BUILD NO-LICENSE RADIO TRANSCEIVER

POPULAR ELECTRONICS

DECEMBER 1961

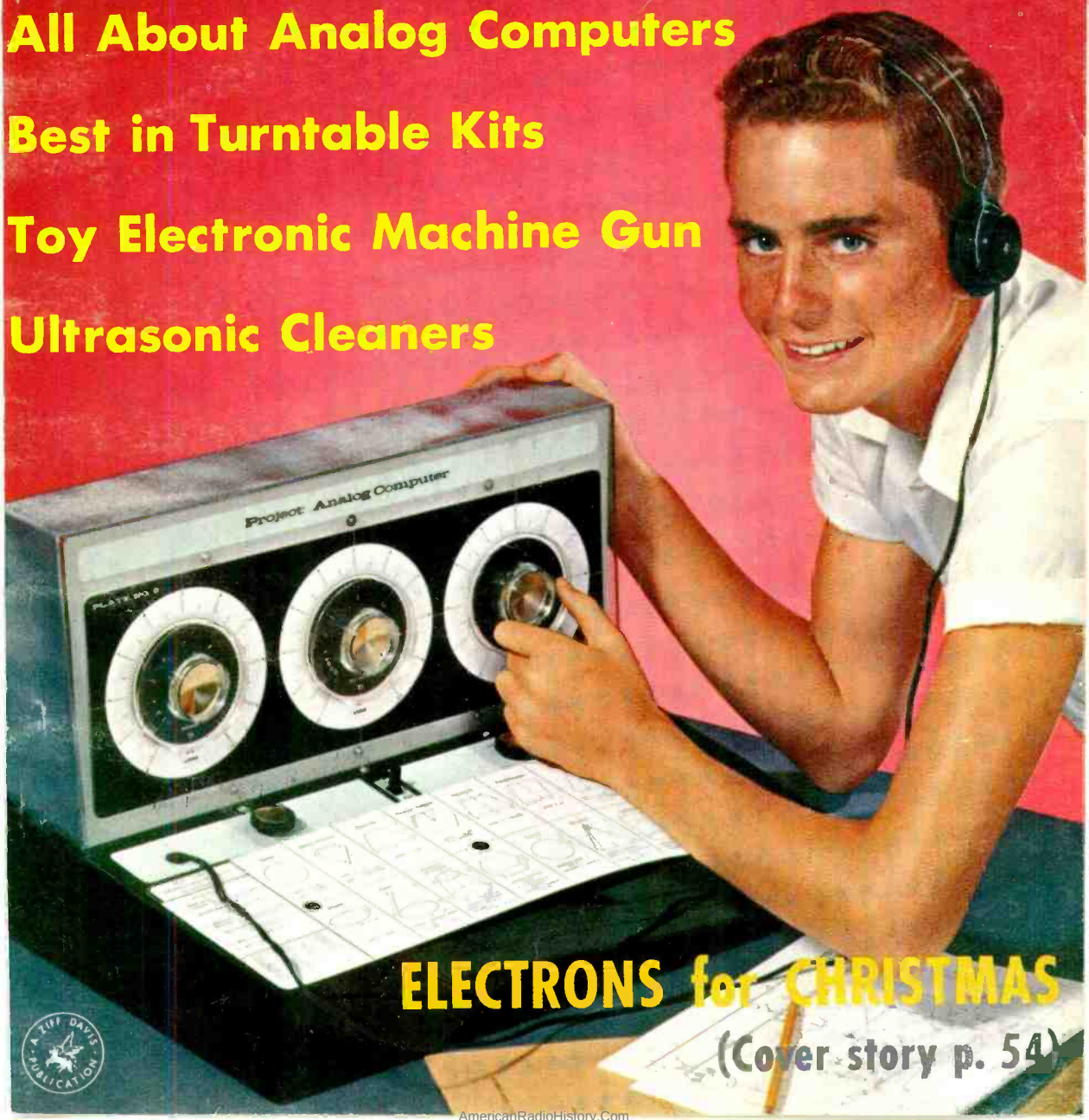
35 CENTS

All About Analog Computers

Best in Turntable Kits

Toy Electronic Machine Gun

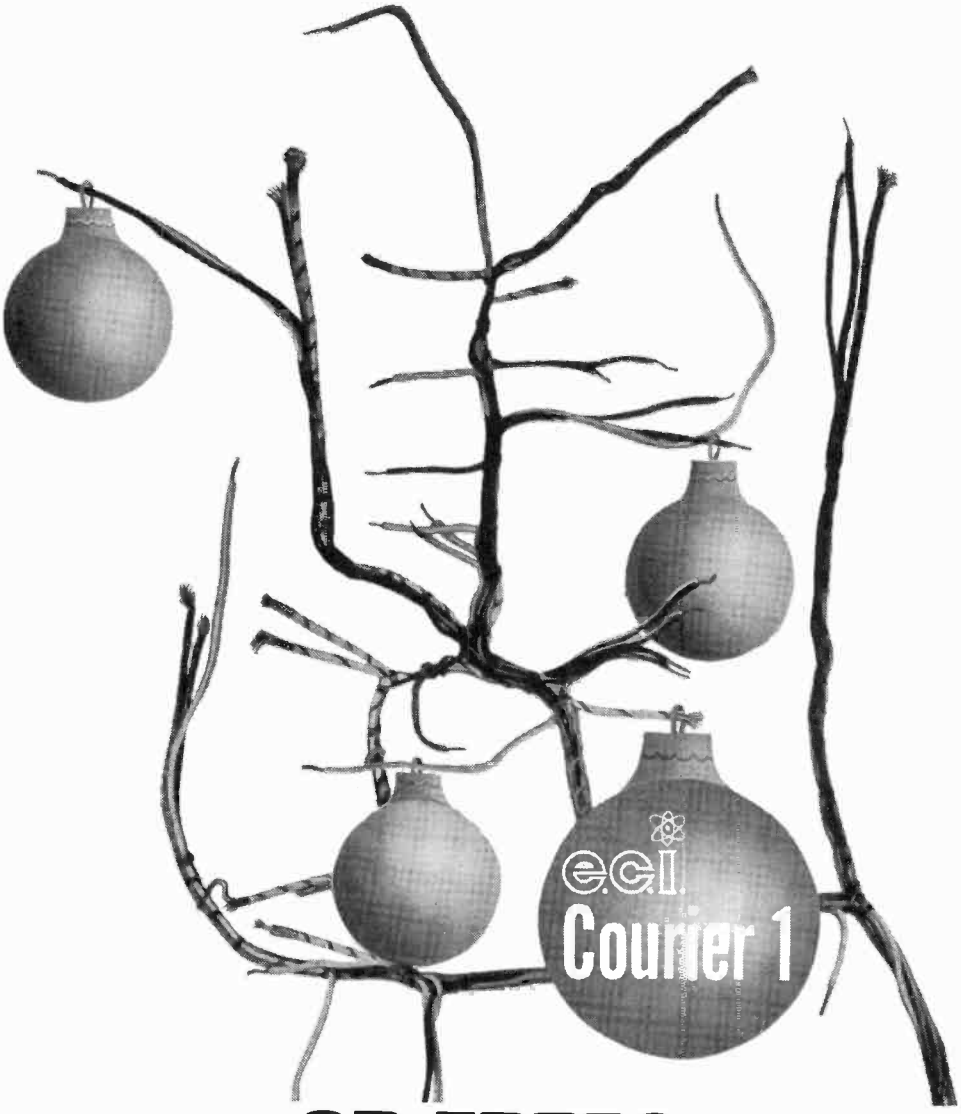
Ultrasonic Cleaners



ELECTRONS for CHRISTMAS

(Cover story p. 54)

A ZIFF-DAVIS PUBLICATION



CB TREE? It's actually the e.c.i. Courier 1 hand wired harness that ties together its five individual segments into a unitized chassis for simple installation, use and maintenance. And that's only part of the e.c.i. Courier 1 quality story. Think of every conceivable feature you need and want in a CB transceiver that will still get out more than 3 watts . . . e.c.i. Courier 1 has them. See for yourself.

- TRIPLE CONVERSION
- 12 CHANNEL TRANSMITTING
- FIXED & TUNABLE DRIFT-FREE RECEIVING
- BUILT-IN NOISE LIMITER & SQUELCH
- ELECTRONIC SWITCHING (no relays)
- FULLY MODULATED (100%)
- BUILT-IN "S" & "RF" METER
- LOWEST NOISE FRONT END
- MOBILE OR BASE (117 V. and 12 V.)
- ENTIRE UNIT SLIDES OUT ON TRACKS

write for free brochure

$189.50

Slightly higher west of Rockies

e.c.i. **electronics communications, inc.** 325 no. macquesten pkwy. mt. vernon, n.y.

"hello, little girl!"

Remember when birds talked? When toys came to chattering life at midnight and unseen playmates whispered in your ear?

The magic sounds of childhood's imagination are as elusive as smoke. Even Audiotape can't capture them. But fortunately there's magic in reality, too. And there, Audiotape doesn't miss a murmur.

Audiotape has greater clarity, range, more uniform output than others. And only Audiotape comes on the famous C-slot reel . . . Make it your silent (but knowledgeable) partner in capturing everything from Papa Haydn to Pop's bathtub baritone.

Remember: if it's worth recording, it's worth Audiotape. There are eight types . . . one exactly suited to the next recording you make!

audiotape TRADEMARK

"it speaks for itself"

AUDIO DEVICES INC., 444 Madison Ave., New York 22, N.Y.
Hollywood: 840 N. Fairfax Ave., Chicago: 7321 N. Hamlin Ave., Skokie, Ill.

POPULAR ELECTRONICS is published monthly by Ziff-Davis Publishing Company at 434 South Wabash Avenue, Chicago 5, Illinois. **Subscription** Rates: One year United States and possessions, $4.00; Canada and Pan American Union Countries, $4.50; all other foreign countries, $5.00. Second Class postage paid at Chicago, Illinois, and at additional mailing offices. Authorized by Post Office Department, Ottawa, Canada, as Second-Class matter. December, 1961. Volume 15, Number 6.

POPULAR ELECTRONICS

DECEMBER 1961

VOLUME 15 NUMBER 6

ZIFF-DAVIS PUBLISHING COMPANY

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

This month's cover photo by Joe Petrovec
Equipment courtesy General Electric Co.

Special Feature

Ultrasonics—Successes of Silent Sound.....*Ken Gilmore* 41

Electronic Construction Projects

The Roof Hopper.....*Hartland B. Smith, W8VVD* 47
Electronic Machine Gun.....*Martin H. Patrick* 58
The Whirly-Gig.....*Lee Martin* 70
Simple, Stable VFO.....*Herb S. Brier, W9EGQ* 74

Audio and High Fidelity

Hi-Fi Showcase..... 22
Turntable Kits Grow Up—Big!.....*Oliver P. Ferrell* 51
The Audio Pack.....*E. G. Louis* 61
Bigger Bass from Broadcast Sets.....*R. H. Decker* 72

Electronic Features and New Developments

Best Buys in EL-ED Kits.....*Louis E. Garner, Jr.* 54
Hobnobbing with Harbaugh: Key Clicks and Mike Splatter.....*Dave Harbaugh* 60
Introduction to Analog Computers.....*Julian M. Sienkiewicz* 65
Voltage Quiz.....*Robert P. Balin* 69
Transistor Topics.....*Lou Garner* 78
Carl and Jerry: The Bell Bull Session.....*John T. Frye, W9EGV* 82

Amateur, CB, and SWL

SWL/QSL Bureau..... 32
On the Citizens Band.....*Dick Strippel, 2W1452* 64
Across the Ham Bands:
How to Develop C.W. Operating Skill.....*Herb S. Brier, W9EGQ* 73
BBS—Black Box Special.....*Basil Barbee, W5FPJ* 76
Short-Wave Report:
DX'ing the VOA Amateur Radio Program.....*Hank Bennett, W2PNA* 81
Short-Wave Monitor Certificate Application..... 113

Departments

POP'tronics News Scope..... 6
Letters from Our Readers..... 8
Tips and Techniques..... 12
Coming Next Month..... 20
New Products..... 28
POP'tronics Bookshelf..... 34
Index to Volume 15 (July-Dec., 1961)..... 114

INTERNATIONAL'S Executive MODEL 100

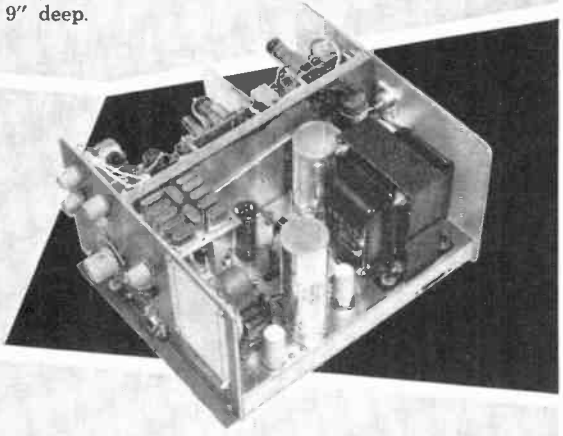
citizens band transceiver

A precision engineered transceiver for Citizens Band licensees seeking outstanding design and performance. Tunable dual conversion superheterodyne receiver covering all 23 channels. Two crystal control receive positions. Push-to-talk operation. Three way power supply for 6/12 vdc and 115 vac. Five watts plate input. Certified tolerance ±.005%. Size 5½" x 8½" x 9" deep.

Complete with 1 transmit crystal, 1 receive crystal, new style ceramic microphone and coil cord.....$199.50

Advanced engineering featured in the Executive Model 100

- NEW crystal filter minimizes adjacent channel interference.
- NEW built-in calibration circuit.
- NEW International NR squelch.
- NEW 12 position crystal control transmit channel selector.
- NEW front panel microphone jack.
- NEW provision for connecting external speaker and S/meter.



FREE INTERNATIONAL'S 1962 CATALOG

Your buying guide for precision radio crystals and quality electronic equipment. Complete data on International's Citizens Band transceivers and accessories.

Send for it TODAY!

International Crystal Mfg. Co., Inc.
18 North Lee, Oklahoma City, Okla.

Rush FREE 1962 Catalog PE2

Name_____
Please print

Address_____

City_____ Zone____ State_____

INTERNATIONAL Crystal Manufacturing Co., Inc. • 18 North Lee • Oklahoma City, Okla.

POPULAR ELECTRONICS

World's Largest-Selling Electronics Magazine
Net Paid Circulation 387,690

Publisher **PHILLIP T. HEFFERNAN**
Editor **OLIVER P. FERRELL**
Managing Editor **JULIAN M. SIENKIEWICZ, WA2CQL**
Art Editor **JAMES A. ROTH**
Associate Editors **MARC E. FINKEL**
RICHARD A. FLANAGAN
MARGARET MAGNA
Draftsman **ANDRE DUZANT**
Editorial Assistant **MARY ANNE O'DEA**
Editorial Consultant **OLIVER READ, W4TWV**
Contributing Editors **H. BENNETT, W2PNA**
H. S. BRIER, W9EGQ
J. T. FRYE, W9EGV
L. E. GARNER, JR.
D. STRIPPEL, 2W1452
Advertising Manager **WILLIAM G. McROY, 2W4144**
Advertising Service Manager **ARDYS C. MORAN**

ZIFF-DAVIS PUBLISHING COMPANY

Editorial and Executive Office (ORegan 9-7200)
One Park Avenue, New York 16, New York

William B. Ziff, Chairman of the Board (1946-1953)
William Ziff, President
W. Bradford Briggs, Executive Vice President
Hershel B. Sarbin, Vice President and General Manager
M. T. Birmingham, Jr., Vice President and Treasurer
Robert P. Breeding, Circulation Director
Charles Housman, Financial Vice President

Midwestern and Circulation Office (WAbash 2-4911)
434 South Wabash Avenue, Chicago 5, Illinois
Midwestern Advertising Manager JAMES WEAKLEY

Western Office (CRestview 4-0265)
9025 Wilshire Boulevard, Beverly Hills, California
Western Advertising Manager WILLIAM J. RYAN

Foreign Advertising Representative
D. A. Goodall Ltd., London, England

Member
Audit Bureau of Circulations

SUBSCRIPTION SERVICE: All subscription correspondence should be addressed to POPULAR ELECTRONICS, Circulation Department, 434 South Wabash Avenue, Chicago 5, Illinois. Please allow at least six weeks for change of address. Include your old address as well as new—enclosing if possible an address label from a recent issue.

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

We Really Mean It...When We Say

You DON'T Need **A High School Diploma**

Previous Electronics Experience

to prepare AT HOME the DeVry way for a job that

Pays REAL MONEY in **Electronics!**

LET US TELL YOU WHY!

OUR INTEREST IN YOU... MAKES THE BIG DIFFERENCE!

In preparing you at home for a profitable job in the billion dollar opportunity field of electronics, DeVry Tech is more interested in your DESIRE TO GET AHEAD than we are in what you know about the field now. DeVry's training is thorough and practical. No previous electronic experience is required. We train you even if you don't know how to splice a lamp cord.

Our thorough training, with its many exclusive features such as home movies, has produced many graduates so well-trained, they have been employed by some of today's best-known firms and by scores of Radio and TV stations across the continent. DeVry Tech graduates are in demand. There are many job opportunities for them.

Becoming a DeVry Tech man in itself is a big lift. We have found during the past 29 years that by understanding a man's problems . . . by encouraging him in every way possible, we usually help him get the break he wants. It helps him do things he cannot do alone.

Another important benefit of becoming a DeVry Tech man is knowing you are part of an institution that not only trains you and helps you get started . . . but an organization that stands behind you on the job. It is such things as these that make DeVry Tech graduates DIFFERENT . . . it makes them PREFERRED men by so many employers.

Why don't you send the coupon below for 2 FREE booklets . . . Mailing that coupon could be a big step forward . . . toward greater heights . . . better pay!

Exclusive training movies help you learn FASTER!

DeVry Sends You Actual Equipment You Need At No Extra Cost!

DeVry Tech, in addition to its exclusive training movies, sends you the practical "Electro-Lab" system which includes 16 shipments of equipment to work more than 300 learn-by-doing projects in your own home. We know of nothing more effective than DeVry Tech's tool-in-hand training.

Send for these **2 FREE BOOKLETS**

Accredited member of National Home Study Council

We Have Residential Training for High School Graduates

MILITARY SERVICE	EARN WHILE YOU LEARN	RESIDENT TRAINING
We have valuable information for every man of draft age.	Practical training shows you how to earn good money in spare time.	DeVry Tech has modern training centers in Chicago and Toronto.

WORK IN THESE EXCITING FIELDS WHEN TRAINED!

Radar • Guided Missile Control • Television • Radio
Micro-Waves • Communications • Industrial Electronics
Computers • Automation Electronics • Broadcasting
Remote Control Systems • Your Own Service Shop

DeVRY TECHNICAL INSTITUTE
CHICAGO • TORONTO

DeVRY TECHNICAL INSTITUTE
4141 Belmont Avenue • Chicago 41, Illinois • Dept. PE-12-R

Please give me your two free booklets, "Pocket Guide to Real Earnings" and "Electronics in Space Travel"; also include details on how to prepare for a career in Electronics. I am interested in the following opportunity fields (check one or more):

- ☐ Space & Missile Electronics
- ☐ Television and Radio
- ☐ Microwaves
- ☐ Radar
- ☐ Automation Electronics
- ☐ Communications
- ☐ Computers
- ☐ Broadcasting
- ☐ Industrial Electronics
- ☐ Special "Short Courses"

Name_____ Age_____
PLEASE PRINT
Address_____ Apt._____
City_____ Zone_____ State_____

☐ Check here if you face military service.

Canadian residents: Write DeVry Tech of Canada, Ltd.
970 Lawrence Avenue West, Toronto 19, Ontario 2078

POP'tronics

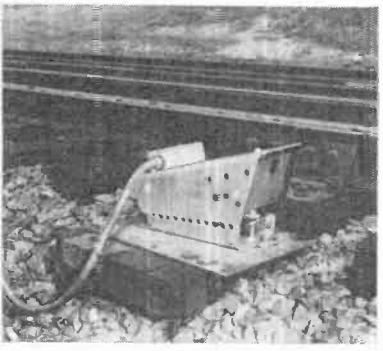
NEWS SCOPE

UPI

HEARING THINGS—Milady's demands often make difficult problems in unheard-of fields. The Electronic Components Division of the Clevite Corporation, Bedford, Ohio, has come up with specially designed language laboratory headphones which can be adjusted to fit any head size, and even accommodate milady's fluffy coiffure. This comfortable, durable, single-unit headpiece was created to meet the growing demand for electronic equipment in more than 5000 modern language training centers in high schools and colleges across the nation.

UPI

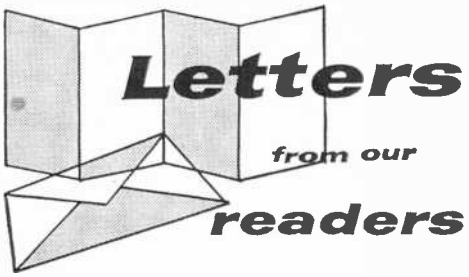
CAUGHT FLAT-FOOTED—A grim-faced patrolman seems about to give Ray Besasie of Milwaukee a ticket for driving without a steering wheel. Patrolman Arthur Coughlan of the Suffolk County, N.N., police spotted Ray driving in his apparent highway "Kamakasie." The matter was cleared up when Ray explained that his "car of the future" was electronically controlled by special steering knobs. He drove it 1000 miles to the Custom Auto Show at Long Island Arena. Ray fast-talked his way out of a ticket, but what will happen if he blows a fuse?



Authenticated News

HOT BOX DETECTOR—Trackside infrared scanner unit developed by the Generai Electric Company detects hot boxes on fast-moving trains. Previously, train crews peered from cabooses and locomotives to spot smoking overheated wheel bearings, or "hot boxes" to railroad men, as trains rounded curves. Now the infrared scanner, mounted in a rugged steel housing on extended ties, "senses" the temperatures of the wheel bearings—even at train speeds up to 70 mph. The temperature of each bearing is permanently recorded on a moving graph chart. Coupled into an extensive alarm system, a passing hot box will switch a train signal to a stop position, and flash light and audible signals at control points. Wonder if the system can detect cigar-smoking hoboes?

WEATHER SNOOPER—Keeping tabs on the weather in the Gulf of Mexico is the job of a moored, unmanned weather station called the "NOMAD." Crammed on the NOMAD's 10′ x 20′ deck are weather detecting instruments, radio antennas, two masts, a large flashing beacon, and a buoy-type bell. Sensing devices measure air temperature, water temperature, wind speed and direction, and the direction of the ocean's surface current. Eventually, it will be possible to measure temperatures and pressures down to 1000 feet below the surface. Four watertight compartments house the maze of electronic equipment and batteries which enable the unmanned NOMAD to radio reports every six hours during periods of low winds, and at hourly intervals during periods of high winds. This is the first of many such weather stations to be employed in the Atlantic and Pacific Oceans by the U. S. Navy.



Capacitor for "Sweet Sixteen"

■ After building a slightly modified "Sweet Sixteen" speaker system, I suddenly found myself up against a blank wall. Where can I buy a 3-μf. metalized-paper capacitor that is not an electrolytic? I'm unable to find such a unit listed in the Allied or Lafayette catalogs and have had no luck at the local supply houses.

ROBERT NICHINI
Elmsford, N.Y.

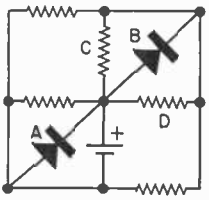
Both the 3- and the 12-μf. metalized paper capacitors mentioned in "Sweeter with a Tweeter" (April 1961) are listed in the Allied industrial *catalog. Either unit can be ordered by mail.*

Diode Quiz

■ The "Diode Quiz" in the July 1961 issue is quite interesting, but I'm puzzled by the answer to problem 6. According to you, the answer is 2 ohms; but as I see it, there are only two effective resistors in parallel with the battery. This would make the total resistance across the battery 3 ohms.

GEORGE H. CUNNINGHAM
Clark, N.J.

The answer really is 2 ohms, George, and to prove it we've reprinted the diagram for problem 6. Notice that diode "A" is connected in reverse



across the battery and, therefore, may be considered to be an open circuit. The polarity of diode "B," however, is such that it does conduct—and it effectively shorts out resistors "C" and "D." This leaves the remaining three resistors (6 ohms each) connected in parallel with the battery. Accordingly the total resistance of three 6-ohm resistors in parallel is 2 ohms. Right?

Adapter for VTVM Leads

■ I believe that I've detected a mistake in the article "Adapter for VTVM Leads" (September, 1961). In describing the installation of the d.c. isolating resistor in the adapter, the author states:

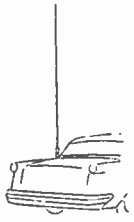
NEW TOPPER WHIP
FOR CITIZENS BAND

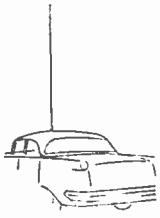
GUARANTEED TO EQUAL OR SURPASS IN PERFOMANCE ANY OTHER LOADED OR FULL LENGTH MOBILE ANTENNA.

This new mobile whip utilizes the exclusive "top-loading" design with polyethylene enclosed coil capsule sealed permanently to the top portion of the stainless steel whip, and nearly its same diameter.

This feature raises the radiating portion of the whip to the highest point, increases resistance to perfect 52 ohm match, and allows for higher mounting on vehicle — all increasing the superiority of performance. Overall height is only 50". Rugged and ready for any climate or weather.

Four models are available for a variety of mounting arrangements.





TWL-M: with chrome-plated, single hole, top mounting body mount.

TLWT-M: identical to TWL-M but in three sections for telescoping down to 28".

TLW: with standard 3/8"x24 threaded base stud for use with adaptive mounts.

TLWT: identical to the TLW but in three sections for telescoping down to 28".

WRITE FOR NEW ENGINEERING REPORT !

COMPLETE LINE OF MOBILE ANTENNAS AND MOUNTING ACCESSORIES.

hy-gain antenna products

1135 No. 22nd St. **Lincoln, Nebr.**

Letters

(*Continued from page 8*)

"Simply wire it between the uninsulated jack and the phone plug's 'inside' terminal." The word "*un*-insulated" should be changed to "*insulated.*"

I agree that this adapter makes a VTVM easier to use, but it does have one drawback. The purpose of the resistor mentioned above is to isolate the cable from the test voltage. Moving the isolating resistor from the probe into the adapter leaves the cable connected to the test voltage. In some cases, this is not permissible. When testing oscillator circuits, for instance, the added capacitance of the unisolated cable may load the circuit enough to cause erroneous voltage readings.

Personally, I find no difficulty in using the usual three VTVM leads—and I prefer reliability to ease of operation.

JAMES R. SEBOLT
Springfield, Mass.

The word "uninsulated" in the last sentence of the article should indeed be changed to "insulated." Thanks for calling this to our attention, Reader Sebolt. And, as you say, experimenters working with sensitive circuits might be better off with the conventional three-lead system.

Starved Circuit Amplifier

■ I have just completed the "Starved Circuit Amplifier" (July, 1961), and am quite pleased with it. Because of the limitations of my spare parts box, I used a 6BH6 (it has curves almost identical to the 6AU6) for *V1* and an 8-μf. capacitor for *C1*. Lacking a metal box, I made one out of Bakelite, and built a power supply (using a 6X4) as an integral part of the unit. I don't know the exact frequency response, but the amplifier sounds quite good and will overdrive an 8-inch speaker with the gain turned up.

ARTHUR R. STICH
Jackson, N.J.

■ While looking for a useful project to build, I came across the "Starved Circuit Amplifier." After completing it, I found that the amplifier (with the proper probe plugged into the input) made a fine signal tracer.

It may also interest your readers to know that, for private listening, a 3000-ohm resistor in series with a pair of 2000-ohm headphones can be substituted for *T1*'s primary winding.

MIKE EXNER, KN5KBK/WPE5BTN
Houston, Texas

Gonset 3002 Wanted

■ I've just read "New Life for Obsolete Converters" (April, 1961) and would like to acquire one of the used Gonset 3002's adapted by the author. Any leads you can give me as to the whereabouts and price of a good 3002 converter would be appreciated.

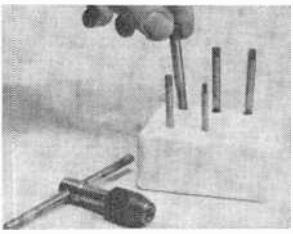
NORMAN BASH, WPE8DHU
2215 Beecher St.
Findlay, Ohio

Do any of our readers have an old Gonset 3002 they would like to dispose of? -30-

Tips and Techniques

SOAP STORES TAPS

A bar of soap with a number of holes drilled in it makes a useful stand for storing taps. The soap holds the taps handy for easy selection and keeps them lubricated as well. For more durability, apply several coats of lacquer to the bar of soap. Otherwise, the soap would tend to deteriorate after it has been handled for a while.



—John A. Comstock

ERASER IS WORKSHOP AID

A Fiberglas typewriter eraser, available at most stationery stores, makes a useful addition to any workbench. With it, you can clean relay and key contacts, remove decals, and shine panels. Experimenters who like to build equipment in plastic boxes will also find that a Fiberglas eraser, when rubbed on clear plastic, provides a professional "frosted" effect. *—Bob Culter*

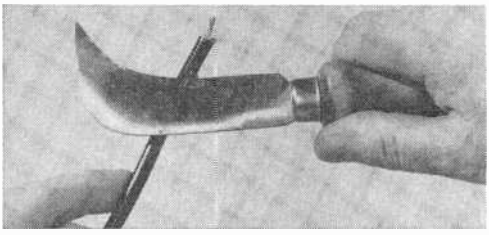
NON-WRINKLE DECAL COATER

The print coater packed with every package of Polaroid film is an excellent "fixer" for decals. Ordinary lacquer is apt to make decals wrinkle, but this compound won't. Just brush it on with the applicator and you'll have a permanent protective coating.

—James Arconati, KNØFBJ

LINOLEUM KNIFE STRIPS WIRE

A linoleum knife is a fine tool for stripping heavy wire. The curved blade and hefty

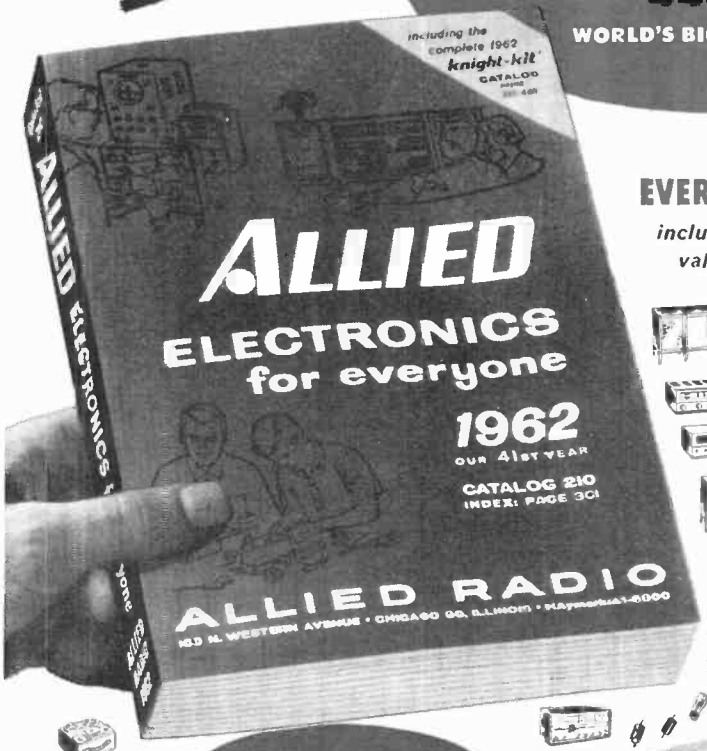


Free

ALLIED 1962 ELECTRONICS CATALOG

444 PAGES!

WORLD'S BIGGEST—MOST COMPLETE



SAVE MOST ON EVERYTHING IN ELECTRONICS

including exclusive products & special values available only from ALLIED

- New Multiplex Stereo FM—All-Transistor Stereo Hi-Fi
- New Stereo Hi-Fi Systems—Everything in Hi-Fi Components
- Money-Saving Build-Your-Own KNIGHT-KITS® for Every Need
- Best Buys in Tape Recorders, Tape and Recording Supplies
- Citizens Band 2-Way Radios
- Amateur Receivers, Transmitters, and Station Gear
- Public Address Systems, Paging and Intercom Equipment
- Test and Laboratory Instruments
- TV Tubes, Antennas, Accessories
- Batteries, Wire, Tools, Hardware
- Huge Listings of Parts, Tubes, Transistors, Technical Books

NEW Multiplex Stereo FM All-Transistor Stereo Hi-Fi

NO MONEY DOWN on Allied's new Credit Fund Plan

Now—enjoy 50% more buying power—up to 24 months to pay—see our 1962 Catalog for simple details.

ALLIED exclusives:

MONEY-SAVING KNIGHT-KITS®. Enjoy the most satisfying do-it-yourself experience in the world! Build KNIGHT-KITS—lowest in cost, easiest to assemble, best for performance. Select from over 90 exciting KNIGHT-KITS—Stereo, Hi-Fi, Hobbyist, Amateur and Test Instruments. An exclusive ALLIED product.

BEST-BUY KNIGHT® PRODUCTS. Save most on famous KNIGHT Stereo Hi-Fi—comparable to the best in quality, styling, performance—yet priced far lower. Select super-value KNIGHT components or complete systems (including latest Multiplex Stereo and All-Transistor Hi-Fi). KNIGHT products are acclaimed by all who recognize integrity in design and manufacture and who appreciate value.

- World's Largest Stocks • Lowest Money-Saving Prices
- Fastest Shipment • Expert Personal Service

send today for the world's biggest electronics catalog!

Free

ALLIED RADIO, Dept. 225-M1
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 1962 ALLIED 444-page Catalog

*Name*_____
PLEASE PRINT

*Address*_____

*City*_____ *Zone*____ *State*_____

ALLIED RADIO

World's Largest Electronic Supply House

Satisfaction Guaranteed or Your Money Back

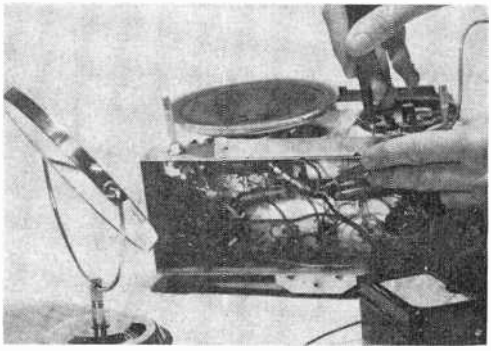
Tips

(Continued from page 12)

handle make it faster and easier to use than an ordinary pocket knife. You can pick one up inexpensively at any hardware store. *—Ken Murray*

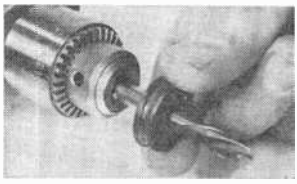
SHAVING-MIRROR SERVICING LIGHT

An adjustable stand-mounted shaving mirror makes an excellent device for illuminating the dark corners of equipment being serviced. Set the mirror so that it catches light from a window or lamp and reflects it into the desired area. The two-way adjustment makes it easy to put the light exactly where you need it. *—John A. Comstock*



GROMMET SERVES AS CHUCK GUARD

When using a hand drill on thin materials such as sheet metal, the bit usually breaks through suddenly and the chuck bangs hard against the work. To avoid scarring a chassis or panel, slip a rubber grommet over the bit. With this protection, you won't have to worry about putting too much pressure on the drill.



—Jerome Cunningham

SNAPS CONNECT WIRES

Unpainted clothing snaps are ideal lightweight electrical connectors. Just solder a half of a snap to each of the two leads to be joined. Such snaps are easily connected and disconnected, yet provide excellent contact and are not affected by vibration.

—Edward E. Brown

(Continued on page 20)

The Same School That Originated The RTS BUSINESS PLAN

...NOW *Proudly Presents*...

A SPECIAL COMPACT COURSE COVERING ALL THREE PHASES OF

ELECTRONICS

BASIC • INTERMEDIATE • ADVANCED

The Entire Course Is Made Up Of The Following:

- 35 LESSONS COVERING BASIC AND INTERMEDIATE ELECTRONICS
- 9 EQUIPMENT KITS COMPLETE WITH TUBES AND BATTERIES
- SOLDERING IRON
- 25 LESSONS COVERING THESE ADVANCED ELECTRONIC SUBJECTS:

  Thyratron Tubes • Semiconductors • Electronic Symbols and Drawings • Voltage-Regulators • Electronic-Timers • Control Systems • X-Rays • Photoelectric Devices • Dielectric Heating • Geiger Counters • Pulse Circuitry • Clippers and Limiters • Multivibrators • Electronic Counters • Radar • Magnetic Amplifiers • Analog-Computers • DC Amplifiers • Digital Computers • Storage Systems • Input and Output Devices • Servomechanisms • Telemetering
- 60 EXAMINATIONS
- UNLIMITED CONSULTATION SERVICE
- KIT MANUALS
- DIPLOMA UPON GRADUATION

AND MUCH MORE...

DESIGNED FOR THE BUSY MAN OF TODAY
This is MODERN training for the MODERN man. You'll find no "horse and buggy" methods here. Every page of this streamlined course is devoted to important Electronics principles and practical projects. You'll be amazed how fast you grasp Electronics the RTS way. RTS has combined modern THEORY and PRACTICE to make this the finest training program of its kind available!

SATISFIES NOVICE, TECHNICIAN OR HOBBYIST
Whether you're new to Electronics or an old "pro," chances are you'll find this to be the ideal course for you. The novice will appreciate the completeness of the training. It starts with the most basic considerations, covering each important point thoroughly, yet concisely. The technician will enjoy the practical review of fundamentals and profit from the 25 advanced subjects covered.

RTS GIVES YOU "TOP MILEAGE" FOR YOUR TRAINING DOLLAR
The price quoted below buys EVERYTHING — there are no extras to pay for. RTS has gone "all out" to give you the best training value in America. Why pay hundreds of dollars for training such as we offer when it's available for this LOW PRICE? If you can find a better training bargain... BUY IT!

CAN BE COMPLETED IN MONTHS INSTEAD OF YEARS
Some students will complete this course with "Jet-Like" speed but we allow up to two years if your circumstances require it. You study at your own rate. You are ENCOURAGED but not pushed. You'll find the lessons professionally written but easy to understand. LET US SEND YOU ONE OF THESE LESSONS ALONG WITH YOUR CAREER BOOKLET SO YOU CAN SEE FOR YOURSELF. NO OBLIGATION!

COMPLETE COST... INCLUDES ALL KITS, TUBES, BATTERIES, ETC. $125.00*

*TERMS ALSO AVAILABLE

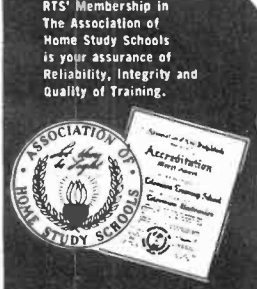
AS LITTLE AS...

$5.00 DOWN

$5.00 PER MONTH

THE FIRST TRAINING KIT IS SENT IMMEDIATELY UPON ENROLLMENT

RTS' Membership in The Association of Home Study Schools is your assurance of Reliability, Integrity and Quality of Training.



Rush Coupon for FREE FACTS!

DON'T LOSE OUT — *FIND OUT!*

RTS ELECTRONICS DIVISION Dept. PE121
815 E. ROSECRANS AVENUE LOS ANGELES 59, CALIFORNIA

Rush me full information by return mail. (Please Print)

Name _____ Age _____

Address _____

City _____ Zone ____ State _____

NO SALESMAN WILL CALL ON YOU!

RTS ELECTRONICS DIVISION
815 E. ROSECRANS AVENUE
LOS ANGELES 59, CALIFORNIA
Est. 1922

L201A

A PROPHECY

For men and women with a sincere desire to succeed

"In the years that have passed since my days on the faculty of RCA Institutes, I have become even more firmly convinced that the individual who continues his education . . . particularly his technical education . . . is the individual who profits both as a thinking man and as a working man. Science and industry will reward you for your talents and energy. Out of your efforts may come inventions, new products, processes and services. There is everything good yet to be accomplished in our lives and in our work. What man has done, man can do better."

David Sarnoff

Chairman of the Board,
Radio Corporation of America

RCA Institutes Offers the Finest of Home Study and Resident Training for Your Career in the Rapidly Expanding World of Electronics

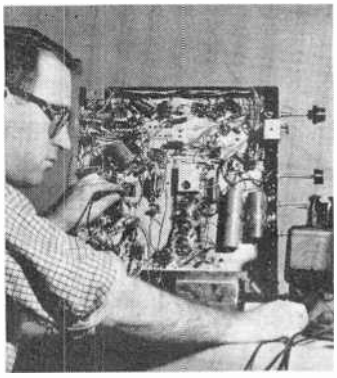
RCA Institutes, founded in 1909, is one of the largest technical institutes in the United States devoted exclusively to electronics. A service of Radio Corporation of America, RCA Institutes offers unparalleled facilities for technical instruction . . . tailored to *your* needs. The very name "RCA" means dependability, integrity, and scientific advance.

RCA Institutes Home Study School, licensed by the New York State Department of Education, offers a complete program of integrated courses for beginners and advanced students ranging from electronic fundamentals to automation. All courses are designed to prepare you for a rewarding career in the rapidly expanding world of electronics. *The caliber of the training you receive is the finest!* And you get top recognition as an RCA Institutes graduate!

HOME STUDY COURSES *in*

Electronic Fundamentals • TV Servicing Color TV • Electronics for Automation • Transistors

Voluntary Tuition Plan. The important thing to remember about RCA Institutes Training is the convenient, *no-obligation payment plan*. This plan affords you the most economical possible method of home study training because you pay for each study group only when you order it. If you interrupt your course *at any time, for any reason*, you owe nothing more. You *never* have to pay for the whole course if you don't complete it. No other obligations. No monthly installment payments!



RCA Instruction is Personal. With RCA Home Study training you set *your own pace* in keeping with *your own ability*, finances, and time. The Institutes allows you ample time to complete the course. Your lesson assignments are individually graded by technically trained personnel, and helpful comments are added where required. You get theory, experiment, and service practice beginning with the very first lesson. All lessons are profusely illustrated. You get *a complete training package* throughout the entire course.

You Get Prime Quality Equipment. All kits furnished with the course are complete in every respect, and the equipment is top grade. You keep all the equipment furnished to you for actual use on the job . . . *and you never have to take apart one piece to build another!*

* * *

RESIDENT SCHOOLS *in*

Los Angeles and New York City train you for any field of Electronics you may choose!

No Previous Technical Training Required For Admission. RCA Institutes Resident Schools in Los Angeles and New York City offer training that will prepare you to work in rewarding positions on research and production projects in fields such as automation, communications, technical writing, television, computers, and other industrial and advanced electronics applications. Even if you did not complete high school, RCA will prepare you for such training with courses specially designed to provide the basic math and physics required for a career in electronics.

Free Placement Service. RCA Institutes graduates are now employed in important jobs at military installations such as Cape Canaveral, with important companies such as IBM, Bell Telephone Labs, General Electric, RCA, and in radio and TV stations all over the country. Many other graduates have opened their own businesses. A recent New York Resident School class had 92.06% of the graduates who used the Free Placement Service accepted by important electronics companies... *and had their jobs waiting for them on the day they graduated!*

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

SEND POSTCARD FOR FREE ILLUSTRATED BOOK TODAY! SPECIFY HOME STUDY OR RESIDENT SCHOOL

RCA INSTITUTES, INC. A Service of Radio Corporation of America 350 W. 4th St., N.Y. 14, N.Y. • 610 S. Main St., Los Angeles 14, Calif.

RCA® The Most Trusted Name in Electronics

Tips

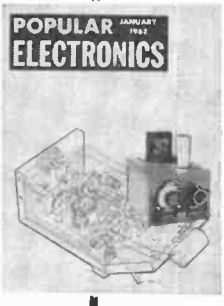
(*Continued from page* 14)

THERMOS MIKE STAND

Families with small children always seem to have a large supply of extra junior-sized Thermos bottles. If your family is in this position, you can press one of them into service as a mike stand; just drill a hole in the cap and fasten the microphone with a small screw. A round metal plate fastened to the bottom of the Thermos bottle minimizes the danger of tipping the mike—or spilling your coffee.

—Ross A. Sheldon, K5UCH

COMING NEXT MONTH



Our January cover shows a converter that's a cinch to build and a picnic to operate. Covering the rarely heard 150.8-162 mc. "police" band, the converter works with any FM receiver or tuner and can be built for $20.

