. Some defect is in all but can easily be repaired by the radio man, sometimes only a tube needs replacement. Ship. wt. 18 lbs.

American Radio History

www.americanradiohistory.com
FREE EICO CATALOG

SAVES YOU 50% on your TEST INSTRUMENT & HI-FI COSTS

50 KITS & WIRED MODELS to choose from!

Home, car, TV, appliance repairs:
#540 NEW! REDI-TESTER KIT $12.95 WIRED $15.95
VACUUM TUBE VOLTMETER #221 KIT $25.95 WIRED $39.95
NEW! PEAK-to-PEAK VTVM #232 & UNI-PROBE (pat. pend.) KIT $29.95 WIRED $49.95
1000 Ohms/Volt MULTIMETER #536 KIT $12.90 WIRED $14.90

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

5" PUSH-PULL SCOPE #425 KIT $44.95 WIRED $79.95
Lowest-priced professional Scope
NEW! COLOR & BLACK & WHITE S-MC TV SCOPE #460 KIT $79.95 WIRED $129.50

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

NEW! 20-WATT Ultra-Linear HIGH FIDELITY AMPLIFIER #MF20 KIT $49.95 WIRED $79.95
NEW! HIGH FIDELITY PREAMPLIFIER #HF61 KIT $34.95 WIRED $49.95
with Power Supply:
KIT $29.95 WIRED $44.95
Sine & Square Wave AUDIO GENERATOR #377 KIT $31.95 WIRED $49.95
RF-AF SIGNAL GENERATOR #320 KIT $19.95 WIRED $29.95

LATEST engineering • FINEST components • EASY instructions

NEW! RF-AF SIGNAL GENERATOR #324 (150 kc to 435 mc!) KIT $26.95 WIRED $39.95
TV-FM SWEEP GENERATOR #360 KIT $34.95 WIRED $49.95
MULTI-SIGNAL TRACER #145 KIT $19.95 WIRED $28.95
1000 Ohms/Volt MULTIMETER #556 (4½" METER) KIT $18.90 WIRED $22.50

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

6V & 12V BATTERY ELIMINATOR & CHARGER KIT $29.95 WIRED $38.95
R-C BRIDGE & R-C-L COMPARATOR #950B KIT $19.95 WIRED $29.95
BATTERY TESTER #584 KIT $9.95 WIRED $12.95
 RETMA Res. Sub. Box #1100 KIT $5.95 WIRED $9.95
 RETMA Cap. Sub. Box #1120 KIT $5.95 WIRED $9.95

Always say you saw it in—POPULAR ELECTRONICS
Politics and pure reason mix in computer guesswork on national elections

By HERBERT REID

Electronic Election Bet

DWIGHT EISENHOWER and Adlai Stevenson won't be the stars of the show when TV covers the election. At the moment of decision, CBS cameras turn their backs on personalities, parties, and passions. Instead, Univac, Remington Rand's giant electronic computer, swings into focus. With its blinking lights and shining dials, this computer out-sparkles even the flashiest politico. But, unlike the candidates and their drum-beaters, Univac never raises its voice. The even-tempered humming of its circuits and the logical nature of its innards bespeak the very opposite of politics: pure reason.

For all its rationality, Univac won't throw a wet blanket of cool mathematics over the excitement of election night. On the contrary, with the whole nation figuring the odds of the race, Univac gets into the act as champion guesser of them all.

Hindsight for the Future. If you are planning to wager some last-minute election bets, better take a tip from Univac, no matter what your own "expert" notions may be. CBS learned this the hard way on election day in 1952. At 8:30 P.M., November 4, less than two hours after the first poll closed, the computer had predicted an Eisenhower landslide. At that time, only three million returns were in from scattered Eastern states. No returns at all had been received from 21 states. Univac had to rely solely on historical information in those cases. But the machine wrote: "100:1 in favor of Eisenhower."

Everybody had been expecting a close race. The scientists masterminding the
computer were doubtful of their own robot. They threw out the prediction, not daring to put it on the air. They thought something was wrong with the setting of the machine. There was a mad scramble, after which they proceeded to feed Univac a series of cautious "correction factors" to lessen the assumed chances of Eisenhower carrying Southern states. Despite this, Univac still stuck to Eisenhower, but reduced the odds to 6 to 5.

By midnight, evidence had piled up showing that Univac's first prediction had been amazingly accurate. And the final tally of electoral votes brought complete vindication. Univac had said, on the basis of a relative handful of returns, that Eisenhower would get 438 electoral votes and Stevenson would get 93. The actual result was 442 to 89.

Had Univac been human, it probably would have spelled out as a final message: "I told you so!" Univac wasn't psychic. But primed with past election results, the machine had at its electronic fingertips more political data than any human brain could scan and digest. Thanks to this storehouse of facts and the fast sifting of information, the machine's agile hindsight outsmarted the foresight of the prognosticators.

**History and Math.** This trick of "looking backward" into the future is not at all unique. In fact, it is the basis of all science, which always assumes that the future will shape up as a logical outgrowth of the past. Thus, past experience becomes the raw material for future theory, and hindsight forms the basis of prediction.

Yet history and experience in themselves are not enough. The trick lies in knowing how to interpret the historical information. This is something no computer can do for itself. Like all so-called electronic brains, it hasn't really got an ounce of intelligence. It is merely an oversize gadget—blind, dumb, senseless and inert. What makes it work is the mind of its human masters, who have fed it in advance mathematical instructions as to how to deal with the numbers from the polls, and who,

(Continued on page 113)

**Simplified Radar to Use "Wamoscope"**

**Radio Engineers** attending the Western Electronic Show in Los Angeles recently were amazed to hear of a single-tube radar set. Developed by Sylvania Electric Products, Inc., for the U.S. Navy, the radar has been dubbed the "wamoscope." Literally interpreted, "wamoscope" means "wave-modulated oscilloscope." Microwave radar signals can be fed directly into the tube where—in a single glass envelope—they are amplified, detected, and finally displayed on a fluorescent screen.

Secret of the "wamoscope's" unusual ability is the traveling-wave focusing principle. (The focusing solenoid is shown in the photo as the metal cylinder.) The "wamoscope" can be designed for any u.h.f. band and with any size cathode-ray screen. Although the first one is reserved for the military, radio engineers are planning on possible applications in miniaturized commercial and industrial closed-circuit TV systems.

**First "wamoscope" measures just under two feet, but contains complete radar reception system for direct signal display on cathode-ray screen on end of tube.**

*POPULAR ELECTRONICS*
SEE WHO'S ON THE PHONE

Soon you will see as well as hear your partner in a telephone conversation. Practical two-way transmission of pictures along with the voice over ordinary telephone lines from coast to coast was recently demonstrated by Bell Telephone Laboratories. Head and shoulders of the callers appeared clear and recognizable on small TV attachments to ordinary telephone sets.

Unlike conventional video transmission channels, the new "picture-phone" uses a narrow frequency band, making it possible to send pictures over regular telephone wires rather than expensive coaxial cable. Because of such limitations, only two “frames” per second are transmitted. This suffices, however, since only the portrait of the caller is shown and there is no need for fast action on the screen.

Furthermore, the raster of the small tube requires only 40 lines for good picture definition. By such means, the video bandwidth was reduced to 600 cps (as compared to 4 megacycles on regular TV). This 600-cycle band travels over the telephone wires exactly like a voice signal, needing no special video lines or amplifiers. It is because of the drastic reduction in bandwidth that the picture-phone appears practical for general use in the not-too-distant future. Both local and long-distance service is planned.

Though transmission of spoken words remains the prime rational aspect of telephony, millions of people rely emotionally on the telephone for its power of making physically distant people seem close. The addition of sight to sound will vastly enhance this psychological by-product of direct message transmission.

Even the occasional need for privacy was foreseen by Bell engineers. If you have to answer the phone after running out of the shower, you can just switch off the video so that you can see your caller but he can’t see you.
**TV Turned Traffic Cop**

REGULATING THE FLOW of truck traffic in and out of Zenith Radio Corp.'s main plant in Chicago is a company-installed closed-circuit TV system. Photo at left shows a plant guard coordinating truck movements with the aid of the traffic picture displayed on his TV screen. The TV camera which picks up the action is located at a strategic spot along the two-lane ramp leading to the plant.

Before the use of TV, a steady procession of trucks throughout the day presented problems of delay and stack-ups. With the new system, one man stationed at a single control point can regulate traffic safely and easily. Waiting time is reduced, all trucks move faster, and the guard need never leave his seat. The TV screen he uses is housed in a master panel along with controls for electrically operated ramp doors and gates. A two-way voice communications system permits the guard and the driver of a truck to exchange traffic and check-out information. The driver's microphone is mounted in the plant wall near the waiting truck.

**Live TV to S.A.?**

LIVE TELEVISION broadcasting from the United States as far south as Venezuela is entirely possible, according to Dr. Allen B. Du Mont, chairman of the Du Mont Laboratories, Inc., Clifton, N. J. On a recent trip to the Caribbean area and South America, Dr. Du Mont noted that local reception was as good as reception in the United States, and that there appears to be an eager audience for U. S. telecasts. Such programs could reach Venezuela by use of "forward scatter" facilities between Florida and Cuba. Dr. Du Mont suggests the installation of a receiving station and beam transmitter atop a 9000-foot mountain in Haiti to relay signals directly into the South American area.

**Electronic Alarm Guards Pool**

GUARDING against accidents as well as trespassers in this swimming pool is an electronic alarm system known as "Pool Guard." The system, activated by a body entering the water, sounds a loud warning bell. It requires no outside electrical connections, being operated on two low-voltage batteries.

A sensing device in the water responds to the displacement of water when an unwanted body enters the pool. The control unit, containing an "ON-OFF" switch, may be located at the pool or remotely. With the switch "OFF," the alarm system is deactivated, and the pool may be used normally. Pool Guard is made by Supertron Corp., Los Angeles 65, Calif.
The oscilloscope, the most versatile of all measuring devices, enables man to perceive facts of nature to which his own senses are blind. It is today's foremost instrument of basic research and applied technology.

By H. H. FANTEL
Associate Editor

Past and present blend
in a single moment in
new cathode-ray display

Tricked-up Cathode Rays Are "On the Beam"

As an "OLD DOG" that has been the pet of physicists ever since the early days of electronics, the cathode ray is lately learning an amazing number of new tricks. Instead of just dancing about on an oscilloscope or putting on TV shows in your home, the cathode ray has taken some memory training and also learned to write. But before showing off these latest frills, let's look at the basic function of the cathode-ray tube.

In its most familiar form, the cathode-ray tube acts as the "picture tube" in television sets. Electrons shoot out in a narrow beam from the "electron gun" in the neck of the tube. They hit a phosphor screen, which lights up under their impact. On the way between the electron gun and the tube screen, the beam is bent—or "deflected"—by electromagnetic fields set up by coils around the tube neck. Another way of deflecting the beam is to employ capacitor plates within the tube, which bend the beam by setting up electrostatic fields along its path. These deflections guide the beam across the tube face so that the "picture" appearing on the tube face represents the electric signal fed to the tube.

In oscilloscopes, the cathode-ray tube acts as a measuring device. It indicates anything that can be expressed as an electric voltage. Factors and forces like pressure, tension, temperature, distance, speed, and weight, can be converted into electrical terms and gaged accurately by the beam pattern on the face of the cathode-ray tube. The measuring range is virtually unlimited, since the scale of representation can be varied from zero to a very high value by switching resistors of different sizes into the circuit. A half-inch line on the tube face might mean a little or a lot. Assuming you are measuring weight, that half-inch line might represent a ton or a grain, depending on the scale selected. This extreme variability of range makes the oscilloscope the most versatile of all measuring instruments.

The Instant Image. Speed is another asset of the cathode ray. No need waiting for a swinging pointer to come to rest; no chance for the pointer to lag behind the signal. For the "pointer" in a cathode-ray tube is a beam of free electrons, capable of moving at almost the speed of light. Since there is nothing faster, the beam can theoretically keep up with even the most rapid events. In actual practice, the time constants in the deflection circuit dictate a speed limit somewhat below the beam's unbeatible record. But for most practical purposes, the beam keeps a comfortable speed margin on almost anything it has to tackle.

But speed is only half the story. Weight, or rather the lack of it, makes up the rest,
In medical instruments, the memory-endowed cathode-ray tube retains traces of past heartbeats to compare successive heart contractions. The functioning of other organs can be similarly checked.

since electrons are virtually weightless. The beam has practically no inertia. It can shuttle back and forth through intricate patterns at breakneck speed without “going off” at the curve. This fast and accurate shuttling enables the beam to trace high-speed oscillations in their rapid rise and fall, showing them as the familiar waveform patterns.

With all these advantages, it is no wonder that the cathode ray became the universal measuring tool of nearly every science. Yet in all its countless jobs, the cathode ray suffered from one major disability. It could display information about any occurrence only during the instant that the event actually happened. It presented data from moment to moment without being able to compare the things happening “now” with the things that had happened “before.” It took no account of the past. In other words, it had no memory. The past was always lost.

The Past Regained. Now the cathode ray—which as Man’s lightest and speediest tool has helped him master mass and space—also enters the dimension of time. The Memotron, developed by Hughes Products, is a new cathode-ray tube with the ability to “store” information of past events so that they can be compared with later data. Both past and present show simultaneously on the screen of the tube.

The image on the tube face lasts until it is intentionally “erased.” This is particularly convenient for the study of transients, i.e., unique occurrences which happen very quickly and only once. A timing pulse in radar, a critical moment in music (e.g., the beat of a kettledrum), the current surge in starting a motor ... all these are typical transients. The Memotron “holds” them permanently for thorough study. Tracings of events occurring at different times can be “stacked” on the tube for comparison at a single glance.

Hughes engineers went even a step further. Instead of simply “remembering” light curves against a dark background, as does the Memotron, their new Tonotron tube “remembers” whole pictures in all their various shades of grey. What’s more, the amount of contrast is variable so that the halftones can be adjusted for best picture quality.

The length of time for which the picture is retained on the screen after being flashed on by the scanning ray is called the “persistence” of the image. The Tonotron features variable persistence, adjustable on the control panel. This, in addition to an accurately shaded presentation of the grey scale, assures “high fidelity” in picture reproduction.

Frozen Action. One Tonotron application is in the form of a TV tube capable of “freezing” the picture. Earlier this year, such a tube was demonstrated by the Institute of Radio Engineers in New York. Mounted side-by-side with a conventional TV receiver and tuned to the same channel, the Tonotron TV tube allowed viewers to push a button and “stop the action” while the program on the regular tube went ahead.

Yet the greatest need for the Tonotron and the new tube’s immediate chance to

The Tonotron, newest cathode-ray tube, retains complete images with halftone shading for variable time periods. It "freezes" action on TV picture at right while show continues on regular tube.
Air traffic patterns are marked in conventional way on transparent board by girl above. But to keep up with today's faster planes and denser traffic, human reactions proved too slow and human error too much of a risk. The "writing tube" (above, right) now takes over the job, marking the planes' positions as fast as radar can track them. This device, a recent development of the Boston Electronics Division of American Machine & Foundry Co., will contribute to greater air safety.

prove its usefulness lie in airborne radar. "With this tube, a pilot need not take his eyes from the control and peer into a hood to see a radar presentation," says Dr. A. V. Haef of Hughes Aircraft Co. "The picture is so bright that he can see it at a glance, night and day, and he gets a continuous picture rather than fleeting blips. He controls the time it takes the picture to fade, holding it brilliant for as long as needed, or erasing it at will. Radar gives the pilot an electronic 'map' of the air around him, showing any storms or obstacles ahead. He will clearly see mountains and the ground below him even through blinding weather. With its ability to hold the picture and to

(Continued on page 116)

**HOW IT WORKS**

The "memory" of a cathode-ray tube is based on the well-known fact that a capacitor is capable of storing electric charges. Just behind the viewing screen on the tube is a fine wire mesh coated with a dielectric, which acts as a negatively charged capacitor. This capacitor-type storage mesh is usually flooded with a gentle stream of slow electrons sprayed on by a special "flood gun." But because of its negative charge, the storage mesh bars the path of these electrons. They never reach the screen and the tube stays dark.

Yet when a signal is to be recorded, the high-velocity, sharply focused beam from the regular electron gun smashes through the barrier of the storage mesh and disrupts its negative charge. This makes an electronically transparent "cutout" for the slow electron stream from the flood gun. Now the electrons can travel through the mesh and the tube screen lights up in the patterns "cut out" by the writing beam. The steady electron flow from the flood gun then keeps these areas lit. And the pattern is thus "remembered."

To erase, a positive voltage is pulsed over the whole storage mesh, equalizing all the charges and obliterating the stored pattern.
Chart Dials TV Troubles

DEFECTS in television reception that are caused by faulty tubes or adjustments are described and illustrated on a large circular chart, a portion of which is shown at right. When the chart's dial is turned to the difficulty encountered, a slide-rule index pin-points the adjustments to be made and the tube or tubes that may need replacing. Known as the "TV Tube Trouble Shooter," the chart is available for $1.00 from Maple Enterprise, Box 42, Dept. 100, Hillside, N. J.

Video Rig Checks Freight

FREIGHT CARS entering Southern Railway's Citico yard, Chattanooga, Tenn., have their pictures taken by RCA closed-circuit TV system to speed sorting of cars for classification and switching to trains. Cameras, installed at yard entrances, enable clerk in office (photo below) two miles away to "see" and record action. Intercom system adds to rig's versatility.

Fast/Slow TV Scanner

A COMPATIBLE system for combining fast-scan and slow-scan television economically has been announced by General Electric Co., Syracuse, N. Y. The system changes fast TV (30 pictures per second) to slow TV (one picture every 4 or 5 seconds) by means of an electronic converter.

Fast TV is the kind used by broadcasting stations and is what you see on your home receiver. The slower scan, while not providing fine detail and unsuitable for action scenes, is considered adequate for many industrial applications, particularly when there is no motion involved. What's more, slow TV can be sent over modified telephone lines and is therefore a much cheaper method than fast TV which requires coaxial cables.

The new G.E. converter, still in its laboratory developmental stage, will permit industrial television users to take advantage of the good features of both scanning methods within one closed circuit system.

Computer Speeds Supplies

A GIANT computer (IBM 705) has been installed as the electronic brain for the Army Signal Corps computer-communications system for signal supply management at the Army Signal Supply Agency in Philadelphia. Designed by International Business Machines Corp., it is a key element of the data processing network that provides high-speed control of global logistical operations of signal supplies.

Operating with the speed of light, the computer can make 30,000 decisions per second, 8400 additions or 1200 multiplications per second. It can process 8000 tabulating machine cards a minute—thousands of times faster than this can be done by manual operation. The IBM 705 is expected to effect a major saving in the cost of supply control and management.
UNLESS YOU LIVE in a very unusual household, you must have had more than one exasperating session with an irate wife or mother on the subject of time wasted in the workshop building useless gadgets. Here's a warranted method of putting an end to those dispiriting gripe sessions. Build something for her exclusive use and convenience!

As a protective device and step-saver, an instant-heating (no warm-up time) intercom between the kitchen and the front door will permit her to find out who is ringing the bell without approaching the door itself; undesirable callers can be sent on their way through the medium of a two-way conversation right from the kitchen sink!

Ordinary office intercoms are not satisfactory for home use. Generally, they use tubes that have a 15 to 30 second warm-up time. To avoid this waiting period, such units are usually left running all day long—an unnecessary extravagance for the average apartment-dweller or home-owner. The intercom described in this article eliminates the need for a warm-up interval by using battery-type tubes arranged for 117-volt a.c. operation.

Construction. The plastic cabinet is supplied without holes for the controls in the front panel so that it may be used as either the master unit or the remote speaker housing. Three 3/8" holes should be drilled in the desired locations before doing anything else; they can be used as templates for locating the control openings in the front apron of the little chassis.

Mount the major parts on the top of the chassis (see the photo on page 50). Se-
Hook up the components of the "Tirade Terminator" as shown in this pictorial diagram.

cure the gain control ($R_1$), the canopy-type switch ($S_1$), and the TALK-LISTEN selector switch ($S_2$) to the front apron. Do not cut the shafts short as yet; this can be reserved for last once you are quite sure that everything fits properly.

Plan your layout so that input transformer $T_1$ is physically close to $R_1$ and pentode amplifier $V_1$. Since connections between these parts are high impedance paths, they are quite subject to hum pick-up and feedback unless made as short and direct as possible. Except for this grid circuit, the remainder of the wiring is not particularly critical. However, delicate filaments combined with high-gain amplifiers are subject to 60-cycle hum unless carefully handled. If the hum is excessive, it
Wiring diagram for instant-heating intercom. The "Tirade Terminator" eliminates need for a warm-up interval by using battery-type tubes arranged for 117-volt a.c. operation—making it particularly suitable for home use. Only the wiring for the grid circuit is critical. The pentode Couplate (PC-90) should be installed after all other wiring is completed.

**PARTS LIST**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>0.01-µfd., 400 volt paper tubular capacitor</td>
</tr>
<tr>
<td>C2a</td>
<td>Filter block capacitor, 30-30-100µfd., 150-150-25 volt, Twist-loc type in can (Sprague TVL-3427)</td>
</tr>
<tr>
<td>R1</td>
<td>1.0-meg. volume control potentiometer, audio taper (Mallory U-53, Midgetrol)</td>
</tr>
<tr>
<td>R2</td>
<td>0.01-meg., 1/2-watt resistor</td>
</tr>
<tr>
<td>R3</td>
<td>22-ohm, 1/2-watt resistor</td>
</tr>
<tr>
<td>R4</td>
<td>2500-ohm, 10-watt resistor (Sprague Kool-ohm Type 10KT)</td>
</tr>
<tr>
<td>R5</td>
<td>8000-ohm, 1-watt resistor</td>
</tr>
<tr>
<td>S1</td>
<td>8-pin switch, rotary canopy type with long shaft</td>
</tr>
<tr>
<td>S2</td>
<td>P.d.t. TALK-LISTEN switch, spring return (Centralab Type 1464)</td>
</tr>
<tr>
<td>SRI</td>
<td>65-ma. selenium rectifier (Sarkes-Tarzian Model 65)</td>
</tr>
<tr>
<td>T1</td>
<td>Intercom input transformer, primary 4 ohms to secondary 25,000 ohms (Stancor Type A-4744)</td>
</tr>
<tr>
<td>T2</td>
<td>Output transformer, 25,000-ohm load to 4-ohm voice coil (Stancor Type A-3327)</td>
</tr>
</tbody>
</table>

usual means one of three things: poor grounds, defective filament filtering capacitor (C2c), or excessively long grid leads in the 1A5 circuit.

All wiring should be completed before the pentode Couplate (PC-90) is installed. This is a printed electronic circuit which replaces three capacitors and three resistors. It is a terrific space-saver and is quite inexpensive. Wire it in last, covering those leads which might touch each other with short lengths of "spaghetti" tubing.

**Testing and Installation.** Preliminary tests are always performed with the a.c. plug disconnected from the power line. These tests do not guarantee that the circuit wiring is correct in all details; they are intended merely as protective measures to avoid damaging tubes or other components.

**HOW IT WORKS**

A permanent magnet dynamic speaker may be used as either a microphone or an audio reproducer. On the TALK position of the switch, the local speaker is connected to the input transformer (T1) and serves as a microphone. Varying acoustic pressure applied to the speaker cone by sound waves induces a tiny audio voltage in the voice coil. This voltage is stepped up by the high secondary to primary turns ratio of T1, further amplified by pentode V1, and the signal fed to the grid of the output tube where it is converted to audio power. The remote speaker is activated by the output tube via the selector switch.

In the LISTEN position, the speaker functions are reversed, the local speaker now doing the reproducing and the remote speaker acting as a microphone.

Use of battery-type tubes is made possible by rectifying the a.c. from the 117 volt power lines and then by filtering it in C2a, C2b, and R3. R4 is the filament dropping resistor which insures that a maximum of only 0.03 amperes will flow through the series filaments. The remainder of the circuit is straightforward. To save considerable space, a printed circuit Couplate is used between V1 and T2.

November, 1956

49
Parts are mounted as shown in photos at right (under-chassis view) and below. If you fit a small piece of plywood tightly into slots near bottom of cabinet, the chassis can rest on this base. A small plywood lip glued to the back of the wood will prevent chassis from sliding, thus holding it securely in place without use of metal screws anywhere.

To eliminate any chance of shock, an isolating transformer having a 1:1 turns ratio could be connected as shown between the line and the a.c. input to the intercom — making precautions in text unnecessary.

Chart at right lists preliminary circuit tests that must be made before using intercom.

(Continued on page 131)
PULPIT eloquence, aided by a unique public address system, has turned an acknowledged "white elephant" into a highly successful religious edifice that boasts congregations of as many as 10,000 people and a fame which is spreading over the world. Known as the Pasadena Community Drive-In Church, it consists of an aggregation of buildings and lush green ground located seven miles outside of St. Petersburg, Florida, and has built its present attendance from little more than a handful of worshippers.

Motivating force behind the drive-in church is dynamic, sparse-framed Pastor J. Wallace Hamilton, D.D. The p.a. system was installed by Altec Service Company whose problem—in addition to the indoor setups—was to cover 18 acres of outdoor area. A room high above the chancel was fitted with a control console, tape recorders, patch panel, amplifiers, and monitor speakers. Microphones and reproducing speakers are located at strategic spots within the church and about the grounds. The patch panel handles 24 circuits. Eight Altec "Voice of the Theatre" speaker systems serve to distribute the sound. Electrically operated windows and curtains, acoustical treatment of rooms, Hammond organ, concert grand piano, and a team of 60 ushers—in addition to Dr. Hamilton's personal staff of seven—complete the picture of this unique drive-in church.
Gas with a Kick

A NEW TYPE of long-life dry battery is now under development at the Union Carbide and Carbon Co. Unlike conventional batteries, which use metals as their active chemical agent, these new cells (right) are energized by gases acting on a caustic paste. They will furnish uninterrupted power as long as oxygen or hydrogen are fed into them. Their first job may be as a power source for submarines.

Good-Bye Barnacles

A NEW INVENTOR has developed an "electronic coating" for ship hulls with which he expects to eliminate the costly twin foes of the shipping industry—corrosion and barnacles. By electronic means, the ship's plates are polarized, causing a thin, flint-hard protective coating of minerals from the sea to form on the hull. This makes the ship very uninviting to plant and animal life and also keeps away rust and corrosion. Inventor Henry Burkey claims that the coating will save millions of dollars yearly by eliminating the need for scraping and painting hulls. At left, Burkey inspects test plates after submersion in raw sea water.

Bell Shakes Them Up

VIBRATION TESTS for electronic components of ballistic missiles are made at Bell Telephone Laboratories. In the photo at left is equipment being subjected to severe test "punishment"—shock, vibration, and extreme temperatures. Electronic components intended for use in the intercontinental missiles Atlas and Titan must be inured to such rigors to endure rocket flight.

TV Peeks from Sky

WITHIN THE CABIN of a helicopter, an engineer pans the camera of a new airborne TV system developed by Philco Corp. for the U. S. Navy. From aloft, the TV transmitter scans amphibian landings and other ship-to-shore movement, relaying the information to remote command posts. Excellent pictures were obtained more than 50 miles away even before sunrise.
A NYONE WHO HAS ever read a set of specifications describing a hi-fi amplifier has, at one time or another, done a double-take when confronted with the following typical statements: (1) the amplifier is flat from 20 cps to 30,000 cps ±0.1 db, and (2) separate bass and treble controls provide as much as 20 db of boost or attenuation at low and high frequencies respectively.

"Why," inquires the hi-fi'er, "does the manufacturer go to such lengths to achieve uniform amplifier response, only to allow the 'uneducated' customer to upset it by the use of tone controls? Aren't we defeating the whole concept of high fidelity by incorporating these 'continuously variable amplitude-distorting' knobs?"

The question is a legitimate one and must be answered. After all, high fidelity does mean "faithfulness of reproduction," and it is highly doubtful that the first bassoon player of the Philharmonic Symphony has a "bass-boost" knob on his instrument. Your amplifier does have one, and a treble control as well. And they're designed for your use. More than mere gadgets, they can serve you well in increasing your hi-fi enjoyment.

"Mellow Like a Cello." The history and development of tone controls parallels the changing public taste for reproduced music. It also follows the fidelity and flexibility of music that is broadcast and recorded. Early "tone controls" in the better

Separate treble and bass tone controls are standard items on hi-fi equipment and are indispensable to maximum enjoyment of hi-fi listening. They may be found on any of three types of components, representative examples of which are shown here. At upper left is the Harman-Kardon "Recital II," a combined tuner-preamp-amplifier; all controls are found on one chassis in this type of unit. At lower left is the McIntosh "Professional Audio Compensator;" this "front end" unit contains preamplifier and equalizer circuits as well as the most versatile control facilities for operating them—it must be used with a separate power amplifier. At lower right is the Rauland Model 1512 "Golden Chief" 12-watt amplifier; an "all-in-one" or "single-chassis" type amplifier, it combines power amplifier with built-in preamp.
console radios consisted generally of a simple treble-cut adjustment, shown in the first of the four schematic diagrams on page 55.

Turning the control knob of such a circuit may give the illusion of scaling from the depths of bass to the heights of treble, but to the ear trained to appreciate live music or initiated in the wide range afforded by hi-fi reproduction, such a "tone control" is practically worthless. At its best, it provides a limited kind of treble attenuation—and absolutely no bass boost. Used originally in radio receivers that were decidedly "un-hi-fi," its action was inherently limited to the relatively thin audio produced by such sets. Cutting the highs is not a real way of getting better bass.