(ON SALE DECEMBER 28)

- **STEREO SIXTEEN + 4**
  Remember the "Sweet Sixteen" speaker system (and who doesn't)? Its author, Jim Kyle, has again put his magic touch to a system containing 16 speakers—this time, for stereo!
- **TD POWER SUPPLY**
  Here's an easy-to-build power supply that's expressly designed for powering tunnel-diode circuits.
- **IN-CAR FM FOR MFL**
  Install an FM tuner or converter in your car and you're in for countless hours of MFL—mighty fine listening!

NOW ANYONE CAN MAKE AS FINE AN AMPLIFIER AS FISHER

with this new Fisher StrataKit!

Introducing a totally new approach to stereo kit design.

When the KX-200 Control Amplifier, first of the new line of Fisher StrataKits, made its appearance, the entire concept of high-fidelity components in kit form entered a new, exciting phase. For the first time, there are kits backed by a name with the tradition, acceptance and stature of Fisher.

Before Fisher could stake its reputation on a product completed by the purchaser, two requirements had to be unconditionally satisfied. First, the performance of a Fisher kit had to meet the same guaranteed Fisher laboratory standards no matter who assembled it—Fisher laboratory technicians or *a totally unskilled and inexperienced builder*. Second, constructing the kit had to be a pleasure, not a problem.

Fisher engineers have responded to both of these unusual challenges brilliantly, as will be evident to any builder of the KX-200 StrataKit. He will own the finest 80-watt Stereo Control Amplifier that Fisher knows how to make.

The StrataKit method of kit construction permits assembly by easy, error-proof stages (strata), each stage corresponding to a *particular page* in the Instruction Manual and to a separate transparent packet of parts, separately identified. Major components come already mounted on the rugged chassis, and wires are *pre-cut* for every stage—which means every page!

Errors of omission, if any, can thus be checked stage-by-stage and page-by-page—before proceeding to the *next* stage. There are no surprises with a Fisher StrataKit, only the pleasure of accomplishment and of effortless learning.

Outstanding features of the Fisher KX-200 StrataKit:

80 watts IHFM music power—the maximum available today with any control-amplifier kit. Harmonic distortion 0.4%. Hum and noise 93 db below full output.

Built-in d'Arsonval laboratory-type calibration meter—a Fisher exclusive. Permits precise adjustment for peak performance; assures optimum results from the start *and* in the years ahead.

Level control facilities for a center-channel speaker *without the need for an additional amplifier*—unlike any other kit now available.

Architectural brass-finish control panel to match all other standard Fisher-built components and to fit standard Fisher component cabinets. **Price $169.50***

Coming Soon: The Fisher High-Sensitivity, Wide-Band, Stereo-FM Tuner StrataKit.

*Less cabinet; slightly higher in the Far West.

USE THIS COUPON FOR FURTHER INFORMATION

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

Please send me the following FREE Fisher literature:

☐ Complete details and specifications on the Fisher KX-200 StrataKit.

☐ The 1962 Fisher Handbook, a 40-page illustrated reference guide and component catalogue for custom stereo installations.

Name_____

Address_____

City_____ Zone____ State_____

PR1271

EXPORT: Telesco International Corp., 171 Madison Ave., N. Y. 16, N. Y. In Canada: Tri-Tel Associates, Ltd.

Hi-Fi Showcase

*A quick look at new products in the stereo hi/fi field**

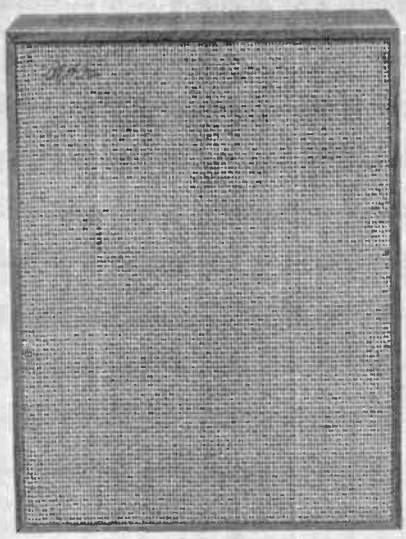
IF you're the sort of audiophile who would rather remain seated in a comfortable chair than trot back and forth across your listening room to fiddle with controls, you'll be interested in *Clairtone*'s new C 1000 R stereo receiver. Combining a stereo AM/FM tuner and a dual 35-watt stereo amplifier on a single chassis, the C 1000 R also has provision for wireless remote control as well as a multiplex adapter. Add the Model CXR remote control unit (actually a tiny wireless radio transmitter smaller than a carton of cigarettes), and you can adjust volume, tone, and stereo balance, even turn the stereo receiver on and off at will. The receiver boasts inputs for magnetic phono cartridge, tape, and TV set; outputs for stereo tape recording. The C 1000 R lists at $438.90; the CXR control unit at $159.95. Also available: a manually operated version of the receiver (Model C 1000) at $394.95. . . .

Clairtone C 1000 R receiver

Dyna Empire's 980 tone arm is another boon for the audiophile who values operating convenience. Equipped with a magnetic self-lifting device that lifts the arm out of the groove at the end of the record, the 980 not only needs a minimum of attention but safeguards records as well. In addition, a calibrated knob permits "dialing" any stylus force between 0 and 8 grams, and a unique cartridge mount enables you to adjust cartridge position for minimum tracking error. A professional-type arm intended for quality installations, the 980 sells for $50.00, complete with the self-lifting device.

A compact two-way speaker system from *Jensen* employs a special miniature woofer in conjunction with a 3" direct-radiator tweeter for response all the way to 14,000 cycles. Ideal for "extra-speaker" installa-

*Write to the manufacturers listed at the end of this column for more data on products mentioned



No one will believe

you built this Fisher Speaker System yourself!

Introducing the KS-1 Slim-Line Speaker Kit. You will have to do some strenuous convincing before anyone believes that this superb-sounding and elegant-looking Fisher loudspeaker system was home-built. A three-way system of this caliber would be important news even if it were factory-assembled, especially as it is of the new slim-line form, which requires ultrasophisticated engineering for top results. But, thanks to exceptionally careful and imaginative planning by Fisher engineers, you can build the KS-1 and have Fisher performance at an important saving

This is the only slim-line speaker system available in kit form and it is designed around the most advanced components: a 10-inch free-piston woofer with 30 cps free-air resonance and 4-lb. magnet structure; a 5-inch Acousti-Glas-packed midrange unit; separate super-tweeter; fully wired and balanced three-way LC dividing network with 1400 cps and 5000 cps crossovers; 18" x 24" x 5" cabinet packed with AcoustiGlas padding; and matching grille cloth.

You install the driver units, connect the network, complete the preassembled cabinet—and you are the owner of a truly high-quality loudspeaker, which can be either wall-hung or placed anywhere on the floor or a shelf to blend harmoniously with your home decor.

The sound of the Fisher KS-1 will astonish you; it is extremely clear, with precise transients, as well as full and rich—quite unprecedented in a system of this size and price. Don't miss a demonstration at your Fisher dealer. Price, in birch or walnut, sanded and ready for your choice of finish, $59.50*. Factory assembled, $84.50*.

USE THIS COUPON FOR COMPLETE INFORMATION

Fisher Radio Corporation
21-52 44th Drive, Long Island City 1, N. Y.
Please send the following Fisher literature without charge:

- ☐ Specifications on the Fisher KS-1 Speaker Kit.
- ☐ 1962 Fisher Handbook, a 40-page illustrated reference guide and catalogue for custom stereo installations.

Name_____

Address_____

City_____ Zone____ State_____

H1212

The Fisher

*Factory assembled in oiled walnut, $89.50. Prices slightly higher in the Far West.
EXPORT: Telesco International Corp., 171 Madison Ave., N.Y. 16, N.Y. In Canada: Tri-Tel Associates, Ltd.

Showcase

(*Continued from page 22*)

tions, the X-10 is housed in an oiled walnut cabinet and measures a compact 7¼" x 13" x 4⅝". For convenience in extension speaker applications, there is a small knob on the front panel which can be used to adjust the volume level. The X-10 carries a power rating of 6 watts, a price tag of $29.75.

If the idea of an all-transistor stereo system appeals to you, a 60-watt stereo amplifier from *Omega Electronics* may be the answer. Frequency response is a smooth 18 to 20,000 cycles, ±0.3 db at full output; hum and noise check out at 75 db below full output. As with any all-transistor circuit, tube microphonics, hum, and excess heat have been eliminated, and the use of direct-coupling and degenerative feedback further improve linearity. Master bass and treble controls allow simultaneous adjustment of both channels, and independent balance controls for both bass and treble are also provided. Other controls include mode, volume balance, blend, loudness, scratch filter, rumble filter, phase, and tape monitor. Price, $229.00.

Three new *RCA* tape-cartridge recorders are compact, dual-purpose units weighing only slightly more than 13 pounds. Intended for use either separately or as attachments to existing monophonic or stereophonic hi-fi systems, the units all play RCA's tape cartridges — which require no threading and are simply placed in the machine much as a record is placed on a turntable. All three recorders operate at both 3¾ and 1⅞ ips, and all provide a safety interlock to prevent accidental erasures. The most inexpensive of the three, the "Prompter" (Model 1YB1), is a monophonic recorder priced at $99.95. The "Trendliner" (Model 1YB2) is an improved version of the "Prompter," featuring a digital tape counter and a more precise magic-eye record-level indicator; it's priced at $129.95. The "Fortnighter" (Model 1YC1), the stereophonic member of the trio, is priced at $169.95.

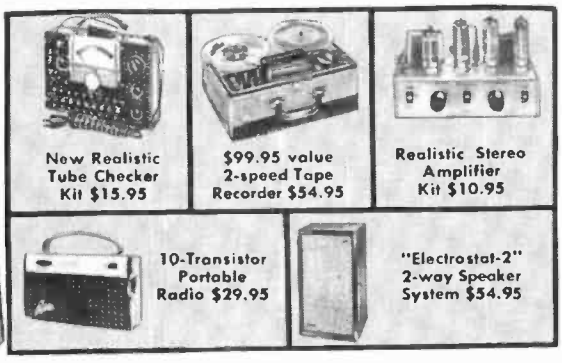
RCA 1YC1 tape recorder

Clairtone Sound Corp. Ltd., Clairtone Bldg., 118 Rivalda Rd., Toronto 15, Ont.
Dyna Empire, Inc., Garden City, L.I., N.Y.
Jensen Mfg. Co., 6601 S. Laramie, Chicago 38, Ill.
Omega Electronics Corp., 10017 N. 19th Ave., Phoenix 21, Ariz.
Radio Corporation of America (RCA), 30 Rockefeller Plaza, New York 20, N.Y.

FREE to everybody in America!

RADIO SHACK'S exciting 1962 Electronics CATALOG

Plus every new issue for one full year.
Each is packed with values like these:



We want everyone to have a free subscription to Radio Shock's famous catalogs! Just clip out one coupon below (the three extras are handy for neighbors, relatives) and mail it right away to start your catalogs coming. Through the year, you get at least 5 books loaded with the latest and best in electronics, all savings priced.

You receive our latest 340-page book and timely supplements, illustrating over 100,000 items. 30 pages of fascinating new kits to build yourself and save. Stereo, Hi-Fi, Ham Radio, Tape Recorders. Vast selection of records, pre-recorded tapes. Parts and Accessories . . . all guaranteed to satisfy you. No Money Down credit terms.

Mail a Coupon to RADIO SHACK Corp., 730 Commonwealth Ave., Boston 17, Mass.

Please send one year of Radio Shack Catalogs FREE

Your name 61M7
Address
City State
Name of a friend 61M7A
Address
City State

Please send one year of Radio Shack Catalogs FREE

Your name 61M7D
Address
City State
Name of a friend 61M7E
Address
City State

Please send one year of Radio Shack Catalogs FREE

Your name 61M7B
Address
City State
Name of a friend 61M7C
Address
City State

Please send one year of Radio Shack Catalogs FREE

Your name 61M7F
Address
City State
Name of a friend 61M7G
Address
City State

LAFAYETTE is America's Citizens Band Headquarters

NO LICENSES, TESTS OR AGE LIMITS

9 LAFAYETTE TRANSISTOR CITIZENS BAND "WALKIE TALKIE"

39.95
2 for 78.88
NO MONEY DOWN

● Completely Wired—Ready to Operate ● Fully Transistorized—9 Transistors plus 1 Diode ● Uses Inexpensive Penlight Batteries ● No License, Tests or Age Limits ● Comes with Leather Carrying Case, Earphone, Antenna, Batteries and Crystals

As simple and easy to use as the telephone—and twice as handy. Receives and transmits up to 1.5 miles under average conditions. Weighs only 18-oz. and slips into your pocket. Push-to-talk button operates built-in speaker as sensitive microphone.

LAFAYETTE HE-20A Citizens Band TRANSCEIVER

● Pi-Network for Greater Power Output ● Calibrated "S" Meter ● Series Gate Noise Limiter ● Tuneable Superhet Receiver over all 23 Channels ● 4 Crystal-Controlled Transmit Positions ● 4 Crystal-Controlled Receive Positions ● Dependable Push-To-Talk Ceramic Microphone & Relay ● Illuminated Dial ● Built-in 12-Volt Power Supply ● Complete with Matched Crystals for Channel 9

109.50
NO MONEY DOWN

NEW! LAFAYETTE TE-20 RF SIGNAL GENERATOR

ONLY 27.95
NO MONEY DOWN

● Factory Calibrated and Tested. Six Bands: 120 KC-260 MC. Dual output RF Terminals

● Separate Variable Audio Output. Dial Calibration ± 2%. Etched Circular Dial — (Vernier Tuned)

A stable, wide-range signal generator engineered to fill the need for an accurate; low cost service instrument. Completely wired and ready to operate, the TE-20 features a large 4¼" etched circular dial calibrated to ± 2% with a frequency output of from 120 KC to 260MC in 6 bands. Built-in audio oscillator, adjustable output to 8 volts, variable RF antenuator and a host of other features. Steel case with leather carrying handle.

EXCITING "EXPLOR-AIR" 4-BAND RECEIVER KIT

Complete Shortwave and Standard Broadcast Reception

Made In U.S.A.

21.95

● 4 Bands For Total Coverage
● Complete Bandswitching From Front Panel
● Built-in 4" PM Loudspeaker
● 550 KC — 30 MC

Precision compact radio kit with everything you need for unexcelled reception. Size: 10x7x5".
KT-135 (less cabinet) 21.95
ML-150 Leatherette covered wood cabinet 2.75

NEW! SUBMINIATURE AUDIO AMPLIFIERS

● For The Experimenter, Hobbyist, Kit Builder

PK-543 **4.95**

PK-522 **3.75**

These amazing little amplifiers are limited in use only by your imagination. Handle recorders, tuners, cartridges and mikes with good output. All leads, and transistors are included with a trouble-free printed circuit board. Not a kit—Ready to mount.
PK-543 4 Transistor Push-Pull Amplifier 4.95
PK-522 3 Transistor Audio Amplifier 3.75

LAFAYETTE RADIO

SEND MAIL ORDER TO LAFAYETTE RADIO
111 JERICHO TURNPIKE, SYOSSETT, L.I., NEW YORK

OTHER LOCATIONS
JAMAICA, N. Y. 165-08 Liberty Avenue

PLEASE INCLUDE SHIPPING CHARGES WITH ORDER

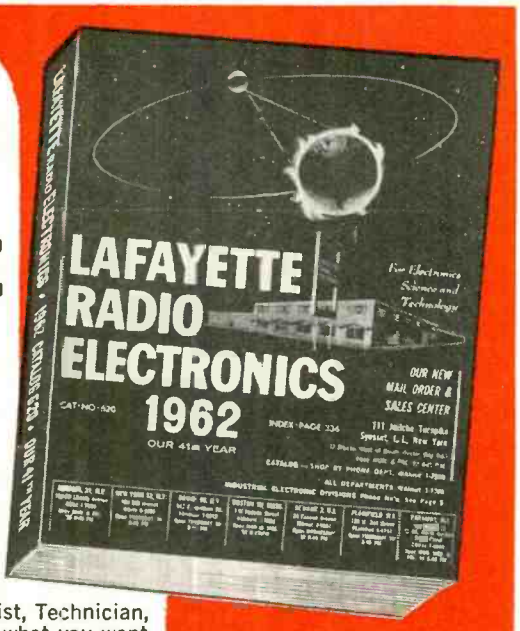
NEW YORK, N. Y. 100 6th Avenue	BOSTON, MASS. 110 Federal Street	PARAMUS, N. J. 182 Route 17
BRONX, N. Y. 542 E. Fordham Rd.	NEWARK, N. J. 24 Central Avenue	PLAINFIELD, N. J. 139 W. 2nd Street

FREE!

LAFAYETTE

340 PAGE
1962 Lafayette Radio Electronics
CATALOG # 620

"America's Hi-Fi & Electronics Shopping Center"



Yours free for the asking — the biggest, best and most comprehensive catalog in the 41-year history of Lafayette Radio. Audiophile, Experimenter, Hobbyist, Technician, Engineer, Student, Serviceman, Dealer — you'll find what you want in this latest Lafayette catalog.

COMPLETELY WIRED, FULL SIZE TUBE TESTER
TE-15 ..... 19.95

SUPERHETERODYNE COMMUNICATIONS RECEIVER
KT-200, Kit 64.50
HE-10, Wired 79.95

10,000 OHMS-PER-VOLT MULTITESTER
TE-10 ..... 9.95

CITIZENS BAND MOBILE ANTENNA WHIP
HE-800WX 6.95

NEW! KORDEX™ TRANSISTORIZED SEMI-KIT TAPE RECORDER
RT-201 ..... 17.95

NEW! FM MULTIPLEX ADAPTER
LT-200 ..... 39.50

LARGEST STOCK SELECTION. Stereophonic Hi-Fi equipment, Citizens Band, Ham and Amateur equipment, Radio & TV parts Optics, Industrial Supplies, and much more, including all the favorite name brands.

LAFAYETTE EXCLUSIVES. Featured are the famous Lafayette Kits . . . dollar for dollar the best value for your money today. You'll also see hundreds of Lafayette specials . . . available only from Lafayette. And, as always, **SATISFACTION GUARANTEED OR MONEY REFUNDED.**

LOWEST PRICES. You'll save money too with Lafayette's low, low prices. The lowest prices are always in the Lafayette catalog.

24-HOUR SERVICE. Quick, courteous service is your guarantee at Lafayette. Most orders are fully processed within 24 hours after receipt in the mail Order Division.

NEW EASY-PAY PLAN. Now, **NO MONEY DOWN** . . . up to 24 months to pay.

LAFAYETTE'S
NEW MAIL ORDER HEADQUARTERS
111 JERICHO TURNPIKE
(2 Blocks West of South Oyster Bay Rd.)
SYOSSET, LONG ISLAND, NEW YORK

LAFAYETTE RADIO, Dept. 1L-1
P. O. Box 10, Syosset, N. Y.

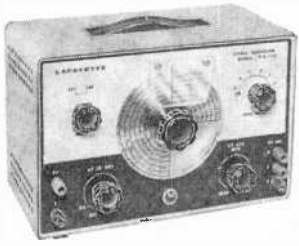
☐ *Rush my* **FREE** *Lafayette 1962 Catalog 620*
☐ *Please send me #_____, shipping charges collect.*
I am enclosing $_____.

Name_____
Address_____
City_____ Zone_____ State_____

NEW products

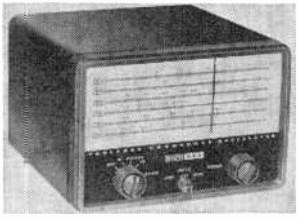
R.F. SIGNAL GENERATOR

A low-cost r.f. signal generator available from *Lafayette Radio,* 165-08 Liberty Ave., Jamaica 33, N.Y., is ideal for i.f.-r.f. alignment, audio signal tracing, etc. The Model TE-20 has a fundamental frequency output of 120 kc. to 130 mc. in six bands, and an extra harmonic band is calibrated from 130 to 260 mc. Frequency accuracy is ±5%, and the built-in 400-cps audio oscillator has an output adjustable to 8 volts. Price of the signal generator, complete with test leads, $27.95.



SELF-POWERED VFO

The EICO Model 722 VFO contains its own power supply and provides full coverage of the ham bands from 80 to 10 meters. The VFO's oscillator is of the electron-coupled, series-tuned Colpitts type; it feeds into a buffer-multiplier-output stage which provides isolation from the load and enough drive to accommodate any modern transmitter. A lever-type spotting switch is provided on the front panel and the slide-rule dial is large and easy to read. Model 722 is priced at $44.95 in kit form, $59.95 wired. (*EICO Electronic Instrument Co., Inc.,* 33-00 Northern Blvd., L.I. City 1, N.Y.)



PIN STRAIGHTENERS

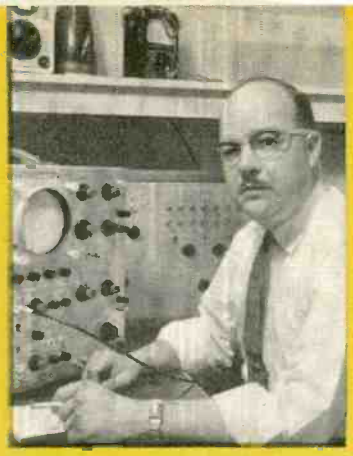
CBS Electronics, Danvers, Mass., is now supplying miniature-tube pin straighteners in three basic designs. Bench-mounted models are available in 7-pin (Model SH-17) and 9-pin (Model SH-19) types. A unit for pocket or caddy use (Model SH-79) com-

Profiles in Electronic Engineering Technology

CREI

"A CREI Home Study Program helped me increase my salary by a factor of four (4)."

—Mearl Martin, Jr., SENIOR ENGINEER, Field Support Manager, Tektronix, Inc., Portland, Oregon



"I AM INDEED GRATEFUL TO CREI for my success," says Mearl Martin, Jr. "Since enrollment in a CREI Home Study Program in Electronic Engineering Technology, I have progressed from Junior Technician to licensed Senior Engineer. My present title is Field Support Manager and my salary has increased by a factor of four (4)."

DEMAND FOR CREI-PREPARED MEN today far exceeds the supply—and has for many years. CREI Home Study Programs, the product of 34 years' experience, *include the latest advancements in the field.* Here Martin discusses home study with company executive W. K. Dallas, V.P., Manager, Marketing Division, Tektronix, Inc.

WHEN YOU ENROLL IN A CREI Home Study Program, you join some 20,500 students working in electronics all over the world. CREI's curriculums were among the first accredited by the Engineers' Council for Professional Development. Rob't. Wruble, Group Manager (center) and Rollie Smith, (right) Field Training Manager at Tektronix, Inc., are shown here with Mearl Martin.

ASSURE A BETTER FUTURE and get more out of life with CREI Home Study. CREI alumnus Martin enjoys living in his comfortable home in Portland, Ore. CREI men are in such companies as Pan American Airways, Federal Electric Corp., The Martin Co., Northwest Telephone Co., Mackay Radio, Florida Power and Light, etc. This attests to the high calibre of CREI Programs.

YOUR WHOLE FAMILY BENEFITS when you achieve success through CREI Home Study. Here Martin relaxes with wife and family who share his success. Check the completeness of CREI Home Study Programs in Electronic Engineering Technology in our catalog, provided on request. For those who can attend, CREI maintains a *Residence School* in Washington, D.C.

INDUSTRY-RECOGNIZED CREI HOME STUDY PROGRAMS PREPARE YOU FOR INCREASED RESPONSIBILITIES, HIGHER-PAYING POSITIONS IN ELECTRONICS.

REQUIREMENTS FOR ENROLLMENT
Pre-requisite is a high school education or equivalent *plus* basic electronics training and/or practical electronics experience. (Electronics experience and/or training not necessary for Residence School.) If you qualify, send for the latest CREI catalog at no cost. Veterans may apply under the G.I. Bill. If you're doubtful about your qualifications, let us check them for you. Mail coupon or send your qualifications to: The Capitol Radio Engineering Institute, Dept. 1212-H, 3224 Sixteenth St., N. W., Washington 10, D. C.

Every COMPLETED Inquiry will be acknowledged.

MAIL COUPON TODAY FOR FREE 58-PAGE BOOK

THE CAPITOL RADIO ENGINEERING INSTITUTE

ECPD Accredited Technical Institute Curricula — Founded 1927

Dept. 1212-H, 3224 Sixteenth St., N. W., Washington 10, D. C.

Please send me details of CREI Home Study Programs and Free Book, "Your Future in Electronics and Nuclear Engineering Technology." My qualifications are noted to obtain immediate service.

CHECK FIELD OF GREATEST INTEREST:

- ☐ Servo and Computer Engineering Technology
- ☐ Automation and Industrial Electronic Engineering Technology
- ☐ Electronic Engineering Technology
- ☐ Nuclear Engineering Technology
- ☐ Aero and Navigational Engineering Technology

Name ..... Age .....

Address .....

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

Employed by .....

Type of present work .....

Education: Years High School ..... Other .....

Electronics Experience .....

Check: ☐ Home Study ☐ Residence School ☐ G.I. Bill

products

(*Continued from page* 28)

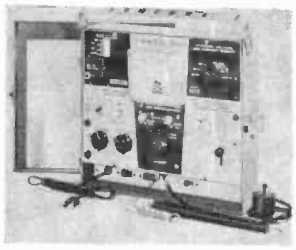
bines a 7-pin straightener on one end with a 9-pin straightener on the other. Also available is the Model SH-97P, which consists of a pair of straighteners (one 7-pin, one 9-pin) made to fit in miniature tube socket cut-outs. The devices range in price from 79 cents to $1.18.

SINE/SQUARE WAVE GENERATOR

A de luxe audio generator, suitable for laboratory or service shop use, is being released by *Lafayette Radio Electronics Corp.*, 165-08 Liberty Ave., Jamaica 33, N.Y. The Model TE-23 sine-square generator produces both sine and square waves over a frequency range of 20 cps to 1 mc. The output level over this range (except in the 0.01-volt position) is flat ±1.5 db. Frequency accuracy is ±5% on all bands. Other features include separate step and variable attenuators for each waveform, dual cathode-follower outputs, and front panel meter to monitor r.m.s. output. Price, $69.95.

SWEEP CIRCUIT ANALYZER

Intended for fast pin-pointing of TV sweep, sync, and high-voltage troubles, the Sencore SS117 sweep circuit analyzer can be used with the TV set turned on and still in its cabinet. Provision is made for checking the horizontal oscillator, output transformer, output, and deflection yoke; the vertical oscillator, output transformer, and deflection yoke; the second anode voltage; and the sync and discriminator circuits. Other features include a 0-300 microampere meter for minimum circuit loading and steel carrying case with a full mirror in its removable cover. Price, $89.50. (*Sencore Inc.*, 426 S. Westgate Dr., Addison, Ill.)



(*Continued on page* 32)

THE NEW NATIONAL NC-105

DESIGNED FOR THE AMATEUR, SWL AND HI-FI ENTHUSIAST

National's new NC-105 general coverage receiver features remarkable versatility for the amateur, short wave listener and hi-fi enthusiast. Compare the performance, features, and styling of the NC-105 with any receiver near its price range and then "step up" to new horizons in operating enjoyment.

Available in either National Blue steel cabinet or handsome custom oiled walnut enclosure, the NC-105 features:

- Continuous coverage from 550 kc to 30 mc in four bands
- Large illuminated edge-reading "S" meter
- Efficient peaking Q multiplier
- Separate product detector/BFO for CW and SSB reception
- Bandspread calibration charts for all popular amateur and foreign broadcast bands
- National's famous noise limiter
- Separate R. F. and audio gain controls
- Built in 5" speaker and front panel headphone jack
- Full wave transformer power supply
- Exclusive short-wave *tuner output*

The NC-105 AM broadcast and short-wave *tuner output* extends the versatility of hi-fi equipment, by allowing the audiophile to listen to (or tape) program material from all over the world!

NC-105 in steel cabinet..... $119.95
NC-105W in walnut enclosure.. $139.95
*slightly higher west of the Rockies and outside the U.S.A.

NATIONAL RADIO COMPANY, INC.
MELROSE 76, MASS.
A WHOLLY OWNED SUBSIDIARY OF NATIONAL COMPANY, INC.

Export: Ad Auriema, Inc., 85 Broad St.
New York, N. Y.

Canada: Tri-Tel Assoc. Ltd., 81 Sheppard Ave. W.,
Willowdale, Ontario

Whether you are an amateur, SWL or audiophile, we invite you to see the new NC-105 at your local National dealer.

products

(*Continued from page* 30)

MULTIPLE-SOCKET TUBE TESTER

The Mercury Model 1100 tube tester checks over 2000 tube types—including Nuvistors, Compactrons, and 10-pin types—for dynamic cathode emission, shorts, leakage, and gas content. Battery, voltage regulator, foreign, hi-fi, thyratron, and industrial types can also be checked. The tester's multiple-socket design eliminates complex switching, and a complete tube chart is located in the cover. Price, $39.50. (*Mercury Electronics Corp.*, 111 Roosevelt Ave., Mineola, N. Y.) —30—

SWL/QSL BUREAU

The SWL/QSL Bureau is a non-sponsored organization operating with the cooperation of the ARRL QSL Bureau. Its purpose is to handle incoming overseas SWL and QSL cards destined for W, K, and VE SWL's. When cards arrive with a complete address, the SWL is notified by post card and requested to send an SASE (business-size, self-addressed, stamped envelope), with an extra stamp, to the Bureau so that the cards may be forwarded to him.

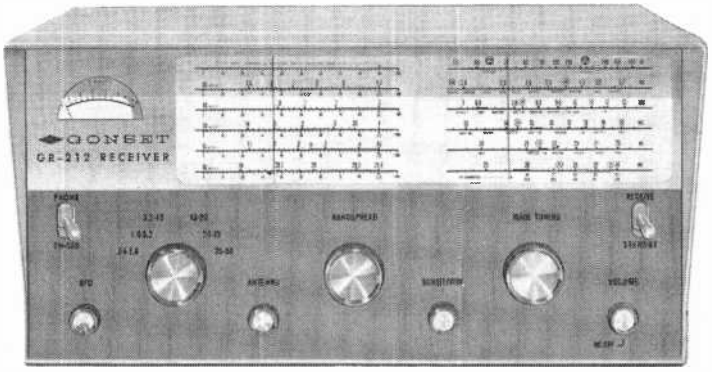
Many SWL and QSL cards arrive incompletely addressed, however, or addressed only to a WPE call-sign. Cards are presently being held for the call-signs listed below:

WPE1CLD	WPE3BUF	WPE6BJW
WPE1TV	WPE3CFT	WPE6OT
WPE1ZQ	WPE3CL	WPE6PG
WPE2APU	WPE3NZ	WPE6UD
WPE2BCA	WPE4CHV	WPE7AIR
WPE2CQP	WPE4CIA	WPE7ALN
WPE2CSE	WPE4FM	WPE9AIR
WPE2CT	WPE5ACB	WPE9BHH
WPE2CVH	WPE5AWV	WPE9BKT
WPE2DEY	WPE5AWX	WPE9BNX
WPE2DJE	WPE5BDC	WPE9BPT
WPE2EAA	WPE5FW	WPE9CQV
WPE3GMT	WPE6ATO	WPE9OL
WPE3BDV	WPE6AXT	WPEØBJM
		WPEØLU

If your call-sign appears in this list, and you have not already filed your name, address, and WPE call-sign with the Bureau, send an SASE to: LeRoy Waite, WPE2AK, Manager, SWL/QSL Bureau, 39 Hannum St., Ballston Spa, N. Y. Upon receipt of the SASE, your card/cards will be forwarded to you.

SHORT WAVE LISTENERS!

HERE'S YOUR BEST BUY IN A DUAL CONVERSION RECEIVER!



THE NEW GONSET GR-212

The only dual conversion receiver that is **priced under $100,** the GR-212 provides the novice with superb performance at modest cost. It is designed for general coverage from standard broadcast through 34 mc band, including WWV, U.S. Bureau of Standards Time Signals, foreign & Voice of America.

Quality features include:

- Dual conversion for increased selectivity
- Variable BFO
- Sensitivity: at least 6db(S+N)/N at 1 uv. (mod. 30% at 400 cps) input on all H.F. Bands.
- Two full-vision, illuminated, slide-rule type dials provide instant identification of broadcast and short-wave frequencies.
- Panel-mounted "S" meter.
- Band-spread tuning knob is inertia fly-wheel weighted for smooth tuning.
- Separate band-spread dial for amateur bands.

Amateur net price **$99.50**

For further information on the GR-212 and the name of your nearest Gonset distributor, fill out and mail this coupon!

COUPON: Please send me, without obligation, full information on the GR-212 dual conversion receiver.

NAME_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

GONSET Dept. PE-12, 801 So. Main Street, Burbank, Calif.

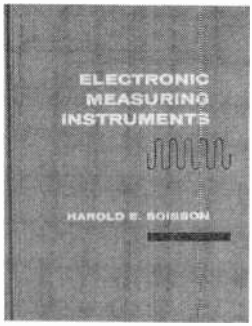
GONSET®
DIVISION OF YOUNG SPRING & WIRE CORPORATION

POP'tronics Bookshelf

ELECTRONIC MEASURING INSTRUMENTS

by Harold E. Soisson

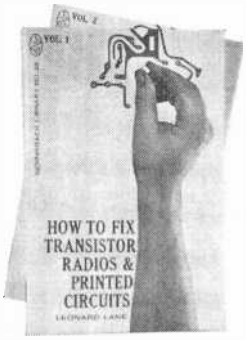
An introduction to electronic measurement and control as practiced in the laboratory and in industry, this book offers a general background for advanced work. The first six chapters deal with the theory and function of the basic components used in measuring systems, covering primary concepts, symbols, and nomenclature. The operation of each of the components making up a system used to measure or control a laboratory variable is discussed in the remaining chapters. This approach gives the reader a complete picture of the component and system relationships.



Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N.Y. 352 pages. Hard cover. $7.50.

HOW TO FIX TRANSISTOR RADIOS & PRINTED CIRCUITS (in two volumes) *by Leonard Lane*

This two-volume set originally appeared as a training course offered by an electronics home-study school. The books tell how transistors work and how they amplify, explain current and voltage gain, and analyze circuits. Both style and language are simple, and the material may be easily grasped by any one with a basic understanding of electronics. Practical applications and techniques are presented, as well as a solid background in theory. A handy



(*Continued on page* 38)

NOW! at a price you can afford!

MAKE MORE MONEY in ELECTRONICS

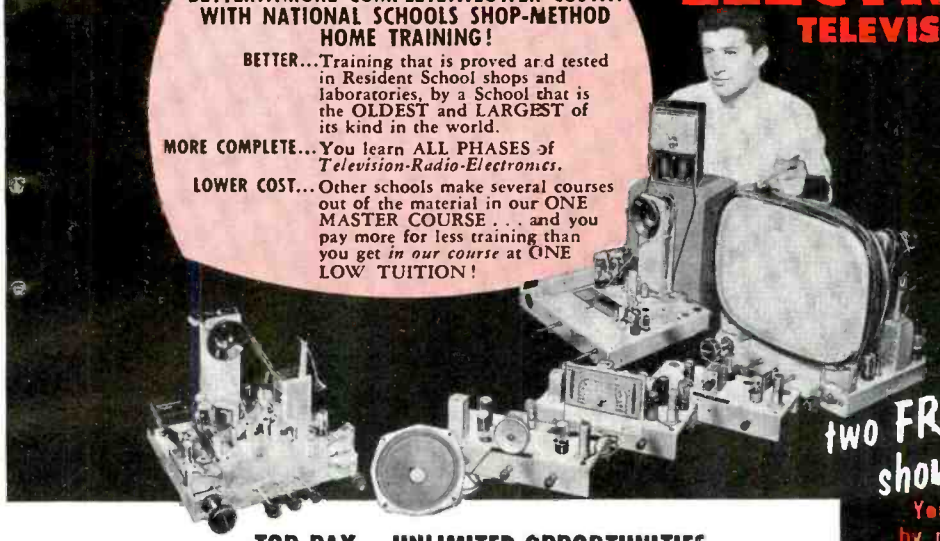
TELEVISION-RADIO

BETTER...MORE COMPLETE...LOWER COST... WITH NATIONAL SCHOOLS SHOP-METHOD HOME TRAINING!

BETTER... Training that is proved and tested in Resident School shops and laboratories, by a School that is the OLDEST and LARGEST of its kind in the world.

MORE COMPLETE... You learn ALL PHASES of *Television-Radio-Electronics.*

LOWER COST... Other schools make several courses out of the material in our ONE MASTER COURSE . . . and you pay more for less training than you get *in our course* at ONE LOW TUITION!



These two FREE books will show you how!

You get all information by mail . . . You make your own decision . . . at home! NO SALESMAN WILL CALL.

SEND FOR FREE FULLY-ILLUSTRATED BOOK AND ACTUAL LESSON TODAY. Your own copy of "Your Future In Electronics-Television-Radio" will be mailed to you at once. No salesman will call; there is no obligation. Cut out card along dotted lines, fill in and rush air-mail today!
NO POSTAGE NECESSARY

TOP PAY... UNLIMITED OPPORTUNITIES LIFETIME SECURITY CAN BE YOURS!

You are needed in the Television, Radio, and Electronics industry! Trained technicians are in growing demand at excellent pay—in ALL PHASES, including Servicing, Manufacturing, Broadcasting and Communications, Automation, Radar, Government Missile Projects.

NATIONAL SCHOOLS SHOP-METHOD HOME TRAINING, with newly added lessons and equipment, trains you in your spare time at home, for these unlimited opportunities, including many technical jobs leading to supervisory positions.

YOU LEARN BY BUILDING EQUIPMENT WITH KITS AND PARTS WE SEND YOU. Your National Schools course includes thorough Practical training—YOU LEARN BY DOING! We send you complete standard equipment of professional quality for building various experimental and test units. You advance step by step, perform more than 100 experiments, and you build a complete TV set from the ground up that is yours to keep! A big, new TV picture tube is included at no extra charge.

EARN AS YOU LEARN. We'll show you how. Many students pay for their course—and more, while studying.

YOU GET...

- 19 Big Kits—YOURS TO KEEP!
- Friendly, Instruction and Guidance
- Job Placement Service
- Unlimited Consultation
- Diploma—Recognized by Industry
- EVERYTHING YOU NEED FOR SUCCESS!

IMPORTANT SEE OTHER SIDE

GET THE BENEFIT OF OUR OVER 50 YEARS EXPERIENCE

APPROVED FOR GI TRAINING

ACCREDITED MEMBER

NATIONAL TECHNICAL SCHOOLS
World-Wide Training Since 1905
Write to Dept. R2G
4000 So. Figueroa Street
Los Angeles 37, California

CUT OUT AND MAIL THIS CARD TODAY

Yes, I want to make more money in Electronics-TV-Radio. Send me your FREE Fully-Illustrated Opportunity Book and Actual Lesson today.

FREE

RUSH AIR MAIL—NO POSTAGE NECESSARY

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

☐ Check here if interested only in Resident Training at Los Angeles. R2G
Veterans: Give date of discharge _____ A

NO SALESMAN WILL CALL; NO OBLIGATION ON YOUR PART

DON'T BE HALF-TRAINED

Be a MASTER TECHNICIAN in ELECTRONICS-TV-RADIO

Only N.T.S. offers you ALL 8 PHASES in ONE MASTER COURSE

SUCCESS IS THEIRS; IT CAN BE YOURS TOO!

When I enrolled with N.T.S. last November, I was trained as a Seismograph Observer. I was promoted to that job on May 1st of this year. With your school and my practical work in the field, my superiors recognized that I was capable of handling the job of Seismograph Recording. My superiors highly praise your school. The day I enrolled started me off to success.

Edgar Wesatzke

As field director of Berean Mission Inc., I have complete charge of our radio work. With the expert advice and training I am receiving from you I can do my own repairs on our recorders and P.A. systems, besides keeping our radios going. My training from N.T.S. helps keep us on the air. I feel privileged to be a member of such a fine institution.

Rev. Enoch P. Sanford

Thanks to N.T.S. I have a business of my own right in my home. I am still in the Air Force but I have paid for all my equipment with money earned servicing TV sets. Yes, N.T.S. gave me my start in television.

Louis A. Tabat

I have a TV-Radio shop in Yorkville, Illinois, about 4 miles from my home, and it has been going real good. I started part-time but I got so much work that I am doing it full-time. Thanks to National Technical Schools.

Alvin Spera

SEE OTHER SIDE

ALL 8 PHASES IN ONE MASTER COURSE

PHASE 1 TELEVISION INCLUDING COLOR TV
90% of homes have at least one set. Color TV is becoming more popular daily. TV Stations grow in number, need technicians. Maintenance and repair offer big opportunities.

PHASE 2 RADIO—AM & FM
Radios in homes, cars, schools, all need expert upkeep. Stations expand as FM becomes popular. Now transistors boom entire field.

PHASE 3 ELECTRONICS
Computers, Data-Processing machines, Electronic Controls, Guided Missile Systems are new fields where Electronics play a vital role.

PHASE 4 SOUND SYSTEMS
New popularity of Hi-Fi-Stereo, as well as industrial sound systems and business intercoms make this a highly specialized and important field.

PHASE 5 FCC LICENSE PREPARATION
FCC License holders have a wide range of top jobs open to them. FCC License now a requirement for most Communication jobs.

PHASE 6 RADAR AND MICROWAVES
These are the communications systems of the future, already used in tracking and contacting satellites.

PHASE 7 AUTOMATION & COMPUTERS
Automation and Computer electronics are the new tools of industry and commerce. Skilled Technicians in these fields are in great demand at top pay.

PHASE 8 BROADCASTING & COMMUNICATIONS
In the entertainment industry, or in commerce, communications and broadcasting have great importance. Installation and maintenance of equipment requires trained technician know-how.

FIRST CLASS
Permit No. 3087
Los Angeles, Calif.

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

VIA AIR MAIL

— POSTAGE WILL BE PAID BY —

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

RESIDENT TRAINING AT LOS ANGELES
If you wish to take your training in our famous Resident School in Los Angeles—the oldest and largest school of its kind in the world—check special box in coupon.

Approved for GI Training

NATIONAL TECHNICAL SCHOOLS
WORLD-WIDE TRAINING SINCE 1905

Address correspondence to Dept. R2G
4000 So. Figueroa Street
Los Angeles 37, California

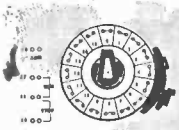
National Technical Schools also offers complete Home Study Training Programs in Auto Mechanics & Diesel, and Air Conditioning-Refrigeration-Electrical Appliances. For information and Free Book write the School, Department RDC, stating course desired.

TWENTY-FIVE THOUSAND DOLLARS IN RESEARCH TIME
. . . NOTHING LIKE IT ON THE MARKET!

Minivac® 601

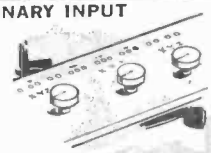
scientific exploration . . . education . . . experimentation at the 24" console of this amazing computer

DECIMAL INPUT-OUTPUT



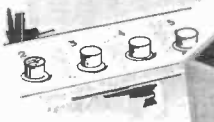
Motor-driven, sixteen position, non-shorting sequences.

BINARY INPUT



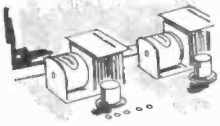
Transmits information for processing, six primary, double-pole, double-throw switches.

BINARY OUTPUT

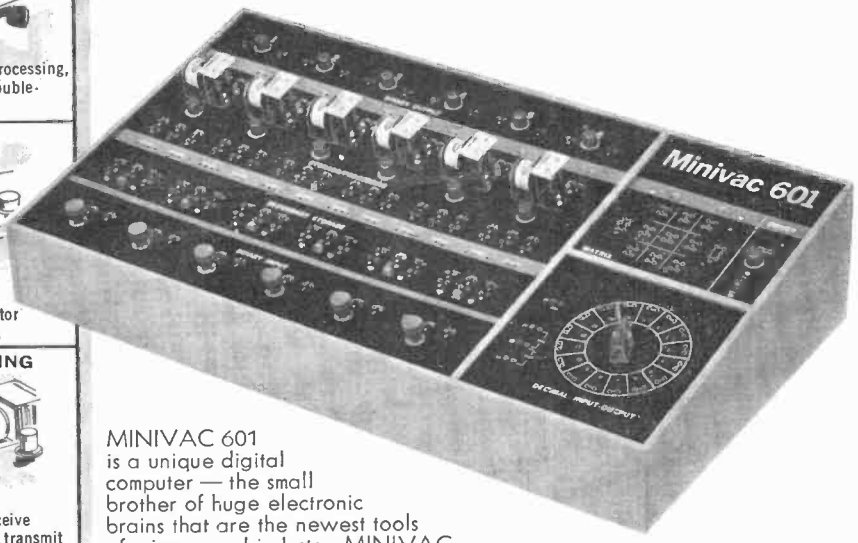


Communicates to the operator results of the programming.

STORAGE PROCESSING



Six double-throw relays receive information . . . process it . . . transmit it to other components.



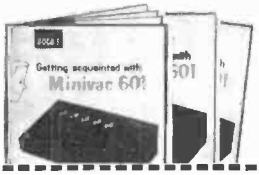
MINIVAC 601 is a unique digital computer — the small brother of huge electronic brains that are the newest tools of science and industry. MINIVAC has memory — it thinks . . . it can even play games. It prepares teenagers and adults for the world of tomorrow.

Created as a private project by Dr. Claude E. Shannon, now Donner Professor of Science, MIT, and developed by the SDC staff, MINIVAC 601 is built of professional components to professional standards.

It opens the way to exciting experimentation with circuits that solve problems and make decisions. It enables you to duplicate control systems like those used in advanced missiles. You may program it to demonstrate data processing techniques used in business. Hundreds of experiments are contained in the booklets. But this is only the beginning. The only limit to MINIVAC's accomplishments is the imagination of the machine's master.

$85.00

A complete set of 6 instruction manuals included. "Getting Acquainted with MINIVAC 601", "What is a Digital Computer?", "How Computers Make Logical Decisions", "How Computers Do Arithmetic", "How Computers Work for Man", and "MINIVAC Games".



SCIENTIFIC DEVELOPMENT CORPORATION

SCIENTIFIC DEVELOPMENT CORPORATION

Data Processing Division

372 Main St., Watertown 72, Massachusetts

Scientific Development Corp., Data Processing Division
372 Main Street, Watertown, Massachusetts

Gentlemen:
Please send free brochure giving complete information on Minivac 601 . . . what it is . . . what it does . . . how it operates.

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

Bookshelf

(*Continued from page* 34)

reference section at the end of Volume 2, designed for "instant servicing," lists common troubles and cures.

Published by Gernsback Library, Inc., 154 West 14th St., New York 11, N.Y. 160 pages per volume. Soft cover edition, $5.90. Hard cover edition, $9.90.

FUNDAMENTALS OF UHF *by Allan Lytel*

This book represents a complete course in ultra-high-frequency electronics. Though written at the intermediate level, the text should prove valuable to the engineer who desires an introduction to the u.h.f. field. Antennas, wave propagation, generators, communications equipment, and test equipment and techniques for that portion of the spectrum from 300 to 3000 mc. are thoroughly examined, as are the relevant FCC regulations.

Published by John F. Rider Publisher, Inc., 116 W. 14th St., New York, N.Y., 160 pages. Soft cover. $3.90.

New Literature

A 4-page illustrated brochure entitled "Why Stereo?" is available free from EICO Electronic Instrument Co., Inc., 3300 Northern Blvd., Long Island City, N.Y. The booklet explains the concept of stereophonic sound and gives details on various kinds of stereo sources. Methods of setting up stereo systems and converting monophonic systems to stereo are also discussed.

Many unusual ways to use tape recorders in business, professions, industry, schools, churches, and the home are suggested in the free Magnecord booklet, "207 Ways to Use a Tape Recorder." Also included are helpful tips on the operation of tape recorders and the handling and splicing of tapes. The booklet is available from Magnecord Sales Dep't, Midwestern Instruments, Inc., P.O. Box 7509, Tulsa, Okla.

Experimenters, amateurs, students, and engineers will be interested in a new catalog of electronic projects available at no charge from the Henry Francis Parks Laboratory. It lists the more than 100 projects for which the laboratory can supply circuit drawings, parts lists and notes. Just send a post-card request for the catalog to P. O. Box 1665, Lake City Station, Seattle 55, Wash. —30—

(advertisement)

How to get the most out of building Radio·Audio·Electronic kits

A new plan by Milton Sleeper, noted figure in electronics

"For a long time," Milton Sleeper explains, "I felt that a society should be formed for the benefit of everyone interested in kit building. There are clubs and leagues to represent and further the interests of stamp collectors, photo fans, and radio hams. Similarly, there should be a kit builders' society, and it should have its own publication to voice the opinions of the members, for the exchange of experiences, and to provide news and information on this fascinating hobby."

Now, at last, there is a such a national society. Here's how it came about:

THE R·A·E SOCIETY

Nearly two years ago, a group of kit builders in the Berkshire Hills area of Massachusetts—comprised of businessmen, lawyers, engineers, and bankers—elected Mr. Sleeper chairman of what they called the R·A·E Society, because the members were all interested in building Radio·Audio·Electronic equipment.

As news of the Society spread, people from far and wide inquired about joining. Letters came from high school and college students, and from men of many different professions. Their enthusiastic interest showed that the Society could be more useful to more people than had been anticipated.

Also, there were many requests for a Society journal to serve a membership growing to national proportions. That posed a problem, however, for it meant setting up offices for the Society, with a paid staff at a cost which could not be met from membership dues.

A SPONSOR FOR THE SOCIETY

Meanwhile, the original members had undertaken to work out their own ideas of components to be assembled from kits. Certainly there was room for many improvements, because no basic changes had been made in kits and instructions over the past 20 years.

They first made a study of the advanced designs and techniques now employed in commercial and military equipment. Then they applied their findings to the design of components to be assembled from kits, and to the preparation of error-proof instructions.

Their undertaking was successful beyond expectations, so much so, in fact, that a company—R·A·E Equipment, Inc.—was formed to produce kits from their unique designs. Then, logically, this Company assumed sponsorship for expanding the Society nationally, and for the Society's R·A·E Journal.

THE R·A·E JOURNAL

Publication of the quarterly R·A·E Journal is important to members of the Society because it provides two much-needed services. First, it is an open forum for the exchange of opinions, suggestions, and experiences. Through it, members can make their views known to the record, tape, and equipment manufacturers, the radio and TV broadcasters, and to the Federal Communications Commission.

Second, the Journal fills a growing need for more specific, less technical information on kit assembly, home workshop projects, plans for stereo and mono record, tape, and radio installations, correct operation of components, and testing methods. Also, since no advertising space is sold, the Journal can carry unprejudiced reports, free of commercial bias, on all new developments.

With Milton Sleeper as editor, you will certainly find the Journal interestingly written from cover to cover, easy to understand, elaborately illustrated, and handsomely printed on fine paper. Please note that only members of the Society will receive the Journal. No copies will be sold.

YOU ARE INVITED

You are cordially invited to become a member of the R·A·E Society, an organization that started from the activities of a dozen kit building hobbyists, and is now growing into a national institution.

Membership is open to high school and college students, to men of all professions, and to hobby-minded women, too. Whether you are a beginner, an experienced kit builder, or an advanced enthusiast, you are welcome to join the Society, and to share in the privileges of membership. By applying for membership now:

- You will take part in various group activities and opinion polls
- You will receive accurate, advance information on new radio, audio, and electronic kits
- You will qualify to serve on one of the Advance-Test Panels, and if you are selected you will receive a free R·A·E kit in return for writing a report on it
- You will receive the four annual issues of the R·A·E Journal
- You may use the buy, sell, and swap columns of the Journal without charge
- You will receive an official membership card identifying you with the R·A·E Society.

CHARTER MEMBERSHIP NOW OPEN

For a limited time (expires January 31, 1962) you can join the Society as a Charter Member. Dues for the first year are only $1.00 This entitles you to receive the Journal for one year, and to enjoy all the other benefits of membership.

Use the coupon below or your own stationery to apply for Charter Membership.

Milton Sleeper originated the idea of step-by-step kit instructions and picture wiring diagrams in the 20's. A pioneer radio engineer and manufacturer, he is an author and magazine publisher, founder of High Fidelity magazine, and a recognized authority on kit design techniques.

R·A·E SOCIETY (sponsored by R·A·E Equipment, Inc.)
COUNTY BANK BUILDING
GREAT BARRINGTON, MASS.

Yes, I want to take part in the Society's activities, to receive the R·A·E Journal edited by Milton Sleeper, and I want to qualify to serve on one of the Advance-Test Panels. I enclose $1.00 for Charter Membership dues for one year.

NAME .....

STREET .....

CITY & ZONE ..... STATE .....

I understand that I am not required to purchase any R·A·E kit in order to enjoy full membership privileges.

I am a ☐ Beginner ☐ Experienced Kit Builder ☐ Advanced Enthusiast

UNCONDITIONAL MONEY-BACK GUARANTEE. If I am not completely satisfied after I receive the first issue of the R·A·E Journal, my money will be refunded on request.

BEST BUYS IN STEREO AND MONO HI-FI

New Transistorized Stereo/Mono 4-Track Tape Deck RP100
Semikit (electronics in kit form) $299.95 Wired $399.95

New FM-AM Stereo Tuner ST96
Kit $89.95 Wired $129.95
Incl. FET

New 70-Watt Integrated Stereo Amplifier ST70
Kit $94.95 Wired $149.95

New 40-Watt Integrated Stereo Amplifier ST40
Kit $79.95 Wired $129.95

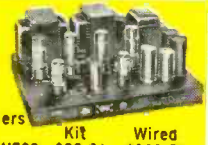
EICO®

28W Integrated Stereo Amplifier HF81
Kit $69.95 Wired $109.95

FM Tuner HFT90
Kit $39.95 Wired $65.95
Incl. FET Metal Cover $3.95

AM Tuner HFT94 Incl. FET
Kit $39.95 Wired $65.95

Stereo Preamplifier HF85
Kit $39.95 Wired $64.95



Stereo Power Amplifiers

		Kit	Wired
100W	HF89:	$99.50	$139.50
70W	HF87:	$74.95	$114.95
28W	HF86:	$43.95	$ 74.95

NEW FM-Multiplex Autodaptor MX99
Kit $39.95
Wired $64.95
(Patents Pending)

Bookshelf Speaker System HFS1 Kit $39.95 Wired $47.95

EXCELLENCE IN CREATIVE ELECTRONICS

Over 2 MILLION EICO instruments in use throughout the world. Compare, take them home — right "off the shelf" — from 1500 neighborhood dealers, most of whom offer budget terms.

BEST BUYS IN CITIZENS TRANSCEIVERS, HAM GEAR, RADIOS

Citizens Band Transceivers from
Kit $59.95
Wired $89.95

New 60W CW Transmitter #723
Kit $49.95 Wired $79.95

NEW Walkie-Talkie Citizens Band Transceiver #740
Kit $54.95.
Wired $79.95.
Complete with rechargeable battery & charger.

BEST BUYS IN TEST EQUIPMENT

New Metered Variable Auto-Transformer AC Bench Supplies
Model 1073 (3 amps)
Kit $35.95 Wired $47.95
Model 1078 (7½ amps)
Kit $42.95 Wired $54.95

Peak-To-Peak VTVM #232 & Uni-Probe® Pat. #2,790,051
Kit $29.95
Wired $49.95

VTVM #221
Kit $25.95 Wired $39.95

DC—5 MC 5" Scope #460
Kit $79.95
Wired $129.50

5" Push-Pull Scope #425
Kit $44.95 Wired $79.95

Tube Tester #625
Kit $34.95 Wired $49.95

RF Signal Generator #324
Kit $26.95
Wired $39.95

1000 Ohms/Volt V-O-M #536
Kit $12.90
Wired $16.90

6- & 12V Battery Eliminator & Charger #1050
Kit $29.95
Wired $38.95

Extra-filtered for transistor equipt. #1060
Kit $38.95 Wired $47.95

NEW AC Volt-Watt Meter #260
Kit $49.95
Wired $79.95

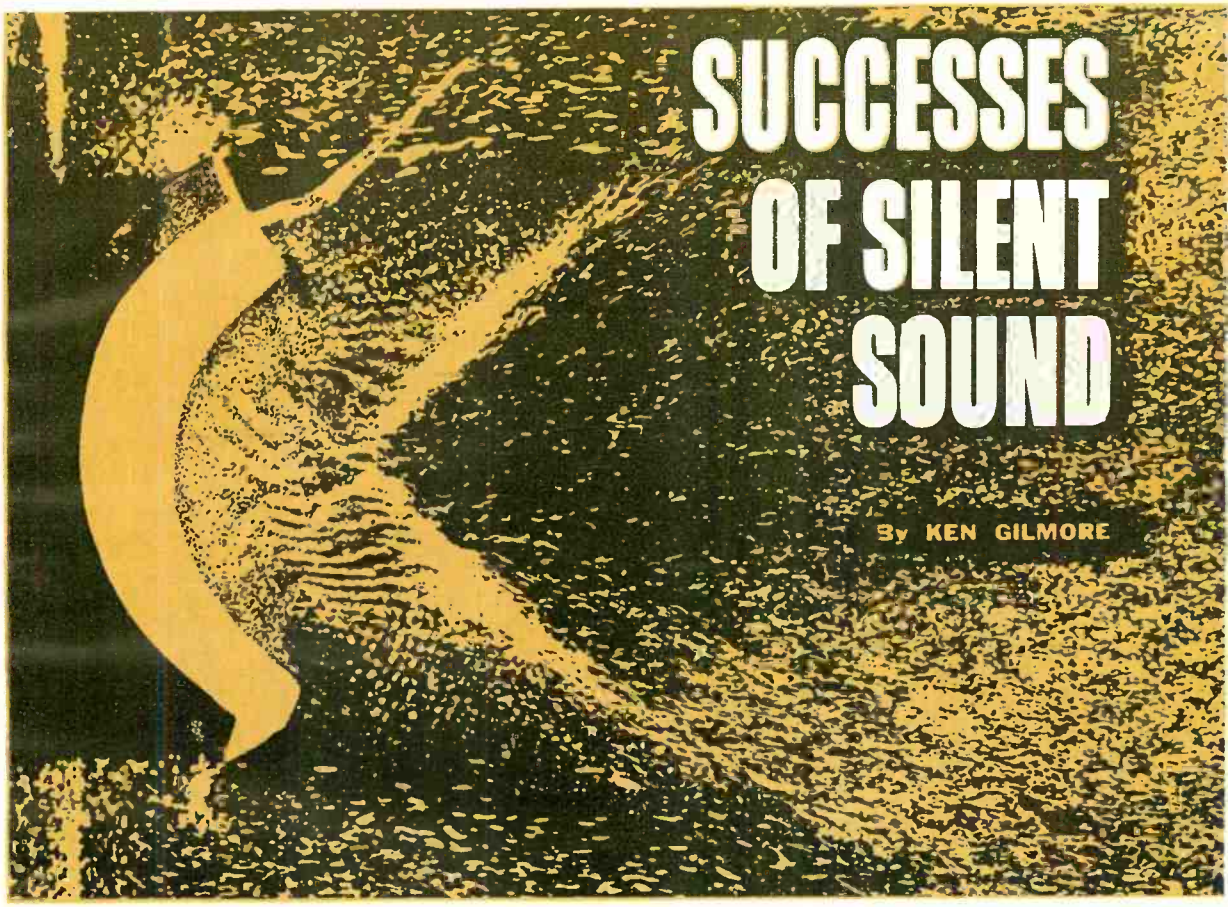
Multi-Signal Tracer #145A
Kit $19.95
Wired $28.95

EICO, 3300 N. Blvd., L.I.C. 1, N.Y. PE-12
☐ Send free Catalog describing over 80 top-quality products, free Stereo Hi-Fi Guide, free Short Course for Novice License, name of nearest EICO dealer. ☐ Send new 36-page GUIDEBOOK TO HI-FI for which I enclose 25¢ for postage & handling.

Name.....
Address.....
City..... Zone... State.....
Add 5% in the West

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

ULTRASONICS



SUCCESSES OF SILENT SOUND

By KEN GILMORE

LAST May 16th, President Kennedy strained his back while planting a tree in Ottawa, and was again victim of the effects of an old back injury. To relieve the pain and promote healing, his doctors prescribed doses of "ultra-sound."

That same day, a housewife in Fresno, Calif., dipped her dinner dishes into an ordinary-looking sink full of clear water, pulled them out after a few seconds, and put them in a rack to dry. In spite of her apparently sloppy housekeeping, the dishes came out antiseptically clean.

That night, millions of Americans all over the country were pressing buttons on cigarette-case-sized remote control units and watching their TV sets across the room change channels and turn themselves on and off.

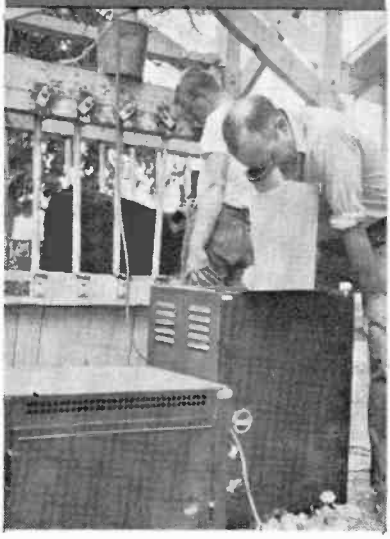
These seemingly unrelated incidents are linked by a common bond: they all had something to do with ultrasonics—sound above the range of human

Branson Instruments

One of the most popular applications of ultrasonic energy is cleaning. Above, a hospital worker cleans surgical instruments by dipping them in an ultrasonic bath. Instruments are cleaned better, faster, than with hand-scrubbing method.

Another use of ultra-sound is checking fat content of beef on the hoof, as is being done at Colorado State University.

Colorado State University



Westinghouse

Even dried egg yokes can be "brushed" from your most prized china with ultrasound. Prototype dishwashers, such as this Westinghouse unit, have proven successful in consumer tests across the country, but they are still too expensive for the average home.

ULTRASONICS

hearing. And newly discovered ultrasonic tools and techniques are now revolutionizing hundreds of industries. For example:

- Brewers "pump" ultrasonic sound through bottles of beer before putting on the caps. The ultra-sound makes the brew foam violently, releases all trapped air, and renders the beer immune to oxidation and spoilage during storage.
- Warehousemen have found that even low levels of ultrasonic sound drive rats crazy. After being subjected to such treatment for a day or so, the rodents give up and move away—permanently.
- Space workers now perform thickness measurements on missile nose cones—which must be machined to exact tolerances to withstand the heat of re-entry—quickly and easily with radar-like ultrasonic gadgets. The thickness, accurate to thousandths of an inch, is read directly on a television-like tube.
- Railroad men check rails, car wheels, and other massive steel parts with a similar radar-like detector which spots flaws and cracks far better and faster than older methods.

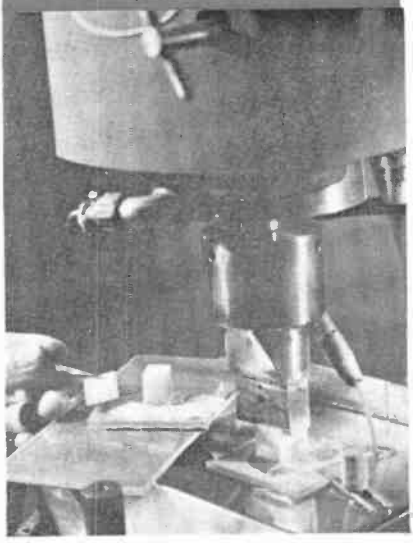
Why Silent Sound? Ultrasonic waves are useful largely because we can pack tremendous power into them. Sound we can hear could do many of the same jobs, but it would split eardrums for miles around. We don't often think of sound as having physical power, but it has. When we drive units with the tremendous energy levels used in ultrasonics, the results can be spectacular.

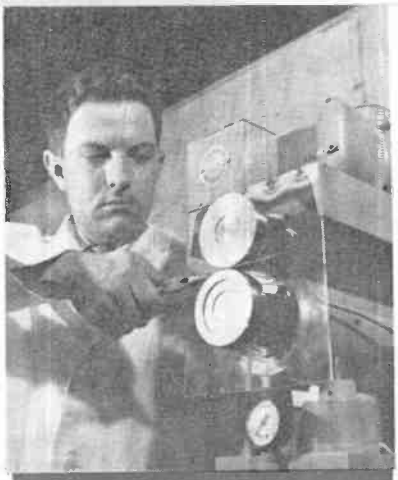
Take ultrasonic cleaning, for example. Dip anything dirty into a tank of water being agitated by ultrasonic waves, and the sound energy literally tears the dirt off. This tremendous cleaning power comes from a phenomenon scientists call cavitation. As the powerful ultrasonic waves vibrate through a liquid, millions of microscopic bubbles continuously form and collapse with such terrific force that they create pressures up to 20,000 pounds per square inch. The ferocious scrubbing action of the collapsing bubbles blasts the dirt off the surface to be cleaned.

Today, hardly a manufacturing industry exists that doesn't use some type of ultrasonic cleaning. In one factory, a

Industrial applications of ultra-sound are many and varied. The Raytheon Company, for example, employs the ultrasonic impact grinder below to slice blocks of quartz into thin sheets for use as crystals in receivers.

Raytheon





Westinghouse

Ultrasonic welding machine pulls strips of metal between vibrating rollers which literally pound the strips into a single sheet. Process generates no heat and is suitable for such hard-to-weld metals as aluminum foil, which would be damaged by temperatures of more conventional welders.

Intricate designs can be reproduced in glass or ceramic with ultra-sound. A counterpart of the design appears on an oscillating tool or die, which drives liquid abrasive into the workpiece to cut the material.

Raytheon

dirt- and grease-coated gas turbine rotor is dipped into an ultrasonic bath, to be pulled out a few seconds later shining and clean. In other plants across the country, all kinds of parts—printed-circuit boards, electric shaver heads, and thousands of other items—come out of their ultrasonic baths with every tiny crevice literally sparkling.

Hospitals throughout the nation now use ultrasonic cleaners to scrub surgical instruments. Dr. George W. Dana, director of the North Shore Hospital in Manhasset, Long Island, was amazed when he used an ultrasonic unit for the first time. "It even took off stains we thought were a permanent part of the finish of surgical instruments," he said.

The energetic bubbles are so small that they can sneak into tiny holes and crevices impossible to clean by other methods. Scouring the tiny, hairlike tube through a hypodermic needle, for example, is a snap.

From Hours to Minutes. Before the advancement of ultrasonic techniques, one large manufacturer of camera lenses kept a staff of 24 women busy around the clock cleaning lenses. The delicate glass discs are coated with a sticky pitch to hold them steady during the grinding process, and getting the pitch off was a nasty job. Now, the company dumps the whole batch into an ultrasonic cleaner and scours an entire day's output in jig time.

Likewise, delicate jet engine nozzles used to be discarded when they began to show signs of clogging, since there was no practical way to clean them reliably. Today, with ultrasonics, they're as good as new in minutes.

Some watchmakers now offer a while-you-wait cleaning service for your watch. They flip the back off your timepiece, dip it in an ultrasonic tank, dry it with a blast of hot air, put in a few drops of oil, then return it to you. The process is both fast and cheap.

A cash register maker now cleans assemblies of 5000 complex parts in 7½ minutes without dismantling a single part; previously it took a skilled man days to do the job. Auto servicemen are installing ultrasonic cleaners, too; your carburetor, among other complex assem-

blies, can be cleaned in seconds without being dismantled.

From Egg Yokes to Soup Cans. Within a few years you may be able to buy a dishwasher that blasts even dried egg yoke off your most fragile china without damaging it. Various companies have been promising this one for several years now, and test models operate beautifully. Some makers are also predicting ultrasonic washing machines for your clothes, but this is still further in the future. The holdup: nobody has been able to get the units down to a moderate price.

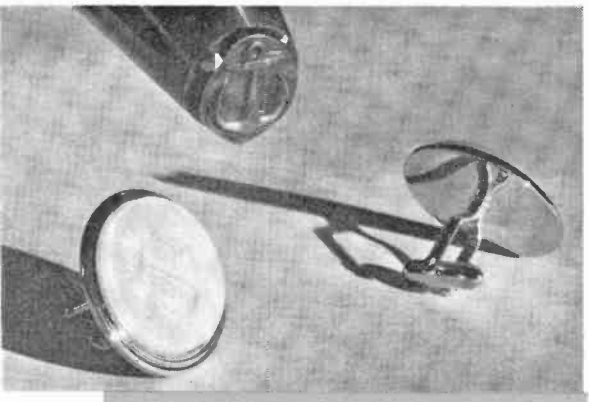
Even air can be cleaned ultrasonically. Aim a beam of silent sound through dirty air and the vibrating waves jam tiny floating particles together, causing them to accumulate in clumps and drop out. This technique has already been incorporated in many industrial smoke precipitators, and recent experiments at Orly Field near Paris, France, indicate that it can also be used to disperse fog. The trouble to date is that enormous amounts of power are needed to cover a large area—an airport such as Orly Field, for example.

Crewmen aboard atomic subs are warned of hull leaks by ultrasonic liquid detectors. A tiny ultrasonic probe vibrates freely in open air. But when you cover its tip with water, the vibration stops, and an alarm goes off. The same detector will keep ground crews alerted to the fuel level in the tanks when America's giant rocket, the "Saturn," blasts off for outer space. Meanwhile, back on planet Earth, one soup manufacturer has tested the same indicator as a foolproof method for determining when soup cans are full.

Meat and Milk, Too. The Reflectone Corporation of Stamford, Conn., has perfected a method of tenderizing meat with ultrasonics. The powerful waves pound tough cuts of meat into tender steaks without producing the flabbiness chemical tenderizers sometimes do. Silent sound helps produce better steaks in another way, too. Researchers at Colorado State University rigged a gadget to shoot low-powered ultrasonic waves painlessly into beef on the hoof—the returning echoes tell how much fat and how much "meat" is on the critter.

Ultrasonics will soon produce a better cup of coffee. Treat green coffee to a dose of ultrasonics before roasting, and the silent sound blasts a series of microscopic holes through the beans. During

ULTRASONICS



Raytheon

Mother-of-pearl intaglios for these cuff links were machined from the tool shown above the set with an ultrasonic device. Jade, spinel, agate, synthetic ruby, sapphire, onyx, and other stones can also be inexpensively worked into beautiful jewelry by means of ultra-sound.

Technician checks thickness of Explorer satellite nose cone with ultrasonic gauge. The sharp vertical line on the scope face indicates thickness to within one one-thousandth of an inch.

Branson Instruments

roasting, heat penetrates more evenly, driving out oils that can cause rancidity.

Some dairies are now using ultrasonic homogenizers. As an added advantage, the ultrasonic waves go to work on bacteria, killing most of them. Experimenters think it may soon be possible to forego pasteurizing altogether and count on just a single blast of ultra-sound to homogenize and pasteurize milk simultaneously. One company recently patented an ultrasonic gadget which sends a signal zooming through a tank of milk, checks the returning echo, and comes up with an automatic analysis of its nutritional value.

Welding and Drilling. A new machine by Westinghouse actually welds metals by ultrasonic energy. Two pieces of metal are run between a couple of rollers vibrating at ultrasonic speed. The intense vibration breaks down the surface molecules of the individual pieces where they come together and causes them to interlock.

Nobody but a comedian would have suggested drilling square holes a few years ago. But ultrasonic drills can now drill them square, star-shaped, in the form of a cuckoo bird, or what have you. A shaft driven up and down thousands of times a second, but with a movement so slight you can't even feel it, does the job.

The "drilling" is accomplished by flowing a slurry of abrasives between the shaft and the material to be drilled. The shaft comes down, strikes the abrasive particles, and causes them to dig into the material like a flock of frantic woodpeckers. In no time at all, a hole the exact shape of the drilling shaft is punched through.

Unlike other methods, the drill doesn't even have to be as hard as the material it is drilling. Naturally, this leads to spectacular tricks. With an ultrasonic setup, you can drive a fountain pen through a pane of glass or slice off a piece of extra-hard steel with a cheap pen knife.

Wartime Development. Ultrasonics, now going to work in literally hundreds of ways, has been known for years. Perhaps the first practical application was the so-called "silent" dog whistle. Dogs can hear it but people can't.

Men first put ultrasonics to work—past the "dog whistle" stage, that is—in World War I when a French scientist named Paul Langevin built a sonar machine for detecting submarines. The

ULTRASONIC PRIMER

An ultrasonic generator is nothing more than a signal generator (much like the one on a radio-TV workbench, only designed to cover a different frequency range), plus an amplifier, and a transducer. This last item is a gadget which converts electrical energy into sound waves. The speaker in your hi-fi setup is a transducer and does the same job, although at different frequencies.

There are two kinds of ultrasonic transducers in general use—piezoelectric and magnetostrictive. In the first, an oscillating current is applied to a crystal, which vibrates, sending out ultrasonic waves. The magnetostrictive head, by contrast, takes advantages of the fact that certain metals—nickel, for example—will expand and contract in the presence of a magnetic field. Surround a nickel rod with a coil hooked to the output of an oscillator, and the bar expands and contracts at the oscillator's frequency rate, again setting up ultrasonic vibrations.

Ultrasonic generators range in power from a few watts for flaw testing, thickness gauging, and similar uses, up to as much as several thousand watts for heavy industrial cleaning, drilling, and so on. Frequencies used in most industrial processes range from 20 to 50 kc., since it takes considerably more power above that rate to do the same job. Medical applications, however, often use sound in the 500-kc. to 3- or 4-mc. range.

war was over before Langevin refined his invention enough for practical use, but when World War II came along, sonar was further developed. And after the war, the strange properties of ultrasonic sound began to be turned to dozens of industrial tasks.

Both Sperry Products and Firestone Tire and Rubber were early users of ultrasonic waves as flaw detectors. Ultra-sound travels readily through solids, but with difficulty through air. Beam a small ray of ultrasonic energy through a piece of steel, and if an air bubble is present, an echo comes bounding back. The time the echo takes to return shows an operator where the bubble is. Firestone originally used this technique to spot defective tires. Today, it's standard practice with manufacturers of parts ranging from locomotives to ball-point pens.

The Field of Medicine. Perhaps the most dramatic post-war gains in ultrasonics took place in the field of medicine. One of the first doctors to use the new therapy in the U. S. was Dr. John H. Aldes of Los Angeles.

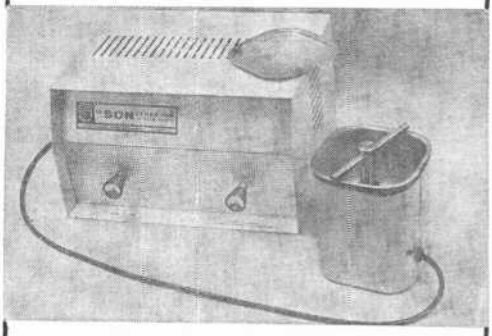
A few years ago, after tests on himself and his co-workers, Dr. Aldes tried ultrasonics on a patient, a 67-year-old widow, so crippled by one type of arthritis that she had to be carried into his office. Dr. Aldes applied treatment after treatment, but nothing happened. He was almost ready to give up when the woman suddenly noticed that she could move one hand a little. A few months later she walked into Dr. Aldes' office under her own power.

Today, ultrasonics is standard treatment for certain kinds of arthritis in hospitals all over the country. It never cures, of course, since there is no known cure for arthritis. But it does frequently bring dramatic relief from pain and it can limber joints after all other treatment has failed.

In recent years, medical uses for ultrasound have multiplied. A woman's hand, severely lacerated during childhood, was so covered with stiffened scar tissue that it was completely immobile. Doctors

(*Continued on page* 94)

LOW-COST CLEANING WITH ULTRASONICS



Ultrasonic cleaning equipment is available in a wide variety of sizes, shapes, and prices. The lowest priced item on the market as this is being written is the "diSONtegrator System Thirty." Manufactured by Ultrasonic Industries, Ames Court, Plainview, L.I., N.Y., it costs $69.95, complete.

The diSONtegrator System Thirty has a 30-watt oscillator operating at about 90 kc. Tuning is broad, and the ultrasonic signal is basically FM. The oscillator is built around a single type 826 tube. A one-pint capacity cleaning tank features a working compartment measuring 3⅝" x 3⅝" x 3" deep.

This small ultrasonic cleaner has been used in the POPULAR ELECTRONICS laboratory for several months. When employed with the proper detergent—ammoniated for glassware, jewelry, eyeglasses, etc.; copper brightener for copper or gold; alkaline for rust removal, etc., etc.—the unit performed with astonishing efficiency. Small electronic parts that could not be adequately cleaned without disassembling were made to shine as if brand-new. In fact, brand-new parts were cleaned also, to remove any traces of soil left from packaging and shipping.

A slightly larger version of this low-cost model is available for $99.95. It is called the diSONtegrator System Forty, and includes a one-half gallon cleaning tank (measuring 5¾" x 5¼" x 4" deep).

Transmit without a license? You can—with this "flea-powered" 27-mc. rig

THE ROOF HOPPER

By **HARTLAND B. SMITH,** W8VVD

MENTION a hundred-milliwatt transmitter to the average hobbyist, and he's likely to think of an anemic handie-talkie or a puny phono oscillator. But a "flea-power" rig can provide solid-copy signals over a distance of several miles, and the license-free transmitter illustrated on the following pages has done just that. Designed to furnish maximum possible transmission range, the "Roof Hopper" complies with all pertinent sections of Part 15 of the FCC Rules and Regulations.

What does "Part 15" have to say about unlicensed transmitters? Just this: that they are legal, provided that they meet the following requirements:

"(a) The carrier of the device shall be maintained within the band 26.97-27.27 mc.

"(b) All emissions, including modulation products, below 26.97 mc. or above 27.27 mc. shall be suppressed 20 db or more below the unmodulated carrier.

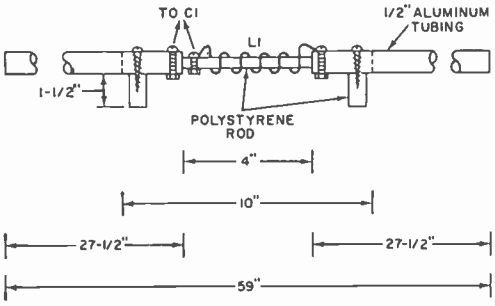
"(c) The power input to the final radio stage (exclusive of filament or heater power) shall not exceed 100 milliwatts.

"(d) The antenna shall consist of a single element that does not exceed 5 feet in length."

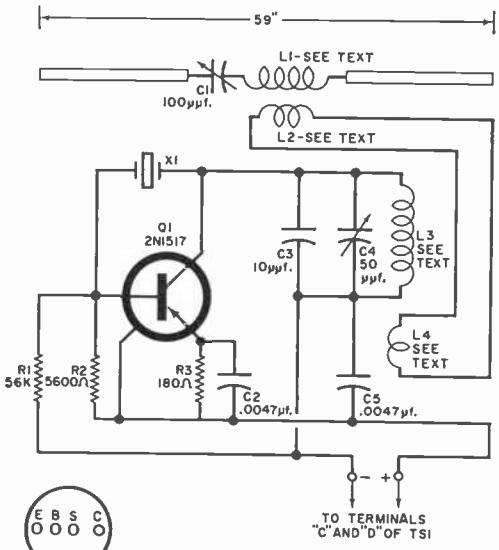
Transmitting Setup. Since even a simple dipole is 17 feet long at 27 mc., the 5-foot limitation on antenna length would seem to rule out an efficient radiating system for an unlicensed transmitter. However, if a loading coil is inserted at the center of a 5-foot element, a surprising amount of energy will be radiated by the 5-footer.

Another "problem" is the fact that a long feedline between transmitter and antenna is not permitted by Part 15. But nothing in the Rules precludes mounting an unlicensed transmitter on top of a pole and then operating it by remote control from a more convenient location. And that is just what was done with this rig.

With the transmitter mounted near the antenna and with a suitable loading coil at the center of the antenna, the op-



Antenna for the Roof Hopper consists of two lengths of ½" aluminum or copper tubing joined with a polystyrene rod. Drawing above shows location of antenna loading coil L1 as well as all dimensions.



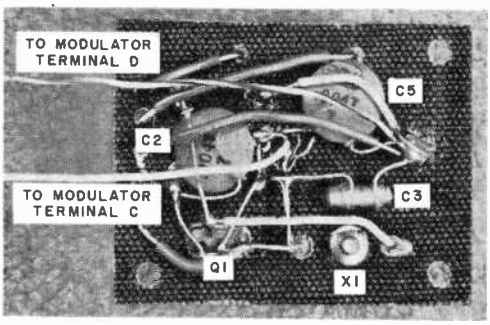
Schematic diagram of r.f. portion of transmitter. The FCC Rules require that XI be ground for a frequency between 26.97 and 27.27 mc.

HOW IT WORKS

Transistor *Q1* and its associated components comprise a standard Pierce oscillator circuit which functions as a low-power transmitter. The circuit oscillates at the frequency of the quartz crystal *(X1)* due to collector-to-base feedback through *X1; L3* and *C4* are tuned to the output of the oscillator, which falls in the 27-mc. band. Radio-frequency energy in *L3* is link-coupled to *L1* via coils *L4* and *L2; L1* and *C1* resonate the antenna to the 27-mc. band, making it appear, electrically, as a full-sized dipole.

In the modulator, transistors *Q2, Q3,* and *Q4* amplify the voltage generated by a microphone connected to jack *J1;* power from battery *B1* passes through the primary of *T1* (which serves as a choke) on its way to the transmitter. The amplified speech signal also appears across *T1*'s primary, where it alternately increases or decreases the transmitter's d.c. supply. This action causes the transmitter's output to vary in accordance with the signal from the microphone.

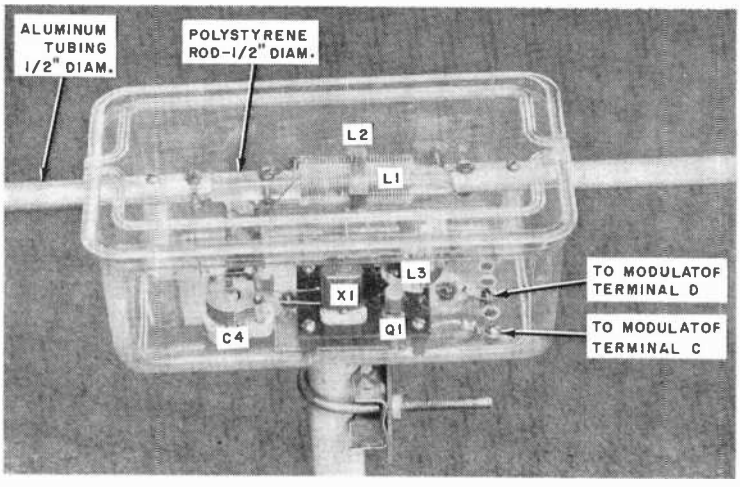
The voltage drop across *R16* prevents the power input from exceeding the legal limit (100 milliwatts). As the current increases, the voltage applied to *Q1* falls, and the current-times-voltage product never quite equals 100 milliwatts. At the recommended operating point of 7 ma., input to *Q1* is approximately 87.5 milliwatts.



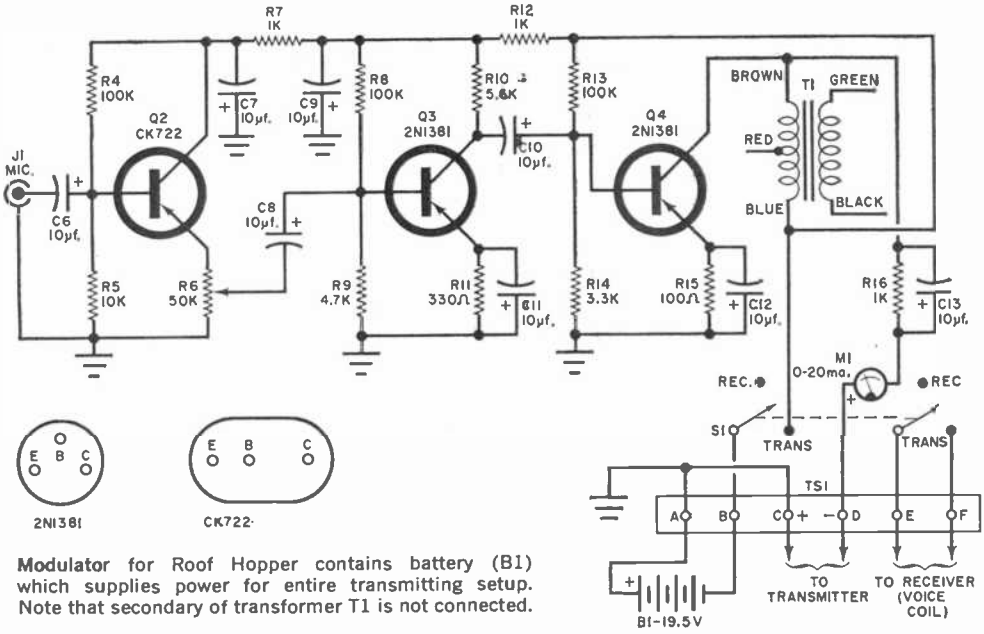
Most components in transmitter are mounted on small phenolic board.

erating range of this setup is more than satisfactory. Provided that the transmitter has been mounted high and in the clear, and provided that the receiving installation is an efficient one, you should have little difficulty maintaining communications at distances of 3 to 5 miles in the average metropolitan area. Naturally, performance over a line-of-sight path or over water will be even better.

Construction. The r.f. portion of the transmitter is housed in a 3" x 4" x 8" methylstyrene refrigerator dish known as a "Crispy-tainer." (Similar containers are sold by most dime stores and supermarkets.) The clear plastic is brittle



Complete transmitter assembly, including antenna and transmitter "chassis" shown at left above, is attached to a mast or other support with a common TV antenna mount. Care must be exercised when drilling holes in the methylstyrene dish.



Modulator for Roof Hopper contains battery (B1) which supplies power for entire transmitting setup. Note that secondary of transformer T1 is not connected.

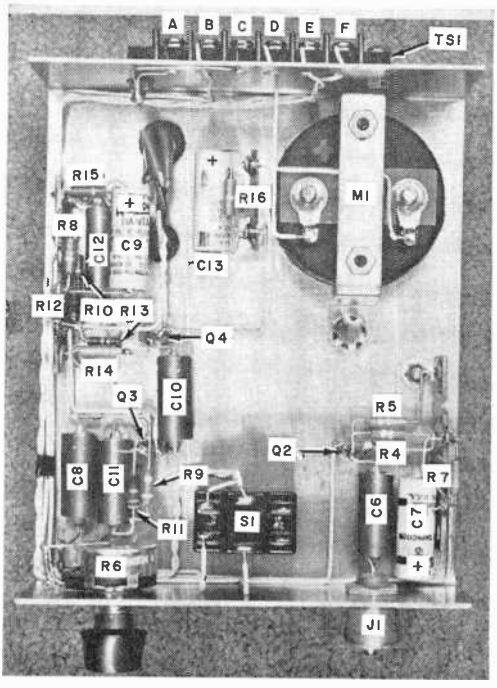
PARTS LIST

B1—19.5-volt battery (13 size "D" flashlight cells in series)
C1—100-μμf. variable capacitor (Hammarlund APC-100 or equivalent)
C2, C5—0.0047-μf., 600-volt disc capacitor
C3—10-μμf., temperature-compensating, tubular ceramic capacitor (Centralab Type TCZ or equivalent)
C4—50-μμf. variable capacitor (Hammarlund APC-50 or equivalent)
C6, C7, C8, C9, C10, C11, C12, C13—10-μf., 25-volt miniature electrolytic capacitor (Aerovox Type SRE or equivalent)
J1—Microphone jack (Amphenol 75-PC1M or equivalent)
L1—30 turns of Barker and Williamson 3011 coil stock—see text
L2, L3, L4—9 turns of Barker and Williamson 3016 coil stock
M1—0-20-ma. milliammeter (Emico Type RF-2C or equivalent)
Q1—2N1517 transistor
Q2—CK722 transistor
Q3, Q4—2N1381 transistor
R1—56,000 ohms
R2, R10—5600 ohms *All resistors*
R3—180 ohms *½-watt*
R4, R8, R13—100,000 ohms
R5—10,000 ohms
R6—50,000-ohm potentiometer, audio taper
R7, R12, R16—1000 ohms
R9—4700 ohms
R11—330 ohms
R14—3300 ohms
R15—100 ohms
S1—D.p.d.t. toggle switch
T1—Transistor output transformer: primary, 500 ohms, CT; secondary, 3.2 ohms (Argonne AR-119 or equivalent)
TS1—6-lug terminal strip
X1—27-mc. 3rd-overtone quartz crystal—see text
1—1½" x 4⅞" x 5¾" open-end aluminum chassis (Bud CB-1629 or equivalent)
1—1¾" x 2¼" Bakelite board, 1/16" thick
2—12" lengths of ½" polystyrene rod
1—55" length of ½" aluminum or copper tubing
1—TV antenna mast mount (Telco 8800-U or equivalent)
1—3" x 4" x 8" plastic refrigerator dish (Tri-State "Crispy-Tainer" or equivalent)
4—Transistor sockets
1—Crystal socket
Misc—Nuts, bolts, metal spacers, solder lugs, insulated tie points, knob, etc.

and tends to crack or split quite easily, so exercise caution (not brute force!) when applying a drill.

In case a crack develops in the plastic during the construction process, you can prevent it from spreading by painting it with polystyrene cement or Q-dope. Other materials are easier to work with, but this particular plastic is recommended because of its good r.f. characteristics.