Nevertheless, such a control could often be used to bring into balance the over-all audio spectrum. This balance, often disregarded in the broadcast studio and completely unstandardized in the record industry until recent years, had to be achieved somehow in the home listening situation. Then, too, up to the advent of hi-fi, a great many people preferred so-called "mellow music."

Muted trombones and alto saxophones seemed to have had the most say in pre-war popular music. And in "classical" music, cellos whose overtones were clipped off and tympani with an anonymous thud but no "bite" filled the air in the homes of serious music lovers. An entire generation was weaned on this kind of listening, whose "hangover" effect is still evident in the opinion expressed now and then by newcomers to hi-fi that "it sounds too shrill." As a matter of fact, discounting those who had the opportunity to attend live concerts, relatively few "music lovers"—even those with extensive record collections—ever really knew what a live violin sounded like before the advent of hi-fi.

In such a reproducing and listening context, the simple treble-cut control had a justifiable, if not spectacular, role. There is still valid reason for its use in low-priced AM receivers and in applications where voice communication is the main thing. Despite recent advances in AM broadcasting, this type of transmission is still subject to static interference, especially in remote areas and during electrical storms. Most of the static heard is contained in the high-frequency portion of the audible spectrum. Since AM broadcasting is generally limited to a tonal range well below 10,000 cycles, it would seem pointless to run a sound system "wide-open" only to allow annoying noise and static to get through with no particular improvement in program content.

A second justification for treble cut lies in the fact that tastes in living room decor differ considerably. A relatively bare-walled, hard-floored "live" room seems to have more treble bouncing around than does a thickly carpeted, heavily drapered room. In the former, the treble tones may sound too exaggerated despite the fact that the electronic system itself has perfectly flat response. In such a situation, cutting the treble by means of a convenient control would certainly be apropos.

Circuit (A) shown on the next page might do the trick very nicely.

Why Bass Boost? FM broadcasting and LP records and the better equipment to go along with these recent program sources have brought the highs into the living room—sometimes with a vengeance. Usually, a hi-fi enthusiast passes through two initial stages upon being exposed to the new medium. First, he may be impressed by the presence of high frequencies in the reproduced sound. Violins, flutes, piccolos and brass choirs take on a new crispness and clarity of tone. Certain notes, like those struck on the triangle, may be heard for the first time. Everything is articulated more clearly and distinctly. The highs have been discovered!

Some time later, the listener reaches a more advanced state of aural sophistication in which he realizes that something is wrong—the bass tones aren't all there! After checking all the components of the system and re-reading their specifications, the listener concludes that either the components manufacturers are making overly
extravagant claims or that he, the listener, isn’t hearing right.

In this case, the latter conclusion happens to be true. He isn’t hearing right! It’s a fact that human hearing does not respond uniformly to all tones at all levels. To put it another way: if you listen to a live concert, your ears respond in a certain manner to all the sound heard. If you play a recording of that concert in your living room at reduced volume, the low tones will seem to be reduced more than the middle and high frequency tones.

To restore the music to its relative tonal balance, some form of compensation must be used. A very simple type of "bass boost" control for this purpose is shown in the schematic (B) at the right. At high settings of the volume control (where we are closer to the original “loudness level” of the live sound), the circuit provides no bass boost action. As the volume control is lowered, the circuit may be used to increase the level of bass tones.

Knobs and More Knobs. Often, in listening situations, tone control may be required which has the opposite effect of that just discussed. We might need a means of reducing bass and boosting treble. Bass attenuation may be desirable, for example, in a multiple speaker system in which the woofer is more efficient than the other elements of the system. Treble boost, on the other hand, might be needed to some degree because at the extreme high end of the audible spectrum human hearing undergoes somewhat the same deterioration that is experienced with low frequencies at subdued listening levels (though to a lesser degree as a rule). Treble boost might also be required to add highs for tonal balance in a relatively "dead" room. This, of course, is largely a

(Continued on page 126)

Schematics of the basic types of tone control circuits in use today are shown at right. Many feel that types (A) and (B) are not versatile enough to be labeled as "hi-fi." Types (C) and (D), however, provide the required range and flexibility of adjustment expected in good audio equipment. Type (C) has been used very widely in modern equipment, although it is gradually being superseded by the Baxandall circuit shown in (D). A study of the wiring schematic of a particular preamplifier (or tuner, if it contains a built-in preamp) will help you identify the type of tone control circuit used in that component. Such identification can tell you just what you have in your present preamp and also serve as a guide to future purchases. Explanations of how these circuits operate are included in the text; for a comparison of the ranges of control available in types (C) and (D), see graphs on page 126.
Capacitor Duo-Decades for the Experimenter

The digits "1," "2," "4," "5," and "8" can be added in various combinations to obtain all sums from 1 to 20 inclusive. For instance, the sum of 8, 5, 4, 2 and 1 is 20, and the sum of 8, 2 and 1 is 11. The author has adapted this interesting fact to the making of miniature capacitor duo-decades. (See table at right for a set of such digit combinations.)

A single duo-decade requires only five fixed capacitors and five s.p.s.t. toggle switches. The unit shown in the photos contains one each of 0.001-, 0.002-, 0.004-, 0.005- and 0.008-µfd. (actually 0.0082-µfd.) 5% tolerance, silver-mica capacitors. It covers the range from 0.001 µfd. to 0.02 µfd. in 20 steps of 0.001 µfd.

Other duo-decades may be made starting at 0.0001 µfd. and 0.01 µfd. Three such miniature units would use only 15 capacitors altogether, yet they would cover the entire range from 100 µfd. to 200,000 µfd. (0.0001 µfd. to 0.2 µfd.) and provide some 2000 different values of capacitance!

Accuracy of each duo-decade depends upon the accuracy of the capacitors used in it. Since only five capacitors are required per unit, a high order of accuracy can be obtained at reasonable cost. Most experimenters will find that an accuracy of 5% is sufficient for a large majority of applications.

Construction. The duo-decade is built in an LMB Type ELA22 flangelock chassis box measuring 2½" x 2½" x 4". All switches, capacitors, and the terminal posts are mounted on the L-section of the box. The mating section merely serves as a protective cover and shield.

Make a label for the switches, bearing the values of the five capacitors contained in the box, out of a strip of thin, white card stock, using hand-lettering or a typewriter. This label is attached to the top of the box with four 4-40 screws.

Solder a length of No. 20 bare, tinned, copper wire to one lug of each of the five switches and then to the solder lug under one of the two terminal posts. Then solder a short length of heavy busbar wire to the lug under the other terminal post. This heavy wire runs almost to the end of the box. One wire lead of each of the capacitors is looped once around and soldered to the busbar, and the other lead of each capacitor is soldered to the second terminal on its own respective toggle switch.

—Frank H. Tooker

POPULAR ELECTRONICS

<table>
<thead>
<tr>
<th>Number:</th>
<th>Sum of:</th>
<th>Number:</th>
<th>Sum of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>11</td>
<td>8.2,1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>12</td>
<td>8.4</td>
</tr>
<tr>
<td>3</td>
<td>2.1</td>
<td>13</td>
<td>8.5</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>14</td>
<td>8.5,1</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>15</td>
<td>8.5,2</td>
</tr>
<tr>
<td>6</td>
<td>4.2</td>
<td>16</td>
<td>8.5,2,1</td>
</tr>
<tr>
<td>7</td>
<td>5.2</td>
<td>17</td>
<td>8.5,4,1</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>18</td>
<td>8.5,4,2</td>
</tr>
<tr>
<td>9</td>
<td>5.4</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>8.2</td>
<td>20</td>
<td>8.5,4,2,1</td>
</tr>
</tbody>
</table>

Diagram and parts list for a single duo-decade.
Transistor Topics

By LOU GARNER

November should be an exciting month, what with a presidential election and the Thanksgiving and Christmas holidays not too far away. Exciting things are happening in the electronics field, too . . . most of the mail order parts distributors have released their new catalogs, color TV is booming, and, in our "pet" field, there are new types of transistors, transistor components, and transistorized equipment. If you haven't visited your new car dealers yet, don't forget to "give a listen" to the recently developed hybrid (tube and transistor) auto receivers.

I don't honestly know whether the average reader of this column is an old-timer or a youngster as far as transistors are concerned . . . but I rather feel that many of you are "new-comers." As an old-timer myself, I'd like to reminisce a little . . . back to about the beginning of 1953. There was great news then . . . Raytheon had just introduced a new low-cost transistor, a p-n-p junction triode selling for the "give-away" price of merely $7.50 . . . Type number CK722! And it was a real bargain at that price, for, prior to the release of the CK722, the cheapest transistor sold for about $18.00, with many types selling for $50.00 to $100.00.

There were relatively few miniature components available in those days, and it was not unusual for an enthusiastic experimenter to assemble a two-transistor "pocket" radio which could barely be squeezed into an overcoat pocket. Few construction projects required more than two transistors . . . the vast majority used only one!

But, as the expression goes, "time marches on" . . . and things change. Today, relatively few transistors sell for more than $5.00, and two popular experimenter types sell for less than one buck! Raytheon's famous CK722 and G.E.'s popular 2N107 both net for only 99 cents. And there are a couple of r.f. transistors available for less than $2.00 . . . Raytheon's CK768, a p-n-p unit selling for $1.50, and G.E.'s n-p-n 2N170 which nets for $1.45. At these prices, most experimenters don't hesitate to tackle four to six transistor projects at a time.

Looking to the future, your columnist fully expects to see the day when transistors sell for appreciably less than that other amplifying device . . . you know what?

Reader's Circuit. The old mail box informs us that radio receiver projects are by far the most popular with home builders and experimenters. Because of this, we have featured simple receiver circuits for the past few months. But we know there are many transistor experimenters who are interested in other applications . . . audio circuits, ham work, test gear, etc. So this month we are departing from usual custom and including a circuit for a "transistorized keying monitor"—a gadget every ham and c.w. operator should find interesting.

 Basically, a keying monitor is intended to permit a radiotelegraph operator to hear

You can hold the transistorized "keying monitor" in the palm of your hand. This unit, designed by L. B. Wyckoff, will also serve as a code practice oscillator.

November, 1956
himself "on the air." Hearing his own transmissions enables the operator to send cleaner, better code, and this, in turn, helps the fellow at the other end who has to copy the signals. L. B. Wyckoff submitted the circuit shown, and assembled the model illustrated.

Referring to the schematic diagram, a single CK722 p-n-p transistor is connected in a modified "Colpitts-type" audio oscillator. Frequency of operation is established by a tuned circuit made up of the earphone's inductance and capacitors \( C_1 \) and \( C_2 \), in series. The ratio of these two capacitors determines the amount of feedback supplied to initiate and sustain oscillation. Operating power is supplied partially by a small penlite cell and partially by rectified r.f. energy, picked up by loop \( L_1 \), rectified by the crystal diode, and filtered by \( C_3 \). According to Wyckoff, the battery's current drain is so small that its useful operating life approximates its normal shelf life; hence no "on-off" switch is needed.

Construction is simple and straightforward, with neither layout nor lead dress critical. Wyckoff assembled the model pictured in a plastic box measuring \( 2\frac{1}{2}'' \times 1'' \times \frac{3}{4}'' \). Capacitors \( C_1 \), \( C_2 \), and \( C_3 \) may be either paper or ceramic units; \( R_1 \) is a half-watt carbon resistor; almost any crystal diode may be used . . . the CK705 or 1N34A will probably be the choice of most builders. The pickup coil, \( L_1 \), consists of approximately five turns of hookup wire, wound in a 2"-diameter loop and secured with string or lacing twine . . . you can use Scotch tape for this job if you wish. A high-impedance (5000-ohm) dynamic ear-

![Circuit diagram of the keying monitor.](image)

phone should be used . . . crystal earphones will not work in this circuit.

The completed gadget may be used as either a code practice oscillator or a key-

**Tickler File.** Again, we "tickle" your memories about items mentioned in previous columns . . . items we feel to be of special interest to you:

1. **Sylvania's new transistor kit** (six transistors and a crystal diode) can be obtained from your regular distributor.
2. **Lafayette's new transistor checker kit**, write to Lafayette Radio, 100 Sixth Avenue, New York 13, N. Y., for price data and specifications.
3. **G.E.'s new tetrode transistor** . . . there is no price data yet, but units will be available for operation up to 120 megacycles!

**Hot News!** We always devote space to tips about new products, but this month we have some news which we feel deserves special mention . . . CBS-Hytron has announced two new power transistors, designed and priced especially for experimenters. These two units, capable of outputs in the watts, should be available from your local distributor before too long. Type numbers are 2N256 and 2N257, for the 15-volt and 30-volt units, respectively. Selling price will be around $2.50 to $3.50, according to present plans. At these prices, the 2N256 and 2N257 will sell for less than half as much as other "high power" transistors, representing a major price break.

**Product News.** In addition to the "red hot" news tip mentioned above, we have quite a few items from other manufacturers and suppliers.

(Continued on page 118)
Transtopic Experiment No. 12

Electronic Timer

This is another experiment in the series that started in the March, 1956 issue. The last experiment, No. 11, appeared on page 63 of the October issue.

Wiring hints and parts lists were included in the March issue. Further information on the components and chassis may also be found in that issue. This is Project No. 12 and concerns the construction of a simple electronic timer.

When the timer is assembled according to the circuit shown in the wiring schematic, it may be used for a variety of applications. If you're a photographic fan, you can control your enlarger or printing box with it. In chemistry, it might be used to control a small heater or an electric stirrer. The only precautions you need observe in assembling the unit are to double-check the polarities of the battery and electrolytic capacitor, C7, and to make sure a good-quality electrolytic capacitor is employed.

With the wiring completed, the relay should pull in and should hold in for a short period of time, finally dropping out. Afterwards, closing the "RESET" switch (hand key) and releasing it should cause the relay to pull in again, and to hold in for a period of time determined by the setting of R1, again finally dropping out. The relay's "OUTPUT TERMINALS" are used as a simple switch to control the circuit being timed.

Timing range depends on the adjustment of the relay, the setting of R1, and on the size of capacitor C7. A 25-µfd. capacitor provides a range of from approximately 1 to 3 seconds to a maximum of from 5 to 12 seconds. If this capacitor is a 100-µfd. unit, the minimum will be 5-8 seconds, the maximum 25-45 seconds.

When the power switch S1 is first closed, there is a rush of current through the R1-R4 parallel combination, through R3 and through the base-emitter circuit of TR1, charging C7. This flow of base-emitter current closes RL1. The relay then holds closed as long as sufficient collector current flows.

As C7 is charged, the current flow in this circuit gradually drops. Since collector current also drops, RL1 drops out. The time required to charge C7 depends on the RC time constant of the circuit. Closing the "RESET" switch discharges the capacitor, permitting the timing cycle to be repeated.

For a given transistor, and assuming C7 to be fixed, the minimum timing period is determined by R3, whose value is chosen to keep the base-emitter current within a safe value as C7 is shorted by the "RESET" switch. The maximum timing period is determined by the total resistance in the circuit.

-Louis E. Garner, Jr.
Number of fish, size, and direction of travel are determined by electronic counter. In display model (right), trout in tank has just passed through tunnel, has been detected. The detector circuit can operate a camera which will photograph fish so as to identify species. Below, right, a technician tests the firing mechanism of the counter.

Electronics on the Fishways

By MARGARET MAGNA

Electric fences protect spawning salmon from Kodiak bears! Fish take their own pictures by means of electronic counters! Sonic trackers chart reactions to various types of fishways! Electrical weirs jolt life out of sea lampreys! And underwater telemeters indicate net depths for "mid-water" trawling!

All of these devices—and many others—are being utilized by the Fish and Wildlife Service, U. S. Department of the Interior, in fishery research and management. Electrical screens protect fish at power-plant intakes. Shockers temporarily "knock them out" to determine population figures. Fish are spotted for harvesting with special finders developed by electronic specialists. With the help of underwater TV, biologists determine methods of saving small fish from destruction. In other words, electronics is playing an increasingly active role on the fishways—the watery roads on which fish travel.

Fish Count Themselves. Created by the Fish and Wildlife Service, the electronic counter is fully automatic. It counts the fish and indicates their size and direction of travel. Through the medium of an underwater camera, it can also identify the species; in effect, enabling the fish to photograph themselves.

The basic element of the counter is a detector which, utilizing the difference in conductivity between fish and water, passes a signal when a fish is between its electrodes. This signal may be used to trip an electric tally, flash a light, ring a bell, etc. Arrangement of the electrodes in tunnels determines the minimum size of fish that can be counted.

Signals from two detectors can be used to actuate a logic device, which indicates the number of completed upstream and downstream passages on separate dials. It rejects all passages that are incomplete. The output of the logic device will also

Above photo, "The Oregonian," by Rollie Dobson
All others, Fish and Wildlife Service
operate automatic devices when a prede
termined number of fish has passed, such as gates at hatchery holding ponds, thus
preventing overcrowding.
Tunnels can be made of transparent,
opaque or pigmented materials. Or detectors may be used with troughs, weirs, posts in stream beds, etc., if tunnels are not
desirable. The system will work at any
depth and in murky water, where visual observation is impossible.
At present, the chief value of the elec
tronic fish counter is in testing effective
ness of the fishways and registering the
number of salmon heading for spawning
grounds. Continuance of a salmon fishery
depends to a great extent upon whether or
not a sufficient number of adult fish reach
the spawning areas. A fish counting lab
oratory is now in operation at Ballard
Locks, near Seattle, Wash., and indica
tions are that this device, when fully developed,
will be used in many parts of the country
where fish runs are important.
Sonic Tracker. A capsule about two
and-a-half inches long and less than one inch
in diameter, the sonic tracker is fastened
to the back of a salmon just to the rear
of the dorsal fin. It contains a 15-volt bat
tery and small transmitting apparatus ca
pable of sending signals for 10 to 100 hours.
This "tattle-tale" electronic device will
flash every twist and turn of the fish to a
recording instrument on land or in a boat.
Under ideal conditions, the signals from
the tracker may be detected as far away
as 2000 feet. A fish carrying the capsule
can be tracked and its position pinpointed
for about 800 feet in clear, still water, and
for about 100 feet in rough, turbulent
streams. Movements of as many as ten
fish can be traced simultaneously using
transmitters with different frequencies.
Initial studies of the sonic tracker—one of the newest of the electronic devices—
are being made at Bonneville Dam on the
Columbia River. By investigating the pas
gage of salmon through several types of
fishways, technicians hope to be able to
determine the most effective fish ladder
design. Although the tracker is being ap
plied particularly to salmon studies, it can
be used on other species as well.
Telemetering and TV. The underwater
telemeter will indicate the exact distance
of a trawl or net below the surface of the
water. As a means of discovering the fish
ery values of the mid-water ocean area, it
is expected to increase the efficiency of
commercial fishing considerably. Compa

Underwater TV hous
ing being mounted on
sled (above) prior to
use at Coral Gables,
Fla. The camera with
in the housing scruti
nizes fishing gear while
it is in operation.

Electrical weir at
Carp Creek, Mich.
(left) is located be
tween two mechanical
weirs used in checking
the effectiveness of
this barrier. Lampreys,
which prey on smaller
fish, are killed by its
charged electrodes as
they attempt to pass
through on their way
to spawning grounds.

November, 1956
Fish are killed into temporary unconsciousness by biologists in West Gallatin River, Montana. The men at left and right hold insulated handles to probes that pass shocking current through stream.

At Woods Hole, biologists are more concerned with the effect of fishing gear on fish which are too small for market, rather than with efficiency of commercial gear. Looking for methods of saving such fish from destruction, they are studying the sizes of fish which can escape through the trawl meshes, and the manner of escape, as well as behavior within the net. These biologists are also making various studies of the ocean bottom and the small marine animals which inhabit the bottom and serve as fish food.

**Electrical Weirs.** Since the power turbine and some of the big irrigation diversions offer a major threat to young fish, considerable research is being done on mechanical and electrical methods of meeting this problem. Numerous screening techniques have been tried. In small experimental streams, such devices have been about 95% successful in guiding the fish into the desired places. Testing is now being done on large streams. Two methods have been used, one based on the fact that fish are attracted to the positive pole, the other based on the principle of repulsion by an electrical field.

The sea lamprey weir is an electrical barrier placed across a stream used by the lamprey for spawning. Its charged electrodes kill any sea lampreys attempting to pass through. Such weirs are installed in tributary streams of the Great Lakes. The sea lamprey, which entered the upper Great Lakes about 20 years ago, destroyed the lake trout fishery of Lake Michigan and Lake Huron, and has now appeared in Lake Superior. Its control is a major objective of the Fish and Wildlife Service at the present time.

For about three years, the electric fence has successfully kept the big Kodiak bears away from critical sections of salmon streams. The electric shocker, which has also been utilized for some time in making fish population studies, is now effective in soft water, thereby extending the range of its usefulness. By and large, it might be said that the role of electronics on the fishways is to protect fish from harm until such time as they become useful to man, at which point it abdicates in favor of the electric stove.
The "Economy" Signal Chaser

By RICHARD GRAHAM

Track down trouble in your receiver or amplifier with this inexpensive device

HOW TO DIAGNOSE a receiver failure is a problem that is practically as old as radio itself. Yet to the novice in the radio game, the problem is as acute as ever, for it often means many hours of head-scratching and experimenting before the trouble is found. For some, this state of affairs is due to the lack of proper test equipment to help point the way.

Somehow, the term "test equipment" conjures up visions of an elaborate test-bench loaded with scopes, meters, signal generators, etc. All of these items are valuable aids to successful servicing although basically they can do no more than the simple device described in this article to help you find what happened to the signal.

The device is called a "Signal Chaser" because it sends out a modulated signal over the entire audio and radio spectrum from 60 cycles to over 10 megacycles. It can be used for tracking down component and stage failures in audio amplifiers, pre-amplifiers, and speakers, as well as in any r.f. or i.f. stage of a radio receiver.

Simple to construct, the Signal Chaser uses only one tube, requires no d.c. power supply, and does not need alignment or adjustment to be put into operation. It is housed in a 2" x 4" x 1½" aluminum box.

The actual chassis is a bracket formed from a 2" x 1¼" piece of scrap aluminum. A ½-inch lip is bent up on the two-inch
C1, C3, C4—0.01-µfd., 600-volt disc ceramic capacitor
C2—0.005-µfd., 600-volt disc ceramic capacitor
R1—960-ohm resistance line cord
R2, R4—47,000-ohm, 1/2-watt resistor
R3—10,000-ohm, 1/2-watt resistor
R5—1000-ohm, 1/2-watt resistor
S1—S.p.s.t. toggle switch
V1—12AT7 tube

**Diagrams and parts list for the "Economy" Signal Chaser.** It is important that the output leads of the resistance line cord, which provides the filament voltage, be connected as shown in the schematic diagram above so that the filament will light and the tube will not burn out. You can see how the various parts are hooked up in the pictorial diagram below.

**HOW IT WORKS**

This circuit is basically a free-running cathode-coupled multivibrator with 60-cycle a.c. voltage applied to the plates. The multivibrator will operate only when the plate supply is positive with respect to the cathode. Frequency of the multivibrator is approximately 1000 cycles; however, it can be varied by the amplitude of the applied a.c. plate voltage (reduce or increase values of R2 and R3).

Multivibrator output is interrupted at the power line frequency of 60 times per second. The resultant waveform has fundamental frequencies of 60 and 1000 cycles, both of which are extremely rich in harmonics. The 60-cycle modulation of the 1000-cycle fundamental results in a signal every 60 cycles from 60 cycles to over 10 megacycles.

The output is taken from the common cathodes of the twin triode. Coupling and/or a.c. isolation are provided by capacitors C1, C3, and C4. A good grade of coaxial cable is necessary since the capacity of the cable will determine the output at the higher radio frequencies.

The 9-pin socket and two small stand-off insulators are mounted on this chassis, which can be assembled and wired before it is mounted permanently in the aluminum box.

Output from the Signal Chaser is fed through a capacitor (C8) and a 2' length of RG-62/U coaxial cable. If RG-62/U cable is not available, the second-best choice is RG-59/U. The cable ends in a standard meter test probe. Only the inner conductor of the coaxial cable is connected to the probe test point. The outer braid shield should extend down the probe handle to within approximately one-half inch of the tip. Details of the probe construction are clearly illustrated at the top of the following page.

In the interest of simplicity, the Signal Chaser is operated directly from the 117-volt a.c. power line. Therefore, it is necessary to isolate the output coaxial cable lead and the aluminum case of the Signal Chaser from the power line. This precaution must be taken to eliminate a dangerous shock hazard, particularly if the Signal Chaser is to be used to service a.c./d.c. sets where the chassis is commonly connected to one side of the power line. For this reason, the coaxial shield is connected to the case through 0.01-µfd. capacitor C3, and one side of the line is connected to the case through capacitor C4.

A resistance line cord is used to provide the filament voltage for the 12AT7. This type of line cord has three output leads on
the end. Make sure that the wires are connected as shown in the diagram. Otherwise, either the filament won’t light or the tube will be burned out. An ohmmeter will help sort these wires if they are not coded clearly.

The basic procedure when using the Signal Chaser is to follow the signal path through the receiver in reverse. For example, in the typical receiver, the Signal Chaser probe can be placed on the grid of the audio output stage. If all is functioning correctly, a loud buzzing sound will be heard from the speaker. The probe can be placed on the plate and then the grid of the first audio stage in the receiver. If the loud buzzing sound is heard, all is well, and the probe can be placed on the grids, plates, and diode of the preceding detector, i.f., and r.f. stages.

Continue this procedure until the point is found where the loud buzzing sound cannot be heard. This, then, is the point at which the signal path is broken. A closer visual inspection and perhaps a few measurements with a voltmeter will most likely enable you to locate the specific difficulty.

This method of servicing radio and audio equipment is known as the signal substitution method and is described in detail in many books on radio-TV servicing techniques.

Storing Small Components in the Workshop

STORING of parts and accessories is a major problem in the home workshop. Most electronic parts are small and delicate, requiring separation and protection from breakage. Small glass jars are readily available, and are ideal for storage purposes—but how and where should you store them? Illustrated here is one of the most satisfactory methods yet developed.

Construction is self-explanatory, and the dimensions are tailored to suit the number and size of jars to be used. The holes can be cut with a carpenter’s expansion bit and should be just large enough to let the jar slide slightly backwards when inserted. The jars are supported at the back of the board by strips cut to size from 1/2” x 1” molding, available in all lumber yards for a few cents a foot.

An additional bonus afforded by this system is that the contents of each jar can be printed directly on the cover for easy identification.

—Robert B. Kuehn

Handy Connections for Ferrite-Rod Loop Antennas

WHEN EXPERIMENTING with ferrite-rod transistor loop antennas, such as the Miller #2000 shown in the photo, it isn’t very hard to break off the pigtail leads. Experimenters can avoid this danger by mounting three small Fahnestock clips on the insulating strip base, and soldering the pigtail leads directly to the small lugs on the clips.

Drill three 1/16”-diameter holes in the strip at the approximate positions shown in the photo, and mount three #15 Fahnestock clips using 1/16”-diameter round-head machine screws 1/2” long with hexagon nuts to fit. After mounting the clips, snip off the excess ends on the screws so they won’t interfere with the levers on the clips. Do not snip off the excess wire on the pigtail leads, but coil them up and then solder the tinned ends into the eyes of the small lugs on the clips.

Now you can experiment to your heart’s content without danger of breaking off the wire leads.

—Art Trauffer
AN OFTEN UNTAPPED source of radio signals for code practice lies in what is known as the long-wave region above the broadcast band. This is a sort of "never-never land" where few experimenters ever tune. Perhaps it is because this area has no voice signals but instead is populated only with c.w. and m.c.w. signals that it has so little interest for the average person—but it's a gold mine for anyone who wants to learn the code.*

Receivers for use in this part of the radio spectrum are not too easy to find. Most, if not all, of those available in surplus are quite big, heavy contraptions with power requirements other than 117-volt, 60-cycle, a.c. If you're interested in tuning here, you are better off building your own converter or receiver. Elaborate, expensive equipment isn't at all essential, especially for code-practice purposes. Many long-wave stations use very high power, so even a simple, one-tube receiver—such as the "Long-Wave DX'er"—can do a good job.

**Construction.** Looking at the front-view photo of the receiver, the knob to the left of the tuning dial is the regeneration control. The one on the right varies **R4**, the volume control potentiometer. To the right of the volume control is the phone jack, **J1**, and to the right again, the power "on-off" switch **S1**. The tuning dial is of the vernier type for easy tuning. It is mounted on a small strip of sheet aluminum.

The heart of any receiver is its "front end." In this particular receiver, it narrows down to the tuning capacitor gang, **C4/C5**, and its coil, **L1**. A large maximum capacitance is necessary and is obtained by paralleling the two sections of a dual 420-pf/d. variable capacitor.

Several different coils were tried at **L1**, but none were as sensitive as the Miller X-121-A specified in the parts list. Although this particular coil requires a fair amount of modification (as described below) before it can be used in the circuit, such modification is not difficult. The coil, as purchased, is enclosed in a ¾" × ¾" × 2" shield can. Since the can will not be used, it should be removed.

First, lift up the two little metal tabs on the underside of the shield. Straighten them up until they are flush with the sides of the can. Then, using a tiny screwdriver, pry out the little Bakelite terminal board and the coil. Do this carefully. Lift a little on one side, then another—working around the four sides of the Bakelite piece until it is free of the shield. The powdered iron core will remain in the can. Directions for removing it will be given shortly.