A TV antenna mount, bolted to the bottom of the box, serves as a convenient means of fastening the transmitter to a mast or other high support. Plastic tape can be used to seal the lid of the box against rain and snow, and four ¼" drain holes drilled in the bottom will allow condensed moisture to escape during humid weather. As a finishing touch, several coats of rust-proof paint can be applied to the nuts and bolts pro-



Placement of parts on modulator chassis is shown in photos above and at right. Author used relatively large chassis to have plenty of room for wiring.

truding through the bottom of the box.

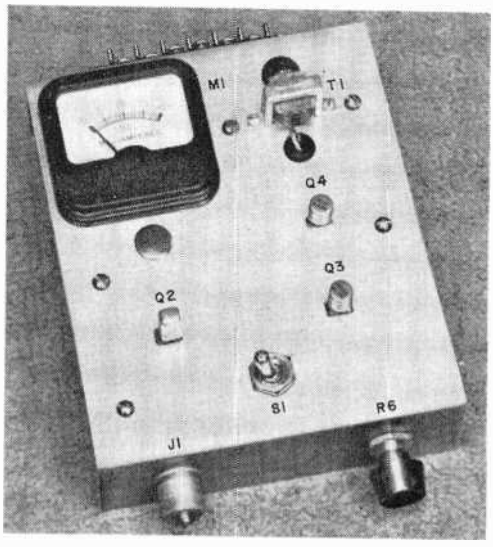
A 1¾" x 2¼" piece of thin phenolic board, supported on ½" spacers, serves as a chassis for the one-transistor transmitter. This method of construction combines the compactness of a printed circuit with the simplicity of ordinary hand wiring.

All parts except *C1*, *C4*, *L1*, and *L2* are mounted and wired before the chassis is installed in the box. Don't forget to provide leads for later connection to *C4* and *L2*. Also, be certain to include power leads long enough to reach the screws which extend through the bottom of the plastic box—these screws serve as terminals for the cable running between the transmitter and modulator.

The antenna is made up of two 27½" pieces of ½" aluminum or copper tubing, mechanically joined by a 10" length of ½" polystyrene rod. The diameter of the rod, for a distance of 3" from each end, must be filed down to allow insertion into the tubing. This leaves 4" of exposed polystyrene at the center of the antenna, over which *L1* is positioned; *L2* is then slipped over *L1*. The antenna passes through ½" holes drilled in the ends of the refrigerator dish, and additional support for the radiator is provided by 1½" pieces of polystyrene rod.

The modulator is built on a 4⅞" x 5¾" x 1½" open-end chassis. A 19.5-volt battery, consisting of 13 size "D" flashlight cells connected in series, furnishes power for the transmitter and modulator. Since there is no standby current and the total drain while on the air is less than 20 ma., cost of operation is under a penny an hour.

Adjustment. Temporarily set up the transmitter in the clear, away from metallic objects. Connect the battery to terminals *A* and *B* of the modulator,



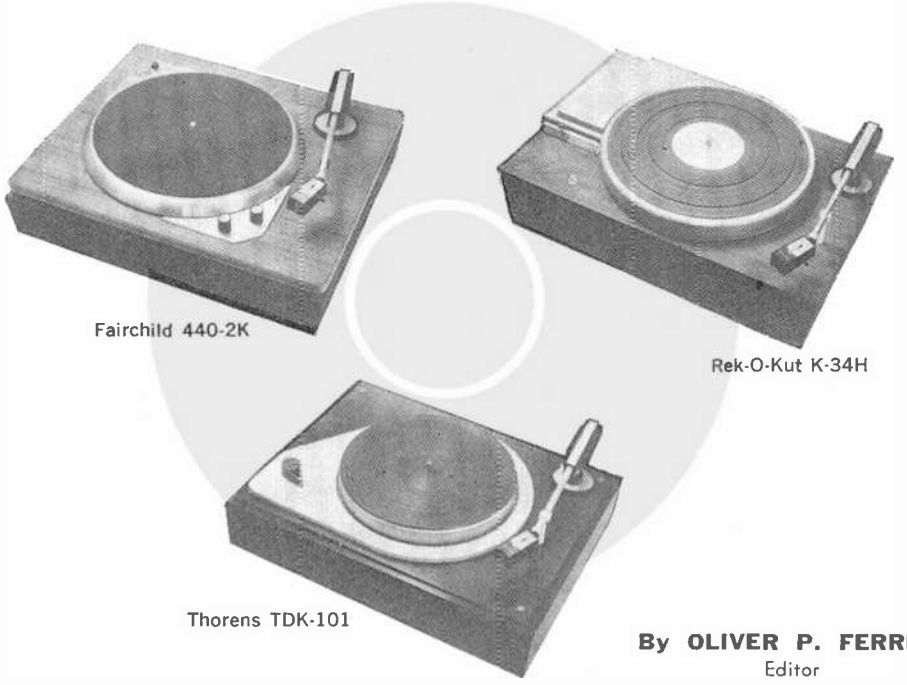
and run a pair of wires to the transmitter from terminals *C* and *D*.

Next, attach a crystal or ceramic microphone to *J1*, and turn on *S1*. The tune-up process is a bit tedious, because the adjustments interact with one another, and you will have to step away from the transmitter after each slight change to avoid body capacity effects.

As *C4* is tuned from minimum to maximum capacity, *Q1*'s collector current (as indicated on *M1*) will vary from a low of around 5 to a high of 10 or more, if the transmitter is operating properly. Adjust *C4* to produce a meter reading of 7 ma., then tune in the transmitter's signal on a 27-mc. receiver. Speak into the mike and advance *R6* until your

(*Continued on page* 105)

Turntable Kits Grow Up—BIG!



By **OLIVER P. FERRELL**
Editor

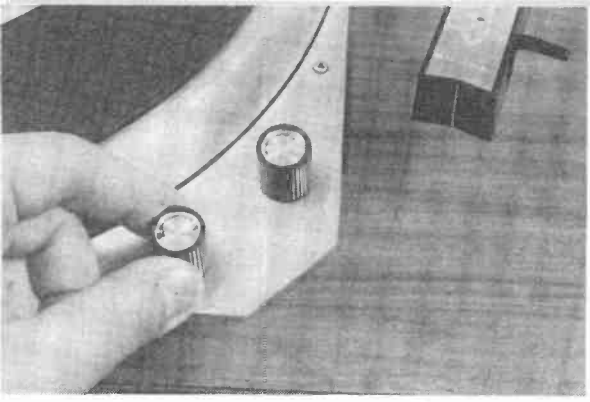
Dual- or single-speed turntables can be assembled in 30 minutes

FIVE YEARS AGO it would have been unthinkable to suggest the home assembly of a hi-fi turntable. Gradually, however, turntable kits did appear on the market. Some were awkward to put together, most of them looked like "kits," and practically all left much to be desired in terms of rumble, wow, and actual speed performance figures.

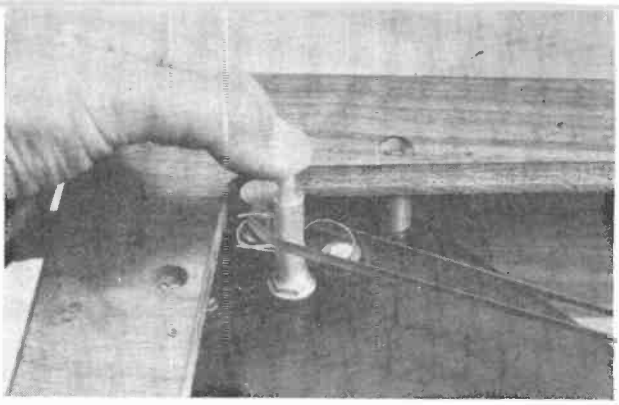
Well, times have changed. The "kit" look has been lost; the performance of these units now approaches or equals that of factory-assembled units; dual-speed operation can be had; and, wonder of wonders, you can assemble the whole turntable in 25 to 50 minutes! Furthermore, you can realize a saving of from $12.50 to $20.00!

This article will give you a "quick look" at several of the presently available turntable kits: the Fairchild 440-2K, the Gray PK-33, the Rek-O-Kut K-34H, and the Thorens TDK-101.

Belt Drive and Speed Adjustment. All of these kits use some sort of belt drive to spin the turntable platter and damp out motor vibration. In the Fairchild, Gray, and Rek-O-Kut units, the belt is wrapped around the periphery of the platter out of harm's way, and the motor is directly coupled to the belt by means of friction drive. Turntable speed is gov-



When using the Fairchild 440-2K, be careful not to confuse speed control knob (nearest tone arm head) with on-off switch which has identical shape.



On the opposite corner of the Fairchild turntable is the speed change plunger; when it is depressed, belt moves down motor drive shaft for 45 rpm.

erned by the diameter of the motor drive shaft and the periphery surface of the platter as well as the rotational speed of the motor itself.

The Gray and the Rek-O-Kut kits each use a hysteresis synchronous motor. This motor is not affected by most voltage fluctuations in the a.c. line and needs no *speed correction* adjustment as long as you have 60-cycle current. Because of this one characteristic, many hi-fi enthusiasts consider a hysteresis motor *the motor* for stereo reproduction.

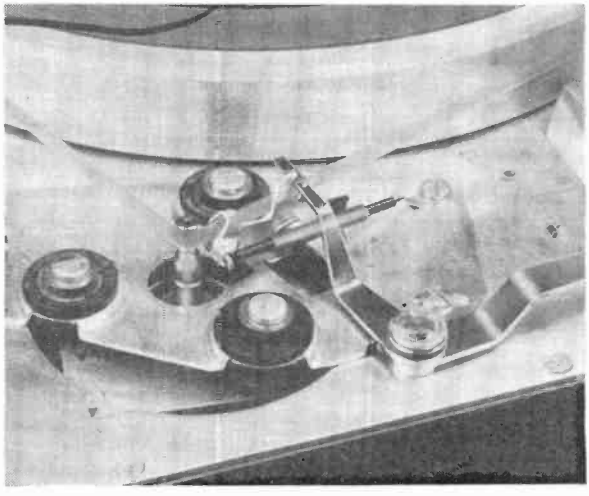
The Fairchild 440-2K and the Thorens TDK-101 turntable kits make use of well-built four-pole motors. Unless your household line voltage swings over too great a range, a good four-pole motor will operate at a constant speed for weeks on end—without once needing a speed check. However, both the Fairchild and the Thorens units must be initially set to speed; this is readily accomplished in each case with strobe discs supplied by the manufacturer.

The Fairchild speed adjustment is a really *new* idea and has a lot to say for itself. The 440-2K motor is designed so that it would ordinarily run just a little too fast, but the speed is held down and accurately adjusted by introducing a d.c. bucking voltage into the motor windings. This d.c. component is obtained from a small selenium rectifier that the constructor solders beneath the base of the turntable. In our tests, the speed of the 440-2K could be set anywhere with precise control from 32 to 35 rpm. When set to 33 1/3 rpm, it maintained this speed during a 24-hour *run-in* period.

In all of the Thorens turntables—including the TDK-101 kit—is a development this company has pioneered: a 2-step drive arrangement consisting of a belt between the motor and a pulley which, in turn, drives an idler on the inside of the platter. To allow for turntable speed adjustment, the pulley has a canted surface contacting the idler which is raised or lowered by a mechanical linkage. This sounds more complicated than it really is; once set, the speed will remain constant for long periods of time.

The Fairchild and Rek-O-Kut turntables are dual-speed devices (33 1/3 and 45 rpm). In each case, arrangements have been made to shift the drive belt

Belt drive on the Rek-O-Kut K-34H is also moved up and down motor shaft in order to change speed. Lever action is "positive," and the unit's operating speed is clearly marked on the turntable panel.



between two different diameters on the motor shaft pulley. The system is foolproof—although the shifting must be done while the platter is spinning.

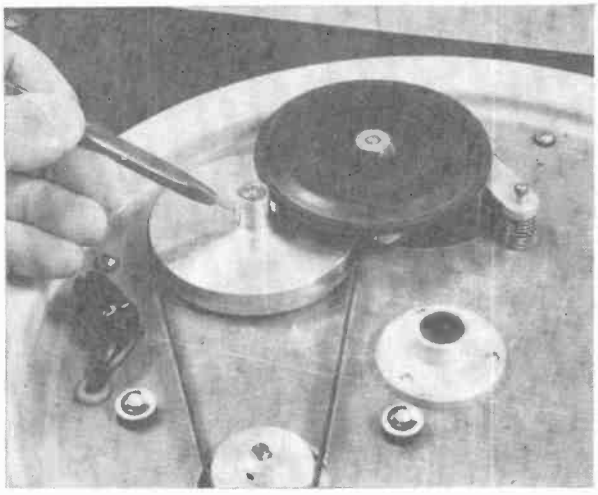
Cost and Assembly Time. The dual-speed turntables (Fairchild and Rek-O-Kut) cost $55.00 and $69.50, respectively. Finished bases are $19.95 for the 440-2K and $14.95 for the K-34H.

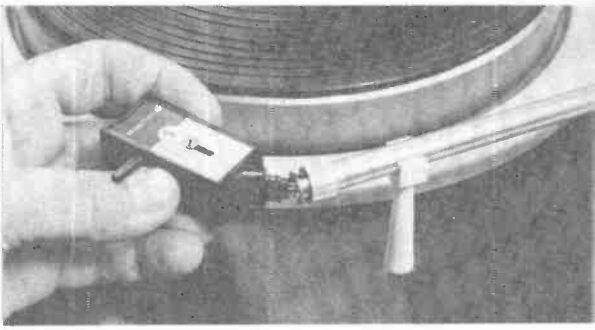
The Rek-O-Kut unit can be assembled —from unpacking the shipping container to plugging the K-34H into your hi-fi set —in 25 minutes. It needs no soldered connections, and your overall saving will be about $20.00. Dollar-for-dollar, this kit is a premium buy.

The Fairchild unit has several soldered connections, but it can be put together in about 45 minutes, and you will save $15.00 by assembling your own. The solid construction of the 440-2K, plus the electronically variable speed adjustment, makes this kit the best four-pole, dual-speed turntable you can buy.

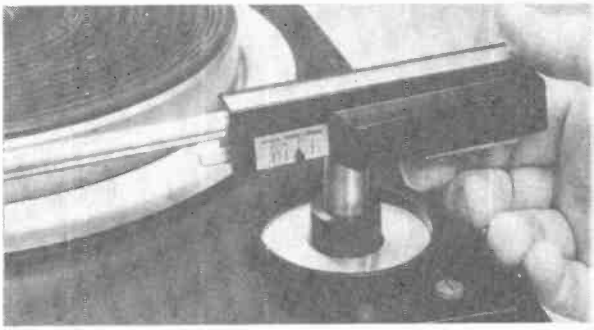
The Gray Model PK-33 and the Thorens TDK-101 are both single-speed units costing $49.50 (base, $17.95) and $47.50 (plus $10.00 for the base), respectively. We did not have an opportunity to assemble the Gray kit, but suspect that it can be put together in about 40 minutes. The Thorens TDK-101 requires 55 minutes to assemble. Both offer a saving of $12.00. -30-

Speed control on the Thorens TDK-101 consists of a mechanical arrangement to raise or lower a pulley. In photo, pencil points to cone-shaped section of this pulley, which varies the idler speed.





On the Shure M232 tone arm, cartridge shell is securely fastened to arm by a threaded key shaft. Screw in top of shell sets cartridge stylus overhang.



The M232 arm is statically balanced by a counterweight which is adjusted by knurled knob under arm. Tension is set by spring adjustment to 3 grams.

Shure Model 232 Tone Arm

The turntable kits pictured in this story were all tested with the same tone arm—the Model 232, available from Shure Brothers, Inc., (222 Hartrey Ave., Evanston, Ill.), for $29.95. This tone arm might best be called a *semi-kit,* since it is delivered to the purchaser in four parts.

To assemble the Model 232, a ¾" hole is drilled through the turntable base. A template on the side of the package easily spots the distance between turntable spindle and the mounting hole for the arm. A mounting base for the arm is screwed or bolted to the turntable base. The tone arm pivot post is inserted, and your stereo cartridge height and static balance adjusted.

Stylus pressure can be set according to scale on the side of the arm; a cable containing stereo cartridge connections plugs into the bottom of the pivot and goes to your amplifier. Total wiring time: 15 minutes.

COVER STORY

By LOUIS E. GARNER, Jr.

BEST BUYS IN EL-ED KITS

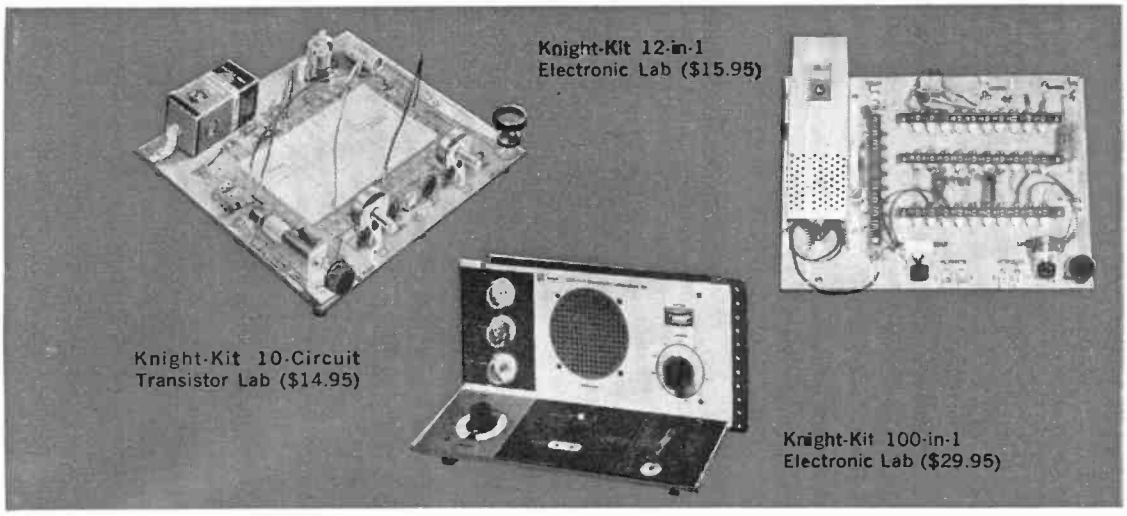
Combine your Christmas giving with ELectronic kits that EDucate

AMERICA'S "secret weapon" in the "war" for scientific supremacy may well turn out to be a group of cleverly designed toys. On this "battlefront," our "shock troops" are our scientists and research workers. Our "line troops" are our engineers and techicians. And our "ready reserves" are our active science and engineering students. All are backed by a reservoir of youngsters and adults who are keenly interested in science and technology and who could pitch in and work as technicians if the Cold War should ever become "hot."

Unfortunately, the study of science has never been overly popular—at least in the past—since most people, adults and children alike, seem to feel that it requires too much "work." On the other hand, if we think of science education as "fun"—as an "adventure" or a "game," it has a lot more appeal. Science projects can effectively challenge other and more pointless "games" for a youngster's time and, at a more advanced level, they can form the basis for a wide range of adult hobbies.

Recognizing the importance of science-oriented individuals to our nation's future survival, a number of progressive manufacturers have introduced toys, construction kits, and hobby items that offer much more than just a "scientific flavor." In addition to having high "play" and amusement value, these new items can do much to develop interest in science and to lay a sturdy foundation for future education and training. Some of them have been on the market for a year or two, but a high percentage are brand-new and are being presented to the public for the first time this holiday season.

Currently available toy and hobby items in the science field may be divided into three broad groups: (1) those which emphasize "play" value and, therefore, may be classed as *toy kits* even though they are valuable in establishing initial interest; (2) those which apply about equal emphasis to "play" and educational values and might be called *experimenter's kits*; and (3) those which emphasize the educational aspect (*educational kits*) and, although fun to work with, can be used for quite serious train-



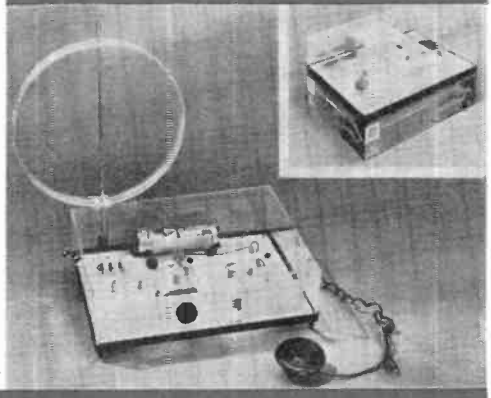
ing. Let's take a look at some of the current electronic items in each of these three groups.

"Toy" Kits. As a general rule, the "toy" kits are characterized by the fact that they primarily consist of a single project; educational experiments with the completed project may or may not be outlined. Only simple tools (which are frequently included in the kits) and limited skills are needed for assembly. Nonetheless, these kits help teach the builder how to recognize components and symbols and provide some background in circuit operation.

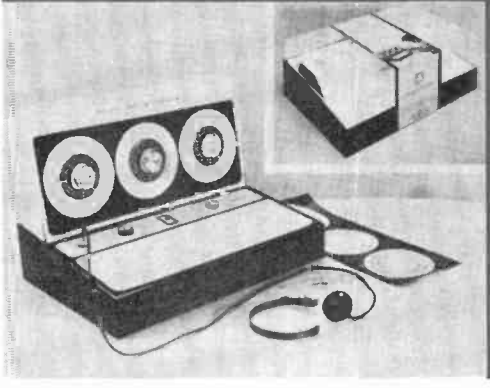
The *Heath Company* is offering several kits of this type, including an intercom, three different transistor and diode radio kits, a simple two-way "walkie-talkie," several wireless microphones or "radio broadcasters," and an electricity kit suitable for assembling a simple battery-operated motor. Dubbed the "Heathkit Jr. Science Explorer Series," these kits retail from $2.95 to $29.95.

Well known as a manufacturer of

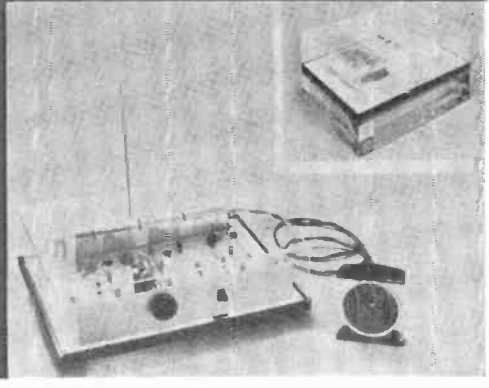
General Electric EF-110 Transistor Radio ($17.95)

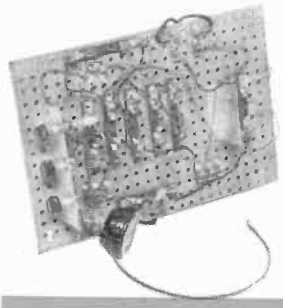


General Electric EF-140 Analog Computer ($29.95)



General Electric EF-120 Transmitter ($19.95)



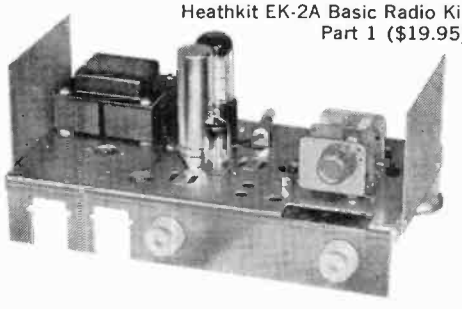


Radio Shack 30-in-1 Transistor Experimenter Kit ($18.95)

Lionel Mark IV Electronics Lab ($25.00)

Lionel Bell Telephone ($9.95)

Heathkit R-120 Electronic Experimenter's Lab No. 1 ($12.95)



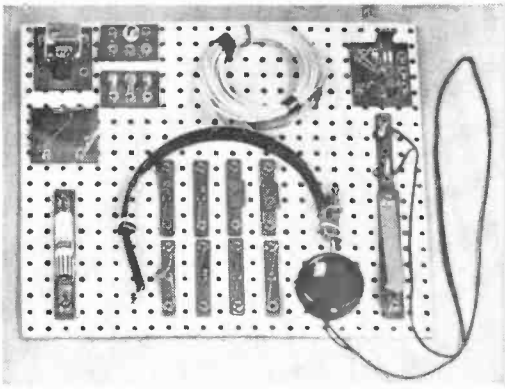
Heathkit EK-2A Basic Radio Kit Part 1 ($19.95)

model trains, the *Lionel Corporation* recently introduced a number of toys called the "Famous Inventors Series." Listing at $9.95 each, these sets permit the recreation of working models of such famous inventions as Edison's electric light, Morse's telegraph, and Bell's telephone. A display bust of the inventor is included with each set.

A newcomer to the science toy field, *General Electric Company* has developed an extensive line of single-project kits. Offered through regular retail outlets, they include a transistor radio at $17.95, a radio transmitter at $19.95, and an intercom at $24.95. All use standard electronic components and are designed for low-voltage battery operation to prevent accidental shock.

Several firms, including *Remco Industries, Inc.*, and *Stuart Manufacturing Company*, are offering low-cost ($1.00, typically) pre-packaged science sets for counter and rack distribution. And a number of manufacturers have introduced true electronic toys which are valuable for stimulating interest in science but which are not educational items in themselves: *Emenee Industries, Inc.* manufactures a transistorized audio amplifier/speaker system dubbed the "Powermeg;" *Bell Products Company* produces several electronic items, including the "Futura" transistorized tape recorder which retails at $29.95; *Infrared Industries, Inc.* is distributing a two-way communications device called the "Astro-Phone," which permits conversations over invisible beams of infrared light.

Experimenter's Kits. Most of the "experimenter's kits" are called either



Superex Electronics Lab ($19.95)

Science Materials Center Analog Computer ($16.95)

"workshops" or "laboratories" and permit the user to conduct a variety of experiments or to assemble a number of different projects. Their educational value is quite high, since the worker becomes familiar with many different circuits. Standard electronic components are used, although circuit interconnections are generally made with short lengths of hookup wire and spring- or clip-type connectors to avoid use of a soldering iron.

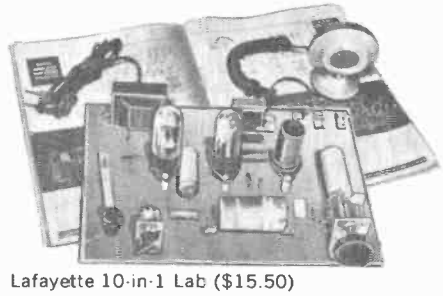
Depending on the manufacturer, the kit parts may be assembled on a pegboard "chassis" or in a fancy plastic cabinet. Typical projects include audio amplifiers, radio receivers, wireless microphones, limited-range transmitters, light-controlled relays, timers, burglar alarms, code practice oscillators, and various types of test instruments. Prices range from under $10.00 to approximately $40.00.

Three experimenter's labs are offered in Heath's "Science Explorer Series," ranging from a 6-project kit at $12.95 to a 20-project workshop at $49.95.

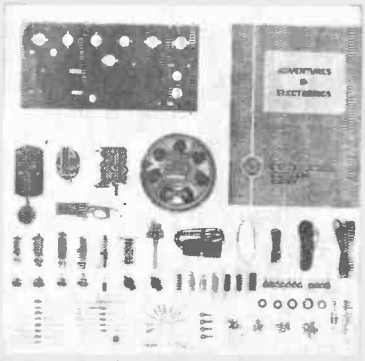
Lionel's "Electronics-Lab" line-up includes four sets, ranging in price from $9.95 for the 25-experiment "Mark I" to $25.00 for the "Mark IV." All feature attractive plastic cabinets and clear plastic covers.

The A. C. Gilbert Company, another famous name in the toy field, is responsible for six electrical and electronic sets, including two "electrical engineering" sets for motor, light, and telegraph experiments; three transistor kits; and an electron tube kit. The Gilbert electronic

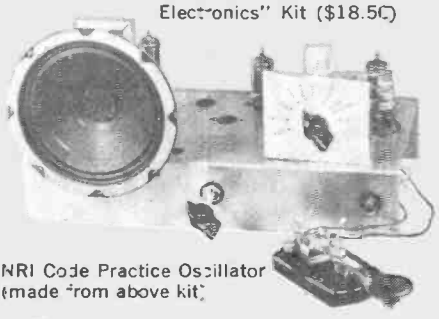
(*Continued on page* 108)



Lafayette 10-in-1 Lab ($15.50)



National Radio Institute "Adventures in Electronics" Kit ($18.50)



NRI Code Practice Oscillator (made from above kit)

Transistors provide startling sound effects for Junior's small artillery

ELECTRONIC MACHINE GUN

By MARTIN H. PATRICK

WOULD you like to delight your child by making his toy machine gun sound like the real McCoy? You can do the job with a couple of transistors, a discarded door buzzer, and a minimum of other components. Built into any toy machine gun having room enough to house it, the circuit produces a loud "rat-tat-tat" which is startlingly like that of a real weapon. For a variety of effects, the pulse rate is adjustable over a wide range.

The Circuit. Essentially a direct-coupled amplifier, the circuit uses two complementary transistors (*Q1* and *Q2*). Collector-to-base feedback between *npn* transistor *Q2* and *pnp* transistor *Q1* is provided through an *RC* network consisting of *R1*, *R2*, and *C1*. The values of the latter components were chosen to make the circuit oscillate, or pulse, at a low rate. Potentiometer *R2* allows adjustment of the rate of oscillation.

The coil of a door buzzer serves as the collector load for *Q2*, and the buzzer armature is pulled in (with a loud click) and released each time a pulse passes through the system. The buzzer's "breaker" contacts are removed and bypassed so that the coil is always in the circuit regardless of the armature position. Power for the device is provided by battery *B1* through switch *S1*.

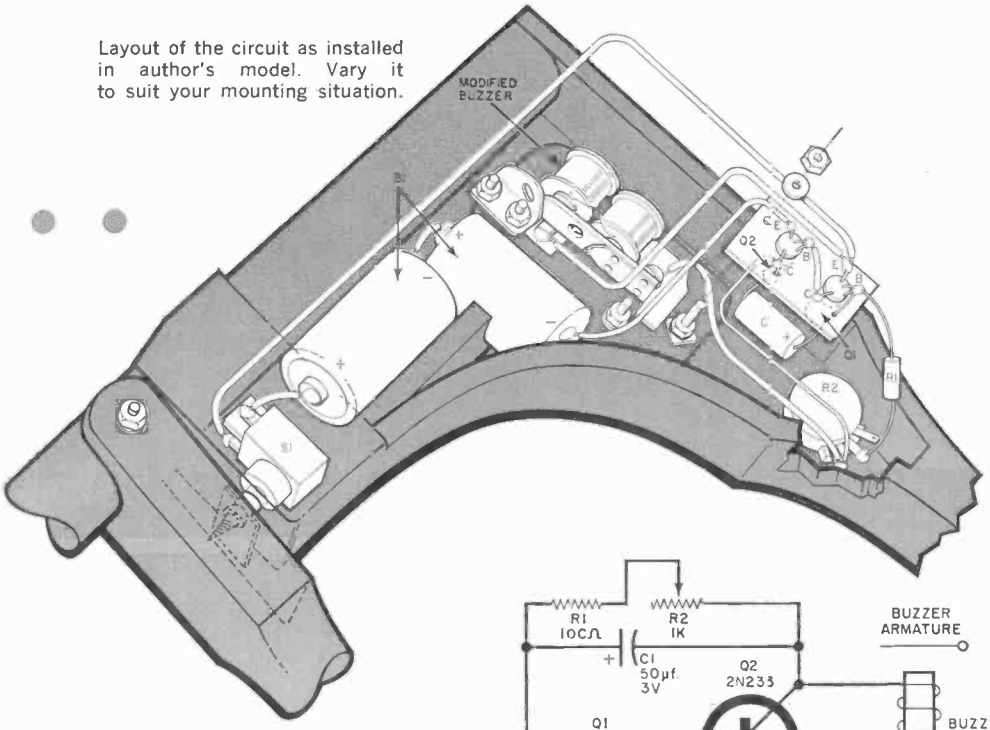
Construction. Building techniques, of course, will vary with the toy machine gun being adapted. The author elected to construct his gun from some scraps of wood. The photographs and pictorial diagram will serve as a rough guide for anyone wishing to duplicate it.

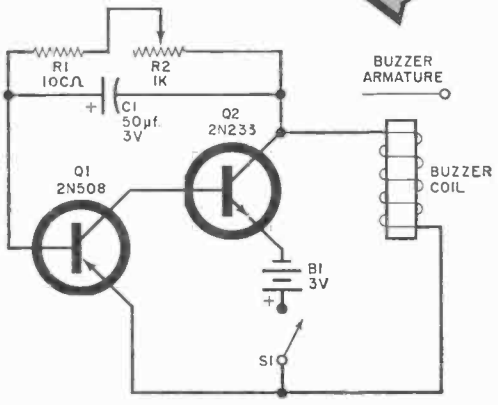
In the author's model, capacitor *C1* and the sockets for transistors *Q1* and *Q2* are mounted on a 1" x 1½" piece of perforated board. This board, and the door buzzer, are fastened inside the stock of the gun with machine screws. Potentiometer *R2* is mounted so that its stubby shaft passes through the stock.

Switch *S1*, which is of the push-button type, is placed just behind the hinged front "trigger," and is depressed each time the trigger is pulled forward. (The mechanical arrangement of the trigger in your gun might be such that a lever-operated snap-action switch would work better.) The two flashlight cells making up battery *B1* were installed without benefit of a holder, the leads having been soldered on directly.

Again, the author's model is intended only as a guide. Your parts layout may be quite different, depending on the

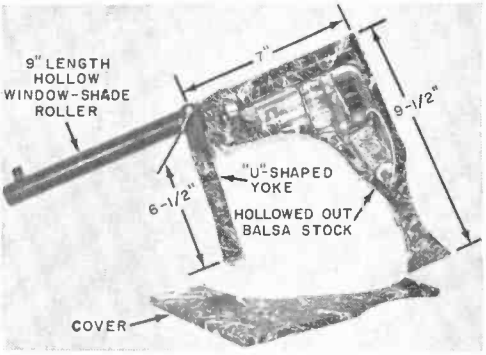
Layout of the circuit as installed in author's model. Vary it to suit your mounting situation.





Oscillator circuit is essentially a direct-coupled amplifier; R1, R2, C1 provide the feedback.

A few key dimensions for those who wish to construct a machine gun similar to the author's. Contact paper gives a "marble" effect.



PARTS LIST

B1—Two 1.5-volt flashlight cells in series (Burgess Type 1 or equivalent)
C1—50-μf., 3-volt electrolytic capacitor
Q1—2N508 transistor
Q2—2N233 transistor
R1—100-ohm, ½-watt resistor
R2—1000-ohm potentiometer
S1—S.p.s.t. push-button or snap-action switch —see text
1—Door buzzer, modified—see text
1—Toy machine gun or materials for homemade version—see text
Misc.—Perforated board, wire, solder, hardware, etc.

mounting space available in the gun you're using. The wiring is not critical and, if it's necessary to separate the components, the longer leads required will not affect the circuit's operation. If your machine gun should be constructed of metal, however, watch out for shorts to the case.

Buzzer Modifications. Before installing the buzzer, remember to remove the "breaker" contacts and connect the coil so that it's in the circuit at all times. In addition, to give the modified buzzer a crisp snap-action sound, mount a metal stop behind—and just touching—the armature. -30-

Hobnobbing with Harbaugh

Key Clicks and Mike Splatter

"Just tell him it's a ham buddy from Jersey."

"You'll get ho ho ho! I told you to go out and buy gifts for the kids."

"That's silly. How do you know that Khrushchev's listening?"

"No, we're not making it into a fallout shelter!"

"So you're the lightest mobile kilowatt in the country; so what?"

THE AUDIO PACK

By E. G. LOUIS

You'll use this portable sound system for everything from a phono to a junior-sized p.a. amplifier

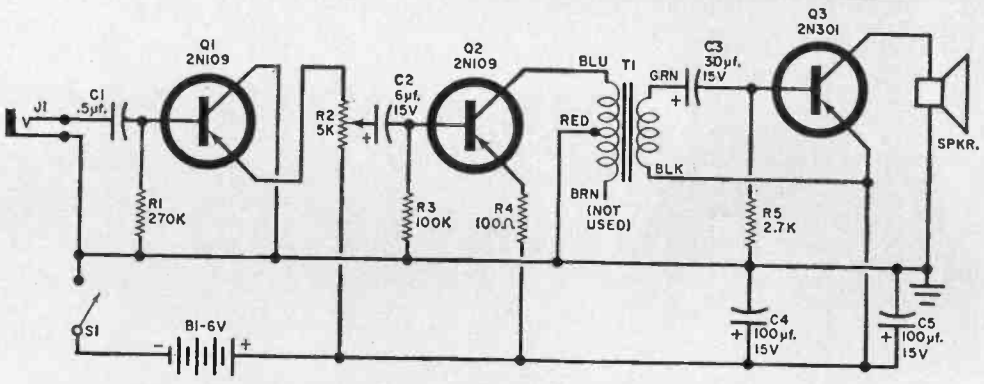
WHETHER you're an advanced electronics hobbyist or just past the "novice" stage, you should enjoy building and using this multi-purpose audio system. It's completely self-contained —the transistorized amplifier and battery power supply are mounted in the same case that houses the speaker.

The "Audio Pack" has a high-impedance input and adequate output volume for schoolrooms, clubs, or homes. You'll find it useful for p.a. work, as a booster amplifier for small radios, as part of a record-playing setup, or for amplifying the sound of musical instruments. It can even be pressed into service as an audio signal tracer or as a test amplifier for checking crystal phono cartridges and mikes.

Construction. The three-stage transistorized amplifier is assembled on a small metal chassis measuring approximately 1″ x 4″ x 2″. Follow the general layout shown in the photographs when mounting the components.

A small "L"-shaped bracket (measuring approximately 1″ x 1″, with a ¾″ mounting lip) is used as a heat sink for power transistor *Q3*. Be sure that the holes for the base and emitter pins are large enough to prevent shorts.

A lockwasher-type ground lug is placed under one of *Q3*'s mounting nuts to serve as the collector terminal. Since the entire bracket is



Schematic diagram of three-stage transistorized amplifier. If desired, power output can be doubled by replacing 6-volt battery B1 with a 12-volt unit, as explained in text.

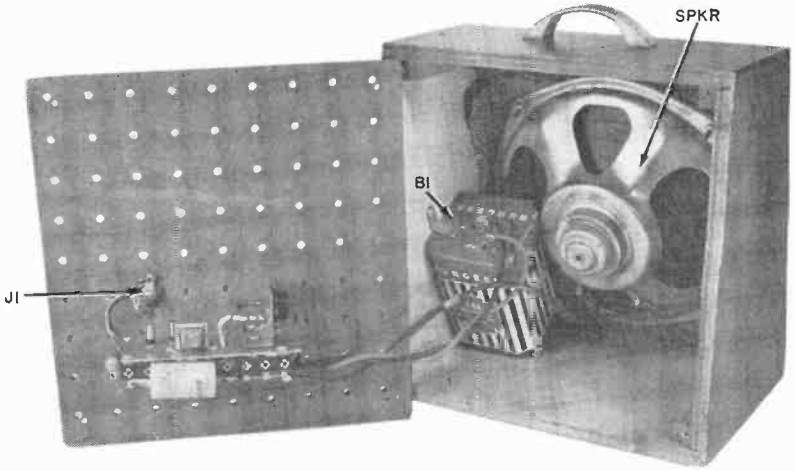
at collector potential, it must be insulated from the main chassis with fiber washers. Check with an ohmmeter to be sure that there is no continuity between the bracket and the chassis.

In carrying out the wiring, all leads should be kept as short and direct as possible. Make the connections to *Q3*'s base and emitter pins via small clips (these can be obtained by breaking up a used 7- or 9-pin miniature tube socket). Since the PM speaker, battery *B1*, and jack *J1* are external to the chassis, it's necessary to provide leads to reach them. Make the battery and speaker leads 10 - 12″ long; the lead to the jack should be a 4 - 6″ length of shielded cable.

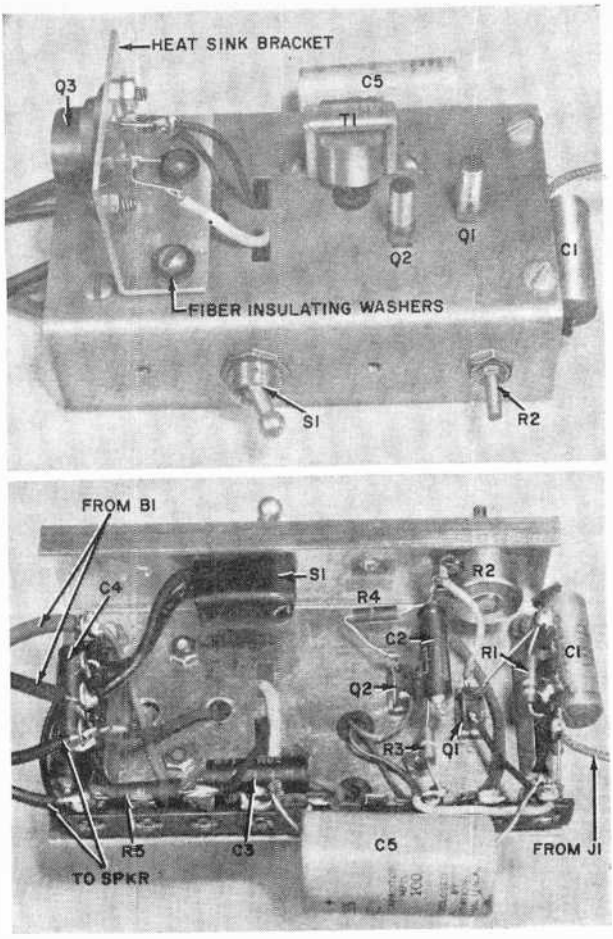
Final Assembly. A standard sloping-front wall baffle, of the proper size to house the speaker, is used as a combination cabinet and carrying case. Rubber feet are mounted at the wide end—normally the top—of the baffle, and a small metal handle is attached to the narrow end.

The PM speaker, an 8″ to 12″ unit, is mounted using ornamental-head machine screws. Battery *B1* is wedged into the case at a slight angle and secured in position with a small "L" bracket. The two-piece back consists of a section of ¼″ perforated hardboard with a smaller panel of aluminum bolted to it—the hardboard provides a stiff, solid back without muffling the speaker, while the aluminum panel adds a decorative touch and provides an electrical shield for the amplifier's input.

Holes should be drilled in the aluminum/hardboard panel for switch *S1*, potentiometer *R2*, and jack *J1*. The mounting nuts for *S1* and *R2* could be used to hold the amplifier in place on the



Standard wall baffle houses amplifier, speaker, and battery; perforated hardboard serves as back for baffle and supports amplifier and jack J1 as well as operating controls S1 and R2.



Top and bottom views of amplifier chassis. Note use of fiber washers to insulate chassis from heat sink for Q3.

PARTS LIST

B1—6-volt lantern battery (Burgess F4H or equivalent)
C1—0.5-μf., 200-volt paper capacitor
C2—6 μf. } *15-volt electrolytic capacitors*
C3—30 μf. }
C4, C5—100 μf. }
J1—Open-circuit phone jack
Q1, Q2—2N109 transistor
Q3—2N301 transistor
R1—270,000-ohm, ½-watt resistor
R2—5000-ohm audio-taper potentiometer
R3—100,000-ohm, ½-watt resistor
R4—100-ohm, ½-watt resistor
R5—2700-ohm, 1-watt resistor
S1—S.p.s.t. toggle switch
SPKR—8" to 12" PM speaker, 3.2-ohm voice coil
T1—Transistor transformer; 500-ohm CT primary to 8-ohm secondary (Argonne AR-164 or equivalent)
1—1" x 4⅛" x 2¾" miniature aluminum chassis (Bud CB-1626 or equivalent)
1—Wall baffle to fit speaker
Misc.—Perforated hardboard, sheet aluminum, carrying handle, rubber feet, transistor sockets, terminal strips, etc.

HOW IT WORKS

The "Audio Pack" is a self-contained audio amplifying system using a 3-stage transistor amplifier. Signals applied to input jack *J1* are coupled, through capacitor *C1*, to the base of transistor *Q1*. This transistor is connected in a common collector (emitter-follower) circuit which provides a high input impedance. Base bias for *Q1* is furnished by resistor *R1*, and gain control potentiometer *R2* serves as the emitter load.

From *R2*, the signal is coupled to the base of driver transistor *Q2* through capacitor *C2*. Resistor *R3* supplies *Q2*'s base bias, and resistor *R4* introduces a small amount of degenerative feedback to improve the frequency response and reduce distortion. Half of transformer *T1*'s primary winding is the collector load for *Q2*; the other half is not used.

Transformer *T1* matches *Q2*'s comparatively high output impedance to *Q3*'s low input impedance. From *T1*, the signal is coupled—through capacitor *C3*—to the base-emitter circuit of *Q3*. Base bias for *Q3* is taken from resistor *R5*, and the speaker serves as the collector load. No output transformer is required, since the output impedance of *Q3* is low enough to be comparable to the impedance of the voice coil winding of the speaker.

Power for the unit is supplied by 6-volt battery *B1*, and bypass capacitors *C4* and *C5* prevent possible interstage coupling through *B1* or through the circuit wiring. In this way, the possibility of oscillation and squealing is reduced and distortion is kept to a minimum.

panel, but the author secured it with a couple of sheet-metal screws. When the amplifier has been mounted, install and wire *J1* and connect the leads to the battery and speaker.

Your Audio Pack is now complete, and it remains only to fasten the back panel to the baffle with wood screws.

Operation. To use the Audio Pack, just plug the mike, phono cartridge, or what have you into *J1*, snap on *S1*, and you're in business. Volume is set to the desired level with *R2*.

To avoid acoustic feedback when working with a microphone, speak in a slightly louder than normal voice, keep the mike close to your mouth, and turn the volume up only as far as required. It's also necessary to keep the microphone and speaker as far apart as possible.

The Audio Pack, as described above, delivers a healthy fraction of a watt. Should more power be desired, it can be obtained with a 12-volt supply source; simply use two 6-volt lantern batteries (wired in series) instead of one. No circuit changes are necessary, and power output will be increased to a little over a watt. The instrument's weight and cost of operation, of course, will be increased as well. -30-

On the Citizens Band

By DICK STRIPPEL, 2W1452

A SHORT ITEM in our September column caused a veritable avalanche of mail. We stated that the impedance of a simple "quarter-wave whip" mounted on a car was not 52 ohms, but closer to 22 ohms; and that by feeding this antenna with two pieces of 52-ohm coax, in parallel, a better match could be obtained. Because of the number of questions which were raised, a short exploration of mobile antennas seems to be in order.

Antenna Facts. In the first place, a half-wave dipole has an impedance at its exact center of about 73 ohms—in free space! Since a quarter-wave antenna is nothing more than "half a half wave," its impedance should be about 36 ohms over a perfectly conducting ground plane right under the feed point. But this is where the trouble comes in.

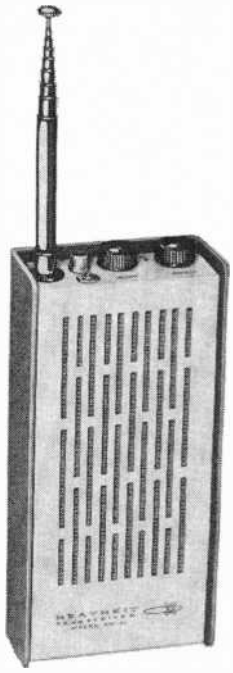
With a fixed-station antenna, the horizontal rods form a predictable ground effect—one you can count upon when you match it to your transceiver. However, the mobile whip has no such ground reference point, and many variables enter into the ground effect of a simple mobile whip. The first, and most important, is the physical size of the car; obviously, a pickup truck is going to have a different ground effect than a sports car.

Another factor which cannot be ignored is the actual composition of the earth over which the vehicle is parked or moving—most pavements are excellent insulators, so the true ground (electrically speaking) might be a foot or more under the pavement. The height of the vehicle above the surface itself is also important.

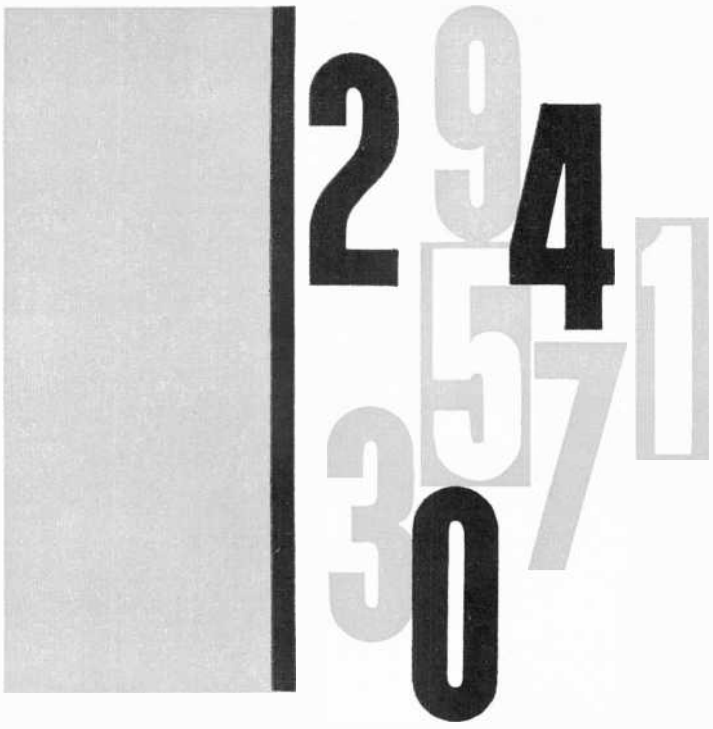
None of these factors can be reduced to a mathematical function that can be inserted into the various antenna formulas. For some years, electronics engineers have used 22 ohms as a compromise impedance for quarter-wave mobile antennas in the 25-40 mc. region. This would represent an average-sized vehicle driving over a common pavement, with a ground of average conductivity slightly more than one foot below its surface.

In the end, the only way to match your transceiver to your mobile antenna is to apply the methods outlined in the article entitled "Getting Peak CB Performance," which appeared in the May 1961 POPULAR ELECTRONICS (page 58). The procedures described in this article apply just as well to mobile installations as to stationary ones.

New Products. The Heath Company, Benton Harbor, Mich.—the outfit which almost single-handedly gave CB radio its initial push with the now-famous Heath CB-1—has added a de luxe 9-transistor hand-held transceiver to its line. More advantages are claimed for the GW-21 than for units selling at twice the price. The transceiver boasts a crystal-controlled superhet receiver with r.f. stage, squelch and noise limiter, and astounding sensitivity. The transmitter section delivers 100 mw. to the final, allowing complete license-free operation with another similar set. Housed in an attractive, two-tone aluminum cabinet, the GW-21 has only three simple controls: on/off volume control, squelch control,



(*Continued on page* 110)



Now you can take your first step into the fascinating world of electronic brains

An Introduction to ANALOG COMPUTERS

By **JULIAN M. SIENKIEWICZ**
Managing Editor

FOR CENTURIES man has been utilizing simple analog devices to solve mathematical problems by analogy. In other words, numbers are converted into something else which can be worked with more easily than the numbers themselves. One everyday example is the slide rule, which converts numbers into distances, then reconverts the summed distances into numbers, providing a solution. Anyone who has multiplied two numbers on a slide rule will testify to its operating ease, rapid solution, and remarkable accuracy.

This article will go one step beyond the slide rule and describe a direct-reading analog computer which will solve simple addition and multiplication problems, extract roots, and perform trigonometric operations. So simple is this computer that it could be called an "electronic slide rule."

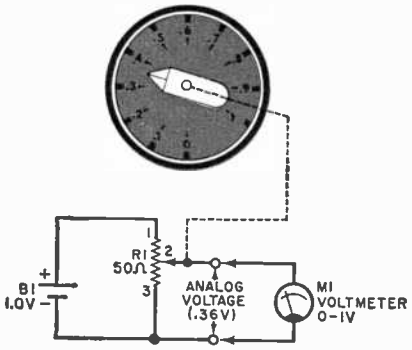


Fig. 1. A potentiometer can be used to convert dial settings to correspondingly equal voltages. When the dial is set at .36, the wiper picks off .36 volt d.c.

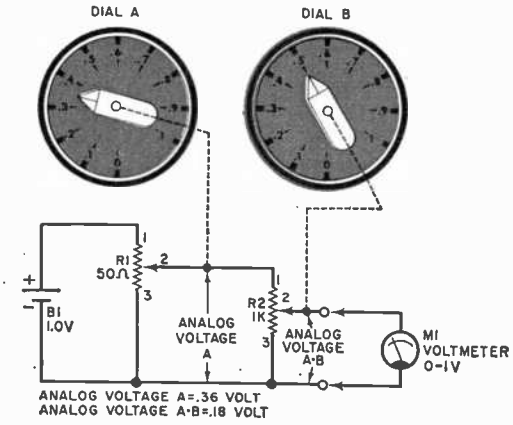


Fig. 2. Two cascaded potentiometers develop voltage analog equal to product of the dial settings.

Voltage Analog. An ordinary potentiometer will help us see how a number can be converted into a voltage analog. Figure 1 shows a simple circuit of a potentiometer, *R1,* connected in series with a battery, *B1.* Rotating the dial pointer on the shaft of *R1* causes the potentiometer wiper to "pick off" a voltage proportional to the dial setting.

In Fig. 1, the dial is calibrated from zero to one and the voltage supplied by the battery is 1.0 volt. Thus, in this particular instance, the dial setting indicates the voltage at the wiper of the potentiometer. A voltmeter connected at the output terminals of this circuit will indicate the setting of the dial—0.36 volt would mean that the dial is set at 0.36 unit. The voltage is an analog voltage, since it may represent a dial quantity of 0.36 acre, quart, or even light year.

Multiplying. In Fig. 1, a voltage analog for the number 0.36 was developed at the wiper of *R1.* It can also be said that the supply voltage across *R1* was multiplied by 0.36. Thus, 1.0 volt times 0.36 will be 0.36 volt. If a voltage other than 1.0 volt were supplied by *B1* in Fig. 1, we would be multiplying the supply voltage by the dial setting.

This apparent ability of potentiometers to multiply can best be seen in Fig. 2. Battery *B1* supplies 1.0 volt across potentiometer *R1.* Dial *A* is set at 0.36 so that analog voltage *A* developed at the wiper of *R1* (0.36 volt) is applied across potentiometer *R2.* Dial *B* is set at 0.50 so that the voltage at the wiper of *R2* will be only 0.50 times the voltage across *R2,* or simply 0.36 x 0.50. The voltage developed at the wiper of *R2* is appropriately called analog voltage A·B, and voltmeter *M1* will indicate this voltage to be 0.18—the product of 0.36 and 0.50.

Loading Error. Looking again at Fig. 2, you will note that the value of potentiometer *R1* is 50 ohms, whereas potentiometer *R2* is a 1000-ohm unit. The reason for this is quite simple, provided you down-gear your thinking from analog computers to simple d.c. networks. Figure 3(A) corresponds to Fig. 2 when

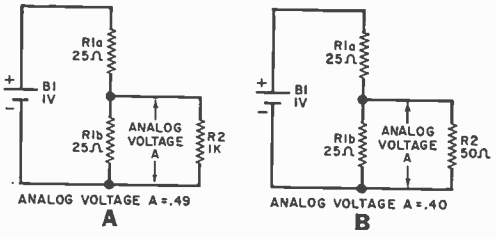


Fig. 3. Circuits showing cause for loading error (A) when R2 is 1000 ohms, (B) when R2 is 50 ohms.

the wiper of *R1* is set at 0.50 or midposition. Hence, *R1a* in Fig. 3(A) represents the "top half" of *R1* in Fig. 2 (the portion between terminals 1 and 2). Likewise, *R1b* represents the "bottom half" of *R1* (the portion between terminals 2 and 3). We know from the dial setting that analog voltage *A should be* 0.50 volt. However, let's see what analog voltage *A* actually is in Fig. 3(A).

First, since *R1b* and *R2* are in parallel, their combined resistance is approxi-

mately 24.4 ohms. Using Ohm's law, we find that the voltage drop across *R1b* (in parallel with *R2*) is approximately 0.49 volt. This means that *R2* in Fig. 2 will tend to lower the true value of analog voltage *A* and introduce a small error. In the case cited, the error is only 2%—not much for this simple computer circuit.

In Fig. 3(B), the value of *R2* was selected as 50 ohms solely to illustrate the loading effect of *R2* on *R1b*. In this instance, the combined resistance of *R1b* and *R2* is approximately 17 ohms. Again resorting to Ohm's law, we find analog voltage *A* developed across *R1b* and *R2* to be approximately 0.40 volt. Compared to the desired analog voltage of 0.50, the loading effect of a 50-ohm potentiometer will introduce an error of 20%—an excessive amount for most purposes.

It should be evident, then, that when two potentiometers are connected as shown in Fig. 2, the second one (*R2*) should be many times larger than the first one (*R1*). However, do not be tempted into believing a potentiometer with a very large resistance—one megohm, say—will completely solve our loading problem. Even if the resistance value of the second potentiometer is very large, a voltmeter connected across its wiper and bottom terminal will also cause a loading effect and hence introduce error. This is due to the resistance of the voltmeter itself—usually only several thousand ohms.

Galvanometer Indicator. One method of removing the loading effect of the voltmeter (*M1*) used in Fig. 2 is to replace it with an indicator that requires no current to indicate the analog voltage developed by a potentiometer. Such a device is the galvanometer indicator shown schematically in Fig. 4.

Close inspection of the circuit in Fig. 4 reveals that current will flow though galvanometer *M1* whenever the wipers of potentiometers *R2* and *R3* select voltages that are not equal. This condition causes the galvanometer pointer to deflect either to the left or right of its normal "center rest" or "zero deflection" position.

Since dial *B* is preset to "some number" input, as described earlier, it remains for dial *C* to be adjusted until the voltage at the wiper of *R3* equals the

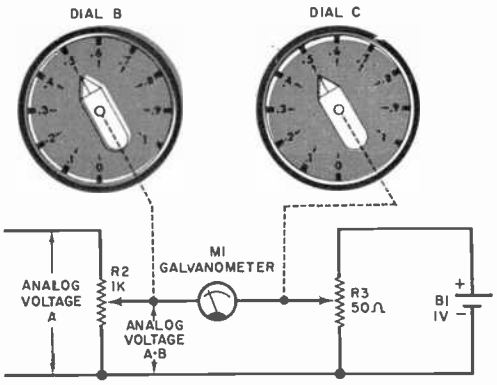


Fig. 4. No loading error occurs when voltage on wiper of R3 equals analog voltage A·B, or .5 volt.

voltage at the wiper of *R2*. When this occurs, the voltage drop across the galvanometer is zero, resulting in zero current through the galvanometer and no deflection of the meter's pointer. Dial *C*, which is calibrated to convert the voltage picked off by *R3* to numbers, indicates the correct value of analog voltage A·B. Since the electrical components *M1* and *R3* draw no current from *R2*, there is no loading on the analog circuits and no errors are introduced into the electrical computations by the galvanometer.

An important fact to note in Fig. 4 is that potentiometer *R3* has a value of 50 ohms. This is permissible, since (1) *R3* does not load the computer circuits when the correct answer is set on dial *C* and (2) the lower value is desired so that when an incorrect answer is selected the deflection of *M1* will be large due to the large currents flowing through the galvanometer movement. This large deflection due to an incorrect answer enables the computer operator to adjust dial *C* accurately for a galvanometer null or zero deflection. In operation, of course, the galvanometer deflects either to the right or left of its center position, depending upon whether the wiper of *R3* is positive or negative with respect to the wiper of *R2*.

Complete Circuit. The simple analog computer circuit shown in Fig. 5 is identical to the one used in the analog computer kit made by the Edmund Scientific Co., Barrington, N. J. (see Fig. 6) and is the culmination of the circuits shown in Figs. 1 through 4.

Two interesting points should be noted:

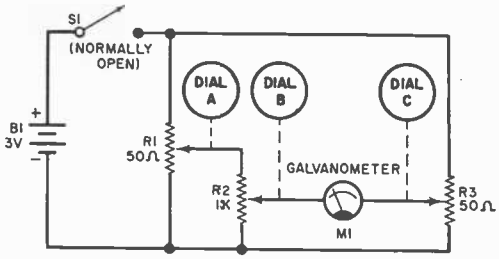


Fig. 5. Schematic diagram of a three-potentiometer analog computer with a galvanometer (MI) null indicator. Switch SI is depressed in order to read MI.

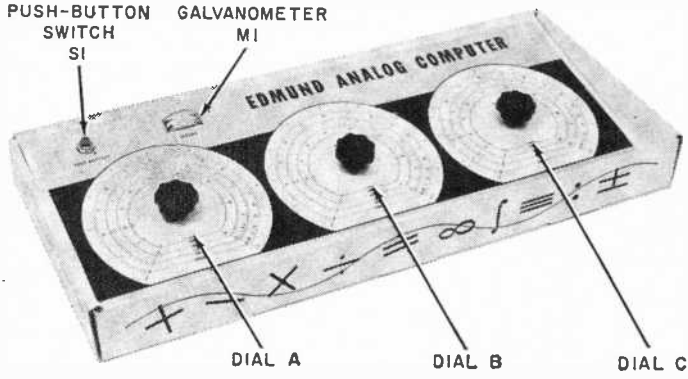


Fig. 6. Circuit components seen on front panel of Edmund Analog Computer are identified here. Each dial has four concentric scales.

the first one is that the battery voltage of *B1* is 3 volts. Previously in our discussion, we used a "1-volt" battery for *B1*. This variance in voltage suggests that the voltage of *B1* is not critical, as is actually the case.

Examine Fig. 5 carefully and note that *B1* is connected across two resistive legs: the summed resistances of *R1* and *R2*, and the resistance of *R3*. Galvanometer *M1* is used to detect a zero voltage difference between the resistive legs exactly like its counterpart in the Wheatstone bridge. Therefore, as long as the two resistive legs receive the same voltage, its value is unimportant.

The second point to be noted in Fig. 5 is that a switch (*S1*) has been added. This push-button switch is nothing more than an on/off switch for reducing battery drain. It is depressed only after dials *A* and *B* have been set to desired values and dial *C* is being adjusted so that the galvanometer indicates a null.

Sound Null. Another good way to determine when the analog computer is tuned to a null (correct answer), is to listen for it rather than look for it. In the Edmund computer, a null can be seen when the galvanometer is not deflected. In an analog computer kit made by General Electric (see cover photo),

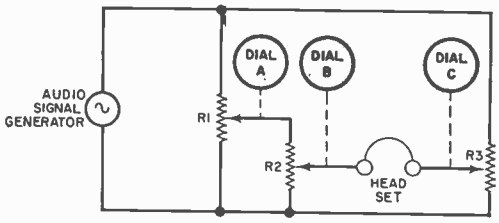


Fig. 7. Simplified schematic of G.E.'s "Project 4" computer. Headset is used to detect sound nulls.

the galvanometer has been replaced with a headset; since the headset can only detect audio signals, the computer potentiometers are powered by an audio signal generator and not by dry cells. Except for these two changes, the General Electric analog computer kit is electrically identical to the Edmund kit.

Figure 7 is a simplified schematic drawing of the G.E. analog computer circuit. To operate, the computer potentiometers are preset to fixed input quantities and the "answer" potentiometer (connected to the *C* dial) is rotated until the audio sound is no longer heard in the headset.

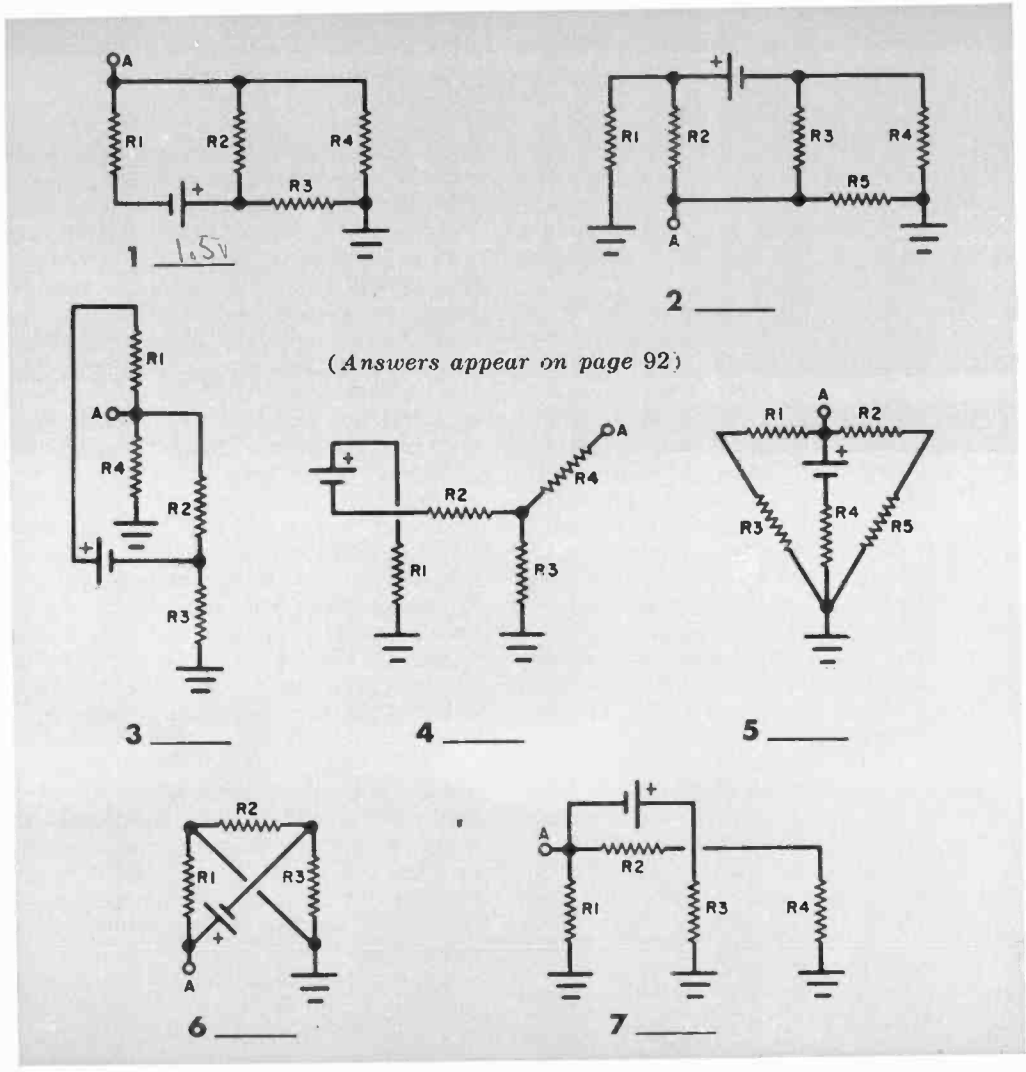
Dials. The dials for both the Edmund and General Electric kits are accurately calibrated so that many complex prob-

(*Continued on page* 95)

VOLTAGE QUIZ

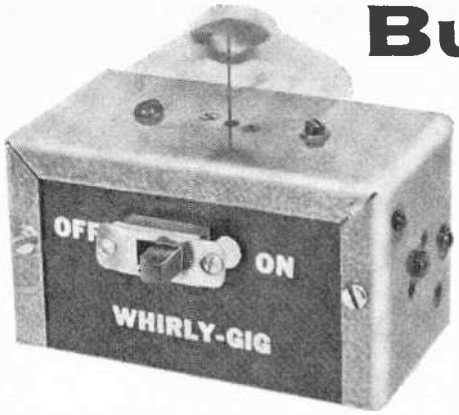
By ROBERT P. BALIN

Can you determine the voltage and polarity of point A with respect to ground in each of the seven circuits shown below? All resistors measure six ohms and each battery produces six volts d.c. You'll find it helpful to use pencil and paper in working out the problems. Write the answers in the spaces provided under the diagrams.



(*Answers appear on page 92*)

Build the WHIRLY-GIG



By LEE MARTIN

A novel d.c. motor that puzzles even the experts

LIKE to baffle your friends with electronic gadgets? Enjoy tinkering with a device that is both novel and educational? Then build the "Whirly-Gig"* and tempt your friends into explaining "How It Works."

The "Whirly-Gig" contains none of the components ordinarily found in a miniature motor; yet there it is, whirling around gaily for hours, powered only by two flashlight cells. What is its immediate value? Perhaps none, but it will serve as an excellent conversation piece, a window-display attention getter, or even as a classroom teaching device.

Start construction by making the yoke or support for the two Alnico bar magnets. Make certain that you observe correct polarity with the magnets; should you have doubt about polarities, simply place the magnets end to end so that they attract rather than repel one another.

The yoke must be made of some nonferrous metal, such as aluminum. And once constructed, the entire yoke assembly can be glued together with a fast-drying airplane glue, then painted.

After the paint has dried, drill or punch two small holes through the aluminum; these holes should be just large enough to allow a heavy needle or piano wire to pass through, and in a line so that the needle point or wire end rests exactly at the apex or top of the yoke.

A solid block of hardwood into which the needle or piano wire is inserted serves as a support and should be fastened to the top of the aluminum chassis box with brass screws. Be certain that the rotor revolves freely with a minimum of friction: "painting" the needle point or wire end with a graphite pencil will reduce excessive drag.

Almost any low-voltage relay coils rated at anything from 1½ to 6 volts will serve for *L1* and *L2* (the original coils were taken from two telephone-type relays). To make the right connections to the coils, connect a dry cell to *L1* and bring a compass near the end that will be closer to the bar magnet. The North-seeking point of the compass should be drawn to it; if it is not, reverse connections to the dry cell.

The terminal of *L1* to which the negative side of the battery has been connected should now be grounded, as shown in Figs. 1 and 2. Then repeat the test for the second coil, *L2*, connecting its "negative" lead to the collector of transistor *Q2*.

To operate the "Whirly-Gig," close the switch and set the rotor spinning in either direction. If the unit has been constructed correctly, its rotor will continue to twirl hour after hour. —30—

**Although it operates on somewhat different principles, the "Whirly-Gig" is similar to a "Super-regenerative Electronic Motor" developed by Dr. Harry E. Stockman and manufactured by the SER Company, 543 Lexington St., Waltham, Mass. The SERCO motor runs for weeks on a single flashlight cell and is intended for educational purposes.*

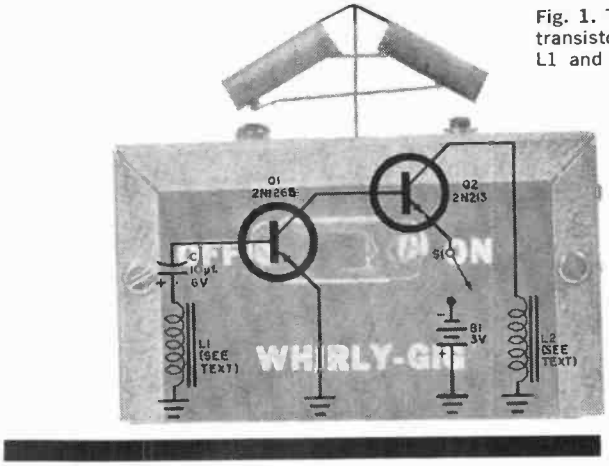


Fig. 1. The "Whirly-Gig" features two transistors in a complementary circuit; L1 and L2 are telephone relay coils.

PARTS LIST

B1—Two 1½-volt flashlight cells in series (Burgess Type 1 or equivalent)
C1—10-µf., 6-volt electrolytic capacitor
L1, L2—Relay coils, 1½ to 6 volts, 60 ohms —see text
Q1—2N1265 transistor
Q2—2N213 transistor
S1—S.p.s.t. toggle switch
1—4" x 2¼" x 2¼" aluminum chassis box (Bud CU-2103A or equivalent)
Misc.—Alnico bar magnets, aluminum strip, wooden block, large needle or piano wire, hookup wire, solder, hardware, paint, airplane glue, etc.

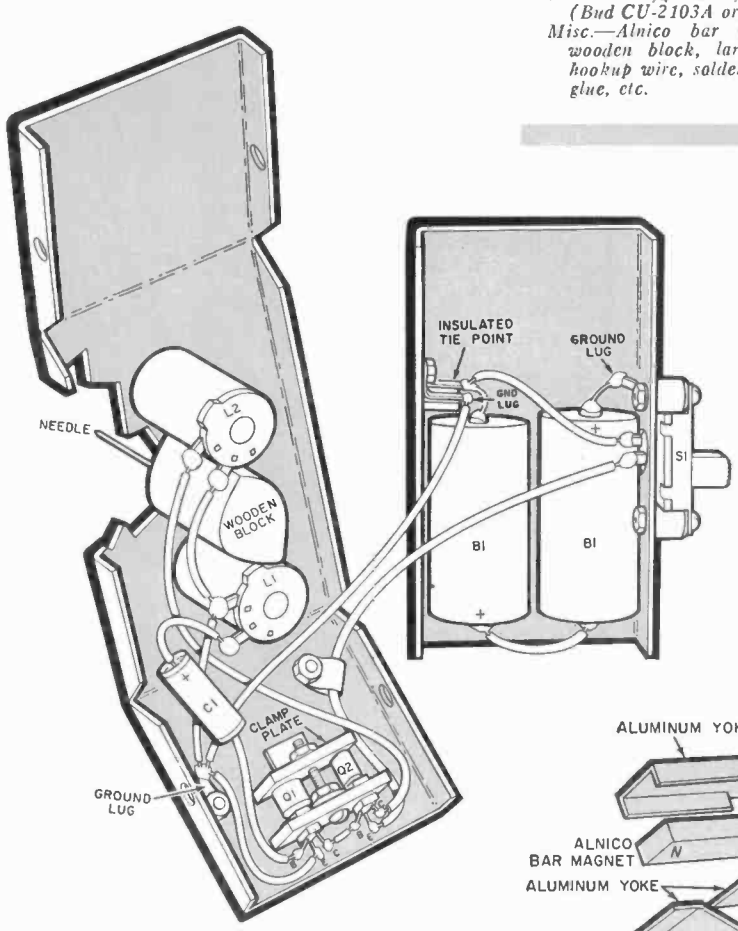


Fig. 2. Construction is straightforward, and all details are explained in text. Wooden block supports needle which serves as shaft for magnetic rotor.

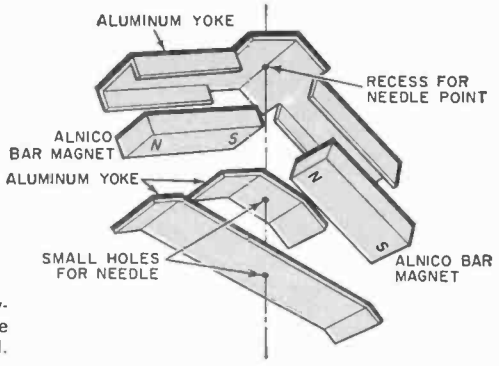
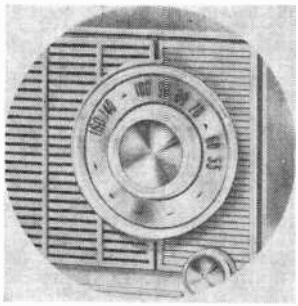


Fig. 3. Exploded view of rotor assembly, showing placement of parts. Yoke must be made of aluminum or other non-ferrous metal.



BIGGER BASS FROM BROADCAST SETS

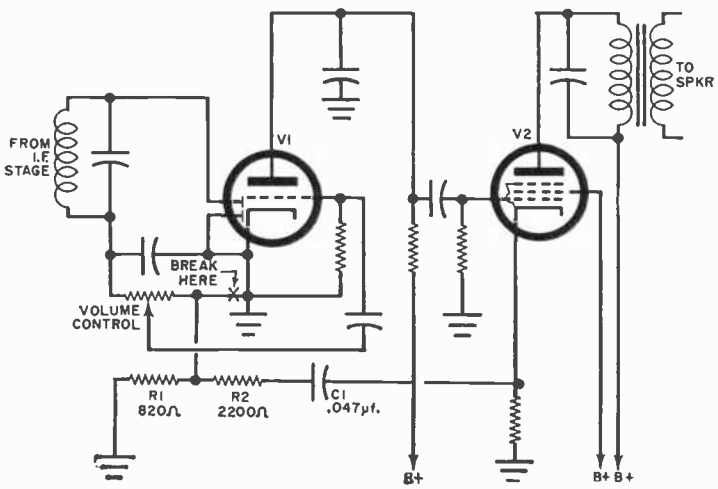
By R. H. DECKER

HERE is a simple circuit that will enhance the tone of most older a.c./d.c. broadcast receivers. The components were selected to give negative feedback at mid and high audio frequencies, with progressively less feedback at lower frequencies. This results in bass boost plus a reduction in distortion to improve the overall audio quality of the receiver.

The schematic diagram below shows the audio section of a typical receiver, with added components and wiring changes indicated in color. As you have no doubt guessed, *V1* is a twin diode/hi-mu triode employed as a second detector and first audio amplifier stage; *V2* is a beam-power tube employed as the audio power output stage which drives the speaker. Before installing the circuit, remove the chassis from the cabinet and compare the original wiring with the diagram below. If the two circuits differ appreciably, it might be wise not to attempt the modification.

Note that one end of capacitor *C1* is connected to the unbypassed cathode resistor of *V2*. If this resistor is bypassed, i.e., if there is a capacitor connected in parallel with it, the bypass capacitor must be removed in order for the circuit to work properly.

Check the modifications carefully, then re-install the chassis in its cabinet. Turn the radio on and tune in a station with a musical program. You should be pleasantly surprised at the improvement in sound quality. -30-



The audio section in most older a.c./d.c. receivers is similar to the circuit shown here; tube V1 is typically a 12SQ7 or 12AT6, tube V2 is often a 35L6, 50L6, or 50B5. Although the necessary components can be easily added to older radios, it's usually more difficult installing them in receivers which employ printed-circuit boards.

Across the Ham Bands

By
HERB S. BRIER
W9EGQ

HOW TO DEVELOP C.W. OPERATING SKILL

IF YOU RECEIVED your General Class license today, would everyone in the General bands immediately recognize you as a newcomer? Even though one purpose of the Novice license is to allow new hams to gain c.w. operating skill through experience, many Novices don't take full advantage of the opportunity. Below are a few sound hints on how you can improve your operating procedures.

Form Good C.W. Habits. In the days before the advent of the Novice license, new hams and old-timers did not operate in separate bands. New hams could automatically pick up good c.w. operating habits by imitating the old-timers they worked. Today, however, Novices seldom work old-timers. In fact, lots of new Novices don't even listen in the General Class parts of the c.w. bands—the average code speed is just too high for their copying abilities. As a result, many Novices pattern their operating habits on what they hear in the phone bands.

Make no mistake about it, there is nothing wrong with phone procedures *in the phone bands*. But in the c.w. bands, they are just too slow. For example, why laboriously pound out "I missed your location in the QRM (interference)—please repeat it," as was heard recently by W9EGQ in the 40-meter Novice band? "QRM. QTH?" says the same thing in 1/7th the time.

An easy way to learn good c.w. operating procedures is to study the booklet "Operating An Amateur Radio Station." Since this booklet is part of the ARRL packet "Gateway To Amateur Radio," you probably already have a copy. If not, you can obtain one from The American Radio Relay League, Inc., 38 La Salle Road, West Hartford, Conn. If you can practice what you learn from the book with a Novice friend, so much the better.

Join a Net. Several training nets operate in the Novice bands for the express purpose of helping Novices become good operators. Joining one is another way to improve your operating skill.

The Indiana Training Net, for example, meets Monday, Wednesday, and Friday from 1800 to 1900 CST on 3745 kc. Except for its code speed (5 to 7 wpm),

Novice Station of the Month

Jim Buchanan, KN8WPI, R.R. 2, Box 138, Kalamazoo, Mich., submitted the winning entry in this month's Novice photo contest. As you can see, he has assembled his station mostly from kits; in the picture are two Heathkit receivers, the AR-3 and the Mohawk, a Heathkit DX-35 transmitter and a 6-meter converter. Jim's favorite Novice bands are 40 and 15 meters. Though his 40-meter folded-dipole antenna is only 20 feet high, it has not prevented him from working most of the U.S.A. and several Canadian hams.

Jim will receive a one-year free subscription to P.E. for his photo. If you'd like to try for a similar award, send us a picture of your station—preferably showing you at the controls, and include with your entry some information about yourself, your equipment, and your activities. You may be one of the lucky winners. Entries should be sent to Herb S. Brier, c/o POPULAR ELECTRONICS, P.O. Box 678, Gary, Indiana.

A good bet for low-power c.w. operators is the Heathkit HX-11 transmitter. Crystal-controlled, it covers amateur frequencies between 3.5 and 29.7 mc. in five bands. The power input is 50 watts.

the training net is operated exactly like the regular Indiana c.w. net. It's under the guidance of an experienced net control station (NCS)—usually W9TT. Members can borrow net crystals upon paying a 25-cent deposit.

Any station within range is invited to join the ITN. Simply listen long enough to get on to the "ropes," then report in when the NCS sends "CQ QIN"—the net call. You can contact Bert Summers, W9VAY, Net Manager, 127 S. 15th St., Chesterton, Ind., for more info on the ITN.

A little listening on the 80-meter Novice band in the early evening hours will locate similar nets in other parts of the country. Incidentally, *Across the Ham Bands* would like to hear about other Novice-band nets from their managers.

Code-Proficiency Runs. The ARRL has scheduled code proficiency qualifying runs for December 6 and December 15. The one on December 6 will take place at 10 p.m. PST over Station W6OWP on 3590 and 7129 kc. The December 15 run is scheduled for 9:30 p.m. EST and 9:30 CST over Station W1AW on 3555, 7080, 14,100, 21,075, 28,080, 50,900 and 145,800 kc.

C.W. Transmitter. The new Heathkit HX-11 crystal-controlled c.w. transmitter is especially designed for Novice and other low-power amateur c.w. operators. Covering the amateur spectrum from 3.5 to 29.7 mc. in five bands, it features a full 50 watts input and a built-in low-pass filter to minimize possible TVI (television interference). Extra contacts on the HX-11's *Transmit-Receive* switch permit single-switch control of the station antenna changeover relay and receiver, and there are provisions for external VFO control for General Class users. The HX-11 nets at $43.50 when ordered directly from the Heath Company, Benton Harbor, Mich.

SIMPLE, STABLE VFO

Designed to give the ham who has graduated from the Novice ranks the advantages of a stable variable-frequency oscillator at minimum cost, the VFO described here feeds into the crystal socket of low-power 3.5- to 29.7-mc. crystal-controlled transmitters. With switch *S1* in the 80-meter position, the VFO's output frequency is 3.5 to 4 mc. (plus a slight overlap on either end of the band). Turning *S1* to 40 meters doubles the frequency. The higher frequency output is normally used for transmitting on all bands above 80 meters.

Construction. The VFO is housed in a 5″ x 4″ x 3″ aluminum utility box. Refer to the photograph for the general parts layout. Exact location of the components is not critical, but it is important that they be firmly mounted. Be sure also to use a pair of cable clamps to anchor the power and output cables to the box.

For precise frequency adjustment, a vernier dial such as the Millen 10039 should be installed on variable capacitor *C1*. A plain dial with a large knob works surprisingly well, however.

Tubes *V1*, *V2* and *V3* are mounted on top of the box so that the heat they generate will not cause the VFO to drift. For the same reason, power resistor *R2* should be mounted either on top of the box or in the power supply.

The power to operate the VFO can be obtained from your transmitter's *Accessory* socket or from a separate power supply. In either event, power requirements are 6.3 volts, a.c., at 0.65 ampere, and at least 375 volts, d.c., at 30 ma. Adjust the slider on resistor *R2*—with the power off—to compensate for different voltages. The resistance should be 34 ohms for every volt above 300.

Adjustment. Double-check the wiring, then connect the VFO to its power sup-

ply and set switch *S1* to 80 meters. You should now be able to hear a signal on your receiver at somewhere around 3 or 4 mc. If all is well, use the receiver as a guide to center the 3.5- to 4-mc. band on the VFO dial. This adjustment is made by removing ¼-turn at a time from the ungrounded end of *L1*.

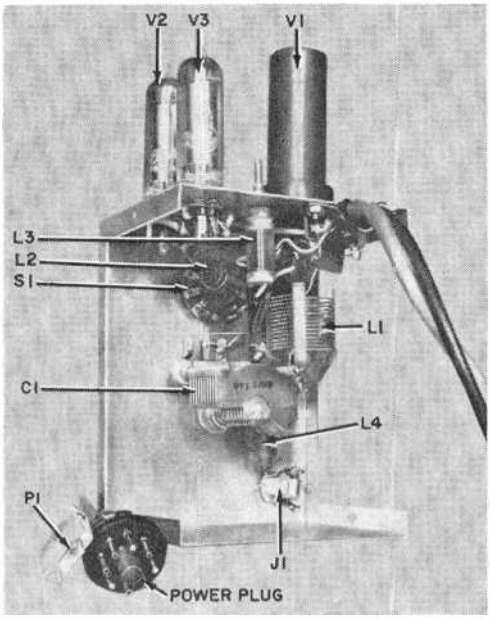
Next, close up the VFO box and insert plug *P1* into your transmitter's crystal socket (or into the separate VFO socket —if there is one). Let the VFO warm up for about a half-hour and turn the transmitter on (leaving the final off). If the transmitter is not provided with a separate switch for the final, remove the tubes from that stage. Listening to the output of the transmitter's intermediate stages on the receiver, calibrate the VFO dial for each of the two bands.

Before carrying out the dial calibration, however, the calibration of the receiver itself should be carefully checked —especially at the band limits. If you

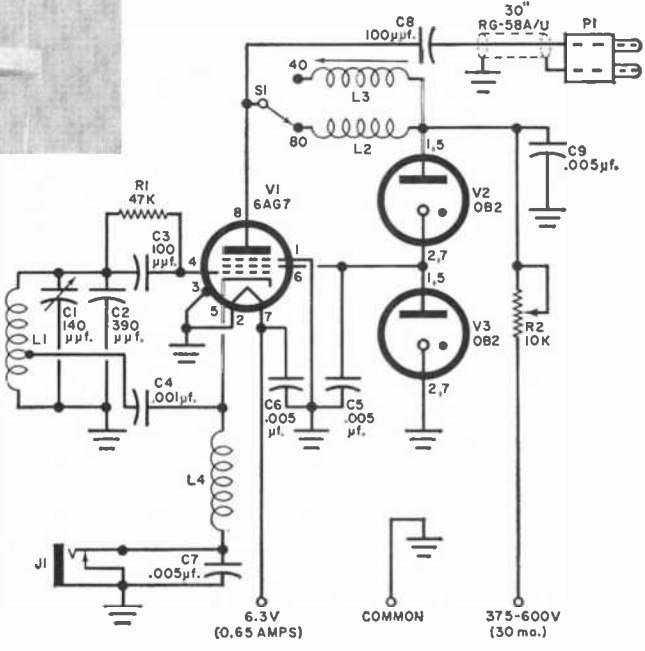
(*Continued on page* 96)

PARTS LIST

C1—140-μμf. midget variable capacitor (Bud 1876 or equivalent)
C2—390-μμf. silver mica capacitor
C3, C8—100-μμf. mica capacitor
C4—0.001-μf. mica capacitor
C5, C6, C7, C9—0.005-μf., 600-volt ceramic capacitor
J1—Closed-circuit phone jack
L1—15 turns of #20 wire, 1"-diameter, 15/16" long, tapped 4 turns from grounded end (B&W 3015 Miniductor stock, or equivalent)
L2—55-μh. r.f. choke (Stancor RTC-8668 or equivalent)
L3—34 turns of #28 enameled wire, close-wound on a Miller 4400 (or equivalent) ⅜"-diameter, slug-tuned coil form
L4—1-mh. r.f. choke
P1—Plug to fit transmitter crystal socket (Mosley 301 or equivalent)
R1—47,000-ohm, ½-watt resistor
R2—10,000-ohm, 25-watt adjustable resistor
S1—S.p.d.t. phenolic or ceramic-insulated rotary switch
V1—6AG7 tube
V2, V3—OB2 tube
1—5" x 4" x 3" aluminum utility box (Bud CU-2105A or equivalent)
1—30"-length of RG-58A/U coaxial cable
Misc.—Dial, tube sockets, terminal strips, power cable, cable clamps etc.



Completed VFO may be powered from transmitter or from separate supply. Use a power plug to suit your supply source; an octal type is used here.



Circuit of VFO is designed around a 6AG7 tube. Plate and screen voltages are held constant by means of two OB2 voltage-regulating tubes.

BBS*

*** Need a code practice oscillator? Convert a BC-451-A control box into . . . the Black Box Special!**

By **BASIL BARBEE** W5FPJ

THIS little transistorized code practice oscillator was designed around a readily available BC-451-A radio control box. Costing less than $2.00 at most large surplus outlets, the compact black box was so well suited for the purpose that it seemed a good idea to call the finished unit "The Black Box Special."

Among the parts provided in the BC-451-A are a 4-position rotary switch, which is used to control the frequency of the completed oscillator, and a key jack. In addition, there's even a handy test switch which can be used as an auxiliary code key.

The author purchased his control box from the Atlas Equipment Co., 227-231 Southwest Blvd., Kansas City 8, Mo. Your favorite surplus dealer probably has the item in stock also.

About the Circuit. Two complementary transistors (*Q1* and *Q2*) are wired in a simple, direct-coupled amplifier circuit. The capacitor (*C1*, *C2*, *C3*, or *C4*) selected by switch *S1* provides feedback between the collector of *pnp* transistor *Q2* and the base of *npn* transistor *Q1*, causing the circuit to oscillate. Frequency of oscillation is controlled primarily by the selected capacitor, together with resistor *R1;* the larger the capacitor, the lower the pitch.