Study the lead arrangement on the coil. The lead nearest the terminal board is the ground point; slightly above it is a double lead that is the antenna tap. The lead furthest from the terminal board is the grid end of the coil. When you can recognize where these leads are to be connected just by looking at the coil, carefully unsolder the three leads from their solder lugs, drill out the eyelet in the center of the terminal

* A feature article on long-wave DX stations appeared in the October issue on page 31. This article described the stations that can be heard, the frequencies in use, and how DX stations may be verified.
Want to learn c.w.? The long-wave region above the broadcast band is ideal for code practice, and the sensitive little receiver described in this article is simple to put together.

By FRANK H. TOOKER

board, and remove the terminal board and the remains of the eyelet from the coil form. Remove 225 turns from the grid end of the coil, and snip off the wire about four inches from the coil form. Solder a 3" length of insulated wire to the antenna tap lead; then solder a 2" length of the same wire to the ground lead. Insulate these soldered connections and anchor them to the coil with small pieces of plastic insulating tape.

The powdered iron core is secured to the top of the shield can with an eyelet and a small nut. Remove the nut and file away the eyelet. Be careful not to damage the threads on the small projecting brass rod in the center, for these will be used with the nut to secure the core and the coil to the side of the chassis in your receiver. When the eyelet is filed away, a light tap on the end of the threaded rod will drop the core out of the can.

The tickler is a ¾"-square coil. It consists of 25 turns of No. 28 enameled wire, and is made by scramble-winding the wire on the Miller shield can. Wind the coil over as narrow an area as possible. Slip it off the can and wrap the coil snugly with plastic insulating tape.

To make the tickler adjustable in the receiver, it is mounted against the side of a short length of ¼"-diameter fiber rod. Prepare a place for the coil on the rod by filing a small flat on one side of the rod. Note that the tickler is located over the tuning coil. Spacing between the two coils is such that the tuning coil will be centered in the tickler when the latter is swung down over the tuning coil. You don't have to be especially precise about the coupling between the two coils.

Normal adjustment of the tickler has little, if any, effect on the tuning of the receiver. Mount the tickler coil on the rod by spreading a generous dab of polystyrene

November, 1956
HOW IT WORKS

This is a regenerative receiver with positive feedback in the detector obtained through a plate tickler coil (L2). Regeneration is controlled by physically varying the position of the tickler with respect to the tuning coil, L1.

One half of a twin-triode tube serves as the detector. The other half operates as a transformer-coupled audio amplifier. Resistor R5, capacitors C2b and C9, as well as the capacitance between the transformer windings and ground, act as filters generally to eliminate "fringe howl."

Antenna coupling capacitor C6 depends to a certain extent upon the length and height of your antenna. The value shown (100 μf) is about right for a 35' to 50' antenna, 20 to 30 feet above ground. Too large a capacitor here will reduce the tuning range and may adversely affect regeneration. The receiver tunes from 100 to 400 kc, and is designed for headphone reception only. It is complete with its own transformer-type power supply.
Wire the "Long-Wave DX'er" as shown in schematic diagram at right. Complete details for modification of coil L1 are given in text. Components should be hooked up as illustrated in pictorial diagram at left.

**PARTS LIST**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>0.02 µfd. ceramic capacitor</td>
<td></td>
</tr>
<tr>
<td>C2a/C2b</td>
<td>20/20 µfd. 150-volt, can-type, dual electrolytic capacitor</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>200 µfd. mica capacitor</td>
<td></td>
</tr>
<tr>
<td>C4, C5</td>
<td>420/420 µfd. dual variable capacitor</td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td>100 µfd. mica capacitor</td>
<td></td>
</tr>
<tr>
<td>C7a/C7b</td>
<td>20/20 µfd. 250-volt, can-type, dual electrolytic capacitor</td>
<td></td>
</tr>
<tr>
<td>C9</td>
<td>0.001 µfd. mica capacitor</td>
<td></td>
</tr>
<tr>
<td>CH1</td>
<td>8.5 henry, 30 ma. filter choke</td>
<td></td>
</tr>
<tr>
<td>CH2</td>
<td>Open-circuit phone jack</td>
<td></td>
</tr>
<tr>
<td>LI</td>
<td>Tuning coil (Miller Type X-121-A modified)</td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td>Square tickler coil. 25 turns of No. 28 enameled wire (see text)</td>
<td></td>
</tr>
<tr>
<td>R1</td>
<td>100,000 ohm. 1/2 watt composition resistor</td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>3300 ohm. 1/2 watt composition resistor</td>
<td></td>
</tr>
<tr>
<td>R3</td>
<td>2.2 megohm. 1/2 watt composition resistor</td>
<td></td>
</tr>
<tr>
<td>R4</td>
<td>150,000 ohm volume control potentiometer</td>
<td></td>
</tr>
<tr>
<td>R5</td>
<td>10,000 ohm. 1/2 watt composition resistor</td>
<td></td>
</tr>
<tr>
<td>R6</td>
<td>47,000 ohm. 2 watt composition resistor</td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>S.p.s.t. toggle switch</td>
<td></td>
</tr>
<tr>
<td>SRI</td>
<td>65 ma, 130 volt selenium rectifier</td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>Power transformer: 125 volts, 1/2 watt, at 5 ma. 6.3 volts at 0.02 amperes (Stancor PA8421) — a smaller unit may be used here if desired</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>Single-plate to single-grid audio transformer, 3:1 step-up ratio</td>
<td></td>
</tr>
<tr>
<td>V1</td>
<td>Type 12AX7 tube</td>
<td></td>
</tr>
<tr>
<td>V2</td>
<td>Type 12AX7 tube</td>
<td></td>
</tr>
<tr>
<td>V3</td>
<td>Type 12AX7 tube</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Type 12AX7 tube</td>
<td></td>
</tr>
</tbody>
</table>

cement or plastic household cement along the flat. Then, hold one side of the coil against the flat and wrap a layer or two of plastic insulating tape snugly around this side of the coil and the rod.

The end of the tickler rod that is inside the chassis is supported by a strip of 3/8"-thick Bakelite. A 3/4"-diameter hole is drilled through one end of the strip at the appropriate height to accommodate the rod. The other end of the strip is secured to the underside of the chassis deck by means of a small L-bracket. Sufficient friction to make the rod (and the tickler coil) stay put in any position to which it is adjusted is obtained by passing the knob end of the rod through a 3/4"-i.d. rubber grommet.

Make a little spring in each of the two tickler leads by winding a couple of turns around the fiber rod on each side of the coil — and, when the leads are soldered into the circuit, leave enough slack so that the tickler can be rotated through 180°. In normal use of the receiver, the tickler adjustment will not be likely to require more than about 20° of rotation, so there is little danger of the leads fouling or break-
Record changer, Model RC-88, is improved version of Garrard RC-80. Unit plays at three speeds automatically or manually, as desired. Motor is 4-pole, shaded induction type. Weighted turntable, 1” high, turns on ball bearings, and is covered with rubber mat. Wow and rumble are said to be negligible. Tone arm, made of aluminum, uses plug-in shell which accepts most pickups. Stylus pressure and pickup height adjustments are provided. Unit is supplied with two spindles; mounting base is extra.

Two-way speaker system (8” woofer and 3½” tweeter) is housed in compact attractive enclosure. The "Linthrop" speaker may be used as a reproducer in a modest hi-fi system, as an extension speaker for another room, or as an auxiliary speaker for stereophonic setups or to improve TV sound. Two leads connect unit to any amplifier. Net price, $23.95.

Forty-watt amplifier includes built-in preamp and full audio controls for hi-fi systems. Controls provide for program selection, equalization of tape and records, loudness, treble, bass, rumble filter, speaker damping, and speaker selection. The "Trend II" (Model A-1040) uses four 12AB5 tubes in a high-efficiency, low-power drain circuit. Net price, $125.00.

Tweeter (Lafayette "HW-7") features louvered "acoustic lens" for uniform dispersion of highs. Lens is detachable for panel mounting, and a separate base for mounting the tweeter externally is also available. The aluminum voice coil has an impedance of 16 ohms. Power rating is 25 watts. This tweeter is designed to take over at 2000 cycles. Net price, $14.95.

AM tuner (Heathkit Model BC-11) may be built from kit containing all parts and instructions. Designed for use in hi-fi systems, it provides broad bandwidth with good sensitivity and selectivity. Set features built-in power supply and cathode-follower output, uses five tubes. Net price of $24.50 includes cabinet.

Fifty-watt power amplifier, built from Regency HF-50K kit, provides enough reserve power to drive low-efficiency, wide-range speaker systems. Response at 50 watts has less than 1% harmonic distortion from 20 to 20,000 cps. Multiple negative feedback circuits assure high damping. Step-by-step instructions are said to permit complete assembly in four hours. Amplifier must be used with audio "front end," or tuner having audio controls. Net, $74.50.
IN OUR platter-spinning this month, we came across several new ones that point up the natural affinity of woodwinds for the phonograph. Flute, oboe, clarinet and bassoon emerge from the loudspeaker with such lifelike tinge that the hi-fi listener finds it easy to forget all about his equipment and simply enjoy the music.

The husky, reedy sound of woodwinds is particularly easy on the foibles of electronic equipment. They sound good on medium-fi as well as on hi-fi because their overtone pattern does not get too badly twisted by a few jags in the frequency response or other minor distortions in amplifier and speaker. Besides, woodwinds don’t produce sharp transients (bangs like in piano or percussion) that throw slightly ramshackle rigs into a jangling frenzy on every beat. Even on a less-than-perfect system, stylus, speaker and transformers can comfortably follow the waveforms of woodwind sound without getting rattled. Blended with orchestra, they add tangy spice or smooth sauce to the musical serving.

Unlike many other instruments, woodwinds sound fine even at low volume, which puts less strain on both your output tubes and your neighbors. Despite the absence of sheer decibel power, woodwinds create an amazing palette of tonal colors from acerbic sneers to silk sonorities.

**Music in the Winds.** The freshest wind to blow out of these woods is stirred up by Alec Wilder on Columbia CL-884. Wilder, one of America’s most gifted young composers, reportedly was kicked out of the Eastman School of Music at Rochester for what appears to be an extreme case of irrepressible high spirits, which compelled him to perpetrate all sorts of antics and spoofs. His good-natured practical jokes were always done with grand aplomb and a sense of style. The same mood of sparkling and imaginative fun pervades these woodwind compositions, variously entitled *Her Old Man Was Suspicious, The Neurotic Goldfish,* etc. The humor is pointed, never broad. The style combines an easy sense of aptness with arch mockery matched to musical craftsmanship. Maybe that’s why top-notch musicians like Mitch Miller (oboe) and Julius Baker (flute) especially got together for this recording and gave it all they had—which is plenty. Their own evident pleasure in playing these pieces speaks from every groove. Behind the music there seems to be an inaudible chuckle. That’s what makes this record something rather special.

Unusual things also happen on the other side. Here stands none other than Frank Sinatra, but this time he isn’t singing. He’s conducting an orchestra in more Wilder music, and doing a fine job of it. Frank accidentally came across these pieces when the composer and the music were quite unknown. He was so taken by a group of flowing, lyrical numbers for solo woodwinds and strings that he talked Columbia Records into letting him conduct them. The result is a deft blend of impressionism and pops: music to relax you.

*(Continued on page 105)*

Frank Sinatra now makes his debut as a "classical" conductor in music by Wilder for solo woodwinds and string orchestra. He interprets this distinctively American music with conviction and finesse.
**Robot Helicopter**

FLOATED ALOFT by a technician operating a radio-control setup from the ground is the "robot" helicopter above. The ground controller is not a pilot himself; ease of control makes the robot capable of being "flown" by anyone. Inside the helicopter, in addition to the R/C equipment, are facilities for taking still pictures as well as TV pictures and transmitting them to ground observers.

In addition, the robot can lay communications lines, fly a "memory" course fed into a ground control station, and respond to commands transmitted from an airborne control station in a second helicopter. Developed by The Kaman Aircraft Corp., Bloomfield, Conn., the robot is shown in the above photo being demonstrated to U. S. Department of Defense officials at Fort Belvoir, Va.

**Auto Antenna Replacement**

MOTORISTS facing the problem of mischievous people breaking off or pilfering auto radio antenna staffs when a car is not under guard can now solve it in about 60 seconds. The answer is a glistening chrome-plated 3-section replacement auto antenna staff (Model RE-8) which will fit virtually every make of antenna.

The bell-shaped base of the replacement antenna staff merely fits over the old antenna base. A few turns of a special spline wrench, which comes with it, and the new staff is firmly fixed. Model RE-8 is 22" high when it is collapsed; with the three sections extended, the staff stands 56" above the bottom of the base. The unit is made by Snyder Manufacturing Co., Philadelphia, Pa.

**Capacitors Use No Leads**

A LINE of flat, tapered capacitors, designed specifically for use without leads in printed-circuit wiring boards, has been announced by General Electric's Specialty Electronic Components Department, West Genessee St., Auburn, N. Y. Known as "Wecaps," the units fit into slots in the board and are bonded by dip-soldering. They will be used in TV receiver circuits.

**Pocket-Size Tester**

UNKNOWN voltages may be measured and circuit continuity checked with the pocket-size test instrument developed by Tele-Matic Industries, Inc., 16 Howard Ave., Brooklyn 21, N. Y. Known as the "Mini-Test," it uses a neon bulb rather than a meter movement for indications. Its range is from 65 to 800 volts.

As shown in the diagram below, its action depends on the amount of voltage impressed across the probe terminals. As the knob, controlling the potentiometer, is rotated from "Start" position, more resistance is shunted across the neon bulb until it is impressed with enough (65) volts to glow. The voltage being contacted by the probes may then be read from the knob setting on the outer cover of the "Mini-Test."

To check circuit continuity, an auxiliary lead must be used which—together with one of the probes—is connected to an external voltage source. Measuring 1¼" x 1¼" x 5¼", the "Mini-Test" lists for $2.49.

![Schematic diagram of the pocket-size tester.](image-url)
BEGINNING radio constructors who want to start with a simple crystal receiver would be wise to purchase parts which can be used later on for that inevitable three- or four-tube superhet. For example, if you buy a two-section superhet variable capacitor, you can use the large section for a crystal set and both sections later on for a superhet. Likewise, if you purchase a loop antenna to match the superhet capacitor, you can use the loop as a tuning coil in a crystal set and then use it later on as an antenna for a superhet. You could even use the crystal as a second detector in your superhet.

Almost every radio parts dealer, or radio mail order house, has two-section superhet variable capacitors with matching loop antennas. It would be well to buy a matching oscillator coil at the same time and put it on the shelf for that eventual superhet.

Mount the variable capacitor, loop, and four Fahnestock clips on a wood base 7 1/2" long, 4" wide, and 3/4" thick. The loop can be bolted to a 2" x 5" wood upright screw-fastened to the back edge of the wood base. A pair of Fahnestock clips about 1 1/2" apart on the right-hand end of the base are used for the earphones, and another pair on the left end of the base for the antenna and ground connections.

The right-hand rear clip is connected directly to the capacitor frame (rotor) and from there to the lug on the loop which connects to the inside wire of the large loop winding. One lead of the germanium diode (crystal detector) connects to the right-hand front clip, and the other diode lead connects to the stator lug of the large section on the variable capacitor. Now connect the same capacitor lug to the lug on the loop which connects to the outside end of the large loop winding. The two remaining lugs on the loop are for the one-turn external antenna winding; connect these lugs to the remaining two clips on the left-hand end of the base.

If your loop has no external antenna winding, simply wind one turn of hookup wire around the outside of the loop, and fasten wire with cement or coil dope.

With regard to the antenna and ground connections for the crystal set, experiment for best results in your location. In some locations a good antenna is sufficient; in other cases a cold water pipe ground connection will give louder signals. Connecting the antenna directly to the stator lug on the variable capacitor will give strong signals, but poor separation between stations. As shown in the schematic diagram (dotted line), you can connect the antenna to the capacitor stator through a small value of fixed capacitor to improve selectivity. Try several different capacitor values until you find the one that is best for the job.

—Carl Dunant
THE SKY, once empty and beyond reach, is now a busy thoroughfare. Aviation has shrinked space aloft as well as on the ground. With the planes themselves made safe by today's superb engineering, congestion of the air has become the chief risk of flying.

As the wild, blue yonder grows wilder and more dangerous with fast planes crowding each other for space, the future of flying now depends on electronic aids to air safety.

Volscan, developed jointly by the Cambridge Research Center of the Air Force and the Crosley Corporation, is the latest answer to the urgent problem of air traffic control in the vicinity of busy airports.

Combining ordinary radar data, Volscan converts a cloud of randomly arriving aircraft into an orderly, safe procession.

A supersonic jet plane may require as much as 50 miles for its landing approach, with some elbow room at either side. Therefore, an air traffic control system must assign each incoming aircraft a long "block of space" reserved exclusively for its use. Volscan automatically marks this space and follows the aircraft on its assigned path until the Instrument Landing System (ILS) takes over and sets it down on the runway.

Since pilots can't just step on the brake and slow down, the problem is complicated by faster planes overtaking the slower ones. A fast plane coming in later might wind up right on top of a slower plane that had already started its landing approach. Hence, not only the sequence of the incoming aircraft but also their speeds must be taken into account. This adds to the space demand of fast planes and to the score of factors that every minute may tip the balance of life and death at a busy airport.

Volscan keeps all these factors "in mind" at any moment, and automatically parcels out to each plane precisely the air space it needs to keep that fateful balance firmly held down on the safe side. As the airport radar sweeps the sky, each plane in the area appears as a "blip" on the radar screen. The operator marks each newly appearing blip with a light gun, which triggers Volscan's electronic brain into action. The computer then "follows" the plane as the blip moves on the radar screen.

Acting as an electronic traffic manager, the computer has stored within itself the correct answers to every possible landing approach situation that may arise. Since the computer has the answer before the problem actually comes up, it needs only a fraction of a second to pick the correct approach instruction—in effect, to assign a block of space. These instructions are then given to the pilot by radio, or fed directly into the airplane's automatic controls by data-link transmission.

Always on guard against error, Volscan...
Tracks invisibly cut in the sky by Volscan electronic flight guidance resolve risky air traffic jams into safe and orderly landing sequence.

keeps its unblinking eye on up to 14 planes which it guides simultaneously. If either the human or the automatic pilot takes any plane off the assigned course, the computer immediately compensates for the mistake and issues new instructions for getting the plane back on its track and arrival schedule. It must "touch down" at just the right moment, for the 13 other planes are strung by the computer in a tight but safe landing sequence. The result is maximum use of the available runway facilities, increasing the safe traffic capacity of any airport almost three times.

In this manner, Volscan can handle one landing every 30 seconds, thus reducing the dangerous practice of "stacking" airplanes waiting around an airport for an opportunity to land. Such stacking is discomforting in present-day planes, but for the jets of the not-distant future, it would be disastrous. For jets use almost three times as much fuel at approach altitude as they do at cruising altitude. While awaiting their landing clearance, they might exhaust their fuel reserve.

Volscan and the whole problem of air traffic control point up those ironic twists by which history bedevils human effort. Fifty years ago, when Man first transformed himself into a creature of flight, the main idea was to get him off the ground. Now, in the headlong progress of the air age, he seems to have trouble in getting down again. But electronics offers him a safe ladder for his descent.

Giant overhead radar scope (left) displays total air traffic situation. As newly arriving plane enters the monitored air space, an electronic computer co-ordinates its position and progress with every other plane in the area. Operators at right relay instructions to incoming aircraft in terms of azimuth and elevation.

November, 1935
WORKING WITH THERMISTORS

WITH TRANSISTORS enjoying the spotlight in current experimental work, we tend to forget that there is another kind of semiconductor material—the thermistor—which is finding wide acceptance in all kinds of electrical jobs.

Just what is a thermistor?

All electrical conductors show a tendency to change electrical resistance as their temperature varies. Some materials such as the alloy “Invar” do this so slightly that they are said to have virtually zero temperature coefficient of resistance; metallic oxides used in today’s commercial thermistors change resistance abruptly with relatively small temperature variations.

Modern thermistors have large negative temperature coefficients. This means that their electrical resistance drops sharply when the temperature rises. The extent of the change can be predicted quite closely from the thermistor ratings—as you will see.

Forms of Fabrication. The most common physical shapes in which modern thermistors are fabricated are rods, beads, discs, and washers. Each unit starts life as a pasty black mix of several metallic oxides. Rods, discs, and washers are made by first shaping the mix paste as desired and then firing the forms in temperature-controlled ovens. The “cold” resistance of an individual thermistor is governed by the composition of the original mix and by the time-temperature constants in the sintering process. This control permits a range of 5 to 100,000 ohms at 25°C by means of only two different mixes.

Manufacture of microscopic bead thermistors is a fascinating process to watch. (See Fig. 1.) Two extremely fine platinum wires (A) are held taut and parallel to each other on a special frame, the distance between wires being less than .005”. Tiny blobs of the mix are then daubed on the wires (B) so that they are bridged by the bead; after drying and shrinking, the strand of beads is sintered and glass-coated. Later, the wires are cut to precise lengths (C) and the units are mounted on holders. Bead thermistors are available in

Common shapes in which thermistors are made. The head of a pin (top) is gigantic compared to tiny bead thermistor [A33 VECO] in center of fine wire. In the bottom square, a 51/2 VECO rod thermistor and a small disc thermistor are contrasted with ordinary paper match-head.
an assortment of values from about 500 ohms to 12 megohms at 25°C.

**Varying Temperature.** To take advantage of a thermistor's characteristics, its temperature must be made to vary and the resulting change of resistance put to use operating a meter, relay, etc. There are three distinct means by which this is done.

1. **Ambient temperature changes.** A thermistor will follow the changes in ambient temperature by varying its resistance accordingly. This is the basis of thermometers, fire alarms, and thermostats.

2. **Self-heating action.** If the current through a thermistor is made large enough, the thermistor temperature will rise, causing the resistance to drop, which in turn allows more current to flow and more heat to be generated. The build-up process continues until the temperature of the thermistor stabilizes at the point where the surrounding medium can carry heat away as fast as it is generated. This action is used in flowmeters, anemometers, liquid level gauges and controllers, and thermal conductivity measurement. The type of medium or its motion causes more or less rapid cooling of the self-heated thermistor, thus setting up the current-change conditions needed for measurement or control.

3. **Independent heater.** Some special thermistor assemblies are provided with a heating element near the temperature-sensitive bead to permit heating control independently of the main circuit current or ambient temperature. This arrangement is used only in highly specialized industrial applications.

**Thermistor Ratings.** A sensible approach to thermistor experimentation requires understanding of thermistor ratings and the circuits for which they are best.

(Continued on page 109)
WHAT do you think of this DX QSL card?” asked Jimmy, waving a gaudy red and blue Australian card.

“Looks real fine,” I replied. “Is it in answer to a SWL card that you sent out?”

“No!” snorted the young Novice. “This is my first DX card for 15-meter operation! I worked him! I’m in the big league now!”

“Well, not exactly, Jimmy! Not with a dipole antenna. You’ve just been lucky so far. The Novice QRM is getting pretty heavy on 21 megs. You had better start thinking about a beam antenna if you want to be a DX-man.”

“That’s why I’m here!” said Jimmy, collapsing into the easy chair next to the operating desk. “Let’s design a good beam antenna and tower that I can put up for about thirty bucks. That’s all the money I can scrape up... Golly, a good rotator for the beam will cost that much, I bet.” An unhappy look clouded Jimmy’s face as he voiced this pessimistic thought.

“All right, pass me a piece of talking paper,” I ordered. “I remember a tower and beam antenna design that was used by W6YAT and some of the other DX-chasers. It worked fine, and was very inexpensive to build. It’s just the ticket for a 21-mc Novice antenna. Look here, I’ll draw you a sketch of it...”

A simple and inexpensive 32' tower can be built from two 20' “two-by-six” pieces of #1 lumber, as shown in Fig. 1. Each piece of material is cut lengthwise (the lumber yard will do it) to form two “two-by-three” pieces. A 4’ section is cut off the end of each two-by-three, leaving four 16’ pieces to form the legs of the tower. The tower should be flat, built much in the manner of a ladder. Make up each leg with two pieces of lumber, spliced together with a 4’ section. A rigid joint is formed when the legs are drilled and four 3/8” steel bolts are passed through the holes in the leg sections and the splice.

The crosspieces of the tower are made of “one-by-four” lumber. These braces should be spaced about two feet apart, starting about four feet above the ground, and held in place with “sixteen penny” cement-coated nails.

“Why do you start the crosspieces four feet above the ground?” asked Jimmy. “That’s to keep the little brats like your younger brother from climbing the tower,” I replied, with a laugh.

The tower is three and one-half feet wide at the base, tapering to sixteen inches at the top. Splice each side joint and lay the two legs out in the driveway, in correct position. Then, temporarily nail a top and bottom crosspiece in place to steady the legs. After that, nail on the intermediate cross braces. Drive two cement-coated nails through each end of each cross brace.

These cross braces may be cut slightly...
longer than necessary, then trimmed up after they are all in place. Use two cross braces at the top and bottom of the tower, one on each side. Check each step carefully, and the tower will remain square and true. Avoid any wood that is split or warped. Finally, turn the tower over and nail the two diagonal braces in place, as shown in Fig. 1, to take the sway out of the tower.

The foundation for the tower is made of two pieces of "four-by-four" creosoted lumber (or redwood) that are sunk vertically in three feet of cement. Foundation holes should be about a foot and a half square. The base hinge is made from a 4' length of ½" water pipe. Drill the legs of the tower and the two mounting posts to pass the pipe, as shown in the drawings.

"How about the rotator?" demanded Jimmy. "Easy, Junior," I said. "You young squirts are getting soft! You can't afford a rotator. I had a beam antenna for ten years before I had a rotator. I used the Armstrong Method of turning it. So can you. After all, you'll find that you only turn the beam occasionally. You won't spin it around too much. There's no reason why you can't rotate the beam by hand."

Obtain enough 1" (i.d.) water pipe to make a continuous section about 30 feet long. Threaded couplings may be used to make splices, but each coupling should be pinned with a bolt to prevent the couplings from coming undone in a heavy wind.

This pipe is passed down the center of the tower. Starting at the top, and at every fourth cross brace, place wood blocks on each side of the pipe to keep it in position. The blocks form a rough bearing, bracing the pipe but allowing it to turn. Wherever the blocks are used, that cross brace should be bolted to the tower legs with ¾" steel bolts, as the nails might just loosen in a strong wind. Also bolt the wooden blocks in position.

At the bottom of the tower, the pipe rests on a wooden block attached to the top of the double cross braces. Thread a pipe flange on the base of the pipe, and pin it. Several holes should be drilled in the block, matching the holes in the flange. Finally, boost up the whole pipe an inch or two, and slip an old 1½" ball bearing under it to provide a smooth surface for rotating the pipe. A long bolt is passed through the flange into one of the holes in the block, locking the beam in the chosen direction.

"How do I turn the beam?" asked Jimmy. "Silly boy! You pull out the bolt, grab the flange, and turn! It's easy!" I replied.

Brace the tower at the 30' level by two sets of guy wires, running forwards and backwards from the tower, at an angle. The tower can be hinged at the base, and "walked up" into vertical position by three or four fellow hams. When the tower is erect, attach the guy wires to nearby points, and tighten them. A second set of guys could be attached at the 20' level to make the tower even more rigid. When completed, the top of the supporting pipe should project about two feet above the top of the tower to take the beam antenna. As a final step, give the tower a coat or two of gray house paint for protection against the weather.

"The antenna! What kind of an antenna can a poverty-stricken Novice like myself build for a few dollars that will really bore a hole in the band?" demanded Jimmy. "Well, here it is," I replied, reaching for a second sheet of paper.

A two-element, 15-meter parasitic beam will provide about 5 db gain—enough to make the Novice 75-watt transmitter sound like a

(Continued on page 114)

November, 1956

Fig. 2. Electrical diagram of the two-element 15-meter parasitic beam antenna.

Fig. 3. Antenna assembly. Joints are made with TV-type U-bolts and gusset plates. See Bill of Materials, page 116.
WHILE EXPERIMENTING with an old crystal phono cartridge, the author connected a pair of high-impedance magnetic earphones across the terminal lugs on the cartridge, and was pleased to find that the recorded material could be heard with surprising volume and clarity.

There are a number of instances where it might be desirable to dispense with an audio amplifier and speaker. Many public libraries, for instance, are equipped with record players using amplifiers for record-aiding in their record-loan departments. Every librarian would welcome a simple record player having improved fidelity, no hum, no tubes to wear out, and consisting of only a turntable with pickup, and a pair of phones. In record shops, the usual row of poorly ventilated booths, with their expensive amplifiers and noisy speakers, could be replaced with a row of turntables with pickups, and earphones.

Measuring 10" x 12" x 3", the author's record-player cabinet was constructed of wood and covered over with Contact adhesive plastic-coated material. You can build a cabinet, buy a ready-made one, or use any suitable record-player cabinet you have on hand. The model utilizes a 33 1/3-rpm phono motor that happened to be on hand, but you may want to use a modern 3-speed motor.

The crystal phono pickup is a Ronette FF2 low-resonance 12" arm containing a Ronette 284-P high-fidelity crystal cartridge. Although the voltage output of the 284-P is relatively low (between .15 and .38 volt) as compared with many crystal cartridges, the earphone volume seems to be entirely satisfactory. Those with below normal hearing, however, will need to use a crystal or ceramic cartridge having a high voltage output. Other high-fidelity crystal or ceramic phone cartridges which may be used are the Sonotone "3" series, the Electro-Voice "80" series, the Shure "Music Lovers Cartridge," etc. Magnetic and dynamic phone cartridges are not suitable for amplifierless earphone listening due to their very low outputs.

Use high-impedance earphones to match the high impedance of the crystal or ceramic cartridge. A crystal headset is the logical choice. The author uses a pair of Brush BA-206 crystal phones. Those who do not wish to invest in a pair of top-quality crystal earphones will find that the little crystal earpiece available from Lafayette Radio, 100 Sixth Ave., New York, N. Y. (Catalog No. MS-111, $1.49 net), is as sensitive as a pair of phones. The frequency response is not nearly as smooth, though, and you'll have to push the earpiece firmly into your ear to get good bass response—which may result in discomfort over long periods of listening. Nevertheless, this little earpiece does a fine job for the money.

—Art Trauffer

POPULAR ELECTRONICS
USUALLY when a short-wave communications receiver is mentioned, one immediately thinks of an elaborate, multtube superheterodyne. The reason for this is that the basic superheterodyne circuit is flexible enough to accommodate the many tubes and special circuits required to give the best possible results under unfavorable conditions. It is the basis of the often repeated advice to get the best receiver you can afford for your radio shack. It does not mean, however, that you must have an elaborate superheterodyne receiver to hear short-wave signals. The much simpler regenerative receiver will also bring them in.

In the hands of a skilled operator, the performance of a two- or three-tube regenerative receiver will approach that of a superheterodyne costing several times as much. In addition, its simplicity makes constructing a regenerative receiver (either from "scratch" or from a kit) and learning how to operate it an ideal project for anyone just getting started in radio. Doing so is fun and will quickly develop the skill and knowledge required to tackle a more elaborate project successfully.

What Is Regeneration? The Knight "Space Spanner" short-wave and broadcast band receiver, available in kit form from Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill., is an example of a modern regenerative receiver. Before discussing it specifically, let's learn a bit about how a regenerative receiver works—with the aid of Fig. 1 on page 83.

To begin, all signals picked up by the receiving antenna are fed into the tuned circuit, consisting of a coil $L_1$ and a variable capacitor $C_2$, via the antenna coupling capacitor $C_1$. $L_1$ and $C_2$ select the signal and deliver it to the grid of the detector tube, $V_1$, via the grid capacitor $C_3$ and grid resistor $R_1$.

In the tube, the desired signal is amplified, and through the influence of $C_3$ and $R_1$, the audio-frequency intelligence it carries is removed from the signal and is delivered to the pair of headphones or to an audio amplifier for further amplification.

Note that the signal from the plate of the detector tube does not go directly to the phones or audio amplifier. Instead, it first flows through the "tickler" coil $L_2$, which is wound on the same form as $L_1$. In this manner, part of the detector output signal is coupled back into $L_1$, from whence it goes through the tube to be amplified again and again. This is regeneration.

Each time the signal makes the round trip through the circuit, it naturally becomes stronger. At the same time, the
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 Herbert S. Brier, W9EQQ, % POPULAR ELECTRONICS, 356 Madison Ave., New York 17, N.Y. Please print your name and address clearly. Names are grouped geographically by amateur call areas.

K1/WI CALL AREA
Bruce A. Childs, P.O. Box 226, Centerville, Cape Cod, Mass. (Code)
Edward Tanzer, 216 Vine St., Everett, Mass. (Code)
Joel L. Richmond, 2 Hiawatha Road, Mattapan 26, Mass. (Code)

K2/WI CALL AREA
Joseph Essington (15), Pedricktown Rd., Penns Grove, N. J.
Jose Garcia, 1905 Stebbins Ave., 5-E, Bronx 59, N. Y.
George Stovall, 112-24 Northern Blvd., Corona 65, New York, N. Y.
Joseph Green, 60 Felice Crescent, Hicksville, N. Y.
Stuart Ring, Box 7, Adams, N. Y.
Martin Gucker, 65 E. Tremont Ave., Bronx 53, N. Y. (Code)
Stuart Mount, P.O. Box 62, Clintondale, N. Y. (Code)
Robert Butcher, 20 McKinley Place, Glen Cove, N. Y.
Ronald Wilensky, 920 E. 17th St., Brooklyn 36, N. Y. (Code)
Boy Freeman (13), 88 Magnolia St., Westbury, N. Y. (Code)
Pete Tedesco (13), 26 Brookside Circle, Bronxville, N. Y. (Code)

K2/W2 CALL AREA
Robert Bair, 160 Craig Drive, Greensburg, Pa.
Robert Himler, 11 W. Madison St., Latrobe, Pa.
Michael W. Vore, 359 Whitfield Road, Catonsville 28, Md.

K1/W4 CALL AREA
Ted Buckland (14), 317 Blowing Rk. Rd., Boone, N. C. (Theory)
Jim Cheek (18), 107 Hampton St., Westminster, S. C.
Richard L. Warren (13), 2780 Skyline Drive, Memphis 8, Tenn.
Kip Coffeen, 126 Pinewood Ct., Lynnwood Subdivision, Woodbridge, Va.
Frank Piekarz, 27 Morgantown St., Fairchance, Pa.
Don Blanton, 2253 Hale Ave., Louisville, Ky.
Ky. 40219 (17), Route 2, Box 48, Henderson, N. C.
Jackie Blackwell, Box 367, Kernersville, N. C.
Mike Fletcher, SWL-42, (18), 300 Redbud Dr., Bakersfield, Tex. (Theory)
George Brooklyser (16), Box 157, Sylva, N. C. (Code and theory)

K5/W5 CALL AREA
Jimmy Day, Box 22, Lone Grove, Okla.
Jim Willcock (13), 309 Pinewood, Hot Springs, Ark.
Bobbi Larse, VA Hospital, McKinney, Texas.
Ronald E. Alford (14½), 1802 Sullivan St., Pasadena, Texas.
John Kusianovich, P.O. Box 6, Fort Stanton, New Mexico.
Bill Blankenship, Box 306, Cooper, Texas.

K6/W6 CALL AREA
Don Petric, 1710 Malcolm Ave., Los Angeles 24, Calif.
Gary Young, P.O. Box 115, Lockeford, Calif.
Thomas Whiteley (14), 1415 19th St., San Francisco, Calif.
Leslie B. Stanfiled Cammer (12), 624 San Pasqual, Santa Barbara, Calif.
Fred Csapshaw, 1928 Chance Ave., Fresno, Calif.
Fred Reher, 12971 7th St., Chino, Calif.

Don Ziegler, 1555 Sonoma Ave., Santa Rosa, Calif.
Philip Saxe (11), 4624 18 St., San Francisco, Calif.
Robert A. Graeber, 450 Milford St., Glendale 3, Calif.
Jim Richman, 737 N. Maxfield, Hollywood 38, Calif.
Thomas Scott (14), 545 Redwood Ave., San Bruno, Calif.
Joe Sharmer (15), 902 Walnut Ave., Santa Cruz, Calif.
Jon Clark (14), 704 Gilroy Drive, Capitola, Calif.
Joseph W. Granville, 1864 Belmont Ave., San Carlos, Calif.
Earl Neuman, P.O. Box 1506, Shafter, Calif. (Code and theory)
Dug Stokes, 636 W. Cypress Ave., Covina, Calif.
Gary Grant, 5988 Upland St., Spring Valley, Calif. (Code)
Floyd L. Herbert, 2399 Ash Ave., Merced, Calif. (Code)

K8/W8 CALL AREA
Ron Rees (13½), 706 Gill St., Huntington, W. Va.
Jim Toreson, 38207 Barth, Romulus, Mich.
Lewis Traxler, 535 Kaler Ave., Bucyrus, Ohio.
Bill Newbrough, 351 W. Washington St., Grafhton, W. Va. (Theory)
Martin Webb, 717 Maryland Ave., Fairmont, W. Va. (Code)
Jerry Bork, 595 Hadagorn, S. Lyon, Mich.
Phone: GE 8-8054. (Code and theory)
Len Behr, 5286 Coplin Ave., Detroit 13, Mich. (Code and theory)
Jeff Bohl (14), 1717 W. Pasadina, Flint 4, Mich. (Code and theory)
Ricky Karash (10), 330 Walworth Dr., Euclid 32, Ohio.
Nicky Swan, P.O. Box 204, Ludington, Mich.
Dennis Beshara, 5335 Stuber Dr., Canton 8, Ohio. (Theory)

K9/W9 CALL AREA
Nick Frato, 6903 So. Anthony, Ft. Wayne, Ind.
Ronald Isaacs (13), 819 N. 6th St., Mt. Vernon, Ill.
William L. Harris, 824 N. 10th St., Lafayette, Ind.
Fred Leadove (15), 1615 Ohio Ave., E. St. Louis, Ill.
Charles Smith, 302 Sixth Ave., Sterling, Ind.

KO/VO CALL AREA
Roger E. Clark, 246 North 9th Ave., Broken Bow, Neb.
I. J. Rusand, 702 W. 1 St., Pittsburg, Kansas.
Bob Ball, 1519 Main St., Lexington, Mo.
Dick Anderson, 4234 Raleigh Ave., St. Louis Park, Minn.
Tom Reiter, 1625 Prescott St., Dubuque, Iowa.
Mac Floyd, 117 No. Chauteaugua, Wichtsa, Kansas (Code)
Dale Kerwood (14), 4560 Wolf St., Denver 12, Colo.
David Bergan, Florence, So. Dakota. (Code, theory and regulations)

WE AND OTHERS
Carl O. Baptiste, Jacmel, Haiti, West Indies, J. G. Badeau, P.O. Box 378, Station "A," Kitimat, B.C., Canada.
Nicky LeMoine, 608 Argyle Ave., Westmount, Montreal, Que., Canada.
Bois Auguste (VP2LB), I.C.T.A. St. Augustine, Trinidad, B.W.I. (Pen pals)

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 1/3 rpm) and a Novice Theory Course for $10.00, postpaid. The complete course of more information on it is available from RETMA, Suite 800, Wyatt Bldg., 777 Fourteenth St., N. W., Washington 5, D.C.
process increases the ability of the receiver to select the desired signal from among other signals. This is because regeneration increases the strength of the desired on-tune signal much more than that of the off-tune signals.

In this circuit, regeneration is controlled by varying the detector plate voltage. However, if the regeneration control is advanced beyond a critical point, so much energy is fed back from the plate of the tube to its grid circuit that the tube breaks into sustained oscillations.

As a result, each time a signal is tuned in, it beats with the signal generated in the tube to produce an audible beat-note (also called a heterodyne, squeal, or whistle) in the phones or loudspeaker. The detector is operated in this manner to receive c.w. code signals. To receive signals carrying voice or music, the regeneration control is normally adjusted to just below the oscillation point.

Knight "Space Spanner." Returning now to the Knight "Space Spanner," this receiver uses a 12AT7 dual-triode tube as a regenerative detector and first audio stage. The 12AT7, in turn, drives a 50C5 output amplifier, which drives a built-in loudspeaker or a pair of phones.

Voltages to operate the receiver are obtained from a self-contained power supply. It utilizes a 35W4 rectifier tube to convert the power line current to the well-filtered direct current required for quiet, hum-free operation of the receiver.

The "Space Spanner" covers the standard broadcast band—545 kc. to 1605 kc.—in one position of its band selector switch and the short-wave range of 6.5 mc. to 17 mc. in the other. Other panel controls include the main tuning dial, which adjusts the main tuning capacitor, and the "bandspread" dial which controls a small variable capacitor connected in parallel with the main tuning capacitor. This small capacitor permits any small segment of the frequency range covered by the main dial to be spread across the entire bandspread dial scale.

Assembling the kit is made easy by the exceptionally easy-to-follow instruction book included with it. All parts, except hookup wire and solder required to assemble the "Space Spanner" are included in the kit.

Results and Conclusions. Reception on the broadcast band with the Knight receiver compares favorably with that of the average table model receiver. A 15' antenna strung across the room will bring in all stations within the normal "service area" with good loudspeaker volume. On the short-wave band, an antenna 50' to 75' long erected as high and clear of buildings and trees as convenient will give loudspeaker volume from the more powerful stations both from the United States and overseas. To receive the weaker ones, however, it is necessary to use headphones. This may be a blessing in disguise. Under unfavorable conditions, signals are always more readable through phones than through a loudspeaker, anyway.

On the basis of its simplicity, perform-

(Continued on page 119)
DO YOU WANT your tape recordings to have that final "finish" that makes them sound like professional programs? Use a "mixer"—it will open a new world of fun for you and program flexibility for your tape machine.

Suppose, for instance, you have taped some music by a favorite band. You want to combine this with voice announcements, coming in occasionally over or under the music, to describe who the musicians are, what they're playing, etc.

Or suppose you're creating on tape a drama in sound, consisting of a play with musical background and sound effects. The music must swell up, die down, and relate itself dramatically to the voice parts. Similarly, the loudness of the spoken parts must be separately controlled so that they can be faded in and out.

These are only two situations out of many in which a mixer could prove invaluable. The separate signal sources it accepts, blends, and feeds to the recorder may be from microphones, phono players, TV sound, radio tuners, other tape recorders, or any combination of such sources.

Mixing in the "Pot." To be really useful, a mixer should also be a "fader"—so that it will not only blend independent sound sources but will also permit you to control their relative levels.

The simplest kind of mixer-fader consists of two potentiometer volume controls wired to accept signals from two input jacks and to feed a common signal out of a third jack. A simple circuit for such a device is shown in Fig. 1. It is easy and cheap to build, but it runs the risk of noise and improper impedance matching.

Electronic mixers provide smooth mixing and fading with little insertion loss and with maximum transfer of signal voltage. What's more, using tubes, you can build a very versatile mixer which will accept both high- and low-level signals simultaneously. In other words, the tube provides gain for the weaker signals available from low-level microphones or weak tuners, etc.

Single Triode Mixer. The simplest form of electronic mixer, with a single triode stage, is shown in Fig. 2. Sometimes termed a "parallel mixer," this circuit is useful only for mixing two signals of fairly high voltage level, such as the output from a phono preamp, high-level microphone, radio tuner, etc. The series resistors (R2 and R4) prevent the fading controls (R1 and R3) from short-circuiting each other, but at the same time they reduce the voltage level of the incoming signals.

Dual Triode Mixer. An improved version of the single triode mixer is one which uses both halves of the dual triode tube (Fig. 3). Each input channel, with its own level control, feeds the grid of one triode. Any combination of signals—selected by adjusting R1 and R2—is passed through C2 to the next stage, which should be the low-gain, high-impedance input jack of a tape recorder.

Resistors R6 and R7 are needed for isolating the two plates, but they will reduce the output signal voltage. The amount of
reduction depends on the value of the grid resistor used in the following stage. The higher this resistor, the lower the signal loss. Thus, it is essential that the mixed signal be fed to a high-impedance input.

The incoming signals to be mixed should be high-level signals, such as are available from a phono preamp, radio tuner, high-level microphone, TV sound, etc.

**Pentode Mixer.** If the mixing stage must provide more gain than the triode circuit above can manage, a mixer with pentodes may be used. The circuit in Fig. 4 has been designed to accept a low-level signal in channel 1, and either a low- or high-level signal in channel 2. With the values shown for the components in this circuit, the mixer will have considerable gain. Either channel 1 or channel 2 (with the switch on "LOW") may be used—not only for mixing, but also as a preamp to boost low level signals. Suitable signal sources would be a low-level microphone, a magnetic phono pickup that has not been fed through its own preamp, the signal from a crystal detector tuner, etc.

With the switch in channel 2 on "HIGH," an additional large resistor is thrown into the grid circuit of the bottom 6AU6. This resistive network reduces the strength of an incoming signal to the point where it will not overload the 6AU6. Therefore, it enables you to feed a high-level signal into channel 2. Needless to say, you may feed a low-level signal into channel 1 at the same time. Such an arrangement provides maximum versatility of operation.

*R1* and *R2* serve as the level and fading controls for their respective channels. *R8* serves as a "master level control" which

(Continued on page 131)
By CLAUDE McCULLOUGH

R/C Triplex

Three Controls on One Channel

TO THE R/C FAN who has been flying single-channel models, the challenge of multiple controls is an enticing one. The "Triplex" circuit shown here was developed over a period of years and flown in a number of the author's models. "Triplex" provides three controls using any ordinary single-channel R/C receiver. Most "rudder-only" models may be easily modified to carry it.

The basic principle of this method is the use of a pulse system of proportional control. Addition of extra control features is accomplished in an uncomplicated manner. They are simple to maintain and also achieve a degree of "fail-safe" operation.

The R/C transmitter is keyed in the usual pulse method by a mechanical or electronic pulser, in which control stick movements vary the pulse length from no signal at one end of the range to a steady signal at the other. For the author's purposes, the movement of the stick is limited, so it doesn't quite reach the extreme positions. Two push-button switches have been added as shown in Fig. 1. One is a normally closed switch which gives "full off" when depressed; the other is a normally open switch which gives "full on" when depressed.

When the pulsed signal is received by receiver relay RL1 in Fig. 2, the twin-coil

---

Fig. 1. Control switch hookup for proportional pulser. S5 and S6 (shown on top of unit at right, which was built by the author) are normally closed for motor control and normally open for elevator control.
actuator displaces the rudder in proportion to the pulse rate. At the same time, RL2 is keyed, which in turn keys RL3 and RL4. Relays RL3 and RL4 are delayed for about one-half second by the 50-µfd. capacitors C1 and C2. A pulse rate above 150 pulses per minute will cause relays RL3 and RL4 to remain closed.

If a full-off signal of about ¾-second duration is sent via S5 (Fig. 1), RL3 opens after a ½-second delay period and keys RL3 and RL4. Relays RL3 and RL4 are delayed for about one-half second by the 50-µfd. capacitors C1 and C2. A pulse rate above 150 pulses per minute will cause relays RL3 and RL4 to remain closed.

At the same time, RL2 is keyed, which in turn keys RL3 and RL4. A pulse rate above 150 pulses per minute will cause relays RL3 and RL4 to remain closed.

If a full-off signal of about ¾-second duration is sent via S6 (Fig. 1), RL3 opens after a ½-second delay period and keys the motor control escapement. If the motor control is an escapement-operated air-bleed valve, then holding the full-off signal for several seconds will cut the motor. And since the continuity of the actuator is broken, the rudder will be left in neutral position. This prevents the model from a failure in flight due to the interruption of the radio signal in some manner (such as transmitter failure or flying out of range).

Similar action occurs in RL4 when "full-on" is sent via S6 in Fig. 1 to operate the elevator escapement. A four-position escapement is used in this case to give half positions. The rudder control will give maneuverability while the elevator is in any position.

When a full-on signal is sent, the rudder again falls to a neutral position after the first ½-second. If you have interfering ra-

The receiving unit is mounted as an extension of the chassis of the McNabb 465-mc. receiver.

**PARTS LIST**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>15-volt hearing-aid battery (Eveready 2411 or one-ounce equivalent)—see text for other battery voltages</td>
</tr>
<tr>
<td>C1, C2</td>
<td>50-µfd., 25-d.c.w.v. electrolytic capacitor (Aerovox Bantam SBE)</td>
</tr>
<tr>
<td>RL1</td>
<td>Receiver relay (part of receiver)</td>
</tr>
<tr>
<td>RL2</td>
<td>Neomatic or similar subminiature relay, about 300 ohms</td>
</tr>
<tr>
<td>RL3, RL4</td>
<td>Neomatic or similar subminiature relay, 5000 to 10,000 ohms</td>
</tr>
<tr>
<td>S1, S2, S3, S4</td>
<td>Miniature slide switches</td>
</tr>
<tr>
<td>S5</td>
<td>Push-button switch, normally closed</td>
</tr>
<tr>
<td>S6</td>
<td>Push-button switch, normally open</td>
</tr>
</tbody>
</table>

Fig. 2. Schematic diagram of "Triplex" control system. Component values are given in parts list above. See text for details of motor control and elevator escapements, actuator and pulser. Note that all switches are shown open in this diagram; they would be closed for normal operation.
dio signals present, simply switching off the elevator with $S_4$ will allow you to fly with only rudder and motor control. The single effect of an interfering signal will then be to return the rudder to neutral.

Since the "Triplex" is to be added to your present equipment, the method of mounting and installation is up to you. The photo shows a McNabb Citizenship 465-mc. receiver, with the extra components mounted on a Micarta extension to the chassis.

Any sensitive relay with coils of 5000-10,000 ohms can be used for $RL_3$ and $RL_4$ with the delay circuits shown; I used the Neomatic 7250-ohm subminiature type in this original unit. It may be necessary to adjust the value of capacitors $C_1$ and $C_2$ and the spring tension of the relays to give the required delay. The keying relay in this circuit is a Neomatic with a 300-ohm coil, employed in conjunction with an actuator using 6 volts through 20-ohm coils. Be certain that the keying relay will close at the lowest voltage used to operate the actuator.

The escapements will determine battery voltage for the elevator and motor controls. Do not employ the same battery for both escapements or tap into the actuator battery. Use a 15-volt Eveready #411 battery or a one-ounce equivalent to power the delay relays. I recommend a twin-coil actuator and a fully variable pulser. Since an elevator is a much larger load than a rudder, use a heavy-weight pulser and try balancing the elevator.

All of the components may be purchased from firms which specialize in R/C equipment.

Novel Probe Adds Range to Your VOM

MOST ELECTRONIC experimenters have used the temporary hookup illustrated in Fig. 1 to measure very high resistance values. With an auxiliary B battery and multiplier resistor, the top indication on the ohm scale of a VOM is multiplied ten times. Thus, resistance values up to 200 megohms can be measured provided that values up to 20 megohms could be measured without the external hookup.

While it is very useful to be able to measure high values of resistance, an external hookup is awkward and inconvenient. The obvious need for a compact and convenient ohmmeter multiplier can be met with miniature transistor batteries. Such a probe can be made completely self-contained and as convenient to use as the conventional test lead.

The Futuramic Co. has announced the availability of a high-ohm probe utilizing the arrangement shown in Fig. 1. It can be used with most popular types of VOM's which have a 12-ohm center-scale indication and an $R \times 10,000$ ohm range with an internal $7\frac{1}{2}$-volt ohmmeter battery.

The battery complement of the probe comprises three Mallory Y-13 transistor packs. Because the current drain is very small, battery life is long. However, after extended service, it will be necessary to replace the batteries eventually. This point is reached when it is no longer possible to zero the pointer on the ohmmeter scale by adjustment of the "zero ohms" control of the VOM.

In effect, the high-ohm probe provides an additional range on the ohmmeter. The probe converts the $R \times 10,000$ range to an $R \times 100,000$ range. With the probe plugged into the VOM in place of the conventional test lead, a reading of "10" on the ohmmeter scale indicates a resistance value of 1,000,000 ohms; a reading of "1000" indicates a resistance value of 100 megohms.

The high-ohm probe finds valuable application in radio and television servicing, and in the electrical and industrial-electronic fields. A refrigeration service engineer is often required to test hermetic compressor-motor assemblies for leakage ("grounded"). Although a VTVM can be used directly to measure resistance values up to 100 megohms (a commonly accepted limit), most technicians prefer a VOM because it requires no source of external power and is simpler to operate. By the use of a high-ohm probe, a valid test of the compressor-motor assembly can be made with a VOM.—Robert G. Middleton
A "First" Project—

Putting Together a Clock Radio

By ALLEN C. TRAINER

Combine an old AM receiver with a clock timer as a start in radio

IF YOU FEEL that you don't know enough about electronics to tackle a resistor-and-capacitor project, try this ordinary conversion job. The project just consists of building a box to house an electric clock and AM radio, and of wiring the radio line cord to the clock. Any old table-model radio will do, and a clock timer can be purchased from a number of radio supply mail order houses for approximately four dollars.

Dimensions are not given for the new cabinet, because each dimension depends upon the size of the radio chassis. The easiest way to figure the size is to measure the old cabinet and add sufficient length to one end to include the clock. Then cut the cabinet pieces to size. Be sure to figure the thickness of the top and bottom pieces when determining the over-all height.

Cut all the pieces to size and make a trial assembly of the parts without fasteners. Now place the radio chassis on the bottom piece and hold the front panel in position, then scribe the outline of the dial assembly and the control shafts. Next, hold the clock in position on the front panel, centering it between the top and bottom, and scribe the outlines of the clock face.

Remove the front panel and cut out the openings with a coping saw. Again place the panel in position and make sure that the dial and shafts, and the clock face, will fit through the openings.

Fasten a grille cloth to the front panel by tacking the cloth near the edges of the panel face. In this position, the tacks will be covered by the molding strip. Puncture the cloth in the center of the dial and clock face openings, and make several cuts from the center to the edge. Fold the resulting wedge-shaped pieces into the open-

Clock mounting position and wiring are shown in rear view of completed clock radio at the right. Above, left, is a front view of the new cabinet containing both the electric clock and the original AM radio (above, right).

November, 1956
The Third Hand You Have Often Wanted

A

N UNUSUAL—but indispensable—tool for the electronics worker can be a pair of "pliers" commonly used by a surgeon for clamping off arteries to prevent bleeding. The "forcep hemostat" has been found, by those who have tried it, to be the third hand that you may have often wished you had.

Such hemostats are made of fine surgical stainless steel and are practically indestructible. They are resistant to soldering acids and fluxes. The beautiful feature which makes them shine is the locking device on the handles. Snap these little wonders on a piece of material and they hold it all by themselves. No help wanted!

There are many different sizes and shapes. My experience has proven, however, that the 6¼" straight model is the best size because of its holding power and capacity. The smaller models are a little too delicate and the larger models just a little husky. Model WW-150, shown in upper right-hand corner of photograph with a nut in its jaw, is available from Murray and Baumgartner Surgical Instrument Co., 5 West Chase St., Baltimore, Md., for $4.00, f.o.b. Baltimore.

In use, hold the hemostat in your hand, lay it off the edge of the workbench, or clamp the handles in a bench or drill vise. For the man who employs a soldering gun, it is the answer to that awkward feeling you get when working on small or subminiature parts. Such a portable "vise" is tops for holding two or more wires together when you are soldering in tight spots.

Keep a close watch on visitors when they start fondling your hemostat and you see that faraway gleam in their eyes. They are probably thinking: "Boy, could I use these when I..."

-Clyde D. Adams

Soldering jobs that are difficult to handle can become much easier with one of the many sizes and types of "medical pliers" shown here.
This month we are going to forego our usual visit into the listening post of one of our P.E. reporters and, instead, make a short trip to the Island of Haiti and the control room of Radio Commerce there. Our guide through the station is engineer Jan-Claude Bance. Mr. Bance, in addition to helping put the signals of Radio Commerce onto the air waves, can also be heard operating his own amateur radio station, HH2JC.

Radio Commerce operates on three frequencies: 1080 kc. in the broadcast band; 6091 kc. in the 49-meter s.w. band; and 9485 kc. in the 31-meter s.w. band. For the medium-wave outlet, the power is 1000 watts; for the short-wave xtnrs, the power is 7500 watts. The call letters for the various outlets are 4VA (1080 kc.), 4VB (6091 kc.), and 4VC (9485 kc.). Mr. Bance tells us that all equipment has been manufactured by RCA and that the wiring of the station was done by engineer Edouard Gentil, a native of Haiti.

The antenna for m.w. station 4VA is a vertical, 200' high, with a transmission line of 230 ohms. This xtnr can be heard, with a good signal, without interference, for 200 miles. Your Editor is willing to bet that some of our readers in the southern states could hear 4VA without much trouble, on the nights when the Cubans and other West Indian stations are coming through.

The antennas for 4VB and 4VC are both horizontal Delta arrays, 80' high for 31 meters and 60' high for the 49-meter outlet. Radio Commerce can be heard daily as follows: at 0630-2230 on 1080 kc.; at 0630-0930 on 9485 kc.; and at 1700-2230 on 6091 kc. In addition, a program in English is heard Sundays at 1700-1900. Two widely reported and well-heard programs in the English xmsn are "Glimpses of Haiti" at 1800-1830 and "Paris Star Time" at 1830-1900.

Our thanks go to Mr. Bance for the pleasant trip around the station, and to Herb Brier, of the Transmitting Tower, for his assistance in preparing this story.

Random Notes. Congratulations are in order for the Universal Radio DX Club for the "New Look" in their club Bulletin. By the same token, Roger Legge and Stewart West, of the Newark News Radio Club, are to be commended for the excellent "Band Survey" that they are writing monthly for the NNRC Bulletin.

Joel Richmond and Port Baughman wrote in to tell us that Radio Netherlands, Hilversum, is offering a pictorial map folder of the Netherlands and a folder entitled "Improving Shortwave Reception" (the latest edition, with more antenna information) to anyone requesting them.

For those who would like to experiment (Continued on page 121)
Electronics Comes to Drive-In

While a great many of the country's drive-in eateries still follow the conventional pattern of serving their hungry customers by way of attractive "car-hops," in view of the shortage of these girls some restaurant owners have enlisted the aid of electronics.

In the photo at right is a gadget that will accept and relay the order of a customer who is comfortably seated in his or her car on the drive-in lot. All the customer need do is read an illuminated menu, press a button, and place his food order via a two-way speaker system.