The speaker also acts, through battery *B1*, as a collector load for *Q2*. A standard code key, plugged into jack *J1*, is placed in series with the negative battery lead. In addition, the oscillator may be keyed with switch *S2*, which is connected in parallel with *J1*.

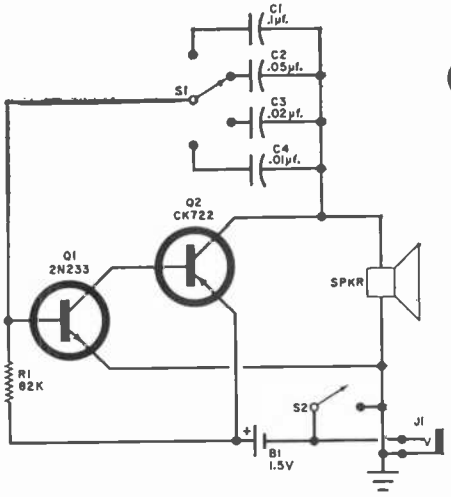
Construction. Begin by removing all components and wiring from the BC-451-A. Remove the two metal nameplates (located at the top and side of the black box) as well. The 4-position "transmitter selection" switch (*S1*), "key" jack (*J1*), and the test key (*S2*) will later be re-installed in their original openings. The other components can be put aside for future projects.

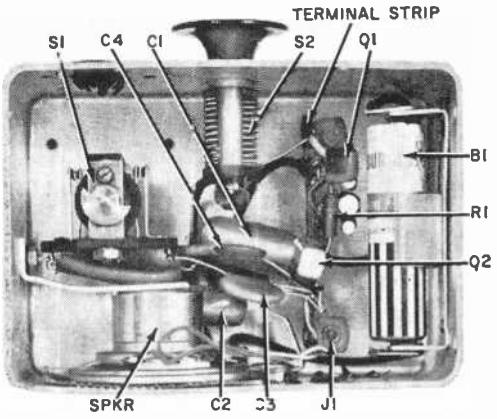
With the box "cleaned out," place the battery holder and terminal strip approximately as shown in the photo above, right, and drill appropriate mounting holes. The speaker mounts in the

PARTS LIST

B1—1.5-volt penlight cell (Burgess Type Z or equivalent)
C1—0.1 μf.
C2—0.05 μf.
C3—0.02 μf.
C4—0.01 μf.
all capacitors 50-volt ceramic
*J1—Open-circuit phone jack**
Q1—2N233 transistor
Q2—CK722 transistor
R1—82,000-ohm, ½-watt resistor
*S1—Single-pole, 4-position rotary switch**
*S2—S.p.s.t. push-button switch**
SPKR.—2"-diameter, 8-ohm PM speaker
1—BC-451-A control box—see text
Misc.—Six-lug (two-grounded) terminal strip, holder for B1, screen wire, wire, hardware, etc.

**Part of BC-451-A control box*





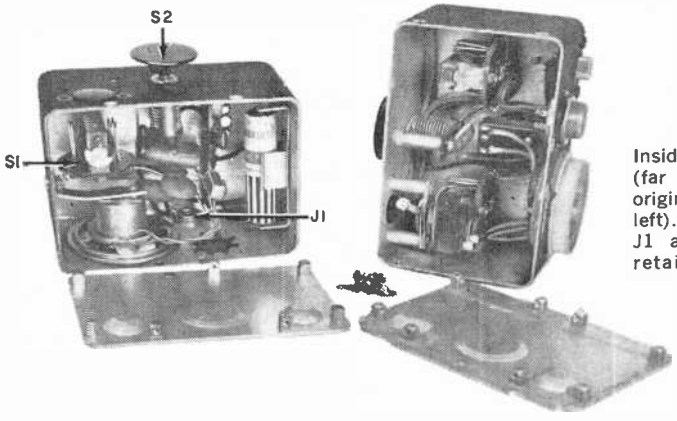
Oscillator circuit is quite simple, and fits compactly in BC-451-A case. Wiring is straightforward, but terminals on some components are hard to reach and leads must be soldered on before installation.

opening formerly occupied by the 18-pin male connector and is protected by a 2″ square of screen wire placed between it and the opening. An "L"-shaped clip bent from a $\frac{5}{16}$″ x 2″ strip of metal holds the speaker in place; make a 90° bend in the strip $\frac{5}{16}$″ from one end and drill a hole to accommodate a *6-32* screw in the tab thus formed. Locate the clip so that it presses tightly against the back of the speaker, then mark and drill the mounting hole.

Now you're all set to begin the wiring —which is simple and straightforward. Some of the components, though, are quite difficult to reach once they are mounted. Be sure to solder all leads to inconveniently located terminals before re-installing *S1*, *J1*, and *S2* or mounting the battery holder, the terminal strip, and the speaker.

When the wiring is completed, you may want to pretty up the unit a bit by covering some of the larger holes with plug buttons. The unwanted labels engraved on the front panel can be concealed with a dab or two of black paint.

Using the Oscillator. Just plug in the penlight cell (being sure to observe the proper polarity), and the BBS will be ready to go. To key it, simply depress switch *S2*; for regular code practice sessions, of course, you'll want to plug a standard key into jack *J1*. Switch *S1* will give you a choice of four different frequencies. -30-



Inside view of completed unit (far left) as compared to the original BC-451-A (directly at left). Switches S1, S2, and jack J1 are the only components retained in the conversion.

Transistor Topics

By LOU GARNER

WITH the Holiday Season almost upon us, chances are you're faced with the rather pleasant chore of selecting gifts for your family and friends. On this note, don't forget that electronic construction kits make ideal gifts. Keep in mind, too, that they carry a double "measure of pleasure"—they are fun to assemble and, later, may become prized possessions. And if the recipient isn't fond of electronic construction, you can add a personal touch to the item by assembling it for him or her!

Kits are available from such well-known manufacturers as Arkay, Paco, Heath, and EICO, both direct and through local and mail-order distributors. In addition, many mail-order firms feature a number of kits under their own "house brands."

Most companies offer a variety wide enough to suit every taste and need .... receivers for general gifts, hi-fi equipment for music lovers, tape recorders for teen-agers, test instruments for students and experimenters, educational kits for youngsters, ham gear for amateur radio operators, intercoms for the home, marine electronic equipment for yachtsmen and fishermen, and automobile instruments for sports-car enthusiasts.

If you're looking for something a little

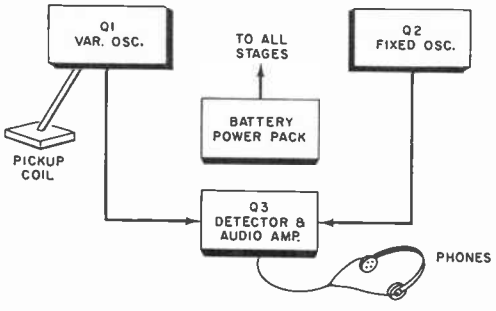


Fig. 1. The Model 100T metal locator, produced by Electronic Applications Co., employs two oscillators and a detector/amplifier. Metals alter inductance of pickup coil (see photo), changing frequency of Q1's oscillations and tone heard in headphones.

different, you might consider a transistorized metal locator. Up-to-date commercial versions of the famed mine detectors used in wartime, these instruments have become increasingly popular as a result of the Civil War centenary. In fact, nearly every mail brings one or more reader inquiries about such units.

The Model 100T metal locator is typical of currently available instruments. Offered by Electronic Applications Co., (P. O. Box 8, Arlington 10, Va.), it operates for up to 3000 hours on a single set of batteries. With suitable "search heads," it will detect a gold sample as small as 0.04 square inch at a depth of a few inches, and large objects (such as a treasure chest) at depths of up to six feet.

The 100T is furnished complete with batteries, headphones, and a general-purpose search head for $49.50 in kit form, or $59.30 factory assembled—both prices are less postage. Special-purpose search heads for large and small objects are available as optional accessories, and a modified version for underwater use may be had at a somewhat higher price. The latter instrument, incidentally, can be used at depths of up to 50 feet.

Three *pnp* transistors are employed in the 100T, as illustrated in Fig. 1. One of these, *Q1*, serves as a variable r.f. oscillator, with its frequency determined by the pickup coil in the search head. Transistor *Q2* is used as a fixed (but adjustable) oscillator, while *Q3* serves as a combinaton mixer/detector and audio amplifier, driving a pair of standard magnetic headphones.

In operation, *Q2* oscillates at a frequency slightly different from that of *Q1*. The resulting "difference frequency" is detected and amplified by *Q3*, and heard as an audio beat note in the earphones. When the search head (pickup coil) is moved into the vicinity of a metal object or piece of ore, its inductance changes, shifting *Q1*'s operating frequency and causing a corresponding change in the tone of the beat note signal. With practice, relatively small changes in beat note tone may be distinguished quite easily.

Yours truly has personally examined a Model 100T metal locator, checking out its performance under varying conditions. The kit version is easily assembled in an evening or two, following the detailed instructions and illustrations furnished in the manual. Transparent "overlays" assist in locating parts on the etched-circuit board, and the completed unit is easy to adjust and use.

Reader's Circuit. Having tried and rejected a number of "wireless broadcaster" circuits, reader J. O. ("Jack") Pettit (533 N. Alfred St., Los Angeles 48, Calif.) decided to try his luck at developing a circuit of his own. His goal was a

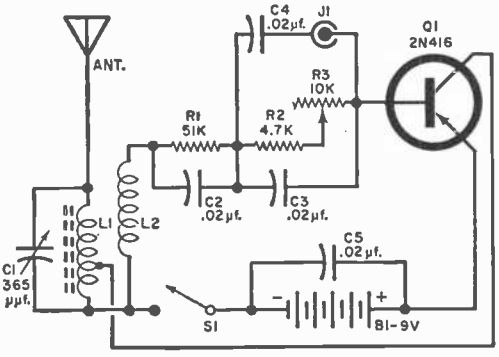


Fig. 2. "Wireless broadcaster" circuit developed by reader Jack Pettit. Housed in a plastic box, the unit is small enough to be mounted almost anywhere.

unit capable of transmitting at distances up to 40 feet, permitting him to listen to code records played on his hi-fi phonograph and received on a small radio far enough away so as not to disturb other members of his household. His efforts met with success . . . resulting in the circuit shown in Fig. 2.

Referring to the schematic diagram, a *pnp* r.f. transistor, *Q1*, is used in the common-emitter arrangement as a "tickler feedback" oscillator. Operating frequency is determined by tuned circuit *L1-C1*, while *L2* provides the feedback necessary to start and sustain oscillation. Transistor *Q1*'s base bias is furnished through a series network made up of *R1*, *R2*, and *R3*, bypassed by *C2* and *C3*. The audio signal is introduced through *J1* and blocking capacitor *C4*. Power is furnished by a single 9-volt battery (*B1*), controlled by *S1* and bypassed by *C5*.

Standard, readily available components are used throughout. Coil *L1* is a Miller Type 2001 ferrite loop, while *L2* is made

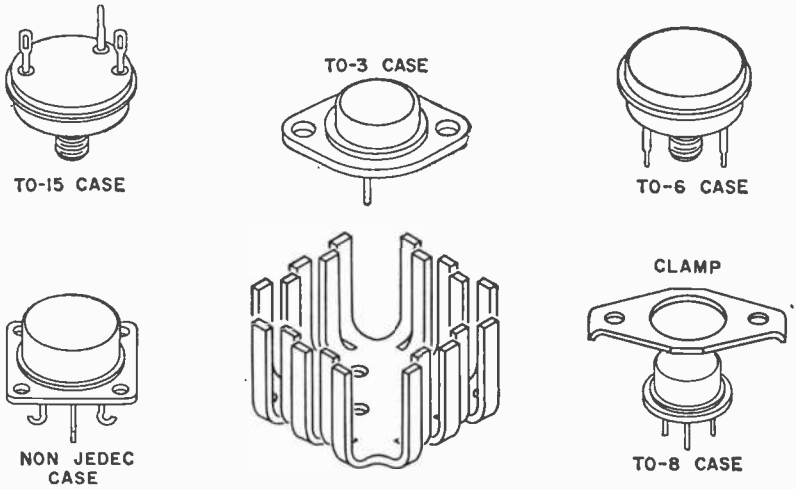


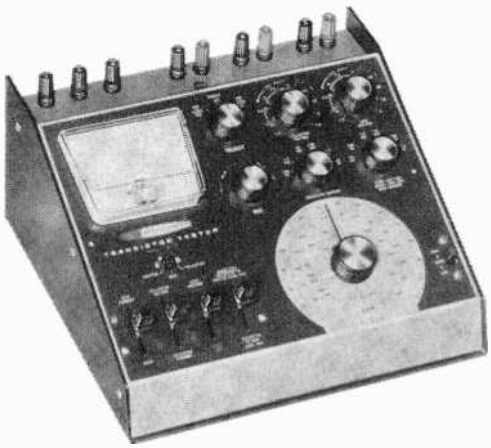
Fig. 3. The Type U-P heat sink, a product of International Electronic Research Corp., is shown surrounded by the transistor cases with which it can be used.

up of 15 turns of #24 enameled wire wrapped around the center of the coil in the same direction as *L1*'s windings; *L1*'s lower lead is connected to *L2*'s upper lead. Capacitor *C1* is a miniature 365-$\mu\mu$f. variable; *C2*, *C3*, *C4* and *C5* are 100-volt tubular capacitors, but small ceramic units should work as well. Resistors *R1* and *R2* are ½-watt units, while *R3* is a miniature potentiometer of the type used for hearing aids. Jack *J1* is a standard RCA phono connector, *S1* any s.p.s.t. switch, and *B1* any standard 9-volt transistor battery—a Burgess 2N6, for example.

Jack assembled his original model in a 3″ x 4″ x 1″ plastic box, mounting *L1/L2* on the outside lid. He used a 35″ length of heavy wire as an antenna, terminating the end in a banana plug. For an audio source, he used a magnetic cartridge coupled to *J1* through a small preamplifier, but a medium- to high-output crystal cartridge should give satisfactory results without a preamp.

In operation, *R3* is adjusted for "cleanest" modulation, while *C1* is set to deliver a signal at a "dead" spot near the middle or upper end of the AM broadcast band. If difficulty is encountered in obtaining oscillation, *L2*'s connections should be reversed.

Recently introduced by the Heath Company, the Model IM-30 transistor tester is available in kit form.

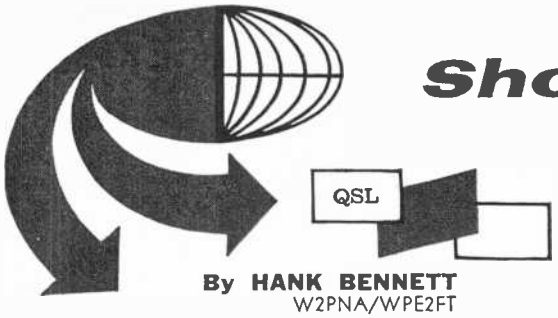


Product News. The International Electronic Research Corp. (135 West Magnolia Blvd., Burbank, Calif.) has announced a new "universal" heat sink that can be used with most power transistors (see Fig. 3). Type No. U-P is suitable for both natural and forced air cooling.

A late release from the Heath Company (Benton Harbor, Mich.) describes a new laboratory-type transistor tester capable of performing a thorough d.c. analysis of all transistor types and checks of diode characteristics. Switches and controls are provided to permit accurate tests at biases from 1.5 to 9 volts at collector currents up to 15 amperes. Identified as kit No. IM-30, the instrument sells for $54.88, f.o.b. Benton Harbor.

A fully transistorized FM converter for automobile radios has been announced by the Automatic Radio Manufacturing Co. (122 Brookline Ave., Boston, Mass.). Featuring six transistors

(*Continued on page* 112)



Short-Wave Report

By HANK BENNETT
W2PNA/WPE2FT

DX'ING THE VOA AMATEUR RADIO PROGRAM

THE amateur radio program broadcast each week by the *Voice of America* is beamed to all corners of the earth, and DX'ers everywhere are invited to participate. A 15-minute show, it features news of the ham bands, interviews with operators from around the world, propagation forecasts, and technical discussions of interest to amateurs, SWL's, and other radio enthusiasts.

The broadcasts are written and voiced by Bill Leonard, W2SKE; the producer is Gene Kern, W2BAK; and the propagation forecasts are prepared by Bill Dulin, W4ETT, and George Jacobs, W3ASK. Reports on the ham show, which has its own distinctive vertification card, may be sent to either of two addresses: Bill Leonard, P. O. Box 29, Geneva 12, Switzerland; or Amateur Radio, Box 922, Washington 4, D. C.

Here is the complete current schedule showing broadcasting times (EST), frequencies, station call-sign or location, and direction of the beam. Please bear in mind that this schedule is subject to change. (You can request periodic schedules from Washington address above).

Sundays at 0230-0245: 5955 kc. (WDSI1) to Europe; 6025 kc. (WLW06) to N. Africa and S. Europe; 6080 kc. (Tangier-3) to Middle East, 7205 kc. (Tangier-5), 9615 kc. (Tangier-2), and 15,205 kc. (Tangier-10), to Europe; 9740 kc. (WLW05) to W. Africa; 9770 kc. (WLW02) to N. Africa and S. Europe; 11,785 kc. (Tangier-9) to Middle East; and 11,805 kc. (WLW01) to N. and W. Africa.

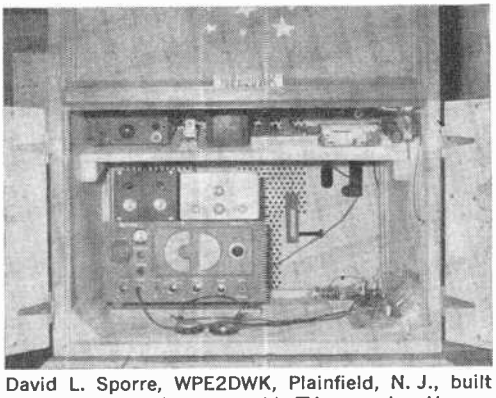
Fridays at 1615-1630: 6145 kc. (Okinawa-5), 7160 kc. (Okinawa-1), 9665 kc. (Okinawa-2), 9770 kc. (Malolos-1), 11,960 kc. (Malolos-2), 15,150 kc. (KCBR5), 17,770 kc. (KCBR1), and 21,740 kc. (KCBR4), to the Far East.

Sundays at 1730-1745: 3980 kc. (Munich-6), 6140 kc. (Munich-5), 9520 kc. (Thessaloniki-4), 9615 kc. (Tangier-2), to Europe; 6185 kc. (Courier-1), 7125 kc. (Courier-2), 7205 kc. (Thessaloniki-3), and 9630 kc. (Munich-3), to the Middle East; 9555 kc. (Munich-2), 11,960 kc. (Munich-1), 15,440 kc. (Munich-4), 17,710 kc. (WLW01), and 21,610 kc. (WLW02), to West Africa.

Sundays at 2230-2245: 11,830 kc. (WBOU4), 15,330 kc. (WBOU6), to the West Indies and Eastern South America; 11,890 kc. (WLW01), 15,205 kc. (WDSI1), 15,290 kc. (WLW02), to Latin America.

There is one additional broadcast frequency used for medium-wave DX'ers: 1250 kc. (Courier-A) beamed to the Middle East on Sundays at 1730-1745. This would be a good catch for anyone in the United States.

(*Continued on page* 97)



David L. Sporre, WPE2DWK, Plainfield, N. J., built his equipment into an old TV console. He receives on a Lafayette HE-10, aided by a Heath Q-Multiplier, and can switch to any of six antennas.

By
JOHN T. FRYE
W9EGV

Carl and Jerry

The Bell Bull Session

IT WAS a Sunday evening in early December, and half a dozen young men were standing in the hall outside the locked door of Carl and Jerry's room on the third floor of the H-3 Building at Parvoo University.

"Knuckle the door again," one of them suggested. "In those notes Carl and Jerry said to be here at 7:00 sharp for a 'Bell Bull Session,' whatever that is. It's after seven now."

At this moment Carl stepped into the hall through the stairway doors. Jerry, puffing a little from the climb, was right behind him.

"Sorry we're late, fellows," Carl apologized as he unlocked the door and waved the visitors inside. "Jerry and I were at the library, and time sort of got away from us."

"Okay, but what's all this about?" a chubby redhead named Jack asked as he took possession of the single upholstered chair in the room.

"Yeah, what's a 'Bell Bull Session'?" a lanky boy from Texas drawled from where he sat on the floor. "Most of the bull sessions I've sat in on get around to women sooner or later, but down Texas way we feel it's a little caddish to name names. Who's this Bell co-ed? Do we know her?"

"Oh, yes, you know her," Jerry answered with a grin; "but let me explain. All of you are friends of Carl or myself or both; and all of you share our deep interest in electronics. We think we've found something that will be as intriguing to you as it is to us, and we want to share it with you. The 'something' was developed by Bell Telephone Laboratories. That, plus the fact that we thought a little mystery might help lure you up here tonight, is the reason we called this a Bell Bull Session."

"Boys, it looks like we've been had!" Tex drawled with a good-natured grin.

"I'm hoping you won't think so when you leave," Jerry answered, and then dived right into his theme. "You see, the behavior of radio waves has always been hard for me to keep straight in my mind; yet one must understand this subject thoroughly in order to have a clear knowledge of such things as resonance, impedance-matching, standing wave ratio, and antenna theory. I was talking to my high school science teacher back home about it recently, and he suggested that I build a wave machine as described by Dr. John N. Shive, Director of Education and Training of the Bell Labs, in his little book called *Similarities in Wave Behavior*. This booklet tells how to build the machine and describes several experiments that can be performed with it. Well, Carl built one, and that's what we want to show you tonight."

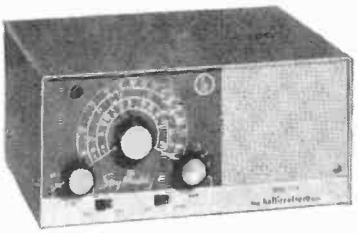
CARL HAD PLACED a long board on one of the study desks. Fastened in a row to the top of the board were about a dozen narrow isosceles triangles of heavy sheet metal with their planes at right angles to the length of the board. A narrow portion of the bottom of each triangle had been bent over to form a foot for fastening the triangle to the board. The top of each triangle had been clipped off and a shallow U-shaped notch had been filed in the top of the resulting trapezoid. All of these notches were perfectly in line and at the same height.

Carl stepped to the clothes closet and carefully lifted out a flimsy, jiggling ar-

hallicrafters means QUALITY and RELIABILITY in COMMUNICATIONS

hallicrafters company

4401 W. Fifth Avenue, Chicago 24, Illinois



S-119K Sky Buddy Receiver Kit—$39.95. S-119 (factory wired and tested) $49.95. Standard broadcast. Two short wave bands (2-5.5 Mc. and 5.7-16.4 Mc.). Superheterodyne circuit. Transformer-type power supply.

SX-62A Receiver—$395.00. Standard and FM broadcast. Three short wave bands (1.62 Mc-109 Mc). Excellent audio. Slide rule dial. Single tuning control. Automatic noise limiter. Uses R-4E speaker. ($19.95)

SX-110 Receiver—$169.95. Standard broadcast. Three short wave bands (1550 kc-34 Mc). Slide rule electrical bandspread dial. Built-in "S" meter, antenna trimmer, crystal filter. Uses R-48 speaker ($19.95).

S-120 Receiver—$69.95. Standard broadcast plus three short wave bands (1650 kc-31 Mc). Three-way antenna system. Slide rule electrical bandspread dial. B.F.O./selectivity control.

Export Sales: International Division, Raytheon Mfg. Co., Waltham, Mass. Canada: Gould Sales Co., Montreal, P.Q.

rangement of closely-spaced slender metal rods fastened at their centers to a still smaller central metal spine. Grasping the spine by its ends and holding the array taut, Carl carefully lowered the spine into the notches of the sheet-metal bearings.

"This thing is rather simple to build," Carl explained. "The spine is a three-foot length of .042-inch steel drill rod. There are 70 18-inch lengths of .042-inch steel drill rod fastened to the spine a half-inch apart. They are soldered to the backbone exactly at their centers, parallel with each other, and at right angles to the backbone. But if you want to build one of these machines yourself, I strongly recommend that you order a copy of The Student's Edition of *Similarities in Wave Behavior*, by Dr. John N. Shive, from the Williams & Wilkins Company, Science Series, 428 E. Preston St., Baltimore 2, Maryland. You can't get the booklet anywhere else, and it only costs 35¢ postpaid. It shows you how to make special jigs for holding the rods in position while you're soldering them, how to conduct many interesting experiments with the machine, and how to understand the significance of these experiments."

"This last is very important in the opinion of Dr. Shive," Jerry smoothly scooped up the conversational ball. "He says science is more than just knowledge; it's a method. You *can* gather facts in the aimless way that your car radiator collects bugs and butterflies in summer; but a scientist carefully selects his specimens and studies them carefully, looking for similarities and differences, searching for clues that will make what is new and puzzling fit into the knowledge he already has. The scientist is forever trying to reduce observed phenomena to a least common denominator.

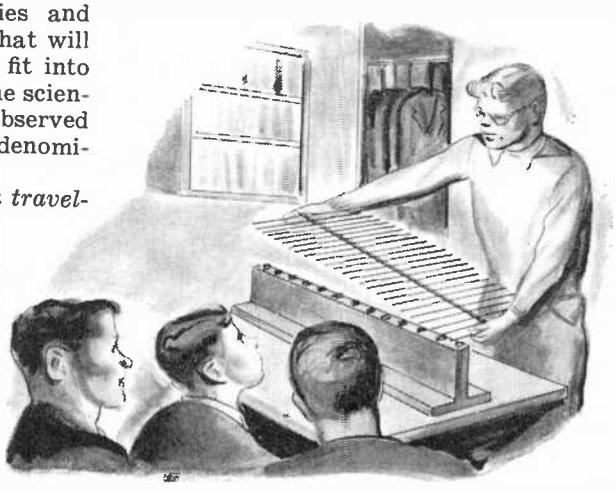
"To him, therefore, a wave is *a traveling disturbance of a medium from its normal condition.* So, in view of that definition, mechanical waves, sound waves, light waves, and radio waves are seen to behave alike. In each case the passage of the wave disturbs the conducting medium which returns to rest after the wave has passed. By studying mechanical waves in this machine, therefore, we can understand the behavior of other waves whose actions cannot be readily seen."

He reached over and pumped the end of the first cross arm of the machine up and down once. A smooth undulation ran slowly up and down the array of steel rods until it gradually died away.

"That wave you see moving the rods is actually a twisting and untwisting of the steel spine," Jerry explained. "The rods soldered to the spine reveal the movement of this torsion wave along the spine by the up-and-down motion of their ends as the twist-untwist I applied at one end of the spine travels along its length. The wave I started with a 'pulse' is a damped waved. It is damped by three kinds of friction: air resistance to the up-and-down motion of the cross arms, rolling friction of the central backbone in the bearing notches, and hysteresis friction in the backbone itself. This damping gradually absorbs the energy of the wave, and it dies out."

"You talk about the 'energy of the wave,' Jack interrupted. "Can you use that coat-hanger marimba to prove waves transport energy?"

Jerry did not answer, but both he and



NEW

CENTRAL'S INSTANT KITS®

Help you to START MAKING MONEY...SOON!

CHOOSE THE INSTANT KITS THAT APPEAL TO YOU!

- Transistorized Electronic and Appliance Tester
- Code Oscillator
- CB Converter
- RF Signal Generator
- Photoelectric Switch
- 4 Transistor Portable Radio
- Oscilloscope

They're **MODERN • PRACTICAL • COMPLETE • MEET COMMERCIAL STANDARDS**

Study Practical Electronics with Central Technical Institute—Select the equipment you wish to build—start making money servicing and repairing radio-TV sets and appliances

NO EXPERIENCE NEEDED! You don't need a high school diploma or previous knowledge of electronics to get started, with Central's PRACTICAL ELECTRONICS COURSE. Quick, low-cost home training for young and old. New, illustrated lessons make learning easy. You learn by doing—building modern, complete, *useful* equipment furnished by Central. You earn *extra money* in your spare time doing work that is profitable and enjoyable. Keep your present job—set your own pace—add to your income—find out how much fun electronics can be!

OVER 50,000 SUCCESSFUL GRADUATES

"I wouldn't be in my present position if it weren't for my Central Technical Institute training. Naturally, I recommend the school very highly. Damon Alarm has ten employees, and four service vehicles." CLARENCE S. DAMON, President, DAMON ALARM CORP., K. C., Mo.

"I am in business for myself, operating a part-time Radio & TV Service Shop in my home. My gross part-time earnings average $100 per month." Grad CARROLL B. SCARBOROUGH, Belton, Mo.

"The field of electronics is exciting. There are opportunities galore. I received training at Central Technical Institute and I recommend the school without qualification." FRANK LEENKNECHT, CONVAIR ASTRONAUTICS DIVISION, GENERAL DYNAMICS CORPORATION.

RESIDENT TRAINING—Central also offers a full-time ECPD-Accredited Technical Institute program at its resident school in Kansas City, Mo., for qualified high school graduates. Details in FREE catalog.

ACT NOW! RECEIVE 2 FREE BOOKS!

FILL OUT REVERSE SIDE AND MAIL TODAY!

FIRST CLASS
Permit No. 3021
Kansas City, Mo.

BUSINESS REPLY MAIL

NO POSTAGE STAMP NECESSARY

IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY—

CENTRAL TECHNICAL INSTITUTE

1644 Wyandotte Street
Kansas City 8, Missouri

Dept. PE 121B

Carl wore smug smiles as the latter took a small stand out of a drawer. This stand had a little toothed and dogged wheel at its top. The axle to which the toothed wheel was fastened had a string wrapped around it with a weight suspended on the end.

Carl clipped a little piece of stiff wire to the cross arm at the far end of the machine. Then he carefully adjusted the bent end of this wire so that each upward movement of the cross arm pushed the toothed wheel around a notch and enabled the dog to catch it; each downward movement let the end of the wire slip down and engage another tooth. The result was that when the end of the cross arm at the near end of the machine was moved up and down and the waves so produced traveled to the other end, the up-and-down movement of the last rod caused the toothed wheel to revolve, raising the weight.

"Guess that answers the question," Jerry said. "Obviously waves *do* carry energy. Just as energy contained in the mechanical waves raised that weight, so

sound waves vibrate our ear drums, the energy of water waves stirred up by Hurricane Carla late last summer battered down dock installations along the Texas coast, and energy carried by light waves from the sun changed the orbit of Echo sufficiently to upset predictions about how long the satellite would last. But

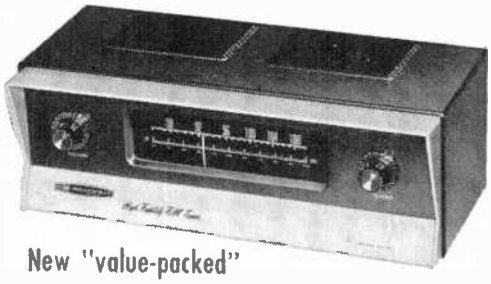
(*Continued on page* 90)

Do your Christmas shopping the easy, economical satisfying way with the 1962 HEATHKIT® Catalog

World's biggest kit catalog—offers over 250 kit selections. The big, new 100-page Heathkit catalog is the world's shopping center for kit builders. It offers over 40 completely new kits and a variety of products priced from $7.95 up. Heathgift certificates are available in any dollar amount you wish.

New easy terms; order now—pay later! Heathkit's new relaxed terms are the easiest ever. Now, no down payment is necessary . . . and take as long as 18 months to pay. See the order blank in the 1962 Heathkit catalog or write for application forms today.

Heathkits give a world of pleasure—at half the price! With Heathgifts you provide more than just a remembrance. You open an exciting, challenging, satisfying new world of pleasure—that lasts a lifetime. What's more, you give the highest quality electronic equipment, but pay up to 50% less than the cost of ready-made units.



New "value-packed" FM Tuner in charcoal gray and ivory

Performs in the true Heathkit quality tradition. Loaded with such features as flywheel tuning and slide rule dial, AFC control, assembled prealigned front end for easy kit completion. 9 tube function, ±20-20,000 cps. A honey for looks! Features multiplex jack for use with the Heathkit AC-11 Multiplex Converter to provide FM stereo.

Kit AJ-31 FM Tuner (shown)...8 lbs.....$39.95
Kit AC-11 Multiplex Converter...4 lbs.....$32.50

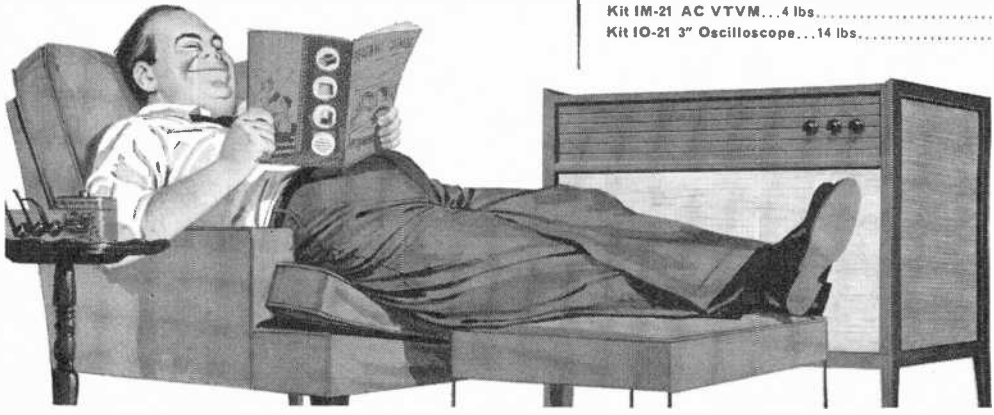
New HEATHGIFTS

New Test Instruments for the technician or serious amateur

The IM-21 AC VTVM has clean design. Extended freq. response 1 db 10 cps to 500 kc. 10 megohm input imp.; 10 voltage ranges; −50 to +50 calibrated db scale.

Versatile 10-21 "general purpose" 3" oscilloscope perfect for industrial, medical and general use. Push-pull vert. and horiz. amplifiers; 20 to 100,000 cps sweep; automatic sync.

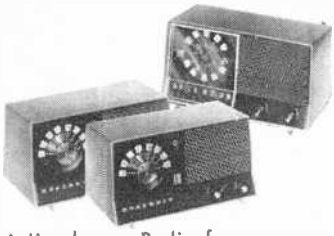
Kit IM-21 AC VTVM...4 lbs.....$33.95
Kit IO-21 3" Oscilloscope...14 lbs.....$49.95



Deluxe 9 transistor Walkie-Talkie keeps you in touch anytime, anywhere

Units at twice the price can't compare! Operating range of 1 to 3 miles; meets FCC regulations. Crystal controlled superhet receiver; squelch noise limiter circuit; push-to-talk switch; rugged, 2-tone alum. case. Use for private reception, as wireless mike or for paging. 75 hours on 9 volt battery. Collapsible 35" whip antenna.

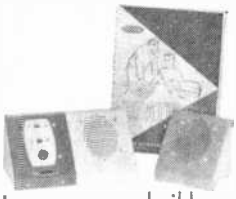
Kit GW-21...3 lbs.....$44.95



A Handsome Radio for every room in the house

Choose from 3 spanking new ivory and beige radios. Low cost AM set provides hours of pleasure. Economical FM table radio is noise-free; has preassembled tuner. AM Clock-Radio has Telechron unit, sleep switch, radio alarm, pillow speaker jack.

Kit GR-121 AM Clock-Radio, 8 lbs. $29.95
Kit GR-11 FM Table Radio, 7 lbs. $27.50
Kit GR-10 AM Table Radio, 7 lbs. $19.95



Learn as you build—an Educational Kit on Transistors

Teaches basic fundamentals of transistors while performing interesting experiments! Text is written in simple easy-to-understand language. Final product is highly useful two-station intercom. Textbook provides a storehouse of valuable reference material. Designed for youngsters and adults alike. All components and materials furnished.

Kit EK-3 Basic Transistors... 4 lbs.....$16.95

make it a merrier Christmas for anyone!

New Accessories to make a "Ham" happy

Ham accessories that sing performance, price, features! Spectacular, compact tunnel diode "dip" meter does everything a "grid dip" can do. New rugged VFO covers 80 thru 2 meters. New "Q" multiplier has 2 peak I. F. positions. Exceptional values!

Kit HG-10 VFO...12 lbs.....$34.95
Kit HM-10 "Tunnel Dipper"... 3 lbs.....$34.95
Kit HD-11 "Q" Multiplier... 2 lbs.....$14.95

New Wireless Intercom saves time, saves steps

No home, office or factory should be without this transistorized all-master intercom system. Imagine, only 3c a month to operate. No wires between units, just plug in. Any station calls other stations. Easy to build. In beautiful two-tone beige.

Kit GD-51 Intercom...4 lbs.....$22.95
Kit GD-51-2 (pair)...8 lbs.....$45.90

Safe cruising for the Boating Enthusiast

Compare for price, for quality! See why the 3-band "Mariner" gives you so much. Includes consolan, beacon, broadcast and marine phone bands. 10 transistor, 1 diode circuit. Functionally styled with "sense" antenna, waterproofed 4" x 6" speaker. Preassembled tuner. Bearing accuracy of ±3°.

Kit MR-11 3-band "Mariner"... 12 lbs.....$109.95

Short Wave Radios put the world at your fingertips

Hours of fascinating broadcast, amateur radio, and short wave pleasure await you in the GR-91. Covers 500 kc to 30 mc in 4-bands. Illuminated 7" slide-rule dial & meter. Versatile controls for top reception. "Velvet touch" tuning. Easy circuit board assembly. Beige & Aqua color.

Kit GR-91 SWL Radio...9 lbs.....$39.95

HEATH COMPANY
Benton Harbor 10, Michigan

HEATHKIT by Daystrom

☐ Yes, send me my free 1962 Heathkit catalog

NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

Order direct by mail or see your Heathkit dealer.

Ship ☐ Parcel Post ☐ Express ☐ C.O.D. ☐ Best Way

Ordering Instructions: Fill out the order blank. Include charges for parcel post according to weights shown. Express orders shipped delivery charges collect. All prices F. O. B. Benton Harbor, Mich. A 20% deposit is required on all C.O.D. orders. Prices subject to change without notice. Dealer and export prices slightly higher.

ITEM	MODEL NO.	PRICE

Free Catalog!

Send in today for your free 100-page catalog. Over 250 kits (more than 40 are new) in this most complete catalog of kits. Every piece is top quality . . . save up to 50%. Get a catalog now and receive 1962 Heathkit supplements.

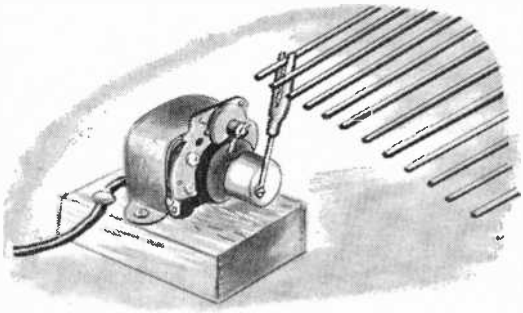
This Christmas Give a Heathgift . . . from the World's Shopping Center for Electronic Kits

Carl and Jerry

(*Continued from page* 87)

enough of these damped waves, Carl; let's send some c.w."

CARL WAS ALREADY placing a small synchronous motor driving a speed-reducing gear train beneath the end of the wave machine. A little drive rod was connected between the rim of the slowest-moving gear and the end rod of the wave machine. When the motor was turned on, this rod was moved up and down at a constant rate of about two complete up-and-down movements per second. After a few seconds the transients died out and the waving ends of the rods settled into a definite pattern of regularly spaced, smoothly varying intervals of maximum and minimum movement.



"That's a pretty picture of a standing wave," Carl said admiringly. "The quiet rods represent nodes of the standing wave and the ones moving the most represent loops. While the pattern of the standing wave *does* stand still, it's actually produced by the interaction of two traveling waves—one going down the machine from our continuous-wave generator, the other coming back after being totally reflected from the unterminated opposite end.

"These two waves combine by adding their energy algebraically," he went on. "When one is trying to raise the end of a rod while the other is trying to push it down, they cancel each other and we have a node. A quarter of a wavelength away—nodes are a half wavelength apart—the two waves work together to produce a maximum movement of the rods. Notice that the first node is a quarter of a wavelength away from the far end of the machine. Now watch what happens when I clamp that end rod firmly so it can't move."

As he did so, the pattern changed on the machine. Now a node appeared at the clamped rod, and a loop appeared a quarter of a wavelength away. The whole pattern shifted endways to accommodate this change and still retain its regular spacing.

"Hey!" Tex exclaimed, "that's exactly what happens in a coax line when you change from a short-circuited to an open-circuited condition. But if you terminate the coax in a resistor equal to its characteristic impedance, you get rid of the standing waves. It's too bad we can't hook a resistor across the far end of that machine and see what happens."

"But we can!" Jerry declared as he took still another piece of apparatus out of the drawer. It consisted of a stiff wire soldered vertically to the center of a thin metal disc. This disc was lowered into a can of water, and the rod was clipped to the last rod of the machine.

"This dash pot arrangement represents mechanical resistance," Jerry explained. "By connecting it to the rod at different distances from the spine, we can change the impedance match between it and the machine in the same way changing the length of the gamma rod on a beam antenna alters the impedance the antenna presents to the coax feeder."

He disconnected the motor and sent a single wave down the machine. A small reflected wave came back. He changed the position of the dash pot clip and tried again. The reflected wave was smaller. Finally he found a position for the clip where no reflected wave could be seen. Now when the motor was connected and started, waves could be seen marching down the machine and disappearing at the far end. All their energy was being absorbed by the dash pot. No standing waves were present.

"I'll be doggoned!" Tex exclaimed. "That little old section of picket fence certainly lets me see clearly some things I've tried to picture in my mind for a long time. Can you do anything else with it?"

"Oh, you can perform lots more ex-

periments with a wave machine," Jerry answered. "You can see what happens when you have an abrupt change in impedance in a line, and you can make a mechanical impedance-matching transformer that will cancel this effect. You can study the relation between wave energy and wave amplitude. You can prove to yourself that the speed of waves in an elastic medium is independent of amplitude. But I'm afraid that will have to wait for another evening. I don't like to be a party-pooper, but Carl and I have to spend two or three hours on graphics before we turn out the lights tonight, and I've the feeling we'd better have at it."

The fellows got to their feet and filed out of the room. Jack stopped in the doorway to say, "Thanks a lot, fellows. I must have rocks in my head, but I actually enjoyed your Bell Bull Session. I'm coming back again to ask that quivering Ouija board of yours some more questions about wave behavior."

CARL AND JERRY quickly cleared away the equipment, and then both boys seated themselves at their respective desks and prepared to study.

"You know I believe the guys really *did* enjoy our little show," Carl said over his shoulder. "I'm glad but a bit surprised. That was dangerously close to studying."

"I think really learning something for sure is pleasurable," Jerry spoke slowly as he opened his book. "It's half-learning that leaves you full of questions and doubts and breaks your back. When you master an idea, when your mind completely wraps itself around the subject and understands it perfectly, all sense of work and effort disappears in a feeling of power and accomplishment.

"Personally, I get a real blast out of knowing that radio and light waves traveling 186,000 miles a second and sound waves traveling a little better than a 1000 feet a second are blood brothers to those waves moving up and down our wave machine. There is something so beautifully simple and *right* about the whole thing."

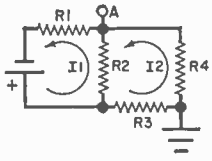
"I feel the same way," Carl agreed as he turned on his desk lamp. —30—

VOLTAGE QUIZ ANSWERS

(*Quiz appears on page* 69)

In each problem, the schematic diagram shown on page 69 must be redrawn for the sake of clarity. The solution to the problem should then become apparent. Remember that each resistor is six ohms.

1 Kirchhoff's law states that the algebraic sum of the products of the current and resistance in any closed path in a network is equal to the voltages connected in the same path. Setting up two simultaneous equations, we solve for current I_2, then determine the voltage drop across $R4$ which is voltage A:



(1) $6 = 6I_1 + 6(I_1 - I_2)$

(2) $0 = 6(I_2 - I_1) + 12I_2$

Now separate variables I_1 and I_2:

(1) $6 = 12I_1 - 6I_2$

(2) $0 = -6I_1 + 18I_2$

Divide equation (1) by 2 and add equations (1) and (2):

$3 = 15I_2$

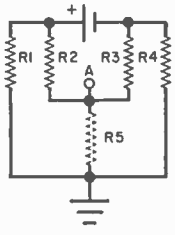
$I_2 = 0.2$ ampere

Now solve for voltage A:

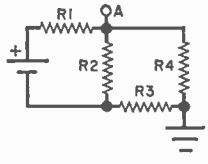
$E_a = R4 \times -I_2$

$E_a = 6 \times -0.2 = -1.2$ volts

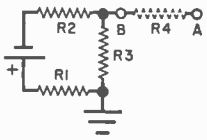
2 The symmetry of the redrawn circuit suggests that voltage A is at ground potential (or 0 volt). Remove $R5$ from the circuit and note that currents flowing through resistor branches $R1$-$R4$ and $R2$-$R3$ are equal. Hence, the voltages at the midpoint of both branches are equal or point A is at ground potential. Now insert $R5$ (which could be any value from zero ohm to infinity). Since point A is at ground potential, no current will flow through $R5$. This can be proved using Kirchhoff's law and setting up three simultaneous equations.