The dulcet tone at the other end of the system accepts the order and relays it to the kitchen. When the food is ready, the "glamor-gal" car-hop delivers it.

This electronic gadget does away with the need for an estimated 50% of the fast-stepping females. And when the device isn't in use for placing food requests, it dispenses a steady stream of music from a record player loaded to the gills with the waxings popularly demanded by teen-agers.

True, the intercom hasn't the glamor of a slender figure or a well-turned ankle or a welcoming smile. Nor does it beseech in twinkling soprano: "What'll you have?" But the robot-like efficiency of this electronic car-hop makes up for its lack of more personal attractions. —Stanley Clark

Metal Monitor

The "Metal Monitor" checks metals without laboratory analysis. It can identify ferrous and non-ferrous metals by comparative testing with known samples, and it sorts mixed metals of unknown character into homogenous groups for further testing. Manufactured by Brush Electronics Company, division of Clevite Corporation, Cleveland, Ohio, it will check stock, parts in process or finished products for many characteristics—hardness, heat treatment, metallurgical structure, uniformity, plating thickness and plating adhesion.

In operation, an electrode (with a self-heating element) is placed in contact with the metal to be tested. Voltage generated by this contact is amplified and transmitted to a meter on the Metal Monitor. The reading is then compared to readings obtained from samples whose compositions and metallurgical characteristics are known. As many as 3000 pieces can be checked in an hour.
You're invited to Launching!

SPECIAL OFFER TO READERS OF POPULAR ELECTRONICS

8 months of POPULAR BOATING only $2.00

This is your special invitation to "sign on" as a Charter Subscriber to POPULAR BOATING—the new Ziff-Davis monthly for everyone who enjoys life on the water.

Beginners and "old salts" ... inboard, outboard and sailing enthusiasts and their families—all are finding POPULAR BOATING the most enjoyable magazine in the boating world. Copies of the first big issue, on sale only a few days, have become hard to find because of their tremendous demand.

POPULAR BOATING, the first new major boating magazine in more than a generation—brings a completely fresh approach to the entire world of boats—from dinghy to power cruiser.

Published by the same company that has made POPULAR ELECTRONICS tops in its field, POPULAR BOATING features money-saving how-to articles that point the way to more fun, greater safety afloat... new construction ideas... information on repairing, improving, fitting out your boat... monthly classes on seamanship and boat handling by expert boatemen... exciting boating yarns that will transport you to every corner of the world where there's fun and adventure on the water... regular features on new products, junior activities, maintenance, fishing, free aids to better boating, and much more!

Here are just a few of the exciting articles in POPULAR BOATING's first issue:

• BREAKING THROUGH THE "WATER BARRIER"—America's best-known racing writer, Hank Bowman, describes the perils of high speeds afloat.

• SHOULD YOUR FIRST BOAT BE POWER OR SAIL?—Two top boating writers defend their favorite craft in a hot debate.

• OUTBOARDS UNLIMITED—There's no limit to the fun outboarding offers. Here's how to enjoy it more fully!

• GUY LOMBARDO'S GREATEST BOATING MOMENTS—In this exclusive article, the famed musician and boatman recalls the most thrilling moments in his racing career.

• ANN DAVisON'S NEXT BOATING VENTURE—An exclusive first-hand report by the only woman ever to sail the Atlantic alone!

A NEW MAGAZINE BY THE PUBLISHERS OF POPULAR ELECTRONICS

November, 1956

Welcome aboard as a Charter Subscriber!
Fill out and mail this coupon TODAY!
Every Heathkit comes complete with detailed step-by-step instructions and large pictorial diagrams that insure successful construction—even for the beginner. Enjoy both the satisfaction and the economy of "building it yourself."

etched circuit vacuum tube

voltmeter kit

In addition to measuring AC (rms), DC, and resistance, the modern-design V-7A incorporates facilities for peak-to-peak measurements. These are essential in FM and television servicing. AC (rms) and DC voltage ranges are 1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC voltage ranges are 4, 14, 40, 140, 400, 1400, at 4000. Ohmmeter ranges are X1, X10, X100, X1000, X10K, X100K, and X1 megohm. A db scale is also provided. Polarity reversing switch provided for DC measurements, and zero center operation is within range of the front panel controls. Employs a 200 microampere meter for indication. Input impedance is 11 megohms.

Etched metal, pre-wired circuit boards insure fast, easy assembly and result in reliable operation. Circuit board is 50% thicker for more rugged physical construction. 1% precision resistors used for utmost accuracy.
Heathkit 3" oscilloscope kit
ETCHED CIRCUIT

Cathode-follower output for isolation.
No oscillator calibration required.
Covers 160 kc to 220 mc (including harmonics).

Push-pull vertical and horizontal amplifiers.
Light weight and small size for portability.
Good sensitivity and broad frequency response.
Etched metal circuit boards for simplified assembly.
Attractive panel and case styling.

MODEL OL-1
$29.50 Shpg. Wt. 14 lbs.

This compact little oscilloscope is just the ticket for use in the ham shack or home workshop. Measures only 9 1/2" H. x 6 1/2" W. x 11 3/4" D. Weighs only 11 pounds.

Employing etched metal circuit boards, the Model OL-1 features vertical response with in ± 3 db from 2 cps to 200 kc. Vertical sensitivity is 0.25 volts rms per inch, peak-to-peak, and sweep generator operates from 20 cps to 100,000 cps. Provision for direct RF connection to deflection plates. Incorporates many features not expected at this price level. The 8-tube circuit features a type 3GP1 cathode ray tube.

Heathkit signal generator kit

This signal generator covers 160 kc to 110 mc on fundamentals in 5 bands. Calibrated harmonics extend its usefulness up to 220 mc. The output signal is modulated at 400 cps, and the RF output is in excess of 100,000 microvolts. Output controlled by both a continuously variable and a fixed step attenuator. Audio output may be obtained for amplifier testing.

This is one of the biggest signal generator bargains available today. The tried and proven Model SG-8 offers all of the outstanding features required for a basic service instrument or for use in experimenting in the home workshop. High quality components and outstanding performance. Easy to build, and no calibration required for ordinary use.

MODEL SG-8
$19.50 Shpg. Wt. 8 lbs.

Heathkit grid dip meter kit

This extremely valuable instrument is a convenient signal source for determining the frequency of other signals by the comparison method. Range is from 2 mc to 250 mc. Uses 500 ua meter for indication, and is provided with a sensitivity control and headphone jack. Includes prewound coils and rack. For hams, experimenters, and servicemen.

MODEL GD-1B
$19.50 Shpg. Wt. 4 lbs.

Heathkit antenna impedance meter kit

Used in conjunction with a signal source, the Model AM-1 will enable you to measure RF impedance. Valuable in line matching, adjustment of beam and mobile antennas, etc. Will double as a phone monitor or relative field strength indicator. A 100 microampere meter is employed. Covers the impedance range from 0 to 600 ohms. An instrument of many uses for the amateur. Easily pays for itself through the jobs it will perform.

MODEL AM-1
$14.50 Shpg. Wt. 2 lbs.

HEATH COMPANY
A SUBSIDIARY OF DAYSTROM, INC.
BENTON HARBOR 5, MICHIGAN

November, 1956
Heathkit

**vfo KIT**

This variable frequency oscillator covers 160-80-40-15-11 and 10 meters with three basic oscillator frequencies. RF output is better than 10 volts average on fundamentals. Enjoy the convenience and flexibility of VFO operation at no more than the price of crystals. May be powered from a socket on the Heathkit Model AT-1 transmitter, or supplied with power from most transmitters.

Features illuminated and pre-calibrated dial scale. Cable and plug provided to fit crystal socket of any modern transmitter.

**Heathkit CW amateur transmitter kit**

This CW transmitter is complete with its own power supply and covers 80, 40, 20, 15, 11, and 10 meters. Incorporates such outstanding features as key-click filter, line filter, copper plated chassis, pre-wound coils, and high quality components. Employs a 6AG7 oscillator, 6L6 final amplifier. Operates up to 30 watts plate power input.

**Heathkit COMMUNICATIONS TYPE all band receiver kit**

The Model AR-3 covers from 550 kc to 30 mc on 4 bands. Covers foreign broadcast, radio hams, and other interesting short wave signals. Features good sensitivity and selectivity. Separate RF and AF gain controls—noise limiter—AGC—VFO, headphone jack—5½” PM speaker and illuminated tuning dial.

**Heathkit 6AG6 electron-coupled oscillator.**

**OA2 voltage regulator tube for stability.**

**Smooth-acting illuminated dial.**

**Easy to build and attractively styled.**

Extra features include copper-plated chassis, ceramic coil forms, extensive shielding, etc. High quality parts!

**SPECIFICATIONS:**

- RF Amplifier Power Input: 25-30 watts
- Output Connection: 52 ohms
- Band Coverage: 80, 40, 20, 15, 11, 10 Meters
- Tube Complement: 3U4G, Rectifier 6AG7, Oscillator-Multiplier 6L6, Amplifier-Doubler

**MODEL AT-1**

- Single-knob band-switching for 80, 40, 20, 15, 11 and 10 meters
- Plate power input 25-30 watts

**MODEL AR-3**

- Frequency Range: 550 kc to 30 mc on four bands
- Tube Complement: 1-12B6 oscillator and mixer
- 1-12BA6 IF amplifier
- 1-12AV6 second detector, AVC, first audio amplifier and reflex BFO
- 1-12A6 beam power output
- 1-5Y3 fullwave rectifier

**SPECIFICATIONS:**

HEATHKIT ECONOMY 7-WATT HIGH FIDELITY amplifier kit

MODEL A-7D
$16.95 Shpg. Wt.

This is a 7-watt high fidelity amplifier that will produce more than adequate output for normal home installations. Its frequency characteristics are ± 1½ db from 20 to 20,000 cps. Output transformer is tapped to match speakers of 4, 8, or 16 ohms. Separate bass and treble tone controls provided. Features potted transformers, push-pull output, and detailed construction manual for easy assembly.

MODEL A-7E: Provides a preamplifier stage with two switch-selected inputs and RIAA compensation for low-level cartridges. Preamplifier built on same chassis as main amplifier. Model A-7E: Shipping weight 10 lbs. $18.50.

Free 52-Page 1956 Catalog Describes more than 65 interesting "build-it-yourself" projects. Amateur equipment, hi-fi amplifiers, and the complete Heathkit line of test instruments. Get yours today!

MAIL TO HEATH COMPANY A Subsidiary of Deystrom, Inc. BENTON HARBOR 5, MICH.

ORDER BLANK

E N C L O S E D F I N D ( ) CHECK ( ) MONEY ORDER FOR_BU $_________ POUNDS. ON EXPRESS ORDERS DO NOT INCLUDE TRANSPORTATION CHARGES—they will be collected by the express agency at time of delivery.

ON PARCEL POST ORDERS INSURE POSTAGE FOR WEIGHT SHOWN.

November, 1956
HUM IN PHONO PICKUP
Electrostatic hum develops sometimes in a phono system which uses a plastic tone arm and partially unshielded signal lead. Much, if not all, of this hum can be eliminated by lining the interior surface of the pickup end of the tone arm with heavy household aluminum foil, and then grounding the foil and the metal case or mounting of the cartridge to the braided shield of the pickup lead.

NEW USE FOR OLD CONSOLE
Television sets and hi-fi equipment have relegated many an old console radio to the attic or junk-heap. With a little work, the cabinets of such sets can be re-done to provide a loud-speaker enclosure with a planter and lamp on top.

To make the planter, cut carefully just below the holes that formerly accommodated the control shafts of the old set. Form a pan of galvanized iron and trim its top edges with copper or brass strips so that it fits snugly into the opened top of the cabinet. In this pan you may install your plants and even the base of a home-designed lamp. And, if the rest of the unused area inside the cabinet is large enough, you can use it for mounting a hi-fi speaker. —O.W.

PORTABLE RADIO CHECKS DOORBELL
A portable radio set will pick up the pulses of radio frequency radiated by doorbell wires at the push button. If “hash” is heard in the portable when tuned to a weak station, you’ll know that the bell or buzzer is working.

The idea is useful in repair of doorbells. There is no need to have someone upstairs inform the repairman if the bell or buzzer is functioning. The portable radio does the job, making the test for a working bell, buzzer, or door-opener a one-man proposition.

—J.A.McR.

VERSATILE POWER TUBE SOCKETS
Different types of power tubes may be interchanged without revision in the filament voltage lines if the correct wiring is made at the tube socket. As many as 11 different types may be used on a 5-volt line. Wire together pins 5 and 6 to form one of the plate connections. Wire pins 3 and 4 for the other plate connection. Pin 8 serves as one side of the filament; pins 2 and 7—wired together—serve as the other side. The B-plus lead to the filter system must always come off pin 8. A socket wired in this manner will accommodate the following tube types: 5AX4GT, 5AZ4, 5R4G, 574, 5U4G, 5V4G, 5W4, 5X4G, 5Y3G, 5Y4G, and 5Z4.

For 6-volt rectifiers, pin 3 serves as one plate and pin 5 as the other. Pin 2 is one side of the filament and pin 7 the other. Wire pins 4 and 8 together to form the cathode take-off. Such a socket will accommodate tube types: 6AX5GT, 6AX6GT, 6W5G, and 6X5.

In either case, just remember that the rating of the tube used must not be exceeded. —B.E.

DO NOT COIL TV LEAD-IN
When installing the flat twin-lead which serves as the lead-in from your TV antenna, there is a great temptation to leave considerable slack at the set to permit moving the TV for service access or changing its location in the room. If such slack is rolled up into a coil, there is apt to be a pronounced reduction in picture brightness—due to the loss of signal strength resulting from coupling effects between the coil turns. A good rule is to leave only enough
Add to Your Income Starting Soon

Make $10-$15 a Week Extra Fixing Sets in Your Spare Time

Soon after enrolling, many N.R.I. students start earning extra money fixing neighbors' radio sets. Many earn enough extra to pay entire cost of course and provide capital to start their own full time Radio-TV business after getting N.R.I. Diploma. Mail Postage Free postcard for Sample Lesson. See how practical it is to learn at home. Get 64-Page Catalog, too. See equipment you get, opportunities in this growing field. Prices of N.R.I. Courses are low, terms easy.

You Learn by Doing—Get Practical Experience with Kits N.R.I. Sends

Nothing takes the place of practical experience. As part of N.R.I. Servicing Course you build AC-DC Radio Receiver and Vacuum Tube Voltmeter shown below. Use them to make tests, conduct experiments, get practical experience. All equipment yours to keep.

Find Out What Oldest and Largest Home Study Radio-Television School Offers You

N.R.I. TRAINED THESE MEN

Thanks N.R.I. for Good Start...

"Right now I am doing spare-time repairs on Radios and Television. Intend to go into full time servicing." C. HIGGINS, Waltham, Mass.

Engineer with Station WHPE...

"I operated a successful Radio repair shop. Then I got a job with WPA...and now I am an engineer for WHPE." VAN W. WORKMAN, High Point, N. C.

Quit Job to Start Own Business...

"I decided to quit my job and do TV work full time. I love my work and am doing all right financially." W. F. KLIMEK, Cincinnati, Ohio.

N.R.I. Course Started His Way...

"I was a cab driver earning $6 a week. Then I enrolled with N.R.I. Now I am a tester with TV maker." J. H. SHEPHERD, Bloomington, Indiana.

SAMPLE LESSON AND CATALOG BOTH FREE

This card entitles you to Actual Lesson on Servicing, shows how you learn Radio-Television at home. You'll also receive 64-Page Catalog.

NATIONAL RADIO INSTITUTE, Dept. D4
Washington 9, D. C.

Please mail me the FREE sample lesson and 64-Page Catalog. (No Salesman will call.)

Name
Address
City Zone State

Approved Member, National Home Study Council

NO STAMP NEEDED! WE PAY POSTAGE
Radio-Television Can Give You a Good Job with a Future

N.R.I. Graduates do Important Work — Get Important Pay

Chief Engineer with Station
"I am Chief Engineer of Station KGCU. I have my own spare-time business servicing two-way communications systems." R. BARNETT, Bismarck, N. D.

Paid for Instruments
"I am doing very well in spare-time TV and Radio. Sometimes we build in two TV jobs while I am working. Paid for instruments out of earnings." G. F. SEAMAN, New York, N. Y.

Has Own Radio-TV Business
"We have an appliance store with our Radio and TV servicing. During my Army service, N.R.I. training helped me." W. M. WEIDNER, Fairfax, S. D.

Here is a line of work that people respect—a vocation where you can advance, win a place for yourself, earn good pay and gain much personal satisfaction. And you can learn at home in your spare time. Smart fellows everywhere are using their spare time to develop new knowledge, new skills. They know it is the trained man who gets ahead; gets the better job. Drives the better car; is respected for what he knows and can do.

Be a Skilled Technician
The technical man is looked up to. He should be. He does important work, gets good pay for it. Radio-Television offers that kind of work. There are more than 40 million Televisions, 150 million home and auto Radios. Millions more are sold each year. There are splendid opportunities for the man well trained in Radio-Television Servicing or Broadcasting Micro-Wave Relay, Aviation and Police Radio, Two-Way Communications for buses, taxis, trucks, etc. are expanding — making more jobs, greater opportunity.

Tested Way To Better Pay
N.R.I. Training is practical, thorough. You get the benefit of N.R.I.'s 40 years experience training men for success in Radio-Television. N.R.I. training is backed by the record and reputation of the OLDEST and LARGEST home study Radio-TV school. Most successful N.R.I. men start without any knowledge of Radio, many without a high school education. Find out what Radio-Television training can mean to you. Make a decisive move today toward becoming one of that select group—a Real Radio-TV Technician. Send for Actual Lesson and 64-Page Catalog, both FREE. NATIONAL RADIO INSTITUTE, Dept. D4, Washington, D.C.

FREE BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY
NATIONAL RADIO INSTITUTE
16th and U Sts., N. W.
Washington 9, D. C.
slack to permit moving the set a short distance, allowing the slack to hang uncoiled. If the set is to be relocated elsewhere in the room, it is no problem to splice on enough additional twin-lead as required. —E.F.C.

INCORPORATING B-BATTERY LIFE
A portable, dry-battery radio receiver may oscillate or howl as its batteries age. This condition is often due to the B battery’s internal resistance, which increases quite rapidly as the battery nears the end of its useful life. The increased battery resistance permits positive feedback to occur across one or more of the receiver circuits. Frequently, in such cases, you can obtain a few more “howl-less” hours of operation from your receiver by connecting a 0.02-µfd. mica or ceramic capacitor across the B battery terminals. The same capacitor may work as well if a similar condition develops in a transistor receiver. —F.H.T.

DOUBLE-CHECK FILAMENTS
When checking filament circuits with an ohmmeter, don’t let the low resistance of the power transformer filament winding mislead you into thinking the winding is shorted. This winding carries the relatively heavy filament or heater current, which may be a couple of amperes, and is therefore made with heavy wire. Also, the step-down ratio from the house 117-volt a.c. line to the low heater voltage requires only a few turns on this winding as compared to the 117-volt winding. The small number of turns of heavy wire account for the very low resistance—which is often less than 1 ohm. —E.F.C.
Give your friends POPULAR ELECTRONICS this Christmas!

What more thoughtful gift to friends than a subscription to POPULAR ELECTRONICS this Christmas!
You’ll be giving 12 full months of pleasure—all the enjoyment and fun that the wonderful world of electronics offers.

SPECIAL GIFT RATES
First 1-year gift subscription .................. $3.00
Second 1-year gift subscription ................. $2.00
Each additional 1-year gift .................... $1.50

As you have no doubt noticed, POPULAR ELECTRONICS has raised its price to 35c per copy—because of increased paper and printing costs—effective with this issue.
Because POPULAR ELECTRONICS subscription rates will now be raised to $4.00 per year, this very favorable Christmas offer can be kept open for a limited time only. We urge you to send in your order at once.

Each gift subscription will be announced by an attractive card naming you as donor.
Fill in and return the prepaid, self-addressed envelope facing this page for your own and gift subscriptions. List additional gift orders on an extra sheet of paper.
(Your own new or renewal subscription may be included.)

POPULAR ELECTRONICS
366 Madison Ave. New York 17, N. Y.

TOOLS and GADGETS

HOLE-SA W WITH SLUG-EJECTOR
Up to seven sizes of circular holes can be cut with the "Arco Hole-Saw," which features an automatic "slug-ejector." Powered by any electric drill, drill press, lathe or motor, it is said to cut perfect holes in wood, wallboard, plastics, sheet metal, etc. The exclusive automatic slug-ejector pops out discs immediately, considerably decreasing working time.
No. 650, which retails at $6.50, cuts 1", 1 1/4", 1 1/2", 1 1/4", 2", 2 1/4" and 2 1/2" holes through any 1/4" stock. The seven circular saw blades slip into grooves of tool head and are easily exchanged; a safety lock screw prevents blades from "jumping out." No. 600 ($4.95) cuts 1", 1 1/2", 2" and 2 1/2" holes. (Arrow Metal Products Co., 140 West Broadway, New York 13, N. Y.)

TV BIAS SUPPLY
Providing any voltage from 0 to 18, either positive or negative, the "Align-o-Pak" Model BE3 TV bias supply is an improved version of the Model BE2—which provided only 10 volts. The BE3 was designed to include high voltages recommended by some TV manufacturers on

Always say you saw it in—POPULAR ELECTRONICS
I DUNNO... SAYS HE DOES IT WITH BURGESS BATTERIES

Powerful, fresh Burgess batteries are outstanding for dependable long life and uniform high quality. They're guaranteed! Ask for them!

Makers of the famous Radar-Lite

Wonderful New Christmas Gift

Personal Pocket Radio

This is no ordinary pocket radio—it is equivalent in sensitivity to most household radios—ruggedly built—and a top beautiful radio. Look at the 3 tubes 6V6, pentode construction—112 A diode—50雖. min. 17 Phn Amp—155 line. AVC and Supersensitive. high Q. ferrite antenna. Three band, marked Case. 112 battery. "Randy" designed for extra earphone. Excellent as a pocket radio and earphone. You'll use this radio every day—take it with you everywhere you go—perfect for sports, camping. Civil Defense emergencies—while walking, at work, at play, etc. Give it as a much appreciated gift.

LEARN
RADAR MICROWAVES
TRANSMITTERS
CODE TV RADIO

Phil. Wireless Technical Institute
1533 Pine St. Philadelphia 2, Penna.
A Non-Profit Corp. Founded in 1908
Write for free catalog "P"

November, 1956

LEASTING POWER
UNIFORM DEPENDABILITY
STEEL CLAD GUARANTEE

BURGESS flashlighT BATTERIES

Burgess

www.americanradiohistory.com
Now in KIT form, the famous
MODEL M-1
"POCKETESTER"

The famous V-O-MA unit we built by the thousands for the Army!

- Easy, step-by-step instructions
- Complete with cable harnesses, test leads
- Military Accuracy
- Precision parts for fast assembly
- Dual color meter scale
- Rugged handsome vinyl carrying case
- 14 broad ranges, for EVERY job!
- BUILD IN 20 MINUTES!

ONLY $17.50 NET

MAIL THIS COUPON TODAY!

ATOMIC ENGINEERING CORPORATION

Manufacturers of quality electronic equipment.

Box 1701, Station P
Grand Junction, Colo.

Measure:

VOLTAGE: 0.2-5000 volts AC-DC
RESISTANCE: 1-500,000 ohms
CURRENT: 0.2-100 Milliamps

TV AND RADIO TUBE TESTER

Most radio and TV set failures are due to burned-out tubes. The new Teleclear tube tester will automatically check all TV and radio tubes. Operating on 110 volts a.c. or d.c., it is safe, quick and easy to use. Just plug the tube into one of the sockets provided and the neon lamp will indicate its condition instantly.

In addition, this tester performs over 1000 electrical tests. It checks appliances, fuses, light or flash bulbs, wires, motors, resistors, etc. It can also be used to check line or other voltages, as a voltage indicator. Retailing for $2.95, the Teleclear tube tester comes in a shockproof metal case. (Teleclear Company, 25 Willett St., New York 2, N. Y.)

Always say you saw it in—POPULAR ELECTRONICS
but at the same time perk up your ears and wake your mind.

**Classical Pipings.** Columbia's record of *The Philadelphia Woodwind Quintet* (ML-5093) features flute, oboe, clarinet, bassoon and French horn in pieces specifically written for this combination.

One side contains works by composers of the past (Haydn and Beethoven); the other side is devoted to moderns like Hindemith and Ibert having a resounding romp among the tootling reeds. This lets the listener trace the evolution of woodwind writing from Haydn's simple band style to Ibert's sophisticated tricks and sensuous harmonies and Hindemith's urbane, yet warm and fun-filled modernism. In a sense, this is chamber music—the clever interplay of just a few instruments. But the woodwinds lend it pungency and bounce, far different from the sound of the usual strings.

The playing makes it quite clear why many listeners consider the woodwind section of the Philadelphia orchestra the finest in the world. The fidelity of this record matches the excellence of the performance. Each instrument stands out clearly, yet they all blend as a group. The "presence" is amazing.

Winds also blow at the hi-fi mike in the jazzy regions of music. *Shifting Winds* by Bob Cooper and Jimmy Giuffre waft over both sonorous sides of Capitol T-6531. Here the reeds stir in a brisk breeze of jazz improvisation but seem at their best in the becalmed interlude on Band 3 of Side 1, called *Round Midnight*. The recording is as lively and smooth as the music.

**An American in Blue.** George Gershwin's *Rhapsody in Blue*, and *An American

---

**RECORDS REVIEWED**

- **Music of Alec Wilder**
  Columbia CL-884

- **Philadelphia Woodwind Quintet**
  Columbia ML-5093

- **Shifting Winds**
  Capitol T-6531

- **Gershwin: An American in Paris**
  *Rhapsody in Blue*
  Capitol P-8343

- **Soundproof**
  Westminster 6014

- **Folk Songs of the Old World**
  Capitol PBR-8345

- **Delibes: Coppelia**
  *Sylvia*
  Victor LM-1913
  Westminster XWN-18241

- **Music for Barefoot Ballerinas**
  Decca DL-8034

---

November, 1956
NEW
HICKOK
VTVM
KIT

King Size and Top Quality in an easy-to-assemble Kit.

MODEL 225K
• Quality 9-inch Meter with Extra-Long Scales
• Unusually High Input Impedance
• Dual-Purpose Single Unit AC-DC Probe
• DC Zero-Center Scale
• Plus and Minus DC Voltages
• Accurate Peak-to-Peak Scales
• Fast Continuity-Test Feature
• 60 Page Easy to Follow Instruction and Theory Book Included

More than 45 years of experience in the engineering design and production of electrical-electronic test equipment backs this Model 225K Quali-KIT. This experience and engineering accomplishment has gained the unchallenged leadership and universal recognition for HICKOK Equipment as "Choice of the Experts". All component parts of the 225K are of the highest practical quality to insure long life and trouble-free service. Numerous field studies have been made to prove the ease of assembly of this instrument. Only basic tools are necessary, and the task is both educational and pleasant.

$59.50 Complete

Portable, 13-1/2" H., 16-1/2" W. 7" D. (Factory wired . . . $104.50)
Write today for additional technical information

THE HICKOK ELECTRICAL INSTRUMENT COMPANY
10500 Dupont Avenue • Cleveland 8, Ohio

in Paris have been recorded so often, and have so much in common, that the listener is apt to blend the two titles into one lazy phrase, such as the heading of this paragraph. Actually, the two compositions are two sides of the same record (Capitol P-8343) and very nearly two sides of the same coin. The "Rhapsody" was the first important American work which used jazz in a full-blown "classical" form.

An American in Paris continued this development. In both works, the composer throws together a rich assortment of melodies, rhythms, and harmonies. Ingenious blends of solo instrument passages with full orchestral choirs produce constantly changing musical patterns — rich in color and irresistible in their rhythm and sweep. From a strictly personal standpoint, the "Rhapsody" represents Gershwin voicing the restless energy — touched with the blues — that was so typical a part of American life in the hip-flask and beaver-coat era. The American then goes abroad and races about Paris — only to wind up with the same restless sadness — or is it nostalgia for the familiar places of his own land? However, even his homesick blues have plenty of bounce, coming from Gershwin's snappy pen.

The performance by Felix Slatkin — conducting the Hollywood Bowl Symphony Orchestra with Leonard Pennario as piano soloist — is truly great. Both sides are breathtaking examples of modern hi-fi recording, with excellent presence and realism. If you like the feeling of the orchestra "coming at you," play this record with your system wide open. Then step back to the far end of the room and hang on!

Searching for Sound. That's exactly what the two gentlemen below are doing. Expert pianists Ferrante and Teicher have discovered new ways of doctoring up instruments to give out bongs, clonks, pings and quivers like nothing on earth — a fact intimated by the flying saucer on the record cover. Old favorites like "Green-
November, 1955

ALL TUBES UNCONDITIONALLY GUARANTEED FOR 1 YEAR

BRAND NEW TV PICTURE TUBES

Type | T.M. Price | 10BP4 | $10.95 | 12LP4 | $12.95 | 14LP4 | $10.00 | 16LP4 | $15.25 | 18LP4 | $12.50 | 20LP4 | $15.25 | 22LP4A | $16.95 | 24LP4 | $24.00

PRETESTED TUBES—INDIVIDUALLY BOXED

Type | T.M. Price | 024 | 015GT | 026GT | 024 | 015GT | 026GT | 024 | 015GT | 026GT | 024 | 015GT | 026GT | 024 | 015GT | 026GT

Picture tubes

F.O.B. PASSAI, N. J.

via Railway Express

TUBE MART

DISCOUNT HOUSE

Prescott 3-0330

The Lopet Bldg.

Passaic, N. J.

GIGANTIC MAIL SALE

WAR SURPLUS EXCESS INVENTORY

BRAND NEW TV PICTURE TUBES

RCA and DUMONT Licensed

Partial Listing

No duel required

Type | T.M. Price | 10BP4 | $10.95 | 12LP4 | $12.95 | 14LP4 | $10.00 | 16LP4 | $15.25 | 18LP4 | $12.50 | 20LP4 | $15.25 | 22LP4A | $16.95 | 24LP4 | $24.00

Picture tubes

F.O.B. PASSAI, N. J.

via Railway Express

TUBE MART

DISCOUNT HOUSE

Prescott 3-0330

The Lopet Bldg.

Passaic, N. J.

ARMY GEIGER TUBE


- Sustained radioactivity to 1000 hours.

- 50% size

- No ionizing components.

- Cost $8.00

SULPERS CENTER

BUYS (Prepaid)

- Gear Reduction Box, 85 to 1000, $8.91

- Govt. Weather Unit (125) 18.71

- Dual Astronomical Clock ($25)

- Power Plasid (110V-80 -1000W) 149.80

- Weston 0-100 DC Voltmeter ($60)

- E. G. -0-100 Amp DC Meter 6.91

- Triplett 0-15 A DC Voltmeter 6.91

- Triplett 5-100 Volt DC Voltmeter 37.91

- Ringer 0-100 Volt DC Voltmeter 59.91

- Triplett 0-1000 Volt DC Voltmeter 239.91

- E. G. -100Q XVA Variable (F83) 1.79

- Tuner Hidden Ultra Low on deck 15.91

- Electric AC-DC Bell ($2.95)

- 110V-5000 Manned Relay ($1.50)

- Relay Spring Adjusters (50-50) 2.91

- Relay Gauge (87.91)

- Machinists Calipers, polished, stainless steel (79.91)

- Telephone Line Test Phone Unit ($250)

- Test 220 Volt (75.91)

- Federal Dual Amplifier-Rectifier ($15.91)

- Wire Chieft Test Board ($175)

- 12V. Step-down Switch (15.91)

PERSONAL CARRIER MOTOR

- Amazing new use for golf cars, factory personnel, go-carts, etc.

- Powerful, reversible, fully reversible, with built-in regulator and heavy duty motor, gear. Smooth, powerful pull on open cable.

- Hundreds of applications, almost anywhere. Mounts on most webbed deck locks, parking anchors, etc.

- Ideal for trucks, farm equipment, trailers, industrial uses.

- 115V, 60-cycle, 10,000 to 1,000,000 capacity.

- 80 lbs. Co. 49.91

- 3000 lbs. $250.00

- 5000 lbs. $500.00

- 10,000 lbs. $1,000.00

- In stock.

- See your local dealer.

- Go-karts - go-carts - go-karts!

- Savings in large orders.

- Power Head MOTOR

- Delightful new use for any modern system.

- Automatic start, full automatic stop. Easy to install.

- Amazing new use for golf cars, factory personnel, go-carts, etc.

- Power head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.

- Power Head motors. Full automatic start, full automatic stop. Easy to install.

- Use in large orders.
sleeves" take on more spectacular hues and a tonal picture of "Man from Mars" shows the sonic climate of that planet most conducive to hi-fi. Brilliantly played, these tonal phantasmies are resoundingly engraved from seventeen microphone channels on "Soundproof," Westminster Record 6014.

Folk Songs à la Carte. A new album of folk songs, recorded by the Roger Wagner Chorale (Folk Songs of the Old World, Capitol PFR-8345) samples songs from England, Ireland, Spain, Italy, France, Germany and the Scandinavian countries. Most of the selections are fairly familiar; a few are rarely heard but are certainly worthy of being recorded.

As a selection of representative folk songs "of the old world," the album raises a serious question: why the omission of any selections from the rich and tuneful storehouse of music from the Slavic and Central-European countries? Then too, the slick arrangements, the unnecessary and obtrusive drums and trumpets, the gaudy slides and swoops in the singing, the over-theatrical tricks with tempo ... all add up to a very un-folksy way of doing folk songs.

As far as simple, down-to-earth folksinging is concerned, this album definitely missed the boat. Instead, it provides another vehicle - a sort of parade float, prettied up and bedecked with artificial flowers. It will probably take many listeners for a very enjoyable ride, providing they like slick arrangements.

As for the recording itself, it is a brilliant hi-fi job. The ensemble effect of the singing group is amazing. All parts are clearly discernible and yet blend very neatly. The words are understandable, even on first hearing. From a purely vocal standpoint, the effect is gratifying; much range and rich sonic effects are achieved by Roger Wagner as he makes of the folk songs showpieces for demonstrating the mettle of his group and the marvels of hi-fi.

Dancing—Public and Private. Thanks to the spate of musical comedies lately from Broadway and Hollywood, ballet dancing has become a popular art. Unlike other indoor sports, ballet demands physical prowess superior to that involved in most outdoor activities. For most of us, ballet therefore remains a spectator game. Hi-fi fans, who would just as soon listen as look, can now get both of Leon Delibes' top-notch ballets, Sylvia and Coppelia, served on a single platter. Here is a flood of easy melody to tingle your ears and tickle your toes. For all its charm and delicacy, this is old-fashioned music of solid

Abraham Marcus, co-author of famous best-seller "Elements of Radio" makes amazing offer!

TRY MY TV and RADIO REPAIR COURSE FREE FOR 1 MONTH

"If you haven't earned at least $100 in spare time during that period you pay not a cent."

Here it is! The most amazing guarantee ever offered on any radio-TV course anywhere! We'll send you Abraham Marcus' course to use FREE for one full month! If in that time you haven't actually made $100 fixing radios and TV sets, just return the books to us and pay not a penny!

Why do we make this sensational offer? First, because these books are so easy to use. They are written in the same clear, easy-to-follow step-by-step fashion as the author's "Elements of Radio," a 1,000,000-copy best-seller. Second, because the books get right to the point—tell you what to do in 1-2-3 fashion. For example, once you master the first few chapters of the TV book you are ready for business—ready to do service jobs in the field—jobs that account for over 80% of all service calls.

DON'T WAIT! You risk nothing when you send the coupon at right. Don't have to keep the books and pay for them unless you actually make extra money fixing radios and TV sets. Even when you decide to keep them, you pay on easy terms. Mail the coupon now.

WHAT YOU GET IN THESE 3 GIANT VOLUMES

ELEMENTS OF TELEVISION SERVICING. Analyzes and illustrates more TV defects than any other book, and provides complete, step-by-step procedure for correcting each. You can actually SEE what to do by looking at the pictures. Reveals for the first time all details, theory and servicing procedures for the RCA 28-inch color television receiver, the CBS Columbia Model 295 color set, and the Motorola 16-inch color receivers.

RADIO PROJECTS. Build your own receivers! Gives you 10 easy-to-follow projects, including crystal detector receiver—diode detector receiver—regenerative receiver—audio-frequency amplifier—tuned-radio-frequency tuner—AC-DC superhet detector receiver—etc.

MAIL THIS COUPON

Prentice-Hall, Inc., Dept. 5702-P1
Englewood Cliffs, New Jersey

Please send me Abraham Marcus' TV & RADIO REPAIR COURSE (3 volumes) for 10 days FREE examination. Within 10 days I will either return it, not owe nothing, or send you first payment of $3.00. If I have used the course for a FULL MONTH, if I am not satisfied, I may return it at my expense, and you will refund my first payment. Do I will keep the course and send you two more payments of $3.00 a month for two months.

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

Always say you saw it in—POPULAR ELECTRONICS
Your choice of school is highly important to your career in

INDUSTRIAL ELECTRONICS

RADIO-TELEVISION

ELECTRONICS COMMUNICATIONS

Become an ELECTRICAL ENGINEER or an ENGINEERING TECHNICIAN at MSOE in Milwaukee

Choose from courses in:

ELECTRICAL ENGINEERING Bachelor of Science degree in 36 months. Communications option (radio-tv) Power option.

ENGINEERING TECHNICIAN Assoc. in Applied Science degree — 18 months. Electronics Communications Electrical Power.

MSOE — located in Milwaukee, one of America’s largest industrial centers — is a national leader in electronics instruction — with complete facilities, including the latest laboratory equipment, visual and theater, amateur radio transmitter — offers 93 subjects in electrical engineering, electronics, radio, television, electrical power, and electricity.

Advisory committee of leading industrialists. Courses approved for veterans. Over 50,000 former students. Excellent placement record.

TERMS OPEN JANUARY, APRIL, JULY, SEPTEMBER

Choose wisely — your future depends on it. Write for more information today!

MILWAUKEE SCHOOL OF ENGINEERING

Dept. PE 1156, 1025 N. Milwaukee St.
Milwaukee 1, Wisconsin

Send FREE career booklets. (Please print)

I am interested in

(name of course)

Name

Age

Address

City

Zone State

If veteran, give discharge date

November, 1956
WANTED
Will ing to pay cash for Early Phonographs with outside horns

WANT Coronet (Illustrated), Double Bell Wonder, Victor Types A, D, and O, Monarch Special, and Improved Monarch. Also Edison Idella, Excelsior, and Treadle Phonographs. Want early Bell-Tainter, American Gramophones. Multiphone, Multinola, Scott Magazine Phonograph, Peerless, Sovereign, Wizard Phonograph, Regina Hexaphone, and Graphophones. Also catalogues or old literature on phonos made prior to 1906. Want unusual machines and coin-in-slot cylinder phonographs.

A few duplicate Edisons and graphophones are now available for sale or trade.

Send clear snapshot and full information to Box 50
POPULAR ELECTRONICS
366 Madison Ave., New York 17, N. Y.

Real Time Savers...
Solderless Terminal Kits

No. 2195
$8.90

For Bench Work or Service Calls!
You get positive, trouble-free connections every time you close your hand...with VACO Solderless Terminals. No. 2195 kit contains supply of 10 different types of terminals and crimping tool in plastic storage box. No. 395 kit comes with assorted Pak and Crimping Tool in carrying case.

Get Them From Your Jobber or Write
VACO PRODUCTS COMPANY
317 E. Ontario Street, Chicago 11, Illinois

In Canada: Atlas Radio Corp., Toronto 10

reference value at "room temperature."

Dissipation constant. This refers to self-heating action. To raise the temperature of a 51R2 thermistor from, say, 50° to 51° C, the current flowing in it would have to be increased. The increment would have to be such as to cause 2.5 more milliwatts to be dissipated at the new temperature. Dissipation constants are very dependent upon the type of mounting and the surrounding medium.

Consider a thermistor for which the dissipation constant is specified as 2.5 mw.°C when the thermistor is suspended by its leads in still air. If it is to be used as a thermometer which must have a maximum error of ½° C, then the maximum power in the thermistor must be limited to 1.25 mw. (2.5 × ½ = 1.25). This limitation is required since the thermistor will self-heat by ½° C when subjected to still air environment while the self-heating in moving air or liquid may be negligible.

Time constant. There is a lag between the time that a current increase occurs and the time that the thermistor reaches the final temperature for the new current. The heating and cooling curves are so similar to those which apply to the charging of a capacitor through a resistor that we can use one as an analogy for the other. The RC time constant tells us how long it takes a given capacitor to charge to 63% of the full voltage through a specific resistor. Similarly, the thermistor time constant specifies the number of seconds required for the thermistor to attain 63% of the rise in temperature it will undergo as a result of the new current. In the case of the 51R2, the time constant is 20 seconds.

Assume that a 51R2 is self-heated to 30° C and a current increase is initiated which will cause the thermistor temperature to go to 40° C, given sufficient time. It will take the thermistor 20 seconds to cover 6.3° C, i.e., 63% of the 10° C increase. Therefore, at the end of the time constant period of 20 seconds, the 51R2 will have reached a temperature of 30° + 6.3° or 36.3° C.

Especially, both the dissipation constant and the time constant depend upon how rapidly the thermistor can absorb heat from and liberate heat to its surroundings. Altering the mass of the thermistor affects both: i.e., if the mass is increased, the dissipation constant is increased and a larger time constant results.

Temperature-resistance ratio (Rf @ 0° C/Rf @ 50° C. This ratio provides information related to the resistance variation which may be expected for a given thermistor as its temperature changes. For the 51R2, the resistance at 0° C is 9.1 times
FREE! Our Biggest Flyer EVER!

HUNDREDS OF BARGAINS, BONUS AND GIFT ITEMS!
WRITE FOR YOUR COPY TODAY!

FREE! ANY $1 ITEM WITH EVERY $10 ORDER!
Free Gift with Every Order!

FAMOUS KIT KING
DOLLAR BUYS!
ONLY ONE DOLLAR EACH!

- 60 XLRMS & COILS. 1/2 lb. oxygen-free copper, $1
- 42 DIODE KIT. Complete w/ electrodes, instructions. All parts insured. Reg. $2.45
- PHOTO-ELECTRIC CELL/FAMOUS makes record phonograph makes excellent sun battery, w/30 pencil points. Framed. 234 M. 15¢ dia. $1
- 10 'POLY BOXES. Asstd. plastic. Clear window, hinged w/mounting flaps. Each 1/#. $1
- 125 RESISTORS, insulated ceramic. 1, 5, 10, 20, 25, 30, 40, 50, 100, 150, 220, 470, 1,000 ohm. Each $1
- 40 SUBMINIATURE RESISTORS. Exclusives! 20 popular values. Each $1
- G-E PRE-AMP KIT. For mag. FAMOUS makes. Complete w/cabinet, parts, instructions. 40X. $8.50
- 30 TUBE SOCKETS. 4, 6, 7, 9, 12, 12a, 12a7, 5727, 6A21, 6B9. Each $1
- 70 STANDARD KNOBS. 1/2"diameter, 5/8" stem. Asstd. colors. Plastic. Wt. 2 lb. each $1

Check items wanted. Return entire ad with check or QO. Include sufficient postage to return C.O.D. orders. 25% down. Refund net 30 days. Print name, address, amount money enclosed margin.

Visit our salesroom, 131 Everett Ave., Chelsea.

GET INTO ELECTRONICS
You can enter this interesting, challenging field with just 6 weeks of training. Fully accredited program! Job assistance and placement given. Prereq. High school or G.E.D. 6 week, 16-hour day course. Graduates in demand by major electronics companies. Graduates offered jobs in top companies. Call for Catalog.

VALPARAISO TECHNICAL INSTITUTE
Dept. PE
Valparaiso, Indiana

GARAGE DOOR OPENER
Actuator Mechanism $24.50
EASY TO INSTALL, SAFE, RELIABLE
WRITE for interesting free information... TODAY
P. E. HAWKINS CO.
631 PROSPECT
KANSAS CITY 24, MO.

Car Owners:
LOCATE MOTOR TROUBLE AT START
SAVE ON BATTERY & MOTOR WEAR
$300
with NEW
AMAZING: Electronic
Auto-Ignition Indicator
Mounted On Dash Board Any Car
In 2 Minutes, No Tools Required
When your car fails to start, this remarkable no-moving-iron indicator immediately shows whether trouble is in fuel or ignition system. While car is in operation, increased or decreased intensity of light tells whether you are getting optimum mileage from your gasoline. Indicator lights red when engine is not running. Green indicates fuel trouble. Red indicates ignition trouble. Country wide demand! Must be on every car. Cannot be supplied by mail. Order TODAY! GUARANTEED.

KAR-AIDS, Inc.
25-118 49th St.
Long Island City 3, N. Y., N. Y.

LEKTRON
28 GARDINER STREET
CHELSEA 50, MASS.
Specifications: 1 to 5 mile range with 18-inch antenna and much more with directional beam antenna. Tuned 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 ever 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 receiver chassis complete with special dual tube $4.50
High output carbon mike $1.49
Miniature mike transformer $ .98
Powerful alnico magnet headphone $1.25
Strong 16 gauge aluminum case (8"x5½"x2") with battery compartment, battery switch plus all hardware and fittings included, 18 inch antenna $1.98

Uses standard batteries available at your local radio store. All components except tubes guaranteed for one year.

Please include 5% for postage. COD's require $1.00 deposit. Thousands sold throughout the world. Foreign currency available, limited edition.

All orders immediately acknowledged.

SPRINGFIELD ENTERPRISES
Box 54-E
Springfield Gardens 13, N. Y.

NEW! PRINTED CIRCUIT Transistor Radio

Pocket size—works anywhere

- Features P-N-P Junction Transistor
- Permeability tuning, Diode detection
- Printed circuit eliminates extra wires
- Batteries last for months
- Expensive hearing aid headset included
- Furnished complete, nothing else to buy

Here is a powerful, completely portable radio, employing the latest type of transistor audio amplification and printed circuitry. Tiny size, only 2½ x 3½ x ½" fits in pocket or purse. Uses so little current, batteries last for months. Kit can be assembled by anyone with just a soldering iron. Guaranteed to work. Comes complete with plastic case, batteries, headset, all parts. Nothing else to buy. See your distributor. If he doesn't stock, write direct.

Send no money. Just pay postman $9.95 plus C.O.D. charges, or send check or money order for $9.95 and we pay postage.

TRA'DYE, INC., 11 W. MONUMENT AVE., DAYTON 2, OHIO
Dept. E-7

WANT A BETTER JOB: BECOME AN ELECTRONIC ENGINEER

ONLY 32 MONTHS TO EARN A BACHELOR OF SCIENCE DEGREE IN ELECTRONICS ENGINEERING

Class enrollment limited to allow for individual instructions. Charter member of State of California. Nonprofit, nonsectarian, co-educational—established 1926.

APPROVED FOR VETS—ENROLL NOW!
SEND FOR FREE CATALOG

PACIFIC STATES UNIVERSITY
1516 S. WESTERN AVE., Dept. M, LOS ANGELES, CALIF.

Long-Wave DX'er

(Continued from page 69)

on the back of the chassis accommodates the antenna and ground connections.

Adjustment and Operation. Plug the power cord into a 117-volt a.c. outlet, and plug a set of headphones into the headphone jack. Turn on the power switch. Set the volume control at maximum. A slight hum will be heard for a second or two, and will fade out and become inaudible as the tube comes up to operating temperature. As soon as the slight hum has disappeared, you may check the regeneration control by rotating it back and forth. A soft "plop" should be heard in the headphones at a setting of the control where the receiver goes into or comes out of oscillation. If the "plop" is not heard at any setting of the regeneration control, turn off the power and reverse the two tickler lead connections.

With the detector oscillating weakly, and the antenna connected, rotate the tuning dial. As soon as you hit upon a station, rotate the tickler coil slightly away from the tuning coil. If you have tuned in a greater than the resistance at 50° C. This constant is an indication of the sensitivity of the thermistor to ambient temperature variations.

Determining Resistance. Although there are mathematical tools available which enable engineers to determine the resistance of a thermistor at any temperature, the formulas are too complicated to be given here. From a data table supplied by the manufacturer, however, any thermistor may be calibrated by means of a curve such as that of Fig. 3. With it, we can find the resistance of the 51R2 at any temperature between 0° C and 50° C (32° F to 122° F), a very useful range indeed.

As a check, note that the curve shows the resistance of the thermistor to be 100,000 ohms at 25° C, which agrees with the nominal rating R, given previously. Note also that the resistance at 0° C is 327,000 ohms and that at 50° C it is approximately 36,000 ohms. This verifies the temperature-resistance ratio of 9.1 (36,000 X 9.1 = 327,000 ohms).

A number of practical thermistor circuits and designs will be presented in After Class in a forthcoming issue. Devices using thermistors were described in "Safeguard Your Home with a Thermistor Fire Alarm" (March, 1956, issue of POP'tronics) and "Make Your Own Electronic Thermometer" (April, 1956). Look for an article on a "Thermistor Anemometer" scheduled to appear in the near future.
Electronic Election Bet
(Continued from page 40)

The Fast Shuffle. Within its vast electronic memory (see Popular Electronics, August 1956), Univac stores a complete analysis of voting behavior all the way back to 1928. On election night, these vast stores of historical data are mixed in the Univac with red-hot news pouring in on the press wires and jiggled together in the strict order of statistical method. The machine compares the early returns, precinct

c.w. station, backing off the regeneration control should cause the audio tone to disappear—indicating that the receiver has stopped oscillating. Advancing the control slightly will bring the audio tone back again. Some stations will come in more clearly when the detector is not oscillating—these are modulated c.w. stations. Try to keep the detector barely oscillating when you are tuning for weak stations, for this is its most sensitive condition.

One of the problems you may run into while using this or any other simple receiver on the long waves is picking up a strong nearby broadcast station. Such a station cannot be actually tuned in on the receiver. In fact, it may occupy half the tuning range. The best way to get rid of it is to insert a broadcast-band wavetrap in your antenna lead, a circuit for which is shown in the diagram on this page. Adjust the tuning capacitors in the trap until the broadcast station comes in at the lowest level or not at all.

LEARN basic electricity electronics
THE EASY "PICTURE BOOK" WAY!

Just Released: 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 are at least one big illustration on that same page to explain it! What's more, an imaginative 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 crystal 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 Oscilloscopes; 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—in your own pace!

10-Day Examination—Money Back Guarantee

Send today for these exciting new training courses—you 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 $9.00! In Canada, prices approximately 5½ 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.
480 Canal Street, N. Y. C.

I have enclosed $ . Please send me

[ ] 5-vol. Basic Electricity set @ $9.50
[ ] 4-vol. Basic Electronics set @ $8.95
[ ] 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.

Add state or city sales tax where applicable.

Name ____________________________
Address __________________________
City & State ________________________

P-40A

November, 1956

www.americanradiohistory.com
by precinct, with the patterns of the past. It weighs in variables, such as splinter trends, Dixicrats and Independents, constantly checking them against the 15 million items of information stored in its magnetic memory.

In this fast shuffle, the computer completes about 2000 calculations per second. Every time it spots a lead of one party in any given precinct, it goes on to figure out whether the difference is small enough to fall within the limits of chance, or big enough to foretell a significant trend. In other words it works out the odds by which the candidate with the early lead would go on to win the state.

From the state odds, Univac then switches to compute the presidential odds on the basis of the 531 electoral votes. Mathematically this is done by means of a "531-degree polynomial." By ordinary methods, this calculation takes at least two weeks to complete. Univac clacks out the answer in just six minutes. First it reports the number of states for each candidate, then the electoral and popular votes, and finally the odds in favor of the candidate expected to win. Then it goes on to cover the Congressional contest in the same way, state by state.

Univac's forecast is the best and fastest guess possible within the margin of that proud unpredictability which is part of human nature. Fortunately, our democratic freedom always leaves a loophole through which sheer human mugwumpery may randomly assert itself to the consternation of all machines, political or electronic.

A Beam and Tower

(Continued from page 79)

quarter-kilowatt. A simple two-element beam that may be fed with a 52-ohm coaxial transmission line is shown in Fig. 2. The antenna is pretuned for the Novice band, but will operate properly over the entire 21-mc. band. It should be used for reception as well as transmission, since there is a reduction of QRM from the back of the beam.

The antenna element is split in the middle, and fed with a quarter-wave section of 75-ohm balanced transmission line. Connect the bottom of this line to a balancing transformer (balun), and also to the 52-ohm coaxial line going to the transmitter. The purpose of the quarter-wave section and the balun is to match the unbalanced 52-ohm line impedance to the load of 20 ohms presented by the parasitic beam antenna.

Figure 3 shows the antenna assembly. The elements are made of 10 sections of electrician's aluminum conduit, known as "EMT"
conduit." This material may be obtained at any electrical supply house. Each element is made of a 10' piece of ½" conduit, and has 5' tips of ¼" aluminum conduit in each end. An overlap of about six inches at each joint is required. Place a short length of scrap ¾" aluminum tubing in each tip to bring the elements to the required length. Each joint should be shimmed with small pieces of aluminum until a tight fit is obtained, then a hole drilled through the joint and a bolt passed through the hole to draw the joint tight. When the antenna element is finished, it is cut in two at the center. Finally, give each element a coat of aluminum paint to prevent rust and corrosion.

Make the supporting boom of the antenna from a 7' section of steel TV mast, obtainable at any large TV or radio supply house. The director element and antenna are supported on the boom by means of gusset plates cut from ½"-thick plywood. The director plate measures 2' x 2' foot on a side, and the antenna plate is sixteen inches on a side. Give the plywood plates a good coat of house paint to prevent moisture from creeping in between the surfaces of the wood. Attach the director to the mounting plate by means of two TV-type "U-bolts." Then attach the plate to the boom with the same type of bolts. No electrical connection should be made between the director and the metal boom.

Four U-bolts are required to attach the antenna to its mounting plates. Use two bolts for each half of the element, allowing a 1" gap between the centers of the two halves. No electrical connection should be made between the halves of the antenna and the supporting boom.

Attach the quarter-wave 75-ohm section to the centers of the antenna by means of bolts passed through holes drilled in the elements. solder the balun terminals to the bottom of the 75-ohm line, coil up the balun and tape it to the supporting boom of the antenna. The quarter-wave section is allowed to droop beneath the antenna. Make sure that no antenna connections touch the boom of the antenna or the vertical supporting pipe.

As a last step, attach the 52-ohm transmission line, as shown in Fig. 2. The antenna may now be carried up the tower, and attached to the vertical supporting pipe by means of a third gusset plate, made of heavy galvanized iron. This material can be obtained.
JOBS IN ELECTRONICS

We can train you and place you in an electronics technician job in the short time of only 12 weeks!

F.C.C. License—the Key to Better Jobs

An FCC commercial (not amateur) license is your ticket to higher pay and more interesting employment. This license is Federal Government evidence of your qualifications in electronics. Employers are eager to hire licensed technicians.

Grantham Training is Best

Grantham School of Electronics specializes in preparing students to pass FCC examinations. We train you quickly and well. All courses begin with basic fundamentals—no previous training required. Beginners get 2nd class license in 8 weeks; 1st class in 4 additional weeks.

Learn by Mail or in Residence

You can train either by correspondence or in residence at either division of Grantham School of Electronics—Hollywood, Calif., or Washington, D. C. Our free booklet, "Opportunities in Electronics," gives details of both types of courses. Send for your free copy today.

MAIL NOW TO OFFICE NEAREST YOU
(mail in envelope or paste on postal card)
Grantham School, Desk 3-C
1505 N. Western Ave., OR 821—19th Street N. W.
Hollywood 27, Calif., OR Washington 6, D. C.

Please send me your free booklet, telling how I can get my commercial FCC license quickly. I understand there is no obligation and no salesman will call.

NAME
ADDRESS
CITY
STATE

LMB BOX CHASSIS OFFERS FREE
Inside LMB boxes

10 tested kit diagram projects for the builder. Each one of these kits diagrams built by a recognized expert. Kit projects are complete in every detail. Circuit diagram, photo of project both front and rear photo. Rear photo shows wiring and parts. Detailed instructions for building, complete parts list and approximate cost. Complete to build except parts and your distributor can supply the parts. Ask your distributor for the list of LMB kit Diagram Projects. If he does not have them, write to

LMB
1011 Venice Blvd.
Los Angeles 15, Calif.

Bill of Materials for Antenna

2—10' lengths of 3/4" electrician's EMT aluminum tubing
2—10' lengths of 1/2" electrician's EMT aluminum tubing
1—10' length of 3/4" diameter aluminum tubing—cut into four pieces for element tips
1—7" section of 1/4" diameter steel TV mast
3—Gusset plates (see A, B, and C in Fig. 3)
1—TV-type U-bolts
1—8" section of 75-ohm heavy-duty twin lead—cut to 8'/6" and trim each end 1/2" clear (Amphenol 14-023 or equivalent)
1—18" section of 52-ohm coaxial line—cut to 15'10", and trim each end 2'/4" clear (RG-8/U line or equal)
1—52-ohm coaxial line to transmitter (any length)

at any sheet metal shop. Use four U-bolts at this joint, two on the boom, and two on the supporting pipe, making a good electrical connection between the boom and the vertical pipe.

"Heck!" said Jimmy, "that sounds easy enough. Am I going to have any trouble getting it loaded?"

"Not particularly," I replied, "although you should keep in mind that sometimes cutting off a foot or so of the coaxial cable may help if things get rough. If you have any problems, give me a call. And by the way, after you've tested out the beam, let's kick around the idea of a better transmitter for you."

-90-

Tricked-up Cathode Rays

(Continued from page 45)

bring out the subler details, the Tonotron gives the pilot enough time for careful study of what he sees on the screen."

Pictures by Phone. The most revolutionary aspect of the new Tonotron is its ability to receive TV-type pictures over ordinary telephone lines instead of complex and costly broadband channels. It is one of the basic facts of electronics that a fast sequence of signals spreads out over a greater bandwidth than a slow sequence of signals. This is the reason why, in radio, a wide r.f. frequency band is required to transmit the fast vibrations of high notes. It also explains why television, where the scanning beam follows very rapid pulses, needs a very broad frequency band of 4 megacycles per channel for clear transmission of these pulses.