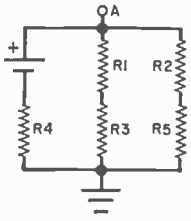
3 The redrawn version of the schematic is identical to the one shown above in Answer 1 except that the battery is connected backwards. So, voltage A is the same as in Answer 1 except for a change in sign, or +1.2 volts.



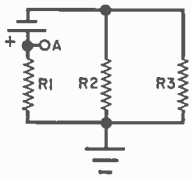
4 Redrawn, the circuit is simplicity itself. It is easy to determine the current flowing through the loop consisting of the battery, $R1$, $R2$ and $R3$ (⅓ ampere). The voltage at point B is determined by the IR drop across $R3$ (−2 volts). Since no current flows through resistor $R4$ to point A, both point A and point B are at the same potential: −2 volts.



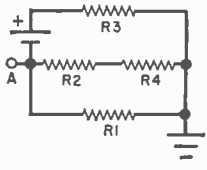
5 A glance at the redrawn circuit suggests that resistors $R1$, $R2$, $R3$ and $R5$ be combined mathematically into one resistor (found to be 6 ohms) and, resorting to Ohm's law, the voltage at point A is +3 volts.

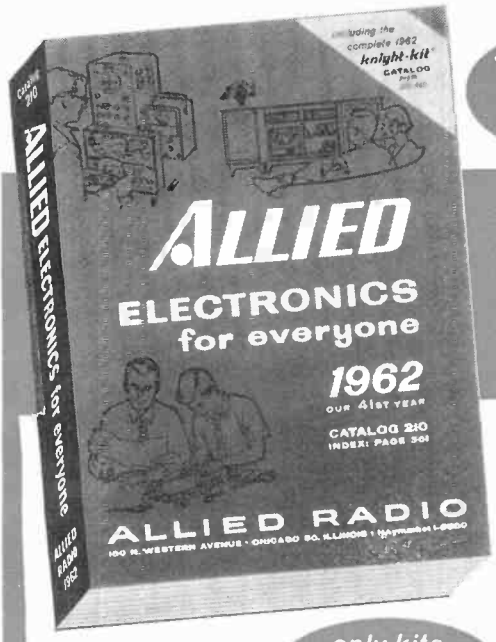


6 The original schematic, impressively complicated in appearance, becomes straightforward when redrawn as above. It is simply a problem of combining resistors $R2$ and $R3$ mathematically and computing current flow. Once done, the voltage drop across $R1$ is computed to be +2 volts.



7 Here again it is wise to combine resistors $R1$, $R2$ and $R4$ mathematically into one resistor and then resort to Ohm's law. The current through $R3$ is six-tenths of an ampere. Thus, we find that the voltage drop across the $R1$, $R2$ and $R4$ resistor combination is +2.4 volts.





Free ALLIED 1962 CATALOG

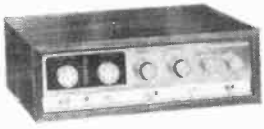
includes complete catalog featuring over 90 exciting

knight-kits

A PRODUCT OF ALLIED RADIO

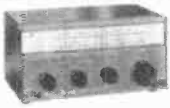
New! Original! Only from Allied!

AMAZING 100-in-1 Electronic Science Lab Kit, an open door to the exciting world of electronics; absolutely unique.....$29.95



ALL-TRANSISTOR 50-Watt Stereo Hi-Fi Amplifier Kit—a revelation in sound performance, less case.....$79.95

only kits of their kind!



ALL-TRANSISTOR 2-Band AM-Shortwave DX-er Radio Receiver Kit.....$19.95

SENSATIONAL PHONE & CW 60-Watt Ham Transmitter Kit for only...$49.95

STEREO TAPE Record-Playback Preamplifier Kit, with professional features, less case.....$89.95

MULTIPLEX Self-Powered Adapter Kit, for Stereo FM reception. A tremendous value at.....$19.95

simply great for '62!

TRANSISTORIZED Electronic Tachometer Kit.....$24.95

ALL-TRANSISTOR Wireless Intercom System Kit (2 units).....$45.90

DELUXE STEREO FM-AM Tuner Kit with latest built-in MULTIPLEX Stereo FM; case included.....$99.95

ALL-IN-ONE FM-AM Tuner-Amplifier with latest built-in MULTIPLEX Stereo FM, less case.....$129.95

building a Knight-Kit is the most satisfying do-it-yourself experience in the world!

5 BIG REASONS WHY:

- Convenience Designed
- Wonderful to Build
- You Own the Best
- You Save So Much
- Easiest to Buy—NO MONEY DOWN!

MONEY BACK GUARANTEE: Buy any Knight-Kit. Build it! Use it! You must be satisfied or you get your money back!

see more than **90** KNIGHT-KITS
HI-FI • HOBBY • AMATEUR • INSTRUMENT

ALLIED RADIO

Send for it today!

KNIGHT-KITS are also available in Canada

- World's Largest Stocks • Lowest Money-Saving Prices
- Fastest Shipment • Expert Help • Easiest-Pay Terms
- Satisfaction Guaranteed or Your Money Back

send for the world's biggest electronics catalog!

Free

ALLIED RADIO, Dept. 228-M1
100 N. Western Ave., Chicago 80, Ill.

☐ Send FREE 1962 ALLIED 444-page Catalog

Name _____
PLEASE PRINT

Address _____

City _____ Zone ____ State _____

Ultrasonics

(*Continued from page* 46)

at New York's Mt. Sinai Hospital shot ultra-sound into the hand. The scar tissue softened within weeks, and the hand became useful for the first time since her childhood.

An ultrasonic dentist's drill has been tested in the Air Force, and patients report less pain than with conventional drills. Some types of brain surgery—using powerful, tightly focused beams of ultra-sound to destroy pinpoint areas deep within the brain—have also been successful.

One novel use: a slim ultrasonic transducer has been installed in a catheter—a tube that can be inserted deep into our bodies. The transducer is guided until it nudges a gall or kidney stone, then turned on. Like an ultrasonic drill, the minute but fierce ultrasonic pounding painlessly batters the stone to powder so that it can be eliminated with normal body wastes. Up to this time, such stones had to be removed by surgery.

Other Successes. While accounts of current accomplishments of ultrasonics continue to mount, scientists find new applications almost daily. Among recent ones:

● Experiments show that one of the oldest problems of the sea—barnacles on ship bottoms—may be solved by ultrasonics. Give the hull a continuous low-power dose of ultrasonics, and the barnacles find it too uncomfortable to settle down.

● Finer grain films have been made by subjecting the liquid emulsions to a shot of ultra-sound before they harden. The sound breaks the particles of silver halides into even tinier particles. Sharper, clearer pictures are the result.

● One company has perfected a way of using powerful beams of ultrasonic sound to sterilize foods after packaging, doing away with the need for heat or other conventional preserving techniques.

So numerous are the applications of ultrasonics that it's anybody's guess as to what's next. But you can be sure of one thing: even the sky is no limit for the magic of silent sound! —30—

Analog Computers

(*Continued from page* 68)

lems can be performed. The similarity of the dials found in each kit can be seen in Fig. 8.

The Edmund dials include a linear scale plus logarithmic and trigonometric scales, whereas the General Electric dials have in addition "squared" and reciprocal scales. Instruction manuals provided

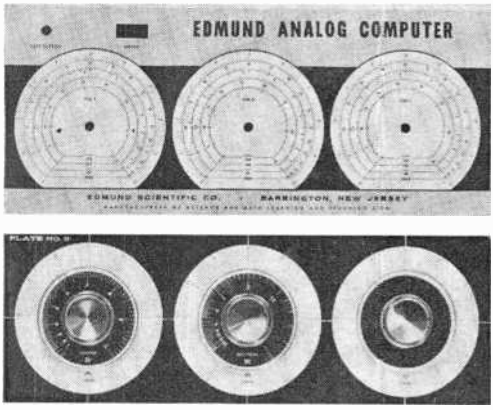


Fig. 8. Dials on Edmund Analog Computer have four scales each, while G.E.'s kit has more but uncluttters scales by using removable dial scale plates.

with both kits give detailed instructions on how to use these dials to solve many typical problems closely related to electrical technology and science.

A Fraction of the Field. The "ground floor" introduction to analog computers which you have just read naturally covers but a very small fraction of the total analog computer field. Besides potentiometers, meters, and switches, manufacturers of analog computers also use synchros, two and three-dimensional cams, linkages, gears, and complex electronic circuits to perform the countless specialized functions the human mind may require of a machine.

If you find the subject of analog computers interesting and this ground floor introduction just whets your appetite, you might want to visit your public or school library. Each day, more and more books on this timely subject are being placed on library shelves. Look for them, and be kind to that gent who beat you there—he may be the author of this article! -30-

Across the Ham Bands

(*Continued from page 75*)

don't have the accurate signal generator required to do the job, perhaps you can enlist the aid of a ham who does. Failing in that, your transmitting crystals can be used to spot-check the receiver calibration. With the latter method, though, you can't be sure of the exact band limits—so it's best to stay away from them when using the VFO.

After the VFO is calibrated, turn on the transmitter's final and tune up the rig at about 14,200 kc. (using the 40-meter position of switch *S1* on the VFO). Then adjust the slug in coil *L3* for maximum transmitter output.

Operation. On 80, 40, and 20 meters, your transmitter should work just the same with VFO control as with the crystal. On 10 and 15 meters, however, the VFO output may be a bit low for maximum transmitter output. *A gentle reminder*: a Novice license does *not* authorize VFO operation.

News and Views

Don Kuykendall, KN5KYG, 1019 Usher St., Ft. Worth 16, Texas, has been applying his educated fist to his key for two months. Twenty-four states—17 confirmed—and Cuba are in his logbook. Forty meters is the band, a Heathkit AT-1 is the transmitter, and a Hallicrafters SX-28 is the receiver. . . . **Stanley E. Goff, KN8BDH,** 624 Summerlee Ave., Oak Hill, W. Va., modestly forgot to tell us how many states he has worked. But he worked them with a home-brew transmitter running 38 watts. Either a Hallicrafters S-53 or a "surplus" BC-454 receiver transfers incoming signals from the antenna to the loudspeaker. . . . **Stan Jaffin, WV2SUY/WA2SUY,** 69-30 198th St., Flushing 65, N. Y., constantly amazes the 2-meter gang in the New York City-Long Island area with the signal his modified Heathkit "Two-er" puts out. No doubt his 10-element Hy-Gain beam antenna helps bend the S-meters. Stan receives on a Hammarlund HQ-140 tickled by an AMECO Nuvistor 2-meter converter. If all goes well, Stan's home-brew 100-watter soon will be carrying WV2SUY/WA2SUY's message even farther.

Winston Jones, KN4CWQ, 125 King St., Appalachia, Va., runs 50 watts to a home-built 1625 transmitter, constructed with the help of W4ZXT. Fifteen states worked on 40 meters his first week on the air prove that the transmitter is operating. A Heathkit AR-3 does the receiving. . . . **Jack O'Connor, KN9BLW,** 1716 Washington St., Manitowoc, Wis., pours 60 watts into his home-brew transmitter on 40 meters. Jack's 28-state total is especially interesting; 26 of the states

were worked on an 8′ center-loaded Master mobile whip. While not as effective as the dipole he now has, the whip antenna obviously got out. Jack receives on a Hallicrafters S-40A helped along with a Heathkit QF-1 Q-Multiplier.

Neal McEwen, K5ZJP, Hurst, Texas, worked 33 states as a Novice and has added 13 more as a General. A Sonar SRT-120 transmitter and a Hallicrafters SX-110 receiver share time on a Mosley V-4-6 vertical antenna. Of interest to other owners of 2-dial ham receivers (like the SX-110) who lack 100-kc. crystal calibrators will be Neal's old-but-good method of putting the receiver's bandspread dial on calibration. After setting the bandspread dial to the frequency of one of his transmitter crystals, he carefully adjusts the receiver's main tuning dial until he hears the transmitter oscillator in the receiver. Presto! The bandspread dial's calibration is on the nose for that band. . . . Hear about the $1400 code practice oscillator? **John, K9QJF**—who is a music teacher—reports that the father of one of his students is teaching the lad the code on a Hammond organ! Wonder which he practices the most—his music or the code?

How about *your* "News and Views," pictures, and suggestions for construction projects for next month? Send all mail to Herb S. Brier, W9EGQ, POPULAR ELECTRONICS, P. O. Box 678, Gary, Indiana. Merry Christmas to all! 73,

Herb, W9EGQ

Short-Wave Report

(*Continued from page* 81)

The following is a resume of current reports. At time of compilation all reports are as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. Please send all reports to P. O. Box 254, Haddonfield, N. J., in time to reach us by the eighth of each month, and be sure to sign your WPE call letters. All times shown are Eastern Standard and the 24-hour system is used.

Algeria—*R. Alger,* 9686 kc., is noted at 0200-0230 with Arabic program of native vocals, instrumentals, talk, and more music; abrupt s/off at 0231. *(WPEØAE)*

Austria—OEI41, Vienna, 9540 kc., is heard well at 1900-2053 with experimental broadcasts of music, apparently beamed to N. A. Another, lower-powered xmtr comes on at 2055 and continues with music. This is dual to 15,255 kc. *(WPE4BC, WPE4FI, Ed.)*

Belgium—New frequencies for Brussels to N.A. include 9725 kc. (replacing 15,335 kc.) at 1615-1800 and 9705 kc. (replacing 11,805 kc.) at 1815-2000. The latter may have QRM from ZYZ24, Brazil. The DX program is still aired on Saturdays at 1930. *(WPE1AZL, WPE2FRK, WPE2FUD, WPE3BWM, WPE3BZK, WPE4FI, WPE5AVN, WPE8BBL, WPE8CUS)*

Bermuda—DX'ers needing this country

should try for medium-wave outlet ZBM, Hamilton, 1235 kc.; it is noted at times in eastern areas from 2230 to 0005 s/off. Another outlet is ZFD76, St. Georges, 16,132.5 kc. This one can be heard during early evenings with a test recording, and the QSL is a beautiful color photograph of St. Georges. According to QSL information, the xmtr is rated at 3000 watts, the antenna is a rhombic type, and emission is double sideband. *(WPE1BDB, WPE3CHJ, WPE4DMX)*

Bolivia—*R. Cobija*, Cobija, 4483 kc., has moved from 4497 kc. It is heard weakly with a request program at 2029 in Spanish. S/off time is now 2107. *R. El Condor*, CP15, 6125 kc., La Paz, is tuned from 2220 to 2340 s/off in Spanish; North American DX'ers will have a rough time logging this one for it is barely audible in Brazil! *(PY2PE1C)*

Chile—*R. El Morro*, Arica, 6130 kc., was noted with commercials around 2245; some music was heard at times; s/off at 2300; all-Spanish. *(PY2PE1C)*

R. Soc. Nacional de Agricultura, Santiago, has been noted on 12,000 kc. at 2130-2300 with news, music, and many ID's; all-Spanish. *(WPE4DMX)*

Congo—Leopoldville was noted on a new frequency of 15,248 kc. and heard well at 1400-1600 (Sundays to 1800) with Home Service relay. *(WPE4FI)*

Cuba—Havana has moved down to 15,300 kc. where it has been noted at 1200-1400 in Spanish, Eng., and French, with about 40 minutes of each. *(WPE2FGX, WPE4BC)*

Denmark—Copenhagen operates on 9520 kc. to N.A. at 2030-2130 and 2200-2300 and on 15,165 kc. to S. America at 1730-1830; to the Far East at 0400-0500; to S. Asia at 0930-1030; and to Africa at 1140-1240. They relay the Home Service at 1240-1615, also on 15,165 kc. *(WPE1AZL, WPE1BDB, WPE3BIK)*

England—London's new schedule to North, South, and Central America, S. E. Asia, India, Pakistan, and Ceylon is as follows: *Special Services* to Canada and USA at 0930-1200 on 17,810 kc. (from 1100 on 15,310 kc.) and to the Caribbean at 1715-1745 on 15,140, 15,070, 12,040, and 11,750 kc.; *Portuguese* to Brazil at 1800-1915 on 11,820 kc. (also to the area south of the Amazon on 15,260 kc.); *Spanish* to S. America (south of the Amazon, excluding Peru) at 1915-2115 on 15,260 and 11,820 kc., and to Central America, South Caribbean areas, and S. America (north of the Amazon, including Peru) at 2015-2115 on 11,820 kc. (to 2215 on 9600 kc., 2115-2215 on 6110 kc.); to Mexico at 2015-2115 on 9600 kc. (to 2215 on 6050 kc.); *General Overseas Service* to S. E. Asia, India, Pakistan, and Ceylon at 1800-1815 and 2045-2115 on 9510 and 7110 kc. and at 1900-1930 on 9690 and 7110 kc.; to Canada, USA, and Mexico at 1615-1715 on 15,375 kc. (to 1915 on 11,780 kc.), at 1630-1930 on 12,095 kc., at 1715-2115 on 9510 kc., and at 1915-2200 on 6195 kc.; to the West Indies, Central America, and S. America (north of the Amazon, including Peru) at 1500-1715 on 17,870 kc. (from 1615 on 15,070 kc., from 1700 on 15,140 and 12,040 kc.), at 1745-1845 on

15,070 kc. (to 2115 on 12,040 and 11,750 kc.) and at 1800-2200 on 9580 kc.; to S. America (south of the Amazon, excluding Peru) at 1500-1745 on 17,740 kc. (to 2115 on 15,110 kc.), at 1800-2200 on 12,040 kc., and at 1845-2200 on 9510 kc.; to South Georgia at 1715-1930 on 11,860 kc. *(WPE3NB, WPE9DN)*

Ethiopia—*Radio Voice of the Gospel,* P. O. Box 654, Addis Ababa, has begun operations with a 1000-watt xmtr using rhombic antennas beamed north-south and east-west. While the new schedule is subject to change upon receipt of new xmtrs from Switzerland in 1962, the present schedule reads: 0800-1000 on 15,315 kc. to S. India and Indonesia; 1000-1100 on 9540 kc. to the Middle East; 1100-1200 on 9740 kc. to Tanganyika, S. Africa, and Madagascar; 1300-1400 on 11,970 kc. to the Middle East; 1400-1500 on 6140 kc. to Ethiopia; and 1500-1600 on 11,880 kc. to W. Africa. Future plans call for broadcasts in 27 languages. *(VE1PE3L, Sweden Calling DX'ers)*

SHORT-WAVE ABBREVIATIONS

B/C—Broadcasting	QRM—Station interference
Eng.—English	QSL—Verification, verify
ID—Identification	R.—Radio
kc.—Kilocycles	s/off—Sign-off
kw.—Kilowatts	VOA—Voice of America
L.A.—Latin America	xmsn—Transmission
N.A.—North America	xmtr—Transmitter

Finland—Pori, 15,190 kc., has rescheduled the N.A. xmsn at 0630-0900, replacing the afternoon time used during the summer. *(WPE4FI)*

Germany—Here is the new and complete schedule for *Deutsche Welle,* Cologne. *Main Program:* 0145-0445 on 21,650, 15,275, 11,795 kc. to Far East; 0445-0745 on 21,705 and 17,815 kc. to Japan; 0745-1045 on 21,730 and 17,875 kc. to Middle East; 1100-1400 on 15,405 and 11,795 kc. to Near East; 1215-1515 on 15,275 and 11,715 kc. to Africa; 1415-1715 on 11,925 and 9605 kc. to West Africa; 1730-2030 on 11,945 and 9735 kc. to South America; 1900-2200 on 9640 and 6100 kc. to Eastern N.A.; 2045-2345 on 9735 and 6145 kc. to Central America; 2200-0100 on 9640 and 6100 kc. to Western N.A. *Second Program:* 0500-0630 on 21,650, 17,845, and 15,405 kc. to Far East; 0300-0430 on 21,735 and 17,815 kc. to Japan; 0845-1015 on 17,815 and 15,275 kc. to Near East; 1030-1200 on 17,815 and 15.275 kc. to Africa; 1230-1400 on 15,285 and 11,905 kc. to West Africa; 1530-1700 on 15,405 and 11,795 kc. to South America; 1515-1845 on 11,795 and 9605 kc. to Eastern N.A.; 1900-2030 on 9605 and 6145 kc. to Central America; 0000-0130 on 9735 and 6145 kc. to Western N.A. *(WPE2BDQ, WPE2DPR, WPE4BWM, WPE4FI, WPE5AUU, WPE6BZM, WPE7YB, WPE8DNJ, WPE8MS, WPE9DFK, WPE9DHN, WPE9DN, WPEØBTN)*

Guatemala—TGHC, *R. Universal,* Guatemala City, 6140 kc., is a rarely reported station. Try for it around 0010-0045; pop and marimba music. *(WPE2FGX)*

Station TGQA, 6110 kc., and TGQB, 11,700 kc., both operate at 0755-2300 (Sundays at

1255-2100). Reports go to *R. Nacional,* Quezaltenango. They verify with a blue-and-white pennant that has the station call-sign on it. *(SM)*

After a five-year absence, TGWA, Guatemala City, is back on 9760 kc. at 1900-2300 with marimba music and announcements in Spanish. *(WPE4BC, WPE4FI)*

India—The Hindi Service, originally thought to be for the West Indies, is actually for the Fiji Islands and is aired at 0200-0300 on 21,700 and 17,705 kc. *(WPE8MS)*

Ireland—E. J. Roth, Director of *R. Eireann,* advises that the Irish Army—and not *R. Eireann*—is presently broadcasting to the Congo for Irish Troops on 17,544 kc. at 1100-1110, 1130-1140, 1200-1210, 1230-1240, and 1255-1300. Reports go to Lt. Col. M. Pure, c/o C Barracks, Curragh Training Camp, Dublin. *(WPE8CUS. WPE8MS)*

Israel—SWL's who like to tune off-beat channels might try for 4XA73 on 13,720 kc. Operated by the Posts, Telephone, Telegraph & Radio Administration, this station is noted irregularly with a test transmission tape. The power is 20 kw., the antenna a rhombic one. Reports go to M. E. Berman, Director of Engineering Services (Radio), 37 Yahuda Hayamit Street, Tel Aviv/Yafo, Israel; QSL

SHORT-WAVE CONTRIBUTORS

Stephen Ray *(WPE1AZL)*, Stoneham, Mass.
Robert Anderson *(WPE1BDB)*, New Britain, Conn.
William Gehan *(WPE1CWT)*, Bangor, Maine
Neil Foster *(WPE2BDQ)*, Brooklyn, N. Y.
Frederick Jennings *(WPE2DPR)*, Bronx, N. Y.
David Listort *(WPE2FGX)*, Elmont, N. Y.
Henry Marbach *(WPE2FHU)*, White Plains, N. Y.
David R. Markus *(WPE2FMR)*, Depew, N. Y.
Howard Sinberg *(WPE2FRK)*, New York, N. Y.
Henry Moore *(WPE2FUD)*, Bronx, N. Y.
Richard Reynolds *(WPE2FVF)*, Livingston, N. J.
Charles Craft *(WPE3BIK)*, Lansdale, Pa.
T/Sgt. Dorsey Wood *(WPE3BWM)*, Washington, D. C.
Robert Reinecker *(WPE3BZK)*, Chester, Pa.
James Pieklo *(WPE3CHJ)*, Conshohocken, Pa.
John Wilson *(WPE3NB)*, Wilmington, Del.
Grady Ferguson *(WPE4BC)*, Charlotte, N. C.
Mike Vanacore *(WPE4BWM)*, Tampa, Fla.
Sim Broadfield *(WPE4CCO)*, Rocky Mount, N. C.
David Pope *(WPE4DMX)*, Crescent Beach, S. C.
Roger Legge *(WPE4FI)*, McLean, Va.
Johnnie Adams *(WPE5AFU)*, El Dorado, Ark.
John Frazier *(WPE5AUU)*, Tyler, Texas
Chilton Goodale *(WPE5AVN)*, Cleburne, Texas
Matt Collins *(WPE6BZM)*, Los Angeles, Calif.
Bill Lund *(WPE6CJ)*, Manhattan Beach, Calif.
Bud Slovinski *(WPE6CKV)*, Santa Monica, Calif.
DX Unlimited Club (WPE7YB), Seattle, Wash.
Robert Kipp *(WPE8BBL)*, Detroit, Mich.
Tim Daum *(WPE8CUS)*, Portsmouth, Ohio
John Mathews *(WPE8DNJ)*, Kenton, Ohio
Dan Wilt *(WPE8HF/6)*, Inglewood, Calif.
Mike Kander *(WPE8MIS)*, Dayton, Ohio
Thomas Farr *(WPE9DFK)*, Villa Park, Ill.
Ray Komejda *(WPE9DHN)*, Niles, Ill.
J. P. Arendt *(WPE9DN)*, Aurora, Ill.
John Beaver, Sr. *(WPEØAE)*, Pueblo, Colo.
Terrance Colgan *(WPEØAQW)*, Atchison, Kansas
Scott Zucker *(WPEØBTN)*, University City, Mo.
George Buchanan *(WPEØVB)*, Webster Groves, Mo.
Giacomo Perolo *(PY2PE1C)*, Bauru, Brazil
Gregg A. Calkin *(VE1PE3L)*, Saint John. N. B.
Edward Graff *(VE2PE1AB)*, Montreal, Quebec
Halid Carim *(VE3PE1LA)*, Ottawa, Ontario
Jorge Faccini *(JF)*, Maracaibo, Venezuela
Samuel Marsh *(SM)*, Baltimore, Md.
Shortwave Messenger, San Diego, Calif.
Sweden Calling DX'ers, Radio Sweden, Stockholm, Sweden

BUILD 20 RADIO CIRCUITS AT HOME

with the New

PROGRESSIVE RADIO "EDU-KIT"®

A Practical Home Radio Course

ONLY $26.95

Reg. U. S. Pat. Off.

Training Electronics Technicians Since 1946

Now Includes

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

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ SCHOOL INQUIRIES INVITED
- ★ Sold in 79 Countries

YOU DON'T HAVE TO SPEND
HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solder in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

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 code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 20 Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $26.95. The Signal Tracer alone is worth more than the 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 Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the 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 will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are twenty Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector circuits. These are not unprofessional "breadboard" circuits, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instruction necessary to build 20 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, instruction Manuals, hook-up wire, solder, selenium rectifiers, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

FREE EXTRAS

• SET OF TOOLS

- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- ALIGNMENT TOOL
- WRENCH SET
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble 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 charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

FROM OUR MAIL BAG

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

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

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Trouble-shooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

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

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

UNCONDITIONAL MONEY-BACK GUARANTEE

ORDER DIRECT FROM AD—RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS WORTH $7

☐ Send "Edu-Kit" postpaid. I enclose full payment of $26.95.
☐ Send "Edu-Kit" C.O.D. I will pay $26.95 plus postage.
☐ Rush me FREE descriptive literature concerning "Edu-Kit."

Name .....

Address .....

.....

PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 587-D, Hewlett, N. Y.

by letter, and don't forget to include return postage! *(WPE5AFU)*

Jamaica—This is another country with no s.w. outlet. Try the medium waves for Galina on 750 kc. at 2100-0000, or Montego Bay, 700 kc., at 2100-0000. These two stations are dual for the most part, with music and news. *(WPE4DMX)*

Monaco—*Trans-World Radio,* Monte Carlo, has been noted on 11,710 kc. at 1105 with an Eng. ID, then into native language. According to their latest schedule, Eng. is given at 0130-0200 and 1400-1510 daily on 7185 kc. *(WPE4BC, WPE8MS)*

Peru—*R. Mineria del Peru,* a new station, is noted on 6204 kc., all-Spanish, with closing from 0000 to 0015 (later on Saturdays.) Location is unknown; the call may be OAX4U, dual to medium wave outlet OAX4E. They have a request program, with time checks, at 2300. *(PY2PE1C)*

Portugal—Lisbon operates at 1645-1845 on 12,080 kc. and at 1315-1430 on 6025 kc., both channels being new frequencies, the latter in parallel with 17,895 and 15,380 kc. and in English. The S.E. Asia xmsn in Eng. can be tuned at 0815-0900 on 21,495 kc. *(WPE2FHU, WPE2FMR, WPE2FYF, WPE4BWM, WPE4FI, WPE6CKV, VE2PE1AB)*

Sudan—Omdurman was heard at 0000 on 9600 kc. in the Home Service with Arabic music, talks, and news. The ID is *Huna Omdurman. (WPEØAQW)*

Sweden—Horby is operating at 2000-2115 and 2130-2245 with N.A. broadcasts on 9725 kc., replacing 11,805 kc. *(WPE1CWT, WPE4FI, WPE6BZM, VE3PE1LA)*

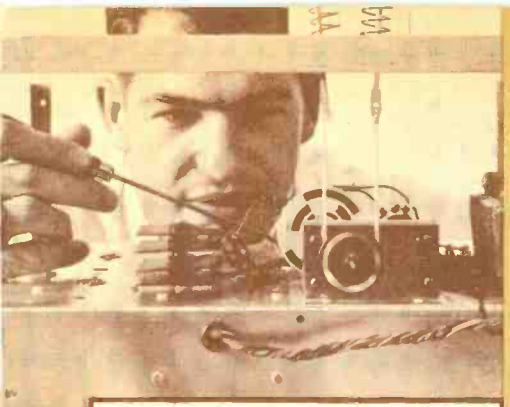
Thailand—According to the *World Radio Handbook* and *Radio Australia*'s DX program, there is a new station in Thailand with the ID *This is Experimental Station SEATO.* Operating on 6315 kc., the station broadcasts in Eng. and Thai until 1005 s/off. *(WPE6CJ, WPE8HF)*

Tunisia—*R. Tunis* is noted on 9635 kc. at 1600-1620 and 2100-2300 in Eng. and around 1720 with Arabic chanting. *(WPE2FGX, WPE4CCO, WPEØVB)*

United States—A new short-wave station in Puerto Rico is under construction with operation slated to commence late in 1961. Other details are lacking. *(Shortwave Messenger)*

If agreements are reached, the *Voice of America* plans to build a powerful station in Sardinia, and a second one in Turkey. The seaborne station "Courier" will be set ashore in Rhodes. New stations will also be set up in Greece and Cyprus. In December, 1962, the new station in Monrovia, Liberia, will go on the air, and at the same time the Greenville (N. C.) station will begin operations to Latin America. Surveys for a Far East broadcasting center have been made in Australia, Philippines, and Christmas Island. *(Sweden Calling DXers)*

Venezuela—*Radio Clube Venezolano,* Seccional Zulia, Maracaibo, is broadcasting a program over *Radio Popular* (YVMG, 4810 kc., and YVMZ, 9530 kc.) Sundays at 2000. All reports are welcomed and will be verified. Reports go to the address above, c/o Apartado 1019. *(JF)* —30—



Special Training
EQUIPMENT INCLUDED

Pick the field of your choice—and train at home with the leader—NRI. In addition to Industrial Electronics and FCC License training explained at the right, NRI offers comprehensive courses in Radio-TV Servicing and Radio-TV Communications. Except for the FCC course, all NRI courses include—*at no extra cost*—special training equipment for actual practice at home building circuits and working experiments. Makes theory you learn come to life in an interesting, easy-to-grasp manner.

Multiplexing, FM Stereo Broadcasting Included

NRI training keeps up with the times. New, additional profit opportunities exist for the Technician who understands the latest technical advances. Course material now covers FM Stereo Broadcasting, tells you about Multiplexing equipment, other recent developments.

Learn More to Earn More

Act now. The catalog NRI sends you gives more facts about the field of your choice, shows equipment you get and keep. No obligation. Cost of NRI training is low. Monthly payments. 60-Day Trial Plan. Mail postage-free card today. **NATIONAL RADIO INSTITUTE, Washington 16, D.C.**

Send for 64-Page CATALOG FREE

The Amazing Field of Electronics

NRI-Oldest and Largest Radio Television School Now Offers
NEW HOME STUDY TRAINING IN INDUSTRIAL & MILITARY ELECTRONICS

This is the age of Electronics. Rapidly expanding uses for Electronic Equipment in industry, business, the military demand more trained men. Prepare now for a career as an Electronic Technician. NRI now offers a complete course in ELECTRONICS—Principles, Practices, Maintenance. Computers, telemetry, automation, avionics are changing our world, yet all employ the same basic principles . . . and that is what this NRI course stresses with illustrated lessons, special training equipment. Mail card below.

NEW HOME STUDY TRAINING FOR YOUR FCC LICENSE

An FCC Commercial License combined with NRI time-tested training can be the keys to a better future for you with higher pay, interesting work, more rapid advancement. Prepare at home *quickly* for your FCC examinations through NRI's new, low-cost, special training. Like other NRI-trained men, you can be monitoring TV shows, radio broadcasts, operating shipboard and aviation radio, or holding down other important jobs. Get full details—mail the card below.

TURN PAGE

Cut Out and Mail—No Stamp Needed

NRI **NATIONAL RADIO INSTITUTE**
WASHINGTON 16, D. C.

Send me your Electronic, Radio-TV catalog without cost or obligation. I am interested in the course checked below: (No representative will call. Please PRINT.)

☐ Industrial Electronics ☐ Communications
☐ FCC License ☐ Servicing

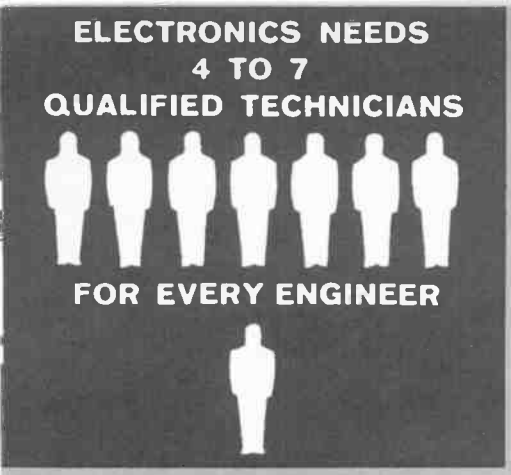
9

Name_____ Age_____

Address_____

City_____ Zone_____ State_____

ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL



Join The Thousands Who Trained For Advancement With NRI

Thousands of NRI graduates throughout the U. S. and Canada are proof that it is practical to train at home. NRI graduates are in every kind of Electronics work: inspectors, maintenance men, lab technicians, testers, broadcasting and mobile communications operators, Radio-TV service technicians, or in essential military and government posts. Catalog tells more about what NRI graduates do and earn. Mail postage free card.

Choose from 4 Courses

1. INDUSTRIAL ELECTRONICS
Learn about Electronic equipment used today by business, industry, the military. Covers computers, servos, telemetry, multiplexing, other subjects.

2. FCC LICENSE
Communications stations must have FCC-licensed operators. New NRI course prepares you for your First Class FCC exams. Train at home in spare time.

3. COMMUNICATIONS
Operation and maintenance of radio and TV stations; police, marine, aviation, mobile radio, etc. Includes FM Stereo broadcasting. Course also prepares you for your FCC license exam.

4. SERVICING
Service and maintain AM-FM Radios, TV sets, Stereo Hi-Fi, PA systems, etc. A profitable, interesting spare or full-time business of your own.

SEE OTHER SIDE

"THE FINEST JOB I EVER HAD" is what Thomas Bilak, Jr., Cayuga, N. Y., says of his position with the G. E. Advanced Electronic Center at Cornell University. He writes, "Thanks to NRI, I have a job which I enjoy and which also pays well."

BUILDING ELECTRONIC CIRCUITS on specially-designed plug-in type chassis, is the work of Robert H. Laurens, Hammonton, N. J. He is an Electronic Technician working on the "Univac" computer. Laurens says, "My NRI training helped me to pass the test to obtain this position."

"I OWE MY SUCCESS TO NRI" says Cecil E. Wallace, Dallas, Texas. He holds a First Class FCC Radiotelephone License and works as a Recording Engineer with KRLD-TV.

MARINE RADIO OPERATOR is the job of E. P. Searcy, Jr., of New Orleans, La. He works for Alcoa Steamship Company, has also worked as a TV transmitter engineer. He says, "I can recommend NRI training very highly."

FROM FACTORY LABORER TO HIS OWN BUSINESS that rang up sales of $158,000 in one year. That's the success William F. Kline of Cincinnati, Ohio, has had since taking NRI training. "The course got me started on the road," he says.

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

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

POSTAGE WILL BE PAID BY

NRI **National Radio Institute**
3939 Wisconsin Avenue
Washington 16, D.C.

Oldest and Largest School of Its Kind

Training men to succeed by home study has been the National Radio Institute's *only* business for over 45 years. NRI is America's oldest and largest Electronics home-study school. Don't delay. Cut out and mail POSTAGE-FREE CARD.

MAIL POSTAGE-FREE CARD

(Continued from page 50)

voice comes clearly from the receiver's speaker.

A field strength meter is required to peak the transmitter to maximum output. If you don't have access to one of these gadgets, insert a 0-1 ma. milliammeter and crystal diode at the center of a 27-mc. dipole.

Tune *C1* for a maximum reading on the field strength meter. If this occurs when the capacitor plates are less than 50% meshed, *L1* is too large; remove a quarter turn at a time until maximum output is achieved with *C1* at approximately two-thirds of full capacity. If all of *C1*'s capacity is required, *L1* lacks sufficient inductance and it will be necessary to add a turn or two.

Vary the position of *L4* with respect to *L3*, again trying for the greatest field strength reading. If necessary, retune *C4* to bring *M1*'s reading back to 7 ma.

When you're satisfied that no further increase in field strength can be achieved, install the transmitter on a mast above the roof of your house, and locate the modulator and battery in a convenient operating spot. Standard TV "twin lead" makes a suitable interconnecting cable between the transmitter and modulator. As a precaution against lightning damage, ground the mast and apply an arrestor to the twin lead.

Reception. A transistorized superregenerative receiver will easily detect the transmitter's signal from at least a mile away. To obtain consistent results over greater distances, however, you will need a more sensitive receiver. Either a communications set of the type used by hams and advanced SWL's or the receiving portion of a CB transceiver will be satisfactory. A less expensive alternative is a CB converter placed ahead of a broadcast receiver.

It's also important to employ a good receiving antenna. Unless you can afford a 27-mc. beam, your best bet is a 17-foot horizontal wire, insulated at the center and connected to the receiver via 72-ohm twin-lead. Stretch the antenna between two tall trees and try to position it broadside to the direction of the sta-

Certificate of Examination

I have examined this low-power communications device and find that it will comply with Section 15.205 of the Rules and Regulations of the Federal Communications Commission, provided that the antenna is a single element not more than 5 feet long and provided that the d.c. potential applied to the companion modulator does not exceed 19.5 volts. A third overtone quartz crystal no lower in frequency than 26.980 mc. nor higher than 27.260 mc. must be used as the frequency-determining element.

DATE_____

SIGNATURE OF TECHNICIAN_____

Before putting the Roof Hopper on the air, you must have it examined by a competent technician (holder of a first- or second-class radiotelephone license) who can certify that it complies with Part 15 of the FCC's Rules and Regulations. The technician must sign a certificate (such as that above) which must be permanently attached to the transmitter.

tion you're attempting to pick up. A ground plane or other vertical antenna is not recommended.

If you wish to "kill" the output of your receiver while transmitting in order to prevent unpleasant audio feedback, connect modulator terminals *E* and *F* across the speaker voice coil. Then, when *S1B* is thrown to the *Transmit* position, the speaker will be shorted out and no sound will issue from the set.

Operation. A low-power device such as the "Roof Hopper" can only communicate with other unlicensed low-power devices and must not be used to contact CB, amateur, or other licensed stations. Further, no call letters may be employed. And even though a license is not required, this unit is subject to FCC Rule 15.210 which states that "the operator of a low power communication device . . . which causes harmful interference to an authorized radio service, shall promptly stop operating the device until the harmful interference has been eliminated."

Unlicensed transmitters are not required to operate on specific channels. Consequently, you may pick any spot between 26.970 and 27.260 mc., but NEVER use a crystal ground for a frequency outside this range! -30-

Now you can build almost any kind of electronic device!

Here are the ABC's of 50 vacuum-tube circuits for electronics experimentation and project construction—all fully diagramed, complete with parts list.

HOW many times have you wanted a diagram of a basic vacuum-tube circuit which you could use as a guide in building hi-fi components, receivers, transmitters, intercom systems, test equipment and other electronic gear? At last, in one book, you can find all the basic diagrams, schematics and other vital information on vacuum tubes and their circuits essential for such projects!

You'll Become An Expert On All Types of Vacuum Tubes

Beginning with the Edison effect (the birth of the diode), Julian M. Sienkiewicz, Managing Editor of Popular Electronics, leads you right up to the multi-element vacuum tubes used in everyday circuits. The first four chapters are devoted to the operation of diodes, triodes, tetrodes, and pentode and beam-power tubes. Chapter five covers construction practices, tools, and test equipment, along with workshop hints that will be a real boon to all who want to get the most out of their equipment. Chapter six contains *a collection of fifty vacuum-tube circuits* that gives you a basic library of useful circuits for quick and trouble-free reference.

One hundred vacuum-tube schematics, plate-characteristic curves, simplified diagrams, test circuits and other selected illustrations supplement the informative text to make this book one of the most useful and invaluable manuals for your electronic experiments and hobby projects.

192 pages, 100 illustrations $4.95

PARTIAL CONTENTS:

DIODE VACUUM TUBES. Emission – Diode Operation – Rectification Power – Supply Filters–Detection (AM and FM). TRIODE VACUUM TUBES. Triode Operation – The Triode Test Circuit – Control – Triode Characteristics – Plate Characteristic Curves–Plate Resistance – Amplification Factor. TRIODE AMPLIFIERS. Load Lines–Operating Point – Cathode Bias – Cathode Load Lines–Signal Amplification – Signal Inversion – Voltage Gain – Computing Voltage Gain – Distortion. MULTI-ELEMENT TUBES. Miller Effect–Tetrodes–Pentodes–A.C. Plate Resistance – Transconductance–Amplification Factor–The Pentode Voltage Amplifier–Operating Point – Cathode Bias–Distortion–Beam-Power Vacuum Tubes – Audio Output Stage. CIRCUIT CONSTRUCTION HINTS. Checking Components – Fixed Resistors – Capacitors – Transformers and Coils – Vacuum Tubes – Where To Buy – Test Equipment – Vacuum Tube Voltmeter–Oscilloscope–Signal Generators–Tools – Soldering – Chassis Construction–BASIC VACUUM TUBE CIRCUITS.

SEE YOUR ELECTRONICS PARTS JOBBER OR BOOKSELLER OR USE COUPON BELOW!

ELECTRONICS BOOK SERVICE
P.O. Box 1187
Brooklyn, N. Y.

Please send me VACUUM-TUBE CIRCUITS FOR THE ELECTRONIC EXPERIMENTER for a free 7-day trial examination. I understand that if I am not completely satisfied, I may return the book and owe you nothing. Otherwise, I will remit $4.95 plus small charge for postage, packing and handling. Same return privilege and prompt refund guaranteed!

NAME_____
(please print)

ADDRESS_____

CITY_____ ZONE____ STATE_____

EF629

Best Buys in EL-ED Kits

Continued from page 57)

sets are offered under the brand name "Erect-tronic" and they feature printed layout sheets which show the location of the individual components as well as the wiring used in each project.

There are several "lab-type" kits in the G. E. educational series, including a basic electricity lab (Model EL-20) at $14.95, a transistor lab (Model EL-10) at $9.95, and an advanced electronics lab (Model EL-30) at $39.95. The latter kit permits the assembly of some 40 different projects and experiments.

Multi-project kits are offered by a number of other firms, including *Progressive Edu-Kits Inc.* with its 20-project "Edu-Kit" and *Superex Electronics Corporation.* Superex produces an 18-project kit which features special templates and screw-type connectors, permitting the assembly of any project with only a small screwdriver.

In addition to the national manufacturers who sell through many retail and mail-order outlets, a number of the larger mail-order electronics distributors offer experimenter's kits under their private brand names. *Lafayette Radio,* for example, distributes a 20-in-1 transistor kit (KT-173) for $18.95 and a 10-in-1 lab kit (KT-36A) for $15.50. And *Radio Shack Corporation* offers a 30-in-1 transistor experimenter kit for $18.95.