Now the Tonotron, with its ability to "hold" the picture, makes it unnecessary for the scanning beam to retrace the picture pattern quite so rapidly. This means that the control pulses don't have to follow one another so closely. Consequently, one can get by with much narrower transmission bandwidth.
Of course, rapid motion is blurred on pictures that are "held" on the tube for relatively long time spans. Despite this limitation, however, the possibility of narrow-band TV transmission over ordinary telephone or radio channels has many potential uses. Navigation charts, weather maps or graphs can be flashed from shore to ship or ground to aircraft by means of already existing voice-radio transmitters and receivers. Most important, early warning radars at distant outposts can transmit a picture of their sky sector over ordinary telephone lines to centrally located defense headquarters. The whole sky area surrounding the North American continent can thus be "drawn together" for observation from a single point.

**Writing Rays.** Once the cathode ray knew how to remember, it became possible to teach it the alphabet. Realizing that electronic brains are now getting so smart that they might insist on having things put in writing, Stromberg Carlson taught their new cathode-ray tubes how to spell. The result is the Charactron, which writes on its own screen just like human beings write on a blackboard.

The Charactron owes its literacy to a small disc intercepting the electrons as they stream out of the electron gun mounted in the long, slender neck of this huge tube. The center of the disc is perforated with tiny letters, numerals, and other symbols to be written on the tube screen. No letter is larger than 12/1000th of an inch. As the electron beam passes through these perforations, it is shaped into the form of a letter, which is then projected on the screen. The beam is guided by the control signals to pick out the proper letter, one at a time. But since the tube is able to "remember" what letters have come before, it holds the image of the letter sequence until the entire message is spelled out on the screen. When the information is no longer needed, another sweep of electrons, like a sponge on a blackboard, erases the

"Letter disc" is inserted into the neck of the Stromberg-Carlson Charactron. Tiny perforations in disc project alphabet letters on the tube screen.

November, 1956
writing and clears the tube face for the next message.

In fact, the tube was originally designed to replace a sort of "blackboard"; namely, the transparent plotting board on which Air Defense officers mark the location and movement of aircraft. Prior to the invention of the new writing tube, the defense coordinator received information by radar or telephone and then marked the board with grease pencil. But this manual plotting method proved too slow for keeping track of jet planes capable of outrunning their own noise. Besides, the plotting officer had to assimilate information from several sources at once, thus increasing the chance of a fatal human error. The Charactron writing tube replaces the slow and fallible human link in the chain between the source of information and its display.

The cathode ray, nimble servant of a thousand tasks, has extended the range of the human senses and hence of human knowledge further than any other instrument in the history of science. Not even the microscope in the three centuries of its use has contributed so much to so many fields of inquiry. In our time, the cathode ray is perhaps the chief exploratory tool of science. Its probing beacon casts the first light into the waiting darkness beyond the present frontier of knowledge. Now, with memory and the skill of writing added to its traditional accomplishments, the cathode ray is really "on the beam."

Transistor Topics
(Continued from page 58)

From Lafayette Radio (100 Sixth Ave., New York 13, N. Y.) comes news of the "world's smallest" shielded i.f. transformers. These units measure only 1/4" square by 9/16" high. Catalog numbers are MS-340 for the first and second i.f. units, MS-341 for the third i.f. transformer. An oscillator coil, to match Argonne's famous "Poly-Vari-Con" subminiature variable capacitor, is available as item No. MS-342.

Also from Lafayette comes news of a new four-transistor superhet receiver kit designed for earphone operation—their Catalog No. KT-94. Available as accessories are a leather carrying case (MS-311) and a Class B push-pull audio amplifier and speaker kit (KT-96). The KT-94 and KT-96, together, form a six-transistor loudspeaker-operated receiver.

From J. W. Miller Company, 5917 South Main St., Los Angeles 3, Calif., there has been an announcement of a whole line of transistor coils and i.f. transformers, including six different antenna coils, four i.f. transformers, three oscillator coils, and
two miniature variable capacitors. For details, write and ask for Catalog Sheet No. 2000 5M Fed. 7-56... or check with your regular distributor.

Do you have trouble finding small resistors to match your other subminiature components? You can get a whole "kit" of around ninety (90) subminiature resistors at no more than you'd pay for a couple of transistors from Wholesale Radio Parts Co., Inc., 311 W. Baltimore St., Baltimore 1, Md. These resistors are but a fraction of the size of regular 1/2-watt units. For full specs, price info, etc., write directly to them and mention this column.

A new technique for the mass production of u.h.f. transistors has been announced by the Philco Corporation. Two new types of transistors, a micro-alloy transistor (MAT) and a surface barrier diffused transistor (SBDT) are now in engineering development. The MAT transistor is reported to be at least ten times faster than the fastest vacuum tube in electronic computers. The SBDT transistor operates in the 500-mc. range, but will probably find its widest use in the 20 to 200 mc. range.

That's it for now, fellows... see you next month.

Lou

WHICH TRANSMITTER KIT TO BUY?

I JUST GOT MY NOVICE TICKET, BUT WHICH KIT SHOULD I BUY?

THAT'S EASY! CHOOSE THE KIT THAT GIVES YOU THE MOST FOR YOUR MONEY!

LATER... SAY! STEP BY STEP INSTRUCTIONS! I'LL BE FINISHED TONIGHT!

EVEN THING IS SUPPLIED, ALL YOU NEED IS YOUR OWN KEY AND CRYSTAL.

JOHNSON MAKES A COMPLETE LINE OF TELEGRAPH KEYS, TOO. WRITE FOR FULL INFORMATION.

The Transmitting Tower
(Continued from page 83)

nce, and cost ($13.95), the Knight "Space Spanner" kit is an excellent doorway for anyone who wishes to get started in short-wave radio in easy steps.

As a broadcast receiver, the "Space Spanner" leaves little to be desired; therefore, when it is replaced by a more versatile short-wave receiver, it will still give many hours of service on the broadcast band.

News and Views

Since getting a new DX-35 transmitter and adding a Q-Multiplier to his receiver, George, K2MBU, (N.Y.) has brought his states-worked total up to 29 from his home location and up to 20 from his vacation site... Gary, KN9BNJ, (Ind.), who for the first six months of his license term had a DX record of seven miles, is now able to work the east coast... Dave, KN2RSM, (N.Y.), sticks to 40 meters, where his AT-1 feeds a 100' "long wire" through an AC-1 antenna coupler for a record of 24 states worked, with 16 confirmed... Gerry (13), KN0GPX, (Minn.), uses a Johnson Adventurer transmitter to feed a 20' folded dipole antenna. His receiver is an SX-71, and he has made 36 contacts in eight states.

Ernie, VEJEGG, (16), (Ontario, Canada), has made 50 contacts in 17 states on 40 meters in the six weeks he has had his license. Ernie...
uses a home-built 25-watt transmitter, a ½-wave antenna, and an S-38C receiver. One thing that amazes him is how American Novices can make so many contacts in the crowded Novice bands. . . . Phil, K5BTW, (Texas), has graduated from the ten-watt transmitter with which he started his ham career to a DX-100, an NC-98 receiver, and a choice of three antennas—a 33° vertical, a "long wire," and a 3-el, 10-meter beam. His record adds up to 43 states worked, three Canadian provinces, Colombia, and Puerto Rico. Dick, K4DB, after being on 40-meter c.w. exclusively, built a modulator for his AT-1 transmitter and tried 10- and 40-meter phone for a while, but he is back on c.w. again—20 meters this time, where he has recently worked Mexico and several Canadian stations.

In three months of operation, the Knight 50-watt transmitter and the ARC-5 receiver of Rex, KN4BJ, have worked 30 states in all call areas. He is now gumming for Canada and Hawaii. . . . Bert, WN11HHN, (Maine), runs 12 watts to a single 6L6 feeding a 60' length of wire thrown out of the radio shack window. Best DX worked is Georgia and Michigan on 40 meters.

Bernie, KN6BV, pushes his Globe Scout transmitter to 65 watts input to excite his "Windom" antenna. It took him five days to figure out the proper way to connect his balun coils between the transmitter and the antenna feed line, but then VE3DKQ answered his first QSO. Lou, KN25ZR, (N.Y.), called for a month after getting on the air without making a single contact because of a poor antenna and insufficient knowledge of how to operate his equipment. In the six months since then, his AT-1 transmitter, AC-1 antenna coupler, and 135° antenna, plus an old EC-1 receiver (somewhat similar to the present-day S-38 series), have accounted for 15 states.

Helen, W9MXML, one of the first to submit news to the Transmitting Tower, is the new president of Chicago YLRL, Inc., and the compiler of an excellently prepared brochure for the information of Chicago YLRL members.

Foreign Notes. Ben Gomboa (19), Philippine Islands, says reading the Transmitting Tower helped him pass the Philippine Commercial Radio Operator examination. He plans to build his own amateur equipment, starting with a one-tube receiver, and has been haunting the Manila radio stores, looking for 80- and 40-meter crystals—without success. . . . In Montevideo, Uruguay, Jose A. Bianco has finished building a 14-tube ham receiver and is now working on his 40-watt transmitter. The cost of higher power is prohibitive. He reports that Q-Multipliers are very popular among South American amateurs, . . . 7/Sgt. Wm. Cooper first heard of amateur radio in the Philippines when he was "phone-patched" to his father in Illinois. Now stationed in Spain, the bug has really bitten, and he is going all out to get his own station.

Boris, VP2LB, started his amateur career using a "guess-timated" power of 15 watts to a
2E26 modulated with a 6N7. When the plate of the 2E26 got red, he reduced the voltage. His modulation transformer was a small power transformer. The antenna was 18' high and the receiver was a Phillips, which worked okay on 50 watts, but always brought in several stations at once. In two months, this lash-up accounted for Puerto Rico, Virgin Islands, Montserrat, Antigua, Barbados, Grenada, Trinidad, Venezuela, British Guiana, and Curacao. Now in Trinidad, Boris is operating at VP4LT until he can get his own station going.

Low-Power Work. Using the "Sandwich Box" transmitter (10 watts) described in P.E. for March, 1956, Jim, W33GQT, has worked 28 states in four weeks on the air using 40 meters. . . . Dub, W41HA, uses the same type of transmitter, which he powers from the "accessory" socket on his AR-3 receiver. In ten weeks, he has worked 50 stations in 18 states, getting many 589/599 reports.

BFO Substitute. Art Fregau, (Conn.), reports that by placing an ordinary broadcast receiver in front of the old Sparkian "all-band" receiver he uses to SWL, he can receive code signals by carefully tuning the broadcast receiver dial until a harmonic of its oscillator beats with the incoming code signals. To produce audible dots and dashes instead of just "thumps" from the loudspeaker.


Tuning the Short-Wave Bands

(Continued from page 91)

on the ultra-high frequencies, the space satellites to be sent aloft next year to travel around the earth will be equipped with transmitters of about 10-milliwatt power operating on 108,000 mc. Our thanks to Stewart West for this information.

Current Reports

Here is a resume of the latest reports received by your Editor. Our apologies to all who do not find their reports printed. Please understand that our mail is very heavy and the column just a certain length. Please continue sending reports in, and sooner or later.

November, 1956

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! Four times out of 5, this giant, 3½-pound, 244-page Ghirardi RADIO TROUBLESHOOTER'S HANDBOOK gives 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 22 manufacturers between 1925 and 1947. 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 4,000 models of old home, auto radio and record changers: Airline, Avon, Avtex, Watek Kent, Belmont, Bosch, Brusswick, Clarion, Crosley, Emerson, Fada, G.E., Hohner, Majestic, Motorola, Philco, Pilot, RCA, Silvertone, Sparton, Stromberg and dozens more. Includes hundreds of pages of invaluable tube and component data, service short cuts, etc. Price $6.50—10-day free trial.

HERE'S HOW TO GET YOUR START

IN RADIO-ELECTRONICS

Here's basic training you can really understand! Training that can help you to set up and be paying radio television electronic career! No matter what part of the work you want to do, this is the kind of training you need FIRST!

Ghirardi's RADIO PHYSICS COURSE is the oldest book of its kind . . . and still a best seller! BECAUSE IT IS SO AMAZINGLY CLEAR AND COMPLETE. Thousands now in electronics got their start from this great book — AND THEY'LL RECOMMEND IT TO YOU TODAY!

Starts with Basic Electricity - over 300 pages; then takes you step by step through the entire radio electronics field. Covers principles, theories and practices that are basic to every modern equipment. 972 pages; 508 pictures; 856 helpful self-review test questions. Price only $6.50.

——— 10 DAYS FREE TRIAL ———

Dept. PE-116, RINEHART & CO., INC. 
232 Madison Ave., New York 16, N. Y.

Send book(s) checked for free examination. In 10 days, I will either send price down (plus postage) or return books postpaid and owe nothing.

□ Ghirardi's RADIO TROUBLESHOOTER'S HANDBOOK, $6.50.
□ Ghirardi's RADIO PHYSICS COURSE, $6.50.

Name ____________________________________________

Address __________________________________________

City, Zone, State ___________________________________

(OUTSIDE U.S.A. — $7.50 each, cash only. Money back if books are returned in 10 days.)

121
Have you ever wondered how a Hi-Fidelity Loudspeaker produces sound?

Send for this FREE book revealing the inner secrets of the loudspeaker—told in a fascinating easy-to-understand manner. Illustrated with delightful cartoons and diagrams—a wonderful guide!

This authoritative book is FREE—just send a dime to cover cost of mailing.

UNIVERSITY LOUDSPEAKERS, INC.

Gentlemen:

Please send me a copy of "Speaking about Loudspeakers." Enclosed is 10c to cover the cost of mailing.

Desk A-22
Name
Address
City Zone State

TALK—LISTEN—AROUND THE WORLD!

WITH THIS RADIO AMATEUR TRANSMITTER-RECEIVER:

SEND IN AND PAY ONLY THOUSANDS OF MILES on Amateur 80 and 40 meter bands. Aircraft and foreign signals 33 in a day. PORTABLE, SELF-CONTAINED, BE

TENTS POWERFUL! NO AC PLUGGING! NO DANGEROUS HIGH VOLTAGES! Low cost starting at $25.00 for 3 MONTHS. Crystal controlled transmitter. Two output up to 5 watts—

COMMUNITY TO TALK WITH THE WORLD. BEST AMATEUR RECEIVING APPARATUS AVAILABLE. Ask for Bulletin 72. Put in your QTH.

RADIO COURSES

FCC LICENSE PREPARATION

COMMERCIAL

· CODE BRUSH-UP

· AMATEUR

· THEORY

TELEVISION AND RADIO SERVICING

Recreational Courses Only

Personal Counseling Approved for Veterans

YMAC TRADE & TECHNICAL SCHOOL OF N. Y.

15 West 63 St. New York 23, N. Y.

EN 2-8117

33rd Year

MOVING?

BE SURE Popular Electronics Follows You. Please Send Your Change of Address To

Popular Electronics

CIRCULATION DEPARTMENT

64 E. Lake St.

Chicago 1, Ill.

yours will appear. All times listed are Eastern Standard, using the 24-hour system.

Australia—One of the lesser-heard stations is VLW9, a regional domestic station in Perth. This one can be heard on 9610 kc. with Eng. at 0845-1030 s/off. Music, popular and classical, and variety programs are featured. (BV)

Belgian Congo—Radio Congo Belge, Leopoldville, 9380 kc., usually has a good signal with popular and variety music at 0020-0100. News in French follows the ID at 0100. (BV)

Bolivia—CP5, Radio Illimani, La Paz, is now heard on 9555 kc. from 0600 s/on until 0700 fade-out. It is also on at 1900-2200 but heavy QRM usually mars reception. (RL, DX)

Brazil—Radio Ministerio da Educacao is again active on 17,875 kc. and can be heard after Cologne goes off at 0800. It apparently does not operate during the evening. Radio Nove de Julho, Sao Paulo, is a new station on 11,855 kc. and is noted at 1900-2100 with programs in Portuguese. (RL)

Two other new stations are Radio Capacabana, 4960A kc., with a program in German at 1700-1730, and Radio Alanuara on 5035 kc. No other details on either as yet. (DX)

Canada—Readers will recall that the Canadian heard a few months ago on 9730 kc. turned out to be the sixth harmonic of the m.w. station on 1320 kc. Another sixth harmonic is currently noted on 7320 kc. The engineer of CKCW, 1220 kc., is asking for reports in hopes of eliminating this harmonic. Reports should go to CKCW, Moncton Broadcasting Ltd., Knights of Pythias Building, Moncton, New Brunswick, Canada. (PM and others)

Canary Islands—Radio Atlanticco, Las Palmas, 9490V kc., has popular and dance music at 1700-1900. Announcements are in English and Spanish; reports are welcomed. (PB)

Ceylon—Colombo is operating on two new outlets in the VOA Service, on 17,800 kc. at 1230-1800 to Africa, replacing 17,845 kc., and on 11,855 kc. at 1400-1900 with "Music USA," replacing 11,875 kc. (BV)

Costa Rica—TIFC, The Lighthouse of the Caribbean, San Jose, is often readable from 0700 to 0000, but peak signal is around 2300-0000 when they present religious programs in English. They operate on 9645 and 6037 kc. (TZ, CH, RS)

Denmark—OZF, The Voice of Denmark, 9520 kc. Copenhagen, has English to N.A. at 2100-2130, repeated at 2230-2300. The half-hour preceding each xmn is in Danish to Danish listeners in N.A. The DX program can be heard Tuesdays at 2115 and 2245. This program is prepared by the World Radio Handbook. (SD, AF, NS)

Ecuador—HOJB, Quito, operates on 11,915, 15,115, and 7945 kc. Monday is a silent day. Station slogans are Call of the Andes and Heraldings Christ Jesus Blessings. They carry English programs, mostly of religious nature, from 2100 to 0000. In this, their 25th anniversary, they are using their new 50-kw. xmnrs. The station sends a nice picture of the entire staff. (CM, MG, TW, LW, MA)

New s.w. stations in Ecuador include: HC-3RM, Radio Cultura Micheli, Machala, 4845 kc., 250 watts, and HC5JL, La Voz de San Cedro (?), 3380 kc., 220 watts. Stations that
have returned to the air are HC2ET, Radio El Telegrapho, 4825 kc., 250 watts, and HC2DC, Radio Senit, 6150 kc., 250 watts. (DX)

**England**—The Overseas Service of the BBC, London (NOT the General Overseas Service), is heard in a daily broadcast of recorded music announced in English at 2215-2225 on 3975A kc. Other channels in dual are 17,715, 15,447, 11,700, and 9625 kc. The 3975-kc. channel is well heard despite QRM from the 75-meter amateur phone stations. The BBC is on 17,700 kc., replacing both 15,310 kc. for the N.A. Service between 1000-1600, and 17,810 kc. for the General Overseas Service to N.A. at 1600-1930. (SW)

**French Cameroons**—Radio Douala, a new outlet on 9900 kc., can be tuned at 1300-1400,

<table>
<thead>
<tr>
<th>SHORT-WAVE ABBREVIATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A—Approximate frequency</td>
</tr>
<tr>
<td>BBC—British Broadcasting Corp.</td>
</tr>
<tr>
<td>Eng—English language transmission</td>
</tr>
<tr>
<td>ID—Identify, identification</td>
</tr>
<tr>
<td>IS—Interval signal between transmissions</td>
</tr>
<tr>
<td>kc—Kilocycle</td>
</tr>
<tr>
<td>L.A.—Latin America(n)</td>
</tr>
<tr>
<td>mc—Megacycle</td>
</tr>
<tr>
<td>m.w.—Medium wave</td>
</tr>
<tr>
<td>N.A.—North America(n)</td>
</tr>
<tr>
<td>QRM—Interference from other stations</td>
</tr>
<tr>
<td>s.w.—Short-wave</td>
</tr>
<tr>
<td>s/off—Sign-off of station</td>
</tr>
<tr>
<td>s/on—Sign-on of station</td>
</tr>
<tr>
<td>xmsn—Transmission from station</td>
</tr>
<tr>
<td>xmt—Transmitter used by station</td>
</tr>
<tr>
<td>V—Frequency varies</td>
</tr>
<tr>
<td>VOA—Voice of America</td>
</tr>
</tbody>
</table>

with news at 1300-1310. Reports go to Radio-diffusion du Camerouns, Yaounde. (DX)

**French Equatorial Africa**—Radio Brazzaville, 11,970 kc., has an English period to North and South America at 1835-1900, parallel with 9625 kc. A "Mail Bag" and listener's request program can also be noted at 0650, but this is not beamed to N.A. (DC, TW, KN, VM)

**Gua—**English programs are broadcast by Radio Goa at 0130-0800 and 1000-1130 on 4880, 7071, and 9610 kc., according to a letter received from the station. The power for 4890 kc. is 5000 watts. (WRH)

**Gold Coast**—JOY. Accra, can be heard nightly at 0055 s/on with a woman giving the schedule. They relay BBC news at 0100. (DX)

**Guatemala**—Radio Universal, 6208A kc., is heard at 0000-0335 with a musical program and 1D of Radio Universal en Guatemala. This one verified with a letter but didn't list the frequency. The call is TOHC and it relays m.w. station TGB. (PM)

New stations in Guatemala include: Radio Programas de Guatemala, TG2B, 3955 kc., 90 watts; TGZA, 6160 kc, 250 watts; Radio Victoria, TGLA, 5970 kc., 100 watts; and TGLAB, 4900 kc., 200 watts. (DX)

**Hong Kong**—Radio Hong Kong, 3940 kc., is heard at 0830-0900 with fair-to-good signals in Chinese. At times they may have cricket matches in Chinese. (GN)

**Indonesia**—The Voice of Indonesia, Djakarta, is heard on YDF6, 9710 kc., with a xmsn in English at 0930-1030. The program is made up of news, topical talks, and good music. They identify often throughout the English session. (BV)

**Jamaica**—Radio Jamaica, Kingston, can be noted on 4950 kc. mornings around 0600-s/on November, 1956

---

**EZ2 Build**

Introducing the Brand New, Low-Cost, Top-Performing

**90 Watt Globe Chief Kit**

(75 WATTS FOR NOVICE USE)

**Only $500 per mo.**

Complete Instruction manual; all parts, chasis pre-punched; wires pre-cut and pre-tined. No experience necessary.

* The new WRIL Plug-In Screen Modulator Kit (complete) has been designed for use with the Globe Chief, may also be used with the Johnson Adventurer, Heath Kit AF-1, or similar CW Xettras. . . . $13.95

SEND FOR DETAILED BROCHURE TODAY!

---

**FREE 1957 CATALOG!**

WORLD RADIO LABORATORIES
3415 West Broadway
Council Bluffs, Iowa

Please rush to me:

- Free 1957 Catalog
- Globe Chief Brochure

**NAME:**

**ADDRESS:**

**CITY & STATE:**

---

123

www.americanradiohistory.com
YOUR F.C.C. LICENSE
GUARANTEED PREPARATION
Get Your License by the Easy Emig Method—Paced at Your Speed—Study Time at Your Convenience.
Write Now For Free Information
EMIG SCHOOL OF ELECTRONICS
4902 SUNSET BLVD.
HOLLYWOOD 27, CALIF.

Please Be Sure to Mention
POPULAR ELECTRONICS
When Answering Advertisements

36" FLEXIBLE SHAFT
For Precision Working
...Hard-To-Reach Places!
Reg. $9.95...NOW $5.95

plus 35c p. & h. iff.

This flexible, heavy, round, all-steel, complete handle increases the utility of your electric file, electric graver, etc., in high places, etc. A 35c tip guard will prevent breakage. Easily attached. Easily attached. Easily attached in a drill, small electric file, driller, bending, polishing, filing, etc., on wood, metal, glass, and plastics. The Flexible Shaft is tamper-proof, seal-approved and designed for life-time service. Can be sharpened at costs up to 6000 R.P.M.

12 Pc. Needle & Warding FILE SET

ONLY $2.48 1/4 c. ea.

Made from the finest quality tool steel to fit the requirements of all general purpose file, watch and jewelry craftsmen, hobbyists. Attaches to your drill or file. Includes the following files: long, medium, short, and extra short—8 sets, 4 sets with high test cutting qualities. Flat, knife, square, or triangular. In all textures: medium fine, medium, medium coarse, course, coarse. Comes with individual wood handle and new, attractive, money-back guarantee. Send check or M.O. COD fee extra.

SCOTT-MITCHELL HOUSE, INC.
DEPT. W-265, 611 BROADWAY
NEW YORK 12, N. Y.

75c ea. for Finest Imported
PRECISION Pliers

- Flat Nose
- Combination
- Bent Nose
- End Cutting Nippers

One Side Flat—One Side Round

Suitable for Jewelers, Optical Workmen, Horologists, Craftsmen of all Kinds.

NOW $1.25

SET OF 6 SWISS PRECISION SCREWDRIVERS

NEW
LOW PRICE

For Jewelers, watchmakers, etc., includes SIX DIFFERENT SIZES.

No. 2 No. 3 No. 4 No. 5 No. 6 No. 10

Received lady grip assures easy handling. Finest steel and top-grade quality. A long-time favorite from Switzerland.

SCOTT-MITCHELL HOUSE, INC.
DEPT. W-265, 611 BROADWAY
NEW YORK 12, N. Y.

SHORT-WAVE CONTRIBUTORS

Maurice Ashley (WIA), Wichita, Kansas
Robert Barnes (RB), Long Beach, Calif.
Port Baughman (PB), Rockport, Texas
John Beaver (RP), Fort Worth, Tex.
Bob Buckner (BB), Victoria, Texas
Donald Chester (DC), Dallas, Texas
Gerry Dexter (DX), Waterloo, Iowa
Jimmy Duncan (JD), Horse Cave, Ky.
Silva Dunn (SD), Little Rock, Ark.
Arthur Fregeau (AF), Boston, Conn.
I. J. Gatuchle (JG), Vancouver, B.C.
Manuel Greco (MG), Spring, Tex.
Harley Grimmer (HG), Cheenook, N. B.
Clifton Hurn (CH), LaJolla, Calif.
Ronald Jones (RD), New Orleans, La.
Roger Legge (RL), Detroit, Mich.
John Mann (JM), Montreal, P.Q.
Paul Moore (PM), Grand Rapids, Mich.
Chuck Maxant (CM), Baldwin, N. Y.
Kurt Meteor, Jr. (KM), Ortonville, Mich.
James Mundal (MO), East Haven, Conn.
Gordon Nelson (GN), Englewood, Calif.
Martin Potter (MP), London, Ont.
Joel Richmond (IR), Mattapan, Mass.
Dale Smith (DS), Milwaukie, Or.
Rick Sears (RS), Osage, Iowa
Norman Siver (NS), Elveron, Pa.
Bill Waltz (WH), Seattle, Wash.
Tom Watkins (TW), Mansfield, Ohio
Stewart West (SW), Union, N. J.
J. Richard Woodyatt (RP), Sanborn, Pa.
Ted Zegoshick (TZ), Johnstown, Pa.

USA, Central and South America. They feature United States pop records with Spanish commentary. Their address is Fomento de Radio S.A., Avenida Colón 101, Mexico City, XEHH, La Voz Polisima, Mexico City. Is a good one for L-A music during most of the day on 11,880 kc, evenings on 11,880 kc, as is companion station, XERH, 1500 kc. (JG)

Mozambique—Radio Clube de Mozambique is being widely reported. It can be tuned on 15,888 kc. around 1500-1515 in a test xmsn of news and music with a gong before each ID. This xmsn is reported parallel with 17,795 kc to Europe. Reports go to Box 594, Lourenco Marques. (SW)

CR7BE is noted on 11,984 kc. at 0030-0100 s/o/off with Portuguese language and popular

Always say you saw it in—POPULAR ELECTRONICS

124
music. ID is *Aquí Radio Clube de Mozambique.* (BV)

The outlet on 4920 kc. can be heard in English around 2310-2320 but this might be difficult due to QRM. (JD)

**Netherlands**—Radio Nederland, Hilversum, presents a program called "Mail Bag" on Sundays at 2343-2350 on 6580 kc. They invite reception reports, comments, and requests. Reports go to Mr. Edward Startz, P.O. Box 136, Hilversum. (RJ, TW)

**New Zealand**—Radio New Zealand has moved from 15,220 kc. to 15,110 kc. for its Australian beam at 2300-0115 s/o, dual to 15,280 kc., to the Pacific Isles. The DX program gave the schedule at 1905-0115 on 15,110 kc. and at 1500-1900 on 15,220 kc. (SW, BV)

Other outlets on 6000 and 8540 kc. can be noted 0100-0445 s/o with news, music, and talks. (RB)

**Pakistan**—Radio Pakistan can be heard on 21,580 kc. at 1330-1400 in English, with recorded music, to Turkey, and on 15,400 kc. at 1940-2000 with native music. (DS, MG)

**Peru**—OAX4T, Radio Nacional del Peru, 9580 kc., Lima, is often heard evenings around 2130 with excellent musical programs and announcements in Spanish.

New stations operating are: OAX1D, Radio Chiclayo, Chiclayo, 3380 kc.; OQB4Z, Radio Luz, Lima, 6115 kc.; and OAX8E, Radio Loreto, Iquitos, 6250 kc. (RL)

**Portugal**—Lisbon has resumed use of 21,495 kc. and is heard at 0600-0800 in dual with 17,895 and 21,700 kc. A new channel is 15,100 kc. heard at 1700-2030. The 15,380-kc. channel has apparently been dropped. The 17,895-kc. outlet can also be tuned in English at 1200-1245, in Portuguese after 1745. (RL, BV)

**Spain**—Radio Mediterraneo, Valencia, 6995 kc. has been heard again at fair level at 1800-1830 s/o with programs of Spanish music. Identity is *Transmision Radio Mediterraneo de la Sociedad Espanola de Radiodifusion.* Closes with Viva Frances, Arriba Espana and the Spanish National Anthem. (PM)

**Switzerland**—HER4, Berne, 9500 kc., is often heard, dual with HER3, 6165 kc. and HER5, 11,865 kc., in English at 2320-0000 with discussions, news, and musical programs. This is in N.A. Service. (BB and many others)

**Tchili**—Radio Tahlit, Papeete, 6135 kc., can be heard in French and native languages at 2350-0030. English segment was changed from 0245-0300 to 0230-0245. (BW, JG)

**Tangier**—Radio Tangier International, not to be confused with WTAN, is testing at various times during the day with English and Danish announcements. It can be noted at 1730-1740 and 1800-1810. Test xmsns usually last about ten minutes. An announcement stated that a service in Danish probably would be started soon. Reports go to 33 Goya Street, Tangier, North Africa. (SW, PM, JG)

**Union of South Africa**—Johannesburg, 25,880 kc., is operating at 0730-0845 Monday to Friday in English and Afrikaans. It has also been noted at 1230-1345. The 3220-kc. outlet carries English at 1300-1600, Afrikaans at the same time on 3380 kc. (DX, MO)

---

**Get This Valuable Book FREE!**

Yes, you get this big, brand new book, "150 Radio-Television Picture Patterns and Diagrams Explained," absolutely FREE! Just off the press. Gives complete 11 x 12" Schematic Diagrams on leading models Radio and TV Sets. Easy to read, large type, x.11" pages, with full instructions on how to use the diagrams. A "must" in every repair kit. You get this book as a FREE gift for ordering to see Coyne's new 7-book set, "Applied Practical Radio-Television!" 

**AT LAST! MONEY-MAKING "HOW-TO" ON TRANSISTORS, COLOR TV AND SERVICING**

Coyne's great 7-volume set gives you all the answers to servicing problems—quickly! For basic "how-to" that's easy to understand, you'll find everything you want in Volumes 1 & 2 on over 5000 practical facts and data. Every step from fundamentals to installing, servicing and troubleshooting all types of radio and TV sets. So up-to-date it covers COLOR TV, UHF and the latest on TRANSISTORS. All this plus Volume 3--Coyne TECHNICAL DICTIONARY with over 4000 definitions of the latest terms, symbols and abbreviations in radio-TV, electronics and electricity.

**EXTRA! 900-PAGE TELEVISION CYCLOPEDIA INCLUDED**

And then there is our unique "In-Your-Hand" 900-page Cyclopaedia. It answers today's television problems on servicing, alignment, installation, etc. in easy-to-understand "how-to" order, cross-indexed. Use this 7-volume TV-RADIO LIBRARY FREE for 7 days; get the valuable Servicing Book ABSOLUTELY FREE!

---

**Educational Book Publishing Division**

COYNE ELECTRICAL SCHOOL

500 S. Paulina St., Dept. BD-PE Chicago 12, Ill.

November, 1956

SEND NO MONEY! Just mail coupon for 7-volume set on 7 days free trial. We'll include book of 150 TV-Radio Patterns and Diagrams. If you keep the set, pay $2 in 7 days and $2 per month until $24.50 plus postage is paid. (Cash price, only $22.95.) Or you can return the library at our expense in 7 days and owe nothing. YOU BE THE JUDGE. Either way, the book of TV-Radio Patterns is yours FREE to keep! Offer is limited. Act NOW!

**FREE BOOK—FREE TRIAL COUPON!**

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

*Check here if you want library sent C.O.D. You save minimum $22.95 plus C.O.D. postage on delivery. 7-day money-back guarantee.*
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 (Bio-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.


INVENTORS
Send for PATENT INFORMATION Book and INVENTOR'S RECORD without obligation

GUSTAVE MILLER
116-PE WARNER BUILDING WASHINGTON 4, D. C.

INVENTORS
REGISTERED PATENT ATTORNEY
ASSOCIATE EXAMINER
U.S. PAT. OFF. 1922-1929

Patent Attorney & Advisor
U. S. NAVY DEPT. 1930-1947
PATENT LAWYER


RANGES OF CONTROL available with the circuits shown in (C) and (D) on page 55 are shown respectively in the two graphs above. Shaded areas indicate total range. Any combination of values between outer lines is possible. Note that the bottom graph shows that the point in the frequency spectrum, where tonal boost or cut begins, can be varied as well as the actual amount of boost or cut. For this reason, the circuit—the Baxandall system—is generally rated as best for hi-fi.

Always say you saw it in—POPULAR ELECTRONICS
generally called "universal" tone controls.

One very widely used type is shown in the schematic (C) on page 55. The first graph on page 126 is the range of control available with this circuit. Given a pair of such controls, the listener becomes a virtual conductor of his own orchestra, and can add such coloration and emphasis (or de-emphasis) as he deems necessary for over-all tonal balance. As is true of less notable conductors, however, some audiophiles insist on overdoing it.

Generally accepted procedure for correct use of tone controls is to start by leaving them in the "flat" or uniform response position. This is usually the center position on the knob. As the listener becomes more perceptive, and more sensitive to the peculiar aspects of his own listening area, he may find that moderate amounts of boost or cut may be used until the system sounds "just right." Cranking up both treble and bass controls as far as they will go proves nothing about the fidelity of the system and generally results in jarred nerves.

**Baxandall Tone Controls.** While great flexibility and range of control is afforded by the system just described, it has what many consider a slight drawback. The point in the frequency spectrum at which boost or attenuation begins is always approximately the same, about 800 cps. Thus, if 6 to 8 db of boost is really needed at 50 cycles to bring a particular speaker system into line, it can only be achieved by including about 3 db of boost at 300 cps. But no boost at all is really desired at 300 cps—it would lend a boomy quality to the sound, particularly to male voices.

This difficulty is overcome by a recent type of universal tone control system which uses feedback. The basic schematic for this system is shown in diagram (D) on page 55; its range of control is shown in the second graph on page 126. Both boost and attenuation, as well as the point at which these effects begin, are made completely variable, depending on the control setting.

For this reason, it is known as a "variable crossover" tone control, as well as by the name of its designer, P. J. Baxandall. This type of control system is considered by many to provide more pleasing results and flexibility. As a result, it has gained favor with many manufacturers in recent years.

The diagrams on page 55 and the two graphs (left) should help in identifying tone control circuits in amplifiers. To assess fully the merits of each system, the prospective buyer should try the action and listen to the results of the various systems. Don't ignore tone controls and the importance of using them correctly. They can pay off in years of pleasurable listening.

November, 1956
Bargain Basement

HI-FI Custom-Kit

YOU can have superb Hi-Fi in your car with this amazing near-deck Speaker kit. Response 30-15,000 cps. with Big 6-1/2" woofer and extended range tweeter. Easy to install. Includes leads, attractive 3-pos. switch, handsome chrome grill, hi-fi speaker, complete instructions.

Money Back Guarantee

ONLY $795

(Regular list $15.95)

NATIONAL ELECTRONICS

6612 Euclid
Cleveland 3, Ohio

EXCLUSIVE WITH LEKTRON!

3 IN 1 TRANSISTOR RADIO KIT

Sun-Powered. Mercury Cell-Powered or Dual-Powered pocket radio. Sensitive, selective, with ample power. Sun Battery for daylight operation (open 100 W lamp, too) mercury cell for night—contains regular batteries 5 times! ALL PARTS MOUNTED—only MINUTES to assemble! Pre-drilled stereo cabinet, hi-gain transistor, s/s speaker, stick, mini. variable condenser, phone jacks, switch, wire, hardware and step-by-step instructions. $7.88

ORDER TODAY! Drive your car make and year. Include payment with order for prepaid shipment. (As C.O.D. fees and postage extra.)

NATIONAL ELECTRONICS

28 GARDNER STREET
CHELSEA 50, MASS.

USED TV CONSOLES

Guaranteed in working condition

Wholesale

RCA 12" 1977.50 ZENITH MOTOROLA 16" $36.95 TELEKING MAGNAVOX 17" $52.95 ADMIRAL OTHERS 19" $54.95

ORDER preferred make. We'll try to accommodate.

Free indoor antenna with each set

Send Check or Money Order. No C.O.D.'s.

All sets shipped F.O.B. Newark, N. J.

TV SUPER MALL, INC.

1 White Terrace
Newark 8, N. J.

Telephone: Essex 5-2162

R-1/Arr-1 RECEIVER

Brand New

$1.95

THE very popular 200 mc. one with conversion dial. Tuned 238-250 mc. Brand new demilitarized (input coil base bled). Ship. wt. 4 lbs. EA. $1.95

Brand new. Not demilitarized. Ship. wt. 6 lbs. EA. $2.95

INCLUDE POSTAGE. MONEY BACK IF RETURNED PREPAID WITHIN 10 DAYS

ESSE RADIO CO.

42 WEST SOUTH ST.
INDIANAPOLIS 25, INDIANA

SIMPLEX—DUPLICITY—TRIPLEX

RADIO CONTROL OF MODELS—ALL SYSTEMS AVAILABLE FROM ESSE RC PRODUCTS

WORLD'S LEADING RC MATERIAL SUPPLIER

Build the new multi-controlled R/C system described in this issue. Complete deluxe parts kit to build your own kit. $14.95

Complete factory-wire tested, ready for use

A Twin Tube Receiver At Price Of Simple Tube

Tune super special Rossom-Lorenz receiver for beginners and old-timers too. Factory wired, includes sensitive Carbon Sigma relay and General Rossom Control Panel.

Complete deluxe parts kit to build your own 9.95

Esso as always brings you the best buy in N.M.K.S. House in handsome black wrinkle case with sturdy whip antenna, remote click type keyer. Dudda antenna tuning network enables easy tuning for maximum output. Complete factory wired ready for use except batteries. $9.95 for 1 or 3 watt Lorenza MOPA. Each models at same low price. With Free FCC form 3.95

Esso Products Available Also From Your Hobby Shop Fracmer

ESSE RC PRODUCTS

58 WALKER ST.
N.Y.C. 13, N. Y.

RAD-TEL SPECIAL DEAL!

ASSORTMENT OF 100 RADIO & TV TUBES

All Packaged! All Popular Types!

Pkg. of 100

$1189

RAD-TEL TUBE CO. Dept. B 115 Colt St. Irvington, N. J.

TWO TRANSISTOR RADIO KIT

TRIKIT Electronics Ad-

duced. Kit includes complete with battery and Plastic Case. Mega neat Loe- In-structious—Pictoral Di-

agrams—Schematic—Parts List. Regenerative Cir-

cuit. Receives all Local Stations. Shipping Weight, .90 lb. Use 101-104 Batteries. R.C. Phone or For Above $5.00. Include Postage With Orders

BRIDGEPORT ELECTRONICS

325 State St., Bridgeport, Conn., Dept. P.E.
SORRY, NO RETAIL

Resistors (in lots of 100 each, no mixed values), half-
waist 10%, $1.75; one-watt 10%, $3.50; two-watts
10%, $4.10/C. Tubular capacitors, .1 mf-400 V. $1.00/C; .1 mf-600 V. $5.00/C; 0.1400 V. $2.75/C;
.001-600 V. $3.85/C; .001-1000 V. $2.75/C; all
wax impregn'd & axial leads. RCA #904 anode tubes, $1.00/C. Hookup wire, plastic, solid or stranded color
choices, $3.50 $24-1000 ft. reels; $4.25 $22-1000 ft.
reels. DM-36 (used) but guaranteed $80.00 for one
hundred. Write for low-watt prices on sockets, snaphetti, wire-wound resistors, jacks, knobs, switches;
molded, mica, silver-mica, disc, ceramic capacitors; adel
clamps; grommets; screws; nuts; anode brackets; ter-
minal strips, etc. Please furnish credit ref. w/initial order. Sorry, on retail. 2/10 n/30
GOULD GREEN, 252 Greenwich St., N. Y. C. 7

RADIO CONTROL

Headquarters For model airplanes, boats, cars, etc. FREE CATALOG -P."
No operator's license required. FREE-SEND FOR FCC FORM 505
Garage Door Radio Control Transmitters & Receivers Kits Available.

R/C TRANSMITTER & RECEIVER KIT

2114, Mr. S. Walker, 2114 East Willaume Ave., Superior, 2- Tube
Simple Receiver-Parts incl. Drilled Bases Wound Coil, Res.,
Cond., SIGNS, Relay, Instruc. Only... $9.95

SIGMA OF RELAY: R-800 ohm: $2.85; 6 Reed Relay
$14.95.

24V Battery Charger Kit $4.85: watt, 3-5 1/2 V. micro
R/C BOOKS: Model Control 91; Radio Control 91; Handbook
2.25
CRYSTALS: 27.255 Mc. Potters # Z5A $3.00, HOLDER
2.15
2 METERS, 150 Microah, $3.95, 500 Microah
3.95
RELAY CONTROL UNIT

$14.95

TUBES: XGCI, RG61, 344, 345, 1AG4, G6K, TRANSISTORS
$9.95
STUFFED BATTERIES: Mini. 6V, N7, $2.45; 2 Volt 278A Hour 2.75
Diode PM MIDGET NOCTOR, 2 Volt 10000 RPM. 2 1/2 G.M.
$1.95
SIGMA RELAYS: 1000 ohm, 3 No., DC-L 110V AC SPDT, 250 VAC, .1 sec.
3.25-P CANAL ST.,
N. Y. 13, N. Y.

GYRO ELECTRONICS

FOR SALE

TUBES-Parts-80% off-Free List. Federal 986, 18th
Ave., Newark, N. J.

COMPLETE Television sets $11.95. Jones TV, 1115
Rambler Avenue, Pottstown, Pa.

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.

DIAGRAMS for repairing radios $1.00, Television $2.00.
Give make, model, diagram service. Box 672-P.E.
Hartford 1, Conn.

DIAGRAMS! Repair Information! Radios—Amplifiers—
—Recorders $1.00, Television $1.50. Give Make, Model,
Chassis. Nordico-Philips and Ampexy tubes in stock!
TV Milite, Box 101-P.E, Hicksville, New York.

"AUTOMATIC Garage Door Control" book; standard
parts, radio or post control. Complete instructions,
exploded view, photos. $1.50. R-L Books. 1339-C
Debby, Van Nuys, California. Guaranteed!

WALKIE-TALKIE. Build wireless portable radiophone
for less than $100. Plans for variable frequency and
crystal control types, only 50c for both. Springfield
Enterprises, Box 54-E11, Springfield Gardens 15, N. Y.

When you order by mail . . .
please print your name and address clearly, be specific in your order,
enclose proper amount, allow ample time for delivery.

SOLD BY

LAFAYETTE SPECIAL

R/C RECEIVER

Completely wired and assembled,
with tube, ready to operate on
exemfree 27,255Mc remote con-
trol band. Size: 156" x 1-1/16" x
3/4" weight 3.3 oz. Use one 1.5
volt and one 46 volt battery. Less
batteries, Shpg. wt., 6 oz.

CLASSIFIED

Please refer to the enclosed articles
for additional information.

When you order by mail . . .
please print your name and address clearly, be specific in your order,
enclave proper amount, allow ample time for delivery.

FOR SALE

TUBES-Parts-80% off-Free List. Federal 986, 18th
Ave., Newark, N. J.

COMPLETE Television sets $11.95. Jones TV, 1115
Rambler Avenue, Pottstown, Pa.

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.

DIAGRAMS for repairing radios $1.00, Television $2.00.
Give make, model, diagram service. Box 672-P.E.
Hartford 1, Conn.

DIAGRAMS! Repair Information! Radios—Amplifiers—
—Recorders $1.00, Television $1.50. Give Make, Model,
Chassis. Nordico-Philips and Ampexy tubes in stock!
TV Milite, Box 101-P.E, Hicksville, New York.

"AUTOMATIC Garage Door Control" book; standard
parts, radio or post control. Complete instructions,
exploded view, photos. $1.50. R-L Books. 1339-C
Debby, Van Nuys, California. Guaranteed!

WALKIE-TALKIE. Build wireless portable radiophone
for less than $100. Plans for variable frequency and
crystal control types, only 50c for both. Springfield
Enterprises, Box 54-E11, Springfield Gardens 15, N. Y.

EXECUTIVE electronic KITS

COMPLETE KITS

FOR ARTICLES

DESCRIBED IN THIS AND OTHER
MAGAZINES—WRITE FOR PRICES
EACH MONTH
ALGERADIO ELECTRONICS CO.

236 N. Franklin St. Phone IV 9-0808 Hempstead, N. Y.

When you order by mail . . .
please print your name and address clearly, be specific in your order,
enclave proper amount, allow ample time for delivery.

FOR SALE

TUBES-Parts-80% off-Free List. Federal 986, 18th
Ave., Newark, N. J.

COMPLETE Television sets $11.95. Jones TV, 1115
Rambler Avenue, Pottstown, Pa.

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.

DIAGRAMS for repairing radios $1.00, Television $2.00.
Give make, model, diagram service. Box 672-P.E.
Hartford 1, Conn.

DIAGRAMS! Repair Information! Radios—Amplifiers—
—Recorders $1.00, Television $1.50. Give Make, Model,
Chassis. Nordico-Philips and Ampexy tubes in stock!
TV Milite, Box 101-P.E, Hicksville, New York.

"AUTOMATIC Garage Door Control" book; standard
parts, radio or post control. Complete instructions,
exploded view, photos. $1.50. R-L Books. 1339-C
Debby, Van Nuys, California. Guaranteed!

WALKIE-TALKIE. Build wireless portable radiophone
for less than $100. Plans for variable frequency and
crystal control types, only 50c for both. Springfield
Enterprises, Box 54-E11, Springfield Gardens 15, N. Y.

EXECUTIVE electronic KITS

COMPLETE KITS

FOR ARTICLES

DESCRIBED IN THIS AND OTHER
MAGAZINES—WRITE FOR PRICES
EACH MONTH
ALGERADIO ELECTRONICS CO.

236 N. Franklin St. Phone IV 9-0808 Hempstead, N. Y.

When you order by mail . . .
please print your name and address clearly, be specific in your order,
enclave proper amount, allow ample time for delivery.
INVENTIONS WANTED


TAPE RECORDERS


PRE-RECORDED Tapes. Low price recording tape. Accessories, Catalogue, also Sales, 270-A Concord Ave., West Hempstead, N. Y.


TAPE RECORDERS, surplus, $244.50 Webcor, brand new, scarred, for $145.50; Telecrosor for $84.50; Wilcox-Gay cost $165.00, used, like new for $75.00. Used Ecor good shape for $59.50. Several P. A. System bargains. Geo. F. Bischof, Fort Worth 4, Texas.


BUSINESS OPPORTUNITIES

TO $100.00 Weekly. Sparet ime, Home Operated Mail-order Business, Successful "Beginner's" Plan. Everything supplied. Lynn, 10420-E National, Los Angeles 34.

VENDING Machines—No Selling. Operate a route of coin machines and earn amazing profits. 30-page catalog free. Parkway Machine Corporation, Dept. 12, 715 Ensor St., Baltimore 2, Md.

PLATE Baby Shoes, jewelry, gifts, bronze and colored pearl. Free booklet. Thompson, 11629 South Vermont, Los Angeles 44, Calif.

BUY Wholesale! Resell at big profits. Brand name merchandise—Appliances, cookware, housewares, watches, jewelry, dry goods, clothing, sporting goods, toys, etc. Etc. Prepaid. Free catalog listing over 100 items with confidential cost sheet. Merit Home Products, Dept. PE 11, 101 Manhattan Ave., Brooklyn 6, N. Y.


HUGE Monster Mall, 25¢—William Greener, Box 396-L, Burley, Idaho.


INSTRUCTION

ENGINEERING. Degrees earned by home study. Residential Courses also Available. American College of Engineering, Box 27724-D, Hollywood 27, California.

BECOME Tax Consultant. Graduates earn $3,000 every tax season preparing returns evenings. State approved. Union Institute, 68 Hudson, Hoboken 3P, N. J.

RECORDS


MISCELLANEOUS

SONGPOEMS and Lyrics Wanted! Mall to: Tin Pan Alley, Inc., 1650 Broadway, New York 19, N. Y.


GUARANTEED 100 Double Edge Blades. Finest Qual ity—$1.00. United, Box 7, Corona 66, N. Y.

COMPLETE Pocket Printer, Pad, Handy Carrying Case. Three Lines $1.00—500 Distinctive Useful Gummed Name & Address Labels $1.00—United, Box 7, Corona 66, N. Y.

Always say you saw it in—POPULAR ELECTRONICS
The "Tirade Terminator"

(Continued from page 50)

guished and left that way throughout tests and installation. In the final installation, mark the plug and the receptacle with paint or crayon to insure that the plug, if inadvertently removed, will be replaced properly.

When the foregoing instructions for establishing the chassis at house-ground potential are followed to the letter, there is absolutely no danger of a.c. shock from the lines. For those who do not wish to perform these checks, it is suggested that an isolation transformer be inserted between the a.c. input to the intercom and the line. It should be remembered, however, that the use of a transformer carrying a.c. introduces the possibility of hum pickup in the high-gain stage of the intercom, so provision should be made for mounting it at a distance from the 1A5, preferably at the far end of the a.c. cable.

Any 117-volt lamp cord may be used between the master unit and the remote speaker. Use a weatherproof housing outdoors and the plastic cabinet indoors, as shown in the photographs, for the remote speaker.

Mixing It Up

(Continued from page 83)

may be used to set the over-all level of the mixed signal as it emerges from the mixer and enters the tape recorder.

Commercially Available Mixers. For those who want to have—but not build—their own mixers, there are several fine units on the market. They range from Switchcraft's modest little "Mini-Mix" to the elaborate, studio-type facilities found on such recorders as the Ampex 601. A neat two-channel mixer-fader, which may also be used as a preamp on one channel, is made by Fisher; a four-channel mixer is produced by Pentron. Some of the newer, high-quality preamp-control units for hi-fi systems have mixing facilities built in. For specific information regarding such units, contact the manufacturers or your local parts or hi-fi dealer.

The mixer you choose to build or buy should be the one that meets your needs as regards the type of signals to be fed into it, the number of different channels required, the degree of gain needed, and the audio quality expected from it in terms of the tapes you're recording. Whatever your choice, the mixer will bring a touch of the professional studio into your home and help you produce better recordings. —30—

SHOOT TV TROUBLE FAST

With H. G. Cisin's Copyright RAPID "TV TROUBLE SHOOTING METHOD"

Without experience or knowledge, this guaranteed new method of servicing TV sets enables you to DIAGNOSE TV troubles as rapidly as an expert. NO THEORY—NO MATH—you can locate all faults in record-breaking time regardless of make or model. "TV TROUBLE SHOOTING METHOD" is the most valuable aid to TV servicing ever written. Be a TV Trouble Diagonist, increase your present earnings. Own your own Profitable Business or get a high-paying skilled job.

It's all in this book...

Nothing more to Pay—Nothing else to Buy

85 picture troubles, over 80 raster and 17 sound troubles. By this unique copyrighted method you know EXACTLY WHERE the trouble is, plus step-by-step instructions, including 60 RAPID CHECKS, enabling you to find the faulty part.

13 IMPORTANT PRELIMINARY CHECKS NEED NO INSTRUMENTS! of the 60 Rapid Checks. OVER 55 ALSO REQUIRE NO INSTRUMENTS! Rapid checks include emergency checks for distorted pictures, defective tubes including P1X tube, plus 57 others. ALL EXPLAINED IN SIMPLE LANGUAGE. PERFORMED WITHOUT INSTRUMENTS. MANY CHECKS USE THE PICTURE TUBE AS A GUIDE.

H. G. Cisin, the author, is the inventor of the AC/DC midsize radio. He licenses RCA, AT&T etc. He has also trained thousands of technicians now servicing their own problems TV servicing organizations or holding highly paid TV positions. His years of experience are embodied in this remarkable new book. Guaranteed Money Back in 5 Days if Not Satisfied!

RAPID CHECKS NEED NO INSTRUMENTS! of the 60 Rapid Checks. OVER 55 ALSO REQUIRE NO INSTRUMENTS! Rapid checks include emergency checks for distorted pictures, defective tubes including P1X tube, plus 57 others. ALL EXPLAINED IN SIMPLE LANGUAGE. PERFORMED WITHOUT INSTRUMENTS. MANY CHECKS USE THE PICTURE TUBE AS A GUIDE.

H. G. Cisin, the author, is the inventor of the AC/DC midsize radio. He licenses RCA, AT&T etc. He has also trained thousands of technicians now servicing their own problems TV servicing organizations or holding highly paid TV positions. His years of experience are embodied in this remarkable new book. Guaranteed Money Back in 5 Days if Not Satisfied!


RUSH COUPON NOW!

H. G. CISIN, CONSULTING ENGINEER, 1327 Pennsylvania Ave., N.W., Washington 50, D. C.

Enclosed find $1. Rush both books.

Name

Address

City Zone State

Guaranteed Money Back in 5 Days if Not Satisfied!

NOW ON SALE EVERYWHERE!

1957 PHOTOGRAPHY ANNUAL

A tribute to the world's greatest photographers, by the editors of Popular Photography

Copyright 1957, Popular Photography

Now ON SALE EVERYWHERE!

November, 1956
WRITE FOR NEW BONUS CATALOG
1000's of Un-Advertised Specials

INFRARED SNOOPERSCOPE
See in Dark Tube
SELECTED, CTG & TESTED for new resolution.
All cases image converter viewing tube. Hi-Res.
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 FULL-VIEW D'Arsonval type meter occupies exactly the same space used by the older standard 2 1/2" Meters, its 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 VOM.

FEATURES

★ Compact—measures 3 1/2" x 3 1/2" x 2 1/4"
★ Uses: Full Vu-true 2% accurate, 850 Microampere D'Arsonval type meter
★ Housed in round cornered, molded case
★ Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

Specifications

6 A.C. VOLTAGE RANGES: 0.15/ 0.30/ 1.50/ 3.00/ 7.50/ 15.00 Volts. 6 D.C. VOLTAGE RANGES: 0.75/ 1.50/ 7.50/ 15.00/ 75.00/ 150.00 Volts. 2 RESISTANCE RANGES: 0.10,000 Ohms, 0.1 Megohm. 3 D.C. CURRENT RANGES: 0.25/ 0.50/ 1.00 Amps. 3 DECIBEL RANGES: 0.6 db to 18 db, 14 db to 34 db, 28 db to 58 db.

The Model 770-A comes complete with self-contained batteries, test leads and all operating instructions.

$15.85

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/ 7,500 Volts
Output Volts: 0 to 15/ 30/ 150/ 300/ 1,500/ 7,500 Volts
D.C. Current: 0 to 1.5/ 15/ 150/ 1,500 Ma 0 to 15/ 15 Ampere

ADDED FEATURE: Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

Resistance: 0 to 1,000/ 10,000 Ohms 0 to 10 Megohms
Capacity: 0.01 to 1 Mfd. 1 to 50 Mfd.
(db test for electrolytics)
Reactance: 50 to 2,500 Ohms 2,500 to 2,500 Mfd. 500 to 25,000 Ohms
Inductance: 15 to 7 Henries 7 to 7,000 Henries
Decibels: 6 to 18 14 to 38 34 to 58

The Model 670-A comes housed in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

$28.40

SHIPPED ON APPROVAL
NO MONEY WITH ORDER — NO C.O.D.

We invite you to try before you buy any of the models described on this and the following pages, if after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE
CUT OUT AND MAIL TODAY!

Moss Electronic Distributing Co., Inc.
Dept. D-287, 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 TV-11... Total Price $47.50.
$11.50 within 10 days, Balance $36.00 monthly for 6 months.

☐ Model TC-55... Total Price $26.95
$6.95 within 10 days, Balance $19.00 monthly for 4 months.

☐ Model 670-A... Total Price $28.40
$7.40 within 10 days, Balance $21.00 monthly for 6 months.

☐ Model 770-A... Total Price $51.85
$17.85 within 10 days, Balance $34.00 monthly for 3 months.

Name ____________________________
Address __________________________
City __________________ Zone ______
State ____________________________

All prices net, F.O.B., N.Y.C.

www.americanradiohistory.com
**Superior’s New Model TC-55**

**Streamlined**

**Tube Tester**

The Experimentor or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester, The Professional Serviceman, who needs an extra Tube Tester for outside calls, The busy TV Service Organization, which needs extra Tube Testers for its field men.

- You can’t insert a tube in wrong socket. Separate sockets are used, one for each type of tube base. *“Free-point!” Element switching system* Any pin may be used as a filament pin and the voltage applied between that pin and any other pin or even the “top-cap.” *Checks for shorts and leakages between all elements.* Provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. *Elemental switches are numbered in strict accordance with R.M.A. specification.* The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system.

**Superior’s new Model TV-11**

**Standard Professional**

- **Tests all tubes including 4, 5, 6, 7, Octal, Octal Miniature, Sensitive, Projector, Condenser, Hearing Aid, Thyatron Miniatures, Sub-miniatures, Noval, Sub-minors, Professional standard snap switches**

- **Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the PMA base numbering system, the user can instantly identify which element is under test.** Tubes having tapped elements and tubes with elements terminating in more than one pin are truly tested with the Model TV-11 as none of the pins may be placed in the neutral position when necessary.

- **The Model TV-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.**

**EXTRA SERVICE** — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaying type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

**Tube Tester**

- **Free-moving built-in roll chart provides complete data for all tubes.**
- **Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.**
- **NOISE TEST: Phone-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.**

**The Model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with panel cover.**

**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 in this and the preceding page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send 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 without making any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

www.americanradiohistory.com