Several kits are offered under the "Knight" label by *Allied Radio,* including a 10-circuit transistor lab kit at $14.95 which features an etched circuit board, a 12-in-1 electronics lab using vacuum tubes at $15.95, and a new 100-in-1 electronic lab at $29.95. The last item features an attractive console-like front panel and a peg-board vertical "chassis" for project assembly.

Educational Kits. The kits that emphasize educational and training features do so, generally speaking, without detracting from their play or "fun" value, and the items still have a lot of appeal for both youngsters and adults.

An outstanding entry in this class is G. E.'s new EF-140 analog computer kit (see front cover). Selling for $29.95, it

teaches both mathematics and electronics and includes "memory" panels, an indicator, and a three-transistor amplifier.

Utilizing many of the principles found in correspondence school training kits, the "Adventure in Electronics" kit offered by the Conar Instrument Division of the *National Radio Institute* features such projects as a theremin and a metronome as well as more familiar radio receiver, transmitter, and audio amplifier experiments. Conventional construction techniques are employed, giving the builder practical experience that can be used in assembling more advanced kits and magazine projects. The "Adventures in Electronics" kit sells for $18.50.

Heath has available several more advanced educational kits, starting with a basic test instrument, the EK-1, at $19.95, and extending to the EK-2A and EK-2B, each at $19.95 (plus postage). Once the experiments are completed, the latter two kits may be combined to assemble a 6-tube, 2-band superheterodyne receiver.

Finally, the *Science Materials Center* distributes a number of educational kits, including a basic physics laboratory which provides over 100 experiments in electricity, magnetism, and static electricity, and two computer kits—the "Brainiac" K-30 computer circuits laboratory and the "Calculo" analog computer laboratory. -30-

WHO'S WHO IN ELECTRONIC KITS

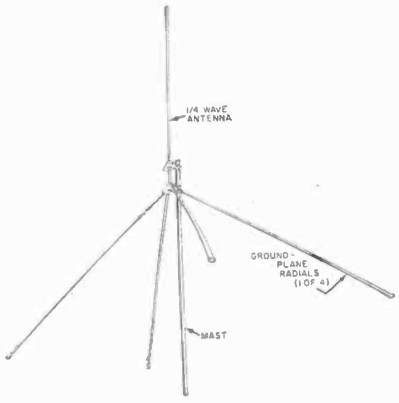
Allied Radio Corp. (Knight), 100 North Western Blvd., Chicago 80, Ill.
Bell Products Co., 4251 Forest Park, St. Louis 8, Mo.
Emenee Industries, Inc., 200 Fifth Ave., New York 10, N.Y.
General Electric Co., 1001 Broad St., Utica, N.Y.
A. C. Gilbert Co., Erector Square, New Haven 6, Conn.
Heath Co., Benton Harbor, Mich.
Infrared Industries, Inc., Box 42, Waltham 54, Mass.
Lafayette Radio Electronics Corp., 165-08 Liberty Ave., Jamaica 33, N.Y.
Lionel Corp., 15 East 26th St., New York 10, N.Y.
National Radio Institute, 3939 Wisconsin Ave., Washington 16, D.C.
Progressive "Edu-Kits" Inc., 1186 Broadway, Hewlett, N.Y.
Radio Shack Corp., 730 Commonwealth Ave., Boston 17, Mass.
Remco Industries, Inc., 113 North 13th St., Newark 7, N.J.
Science Materials Center, 59 Fourth Ave., New York 3, N.Y.
Stuart Manufacturing Co., 337 West 5th St., Cincinnati 2, Ohio
Superex Electronics Corp., 4 Radford Place, Yonkers, N.Y.

On the Citizens Band

(*Continued from page* 64)

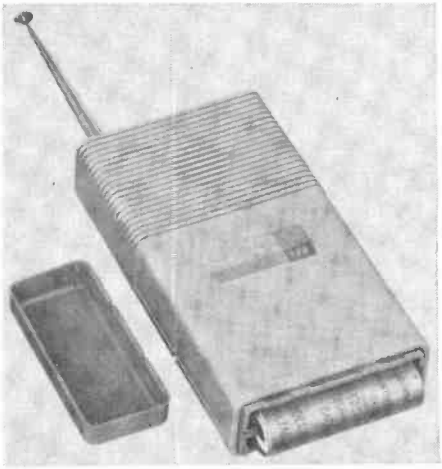
and push-to-talk switch. The Heath people say that it's quite simple to build since all the parts mount on a diagrammed circuit board.

The Antennex Div. of Clear Beam Antenna Corp. has announced a new series of base station CB antennas. The first, Model GP-1, is a ground plane, designed



to match 52-ohm coax accurately, while the CBY-3 is a three-element yagi for "point-to-point" communications (it has a highly directional radiation pattern). Both antennas fall in a price range which will, according to the manufacturer, attract the users of economy transceivers and transceiver kits.

Osborne Electronic Sales Corp. has introduced a "high-powered" all-transistor portable transceiver. Rated at one full watt input, the unit represents quite



a breakthrough in current transistor transceivers. It weighs in at only 28 ounces, including batteries which have a useful life of up to 18 hours before recharging is necessary.

CB Book. Now we're in the book reviewing business! John F. Rider Publisher, Inc., has recently released a book by Allen Lytel which is devoted entirely to CB radio. "Citizens Band Radio" is geared for the user, the prospective buyer and the service technician who repairs CB equipment. It's written from a purely practical standpoint, and theory is held to an absolute minimum.

Particular emphasis is placed on the FCC Rules and Regulations, installation of units, antennas, and circuit analyses of certain popular transceivers. At $3.90, this book represents an excellent investment for the CB'er who is shy on technical knowledge but doesn't want to be burdened with a lot of technical talk.

Club Notes. The Bux-Mont (Pa.) Citizens Radio League recently had Captain Wm. G. Beyer, of the Philadelphia Police Radio Division, speak at one of their meetings. He told how useful radio is in time of emergency, outlined the various procedures followed, and so forth. . . . The Qui-Co Citizens Radio League (Reading, Pa.) reports a recent election of officers. Bob Hoffman, Jr., is president, Charlie Bubp, vice president, and Peg Hoffman was elected secretary-treasurer. . . . The Racine (Wis.) CB Club has been conducting Civil Defense drills Monday evenings on channel 22, with the approval of the FCC and CD authorities. This club is also drafting a CB "code of ethics," which we'll try to present in a future column. . . . The Williamsport Citizens Band Club boasts a member with a Second Class Commercial license, and the club—as a unit—has purchased a frequency meter for crystal checks. A small fee is charged for frequency-measurement tests, and the service is open to non-members as well as members. This is one activity we would like to see more clubs engage in. . . . The Pioneer Valley Five Watters (Holyoke, Mass.) reports that one of its members has designed a CB booster with RCA Nuvistor tubes. Using a cascode arrangement, the booster will add about 10 to 20 miles of reception radius to almost any receiver. —30—

Transistor Topics

(*Continued from page* 80)

and five diodes, it's designed for operation on a standard 12-volt, negative-ground auto system and tunes the entire FM broadcast band (88 to 108 mc.). The converter delivers an output signal at 800 kc., which is then delivered to the car's regular AM radio. It has a sensitivity of 2.5 microvolts for 20-db quieting.

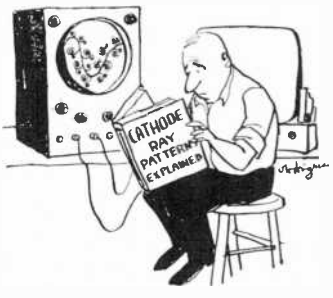
A general-purpose silicon transistor with a 5-watt power dissipation rating and capable of handling up to 40% of the jobs done by most available transistors has been announced by RCA (Semiconductor Div., Somerville, N.J.). Designated as Type 2N2012, it is manufactured using a combination of triple diffusion and planar techniques. According to RCA, this unit represents a significant step towards the development of a "universal" transistor.

Lower Prices. Plagued by limited budgets, most hobbyists try to avoid using the more exotic semiconductor devices. Where possible, they will use germanium "experimenter's" transistors instead of, say, silicon types, even though the latter units have far superior temperature characteristics than the former and much lower leakage.

Until recently, such tactics were justified, since silicon transistors carried price tags in the 12- to 20-dollar range. Now, a major manufacturer (Texas Instruments, Inc., Box 5012, Dallas 22, Texas) has announced a new series of low-cost *npn* silicon transistors. Unit prices range from $1.75 to $5.65.

That's the story for now. Next month, yours truly will be digging out his old crystal ball again . . .

—*Lou*



SHORT-WAVE MONITOR CERTIFICATE APPLICATION

To become a Short-Wave Monitor registered with POPULAR ELECTRONICS, just follow these simple directions:

1 Fill out the form below. (You must be a short-wave listener presently active in the hobby to be eligible for a Short-Wave Certificate.)

2 Send us 10 cents in coin to cover the cost of the certificate as well as the handling and registration costs. If you live outside the United States and cannot obtain U. S. coins, send either 15 cents in Canadian currency or two International Reply Coupons (IRC's).

3 Insert the application form, coins (or IRC's) and a stamped, self-addressed envelope in another envelope and mail it to:
Monitor Registration, POPULAR ELECTRONICS
One Park Avenue, New York 16, N. Y.

(Please Print)

Name . . . . . Ham Call-Area Prefix . . . . .

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

Receivers — Make . . . . . Model . . . . .

Make . . . . . Model . . . . .

Principal SW Bands Monitored . . . . . Number of QSL Cards Received . . . . .

Type of Antenna Used . . . . .

Signature . . . . . Date . . . . .

INDEX TO VOLUME 15 July-Dec., 1961

AMATEUR RADIO AND SWL

Across the Ham Bands (Brier)
- How to Pass General Class Code Test ... 93 July
- Your Antenna System ... 59 Aug.
- 75-Watt Phone/C.W. Transmitter Kit (Hallicrafters HT-40K) ... 75 Sept.
- EICO 723 Transmitter Kit ... 75 Oct.
- DX'ing and the Sun ... 79 Nov.
- How to Develop C.W. Operating Skill ... 73 Dec.

Antenna Coupler, Wide-Range (Brier) ... 61 Aug.
BBS—Black Box Special (Barbee) ... 76 Dec.
Compactron V.H.F. Receiver (Dorris) ... 45 Sept.
Electronics Enthusiasts in the U.S.S.R. (Hannah) ... 41 Oct.
English-Language Voices from the Orient (West) ... 41 July
Field Strength Meter, Sensitive (Friedman) ... 51 July
How to Become a Ham (Stoner) ... 89 July
How to Talk to Non-Hams (Ebel) ... 76 Nov.
Hybrid Cathode Modulator (Kaiser) ... 56 Sept.
Low-Pass Filter Reduces TVI (Brier) ... 80 Nov.
Monitor Meter (Friedman) ... 53 Sept.
Roof Hopper (Smith) ... 47 Dec.
Short-Wave Monitor Registration
- 100 July, 102 Aug., 93 Sept., 74 Oct., 117 Nov., 113 Dec.

Short-Wave Report (Bennett)
- 99 July, 101 Aug., 64 Sept., 73 Oct., 86 Nov., 81 Dec.
- Questions and Answers ... 99 July
- Voice of the Andes ... 101 Aug.
- De luxe Receiver for SWL's (National NC-190) ... 64 Sept.
- The Good Old Days ... 73 Oct.
- More Questions and Answers ... 86 Nov.
- DX'ing the VOA Amateur Radio Program ... 81 Dec.

Signal Booster, Improved (Brier) ... 76 Oct.
Six Meters and Mobile (Buckwalter) ... 47 July
SWL Antenna (Mosley SWL-7) ... 87 July
SWL/QSL Bureau ... 32 Dec.
VFO, Simple, Stable (Brier) ... 74 Dec.

CITIZENS BAND RADIO

Add a Squelch to the CB-1 (Hawbaker) ... 55 Nov.
CB Goes on TV ... 48 Nov.
Cubical Quad for CB (Orr) ... 79 July
- Corrections ... 110 Sept.

Equipment Catalog ... 79 Aug.
- Part 19 Transmitters and Transceivers ... 79 Aug.
- Antennas ... 88 Aug.
- Special Attachments ... 91 Aug.
- Microphones ... 91 Aug.
- Crystals ... 92 Aug.
- Test Equipment ... 93 Aug.
- Part 15 Transceivers ... 94 Aug.
- Noise Elimination ... 97 Aug.

FCC Report (Tall) ... 10 July, 10 Sept., 16 Nov.
Knack of Buying CB Equipment (Griggs) ... 69 Aug.
On the Citizens Band (Kneitel) ... 85 July
- (Strippel) ... 98 Aug., 69 Sept., 60 Oct., 75 Nov., 64 Dec.

SWR/Power Meter for CB (Lee) ... 61 July

CONSTRUCTION PROJECTS

Adapter for VTVM Leads (Trauffer) ... 68 Sept.
Amplifier, Starved Circuit (Burgess) ... 69 July
Antenna Coupler, Wide-Range (Brier) ... 61 Aug.
Antenna, FM Power Lead (Trauffer) ... 64 July
Antenna Tips ... 50 Aug.
Audia Pack (Louis) ... 61 Dec.
BBS—Black Box Special (Barbee) ... 76 Dec.
Bigger Bass from Broadcast Sets (Decker) ... 72 Dec.
Bi-Slove for AG-1's (Goss) ... 67 Nov.
Cartridge Tester, Fly Swatter Becomes (Trauffer) ... 64 Nov.
Cathode Modulator, Hybrid (Kaiser) ... 56 Sept.
Compactron FM Tuner/Receiver (Hatfield) ... 45 Aug.
Compactron V.H.F. Receiver (Dorris) ... 45 Sept.
Cubical Quad for CB (Orr) ... 79 July
- Corrections ... 110 Sept.

Do-Re-Mi, Electronic (Patrick) ... 61 Oct.
Electroscope, Electronic (Wilensky) ... 68 Oct.
Field Strength Meter, Sensitive (Friedman) ... 51 July
Glow Light, Flea-Power (Pugh) ... 49 Nov.
Headphone "Ear Saver" (Brier) ... 95 July
Light Control for Battery-Powered Toys (Patrick) ... 65 Sept.
Low-Pass Filter Reduces TVI (Brier) ... 80 Nov.
Machine Gun, Electronic (Patrick) ... 58 Dec.
Mikes From Lamp Sockets (Trauffer) ... 58 Oct.
Monitor Meter (Friedmon) ... 53 Sept.
P.A. System, Transistorized (Garner) ... 54 Aug.
Power A' Plenty (Marriner) ... 71 Nov.
Radiation Detector (Mandeville) ... 45 Nov.
Radio Doubles as Intercom (Patrick) ... 62 Nov.
Restorer (Sanders) ... 49 Oct.
Roof Hopper (Smith) ... 47 Dec.
Salt Water Powers One-Transistor Radio (Martin) ... 64 Oct.
Signal Booster, Improved (Brier) ... 76 Oct.
Signal Generator, Fixed Frequency (Sury) ... 76 July
Six Meters and Mobile (Buckwalter) ... 47 July
Speaker System, Space-Saver (Weems) ... 72 July
Stereo Testing Made Easy (Ogur) ... 70 Oct.
SWR/Power Meter for CB (Lee) ... 61 July
Tester, Universal Workshop (Parker) ... 57 July
Trans-Filter (Frantz) ... 63 Aug.
VFO, Simple, Stable (Brier) ... 74 Dec.
Voltmeter, A.C. Transistorized (Frantz) ... 72 Sept.
Voltmeter, Expanded-Scale (Zachary) ... 51 Aug.
VTVM Adapter for Multimeters (Hatfield) ... 54 July
Whirly-Gig (Martin) ... 70 Dec.

DEPARTMENTS

Across the Ham Bands (Brier)
- 93 July, 59 Aug., 75 Sept., 75 Oct., 79 Nov., 73 Dec.

Carl and Jerry (Frye)
- 102 July, 103 Aug., 83 Sept., 82 Oct., 90 Nov., 82 Dec.

FCC Report (Tall)....10 July, 10 Sept., 16 Nov.
Hi-Fi Showcase
18 July, 10 Aug., 14 Sept., 8 Oct., 10 Nov., 22 Dec.
Letters from Our Readers
16 July, 16 Aug., 20 Sept., 12 Oct., 24 Nov., 8 Dec.
New Products
35 July, 28 Aug., 33 Sept., 30 Oct., 106 Nov., 28 Dec.
On the Citizens Band (Kneitel) 85 July
(Strippel) 98 Aug., 69 Sept., 60 Oct., 75 Nov., 64 Dec.
POP'tronics Bookshelf
24 July, 22 Aug., 24 Sept., 16 Oct., 32 Nov., 34 Dec.
POP'tronics News Scope
6 July, 6 Aug., 57 Oct., 6 Nov., 6 Dec.
Short-Wave Report (Bennett)
99 July, 101 Aug., 64 Sept., 73 Oct., 86 Nov., 81 Dec.
Space Electronics (Ferrell)....82 July, 70 Sept.
Tips and Techniques
26 July, 36 Aug., 30 Sept., 24 Oct., 99 Nov., 12 Dec.
Transistor Topics (Garner)
96 July, 66 Aug., 80 Sept., 66 Oct., 82 Nov., 78 Dec.

FEATURE ARTICLES

Analog Computers, Introduction to (Sienkiewicz) .... 65 Dec.
Block Boxes for CD (Gilmore)..... 41 Aug.
Blueprints, Cooking Up Your Own (Wright)..... 60 Sept.
Capaciquiz (Balin) ..... 62 Aug.
Carl and Jerry (Frye)
102 July, 103 Aug., 83 Sept., 82 Oct., 90 Nov., 82 Dec.
CB Equipment Catalog ..... 79 Aug.
CB Equipment, The Knack of Buying (Griggs) ..... 69 Aug.
CB Goes on TV ..... 48 Nov.
Crossword Puzzle (Windser) ..... 88 Nov.
Dr. Lee DeForest: Then There Were 3 ..... 6 Sept.
Electroluminescence (Pugh) ..... 41 Nov.
Electronics Enthusiasts in the U.S.S.R. (Hannah)..... 41 Oct.
Electrostatics Under the Hood (Busse) ..... 46 Oct.
EL-ED Kits, Best Buys in (Garner)..... 54 Dec.
English-Language Voices from the Orient (West)..... 41 July
Hobnobbing with Harbaugh (Harbaugh)
49 Aug., 77 Sept., 60 Dec.
How to Become a Ham (Stoner) ..... 89 July
Operation Telephone 1965 (Gilmore) ..... 41 Sept.
Pediacoumeter (Cipnic) ..... 66 Nov.
POP'tronics News Scope
6 July, 6 Aug., 57 Oct., 6 Nov., 6 Dec.
Quiz, Diode (Balin) ..... 88 July
Quiz, Electronic Analogy (Balin) ..... 59 Nov.
Quiz, Inductance (Balin)..... 59 Sept.
Quiz, Oscilloscope (Balin) ..... 78 Oct.
Quiz, Voltage (Balin) ..... 69 Dec.
Radar Speed Trap Detector (Ferrell & Flanagan)..... 49 Sept.
Record Players, What Can You Tell Me About (Flanagan) ..... 53 Oct.
Spray Can Short Cuts (Murray) ..... 78 Sept.
Transistors in Hi-Fi (Flanagan) ..... 65 July
Turntable Kits Grow Up—Big (Ferrell) ..... 51 Dec.
Ultrasonics—Successes of Silent Sound (Gilmore) .... 41 Dec.
Winners, Meet the ..... 70 Nov.

HI-FI/STEREO AND AUDIO

Amplifier, Starved-Circuit (Burgess) ..... 69 July
Audio Pack (Louis) ..... 61 Dec.
Bigger Bass from Broadcast Sets (Decker) ..... 72 Dec.
Cartridge Tester, Fly Swatter Becomes (Trauffer)..... 64 Nov.
FM Table Radio Turns Tuner (Trauffer)..... 62 Sept.
Headset on a Budget Stereo (Driscoll) ..... 65 Nov.
Heat Wave, Hi-Fi (Welch) ..... 52 Nov.
Hi-Fi Showcase
18 July, 10 Aug., 14 Sept., 8 Oct., 10 Nov., 22 Dec.
Record Players, What Can You Tell Me About (Flanagan) ..... 53 Oct.
Speaker System, Space-Saver (Weems) ..... 72 July
Stereo Any Way You Want It (Sherwood S-7000)... 67 Sept.
Stereo-itis (Cullen) ..... 78 Nov.
Stereo Testing Made Easy (Ogur) ..... 70 Oct.
Transistors in Hi-Fi (Flanagan) ..... 65 July
Turntable Kits Grow Up—Big (Ferrell) ..... 51 Dec.

PRODUCT REPORTS

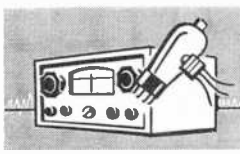
EL-ED Kits, Best Buys in (Garner) ..... 54 Dec.
Receiver for SWL's, De luxe (National NC-190).... 64 Sept.
Stereo Any Way You Want It (Sherwood S-7000) ..... 67 Sept.
SWL Antenna (Mosley SWL-7)..... 87 July
Transmitter Kit, 75-Watt Phone/C.W. (Hallicrafters HT-4CK) ..... 75 Sept.
Transmitter Kit (EICO 723)..... 75 Oct.
Turntable Kits Grow Up—Big (Ferrell) ..... 51 Dec.

TEST EQUIPMENT

Cartridge Tester, Fly Swatter Becomes (Trauffer).... 64 Nov.
Field Strength Meter, Sensitive (Friedman). ..... 51 July
Signal Generator, Fixed Frequency (Sury) ..... 76 July
Stereo Testing Made Easy (Ogur)..... 70 Oct.
Tester, Universal Workshop (Parker) ..... 57 July
Voltmeter, A.C. Transistorized (Frantz) ..... 72 Sept.
Voltmeter, Expanded-Scale (Zachary) ..... 51 Aug.

TRANSISTORS

A.C. Transistorized Voltmeter (Frantz) ..... 72 Sept.
Audio Pack (Louis) ..... 61 Dec.
BBS—Black Box Special (Barbee) ..... 76 Dec.
Bi-Slave for AG-1's (Gass) ..... 67 Nov.
Cathode Modulator, Hybrid (Kaiser) ..... 56 Sept.
Do-Re-Mi, Electronic (Patrick) ..... 61 Oct.
Field Strength Meter, Sensitive (Friedman) ..... 51 July
Glow Light, Flea-Power (Pugh) ..... 49 Nov.
Light Control for Battery Powered Toys (Patrick)..... 65 Sept.
Machine Gun, Electronic (Patrick) ..... 58 Dec.
Monitor Meter (Friedman) ..... 53 Sept.
P.A. System, Transistorized (Garner) ..... 54 Aug.
Radar Speed-Trap Detector (Ferrell & Flanagan).. 49 Sept.
Radiation Detector (Mandeville) ..... 45 Nov.
Radio Doubles as Intercom (Patrick) ..... 62 Nov.
Roof Hopper (Smith) ..... 47 Dec.
Salt Water Powers One-Transistor Radio (Martin).. 64 Oct.
Signal Generator, Fixed-Frequency (Sury) ..... 76 July
Trans-Filter (Frantz) ..... 63 Aug.
Transistor Topics (Garner)
96 July, 66 Aug., 80 Sept., 66 Oct., 82 Nov., 78 Dec.
Transistors in Hi-Fi (Flanagan) ..... 65 July
Whirly-Gig (Martin) ..... 70 Dec.



ELECTRONICS MARKET PLACE

RATE: 60¢ per word. Minimum 10 words prepaid. February issue closes December 6th. Send order and remittance to Martin Lincoln, POPULAR ELECTRONICS, 1 Park Ave., New York 16, N. Y.

FOR SALE

GOVERNMENT Sells Surplus: Electronics; Oscilloscopes; Transceivers; Test Equipment; Radar; Sonar; Walkie-Talkies; Boats; Jeeps; Aircrafts; Misc.—Send for "U.S. Depot Directory & Procedures"—$1.00—Brody, Box 425(PE), Nanuet, New York.

TV Tuners—Rebuilt or Exchanged $9.95 complete—all types—fast, guaranteed service. Send tuner with all parts to: L.A. Tuner Exchange, 4611 West Jefferson Blvd., Los Angeles 16, California.

GOVERNMENT Surplus Receivers, Transmitters, Snooperscopes, Parabolic Reflectors, Picture Catalog 10¢. Meshna, Malden 48, Mass.

WPE-SWL-CB-QSL Cards — Samples 10¢ — "Brownie" W3CJ1, 3110A Lehigh, Allentown, Penna.

DIAGRAMS for repairing radios or Television $2.00. Give make, model. Diagram Service, Box 672-PE, Hartford 1, Conn.

BEFORE You Buy Receiving Tubes or Hi-Fi Components send now for your giant Free Zalytron current catalog—featuring nationally known Zalytron First Quality TV-Radio Tubes, Hi-Fi Stereo Systems, Kits, Parts, etc. All priced to Save You Plenty—Why Pay More? Zalytron Tube Corp., 220 W. 42nd St., NYC.

CB—QSL—SWL cards. Samples 10c. Include your personal picture on cards. No extra Cost. Signal, Adams County, Manchester, Ohio.

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

FAST Computer. Tells time anywhere. Instructions included. $1.25P. P. Loeber, 224-T2 Wyatt, Lincoln, Ill.

CITIZENS Band—Maximum quieting with OZCO "Snoozer." Largest selling add-on squelch still only $2.00 each, $3.95 pair postpaid! Guaranteed. OZCO, Canaan, Connecticut.

WALKIE-Talkie radiophones from $24.98. Free literature. Vanguard Labs, 190-48 99 Ave., Hollis 23, N. Y.

GARAGE Door Operators $59.95. Rugged chain drive automatic units. Highest quality. Free literature. Demsco, Inc., Sebring 27, Ohio.

INVESTIGATORS, Write for Free Brochure on Latest Subminiature Electronic Listening Devices. Dept. 2A Ace Electronics, 11500 NW 7th Ave., Miami 50, Fla.

16 TESTED plans—25¢. "Experimenters' Electronics" magazine—25¢; 12 issues $2.50. Laboratories, 1131-L Valota, Redwood City, California.

SWL Report Forms—complete, concise. $3.50 a hundred postpaid. No C.O.D.'s please.—Calvern Company, 10508 Parkwood Drive, Kensington, Maryland.

QUALITY Printing at low prices. Free catalogue. Jon Hevelone, Sterling, Kansas.

"ONE Transistor ignition system. Greater RPM, high energy spark. Complete instructions $2.00. Anderson Engineering, 16 Williams, Wrentham, Massachusetts.

CHANGE Crystal Frequency Safe Way .001 Tolerances with etching kit complete with instructions. Ham Kit, Box 175E, Cranford, New Jersey.

GARAGE Door Operator Kits—Edwards famous KR-50 kit. Easily assembled and installed. Available with or without remote car control. Thousands sold. Priced from $59.95. Write for literature. Edward T. Fink Co., Inc., 284 Nepperhan Ave., Yonkers, N. Y., Dept. PE.

CONVERT Any television to sensitive, big-screen oscilloscope. Only minor changes required. Simple plans $1.95. Relco, Box 10563-C, Houston 18, Texas.

SUPERSENSITIVE directional microphone picks up a whisper at great distances. Used by investigators to record faint, distant sounds without being detected. Easily constructed for about $7. Step by step plans $1.95. Dee Company, Box 7263-F, Houston, Texas.

1000 **PRINTED,** Gummed, Name & Address Labels, $1.00. Labels, Box 80, Wall Street Station, N. Y. 5, N. Y.

FREE—Electronic parts—tubes catalog—Free New—R.C.A., G.E., etc. tubes—60/10/2% discount off list. More on some types. New resistors, condensers, transformers, flybacks, yokes, etc. at fractions of original cost. New phonograph needles—70% or more off list prices, and more, much more! Arcturus Electronics Corp., Dept. E.W. 502—22nd St., Union City, N. J.

BUY/Rent—Comedy, Party Records. Sampler Catalog: $1.00. The DRC—11024 Magnolia Blvd., North Hollywood. Calif.

NOW you can save up to 50% and more on Brand New Nationally Advertised Hi-Fi, TV, Cameras, Watches, Appliances, Jewelry! Send today for your giant 1962 catalog. 30¢. Moore-Fitzwilliam, 24 Ridge Road, Summit, New Jersey.

COMPUTER Memory Cores, 16 for $1.00. Graycore, Box 642, Times Square Station, New York 36, N. Y.

SHORT Wave Low-cost All-Band Radio. Complete plans $2.00, refunded on wired or kit order. Western Radio, Dept. 12E, Kearney, Nebr.

HEAR Russia—Europe—The whole world on Transistor Short Wave Adapter—works on any radio. Complete plans $2.00, refunded on wired or kit order. Western Radio, Dept. 12E, Kearney, Nebr.

BROADCAST to any radio with Walkie Talkie, Power Tube or transistor models, All 3 plans $2.00, refunded on kit or wired order. Western Radio, Dept. 12E, Kearney, Nebr.

INVESTIGATORS! Do your own sound work. Write for free brochure of latest electronic equipment. WJS Electronics, 1130 N. Highland Ave., Los Angeles 38, Calif.

TELEPHONE Extension in your car. Answer your home telephone by radion from your car. Complete diagrams and instructions $2.00. C. Carrier Co., 5880 Hollywood Blvd., Hollywood 28, Calif.

EAVESDROP with a pack of cigarettes. Miniature transistorized FM Radio Transmitter. Complete diagrams and instructions $2.00. C. Carrier Co., 5880 Hollywood Blvd., Hollywood 28, Calif.

BE A Spy. Correspondence course on wire tapping, bugging, telescopic sound pickup, recording techniques, microphotography, and invisible photography. Lessons in surveillance, tailing, and use of equipment. Complete course $22.50. C. Carrier Co., 5880 Hollywood Blvd., Hollywood 28, Calif.

TV Tape Recorder. Build your own Video Recorder. Complete correspondence course and construction details $22.50. C. Carrier Co., 5880 Hollywood Blvd., Hollywood 28, Calif.

JUNK Your Distributor and Voltage Regulator. Improve automobile mileage and performance. Construction details for transistorized distributor and voltage regulator $4.75. No moving parts. DB Enterprises, 8959 Wonderland Ave., Hollywood 46, Calif.

TV Camera. Build for less than $50. Construction Details $4.75. DB Enterprises, 8959 Wonderland Ave., Hollywood 46, Calif.

TELEPHONE Voice Switch (LS-500). Actuates automatically and unattended any tape or wire recorder. Pictorial installation instructions included. $23.75. Post Paid US. WJS Electronics, 1130 N. Highland Ave., Los Angeles 38, Calif.

ALUMINUM Distance Finder—Sights yardage to objects. Determines navigational, hunting, golfing distances. Perfect gift! $2.00 postpaid. Shang's, 223 Walter Court, Elgin 12, Illinois.

"CITIZENS Band: HE-20 -20A & Mark VII Owners. Enjoy better selectivity, greater sensitivity. Install our dual conversion adapter in easy-do kit form. All parts, schematic, pictorial, complete $15.50, with tubes $17.50. Complete Kit for HE-15 & 15A, TR-800 & 910. $14.95, with tubes $16.95. Order now! $5.00 deposit for C.O.D. Free literature. Bainbridge Radio, 2649 Bainbridge Ave., N. Y. 58, N. Y.

JEEPS—$223.83, Voltmeters—$1.05, Transmitters—$6.18, Receivers—$5.65, Televisions, Walkie-Talkies, Oscilloscopes, Multimeters, Cars. Typical Government Surplus Prices. Buy Direct Full Details, Procedure Depot Directory, Only $1.00. N. Y. Enterprises, International Airport, Box 402-L, Jamaica 30, New York.

HI-FI Strobolamp & Disc $3.00. Transistor Hearing Aid $39.95, $10.00 down, $3.00 month. C. James—P. O. Box 929, Indio, California.

RADAR King, the all frequency radar trap detector. Plans (refundable) $1. Kits (with assembled antenna) $19.95. Wired units $29.95. Extra antennas $4.50 each. Write for information. Wardell Smith, 65 Glenwood Road, Upper Montclair, New Jersey.

CB-QSL-SWL cards. Samples 10c. Excellent Christmas gifts. Include your personal picture on cards. Signal Adams County, Manchester, Ohio.

UNUSUAL electrical devices wholesale. Free catalog. Wellsco Box 3055, North Hollywood, California.

SAVE Big Money on ham equipment and parts, radio & TV parts—tubes—hi-fi—changers—speakers—kits, etc. Send for Free Catalog. Al-Lan Electronics Sales, Inc., 1511 N. Greenwood Rd., Glenview, Ill. Dept. 1101.

LIMITED quantities of Sargent-Rayment amplifiers and tuners at jobber cost. All brand new, in original cartons. Choice of No. 520, 5100, 540 amplifiers; No. 8000, 1020, 2051, 1000B tuners. Kapitol Magnetic Corporation, 2241 Knox Ave., Chicago, Ill. Dickens 2-8500.

POLICE Radar Detector and legal jammer. Stop before those radar speed traps. Easy to build for less than $10; used with your car radio. Complete construction details $3.75. C. Carrier Co., 5880 Hollywood Blvd., Hollywood 28, Calif.

MORSE Code by Sleep Teaching. Guaranteed. 4 Taped lessons to 18 WPM; $12.95 each. Electro-Sleep, 8959 Wonderland Ave., Hollywood 46, Calif.

TRANSISTOR Ignition—Save gas, tune-ups. Points, plugs last 50,000 - 100,000 miles. Improved cold starting, high-speed performance. Complete negative ground 12v system $29.50. Special Coil $9.50. Palmer Electronics, Carlisle, Massachusetts.

VTVM $15. Paco Signal Generator; Triplett Wattmeter; Details. Write 6K 8420 51st Avenue, Elmhurst, L. I.

HEARING Aids—4 transistor, equal to aids selling for $150. 10 day money back offer. $24.50 check or money order. Kam Electronics Inc., 136-04 Northern Blvd., Flushing 54, N. Y.

HOOK-up wire. 40 feet in all. Eight different colors. $1.00. PO Box 72. Woodland, Ill.

DIAGRAMS, Servicing Information, Practically any radio, television, $1.00. Specify manufacturer, model. Supreme Publications, Highland Park, Illinois.

AUTOMATIC screen door opener for pets (and people). Plans & Schematic $1.00. Box 313, Pico Rivera, Calif.

TRANSISTORIZED Test Equipment. Perfect Christmas Gifts. New Products. Popular Price Range. PEL Electronics, Box 555A, Ridgewood, N. J.

W 9 Z S O 1962 Amateur Radio catalog free. Short wave receivers, transmitters and station accessories. All name brands. W9ZSO, 518 State Street, La Crosse, Wis.

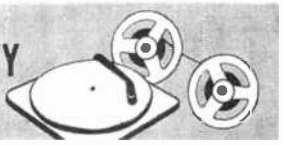
ORGAN Pulse Transformers, Master Oscillator Coils. R. E. Favelka, P.O. Box 5985, Cleveland 1, Ohio.

CBER'S—Improve sensitivity of your transceiver. Our RF Preamp fits Heathkit GW-10, Kit $8.99, wired $11.99. Holstrom Associates, Box 8640-PE, Sacramento 22, California.

TRANSISTOR Radios Repaired $3.50 Plus Parts. Buzzard RT. 3, Hurricane, W. Va.

MULTIPLEX Adapter—Circuit board, 5 coils, sockets and complete instructions, $15.00. Stoner, Box 7388, Alta Loma, Calif.

HIGH-FIDELITY



DISGUSTED with "Hi" Hi-Fi Prices? Unusual discounts on your High Fidelity Requirements. Write Key Electronics, 120 Liberty St., New York 6, N. Y. Cloverdale 8-4288.

DON'T Buy Hi-Fi Components, Kits, Tape, Tape Recorders until you get our low, low return mail quotes: "We Guarantee Not To Be Undersold." Wholesale Catalog Free. Easy time payment plan, 10% down—up to 24 mos. to pay. Hi-Fidelity Center, 220 PC-E.23 St., New York 10, N. Y.

PROMPT Delivery, We Will Not Be Undersold. Amplifiers, Tape Recorders, Tuners, Etc. No Catalogs, Air Mail Quotes. Compare. L. M. Brown Sales Corp. Dept. P, 239 E. 24 St., N.Y. 10, N.Y.

PRICES? The Best! Factory-Sealed Hi-Fi Components? Yes! Send for free catalog. Audion, 25P Oxford Road, Massapequa, N. Y.

RECORDERS, Components. Free wholesale catalogue. Carston, 125-P East 88, N. Y. C. 28.

WANTED

TRIGGER—W9IVJ. We Buy Shortwave Equipment For Cash. 7361 W. North, River Forest, Ill., Phone PR 1-8616. Chicago TU 9-6429.

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

TAPE & RECORDERS

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

RENT Stereo Tapes—over 2,000 different—all major labels—free catalog. Stereo—Parti. 811-G Centinela Ave., Inglewood 3, California.

WRITE for stereo component prices, no catalogues. We ship anywhere in the U.S. (We say: If you can beat our prices, You're lying".) Masterpiece, 1801 Kings Highway, Brooklyn. In business 16 years—Custom made Cabinets for TV, Stereo, Bars, & HiFi.

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

STEREO Playback Tape Deck. Professional Quality Precision Made Telefunken Reads, Dual Speed. Special Price $59.95. Send for Details. Universal Dist. Co.. P.O. Box 204, Richmond Hill, N. Y.

REPAIRS and SERVICING

QUALITY Electronic Kit or Custom Construction by Qualified Technicians. Write Elcon, P.O. Box 271, Ft. Wayne, Indiana.

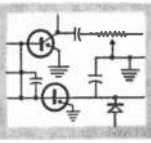
ELECTRONICS Kits Wired. Free Estimate. Write Jerry Stanfield, Talking Rock, Georgia.

PATENTS

PATENT Searches, $6.00. For free Information Record, and "Information Inventor's Need, write: Miss Heyward, 1029 Vermont Avenue NW, Washington 5, D. C.

QUALITY Patent Searches $15.00. Send disclosure. Development Research Service, Box 682, Washington 4, D. C.

INSTRUCTION



EARN $150 Week Mechanical, Electronics Drafting. Send $2 First Lesson, $25 Complete Home Study Course. Prior, Inc., Dept. 122, 23-09 169th Street, Whitestone 57, New York.

BEGINNERS. Radio Electronics Explained Simply. Clear. Basic. Plans. 24 Pages. Send $1. Transspace Laboratory, Box 111, Princeton Junction, New Jersey.

HIGHLY-Effective Home-Study Review for FCC Commercial Phone Exams. Free Literature. Wallace Cook, Box 10634, Jackson 9, Miss.

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

INVENTIONS WANTED

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

INVENTIONS Wanted for immediate promotion! Patented, unpatented. Outright cash; royalties! Casco, Dept. BB, Mills Building, Washington 6, D.C.

DOES Your Product, Invention Need Capital, Manufacturer, Distributor? Patent Engineers Have Nation-wide contacts. Give details. Inventors Creative Service, 354 South Spring, Los Angeles 13, California.

GOVERNMENT SURPLUS

JEEPS $278, Airplanes $159, Boats $7.88, generators $2.68, typewriters $8.79, are typical government surplus sale prices. Buy 10,001 items wholesale, direct. Full details, 627 locations, procedure only $1.00. Surplus, Box 789-C9Z, York, Penna.

BOOKS

BOOKS—All 15¢, 2000 titles, all subjects, catalog free. Cosma, Clayton, Ga.

PLASTICS

NEW Liquid Casting Plastic, clear, colors. Embed real flowers, butterflies, photos, coins. Send 25c for two handbooks "How to Cast Liquid Plastics" and "How to Make Extra Money at Home." Castolite, Dept. L-108, Woodstock, Illinois.

LEATHERCRAFT

FREE "Do-It-Yourself" Leathercraft Catalog. Tandy Leather Company, Box 791-W-41, Fort Worth, Texas.

PHOTOGRAPHY—FILM EQUIPMENT, SERVICES

SCIENCE Bargains—Request Free Giant Catalog "CJ"—144 pages—Astronomical Telescopes, Microscopes, Lenses, Binoculars, Kits, Parts. War surplus bargains. Edmund Scientific Co., Barrington, New Jersey.

EDUCATIONAL OPPORTUNITIES

ENGINEERING Education for the Space Age. Northrop Institute of Technology is a privately endowed, nonprofit college of engineering offering a complete Bachelor of Science Degree Program and Two-Year accredited technical institute curricula. Students from 50 states, many foreign countries. Outstandingly successful graduates employed in aeronautics, electronics, and space technology. Write today for catalog—no obligation. Northrop Institute of Technology, 1179 West Arbor Vitae Street, Inglewood 1, California.

ENGINEERING—Electronic Technical Institute, College of Engineering, Inglewood, California offers you a complete electronics program leading to the A.S. and B.S. Degrees. Send for folder which contains the course description and a picture of one of our unique labs. Morning and evening classes permit you to work full time and attend school. ETI also has schools at San Diego and Costa Mesa, California.

DETECTIVE Profession. Home Study. Badge, Certificate, Future 4563-AG York. Los Angeles 41, Calif.

BUSINESS OPPORTUNITIES

BUY Direct from factories. Appliances, cameras, watches! Free details! Cam Co., 436 PE Bloomfield Ave., Verona, N. J.

VENDING Machines—No Selling. Operate a route of coin machines and earn amazing profits. 32-page catalog free. Parkway Machine Corporation, Dept. 12, 715 Ensor St., Baltimore 2, Md.

ELECTROPLATING equipment and supplies. All types for home work shops. Free Catalog. HBS Equipment Division, 1624 East First Street, Los Angeles 33, California.

BECOME a telephoneman, experience unnecessary, details free. Occupations Unlimited. 1100 Reeve, Santa Clara, Calif.

MAKE $25-$50 Week, clipping newspaper items for publishers. Some clippings worth $5.00 each. Particulars free. National, 81-DG, Knickerbocker Station, New York.

RAISE Rabbits and Fishworms on $500 month plan. Free details. White's Rabbitry, Mt. Vernon 50, Ohio.

FREE Book "990 Successful, Little-Known Businesses." Work home! Plymouth—455R, Brooklyn 4, New York.

$3.00 HOUR—home, sparetime, assembling pump lamps. Easy. Write. OUGOR, 67 E. Caldwell, Arkansas.

$50.00 in your mailbox every day. Sensational home mailorder business. Cameras $2.35; watches $2.60; radios $1.93. Hundreds of fabulous items. 500% profits. What, where, how to buy and sell. Thousands now doing it. 128 pages loaded with complete information sent immediately. Satisfaction absolutely guaranteed. Send $2.00 to: Impex-R, P.O. Box 512, New Orleans 1, La.

SECOND Income From Oil Can End Your Toil! Free Book And Oilfield Maps! National Petroleum, Panamerican Bldg.—PE, Miami 32, Florida.

EARN Good Income Sending Us Information. Weekly Paycheck. Details 10¢. Thomas, Mount Wilson 9, California.

MAILMAN Brings us $150 Daily. Operate Home Mail Order Business. Write Publicity, Box 727ZE, Kalamazoo, Michigan.

FORMULAS—All Kinds. Amazing Big Catalog 10¢. Kemiston, Park Ridge, Illinois.

FREE Book "711 Bizarre, Successful Ventures." How I retired. Work home! Haylings-MP, Carlsbad, Calif.

NEW Low Price Transistor Radio Battery Vending Machines Mean Good Profits For You. Gain Volume Sales Now With Popular Batteries. Send 50¢ for 3 Sample Batteries and Complete Details. Constant Electronics, 4853 Joyce Drive, Dayton 39, Ohio.

STAMPS & COINS

COINS From Formosa, Vatican, plus foreign banknote, 10¢ with Coin Approvals. Littleton Coin Company, Littleton S-12, New Hampshire.

155 Different U.S. commemoratives $1.00. Carstamps, 739 Ordway, Freeport, Illinois.

105 Different U.S. Stamps 25¢, Approvals included. Shelron, Box 907-J, New York 8, N.Y.

TWO Brilliant Uncirculated Mexican Silver Dollars—$1.00 (Refundable). Universal Services, Box 866, San Antonio 6-Z12, Texas.

SELLING entire personal stamp collection. All foreign. Good condition. Assorted packets of 50—25¢ and self-addressed, stamped envelope. Popular Electronics, Box 107, One Park Avenue, New York 16, New York.

EMPLOYMENT INFORMATION

HIGH Paying Jobs in Foreign Lands! Send $2.00 for complete scoop! Foreign Opportunities, Box 172, Columbus 16, Ohio.

EARN Extra money selling advertising book matches. Free samples furnished. Matchcorp, Dept. MD 111, Chicago 32, Illinois.

MISCELLANEOUS

INDEPENDENT Thinkers—investigate Humanism! Write American Humanist Association, Dept. PE, Yellow Springs, Ohio.

QUIT Smoking, Easy Drugless Way. Particulars. Cigarettes Anonymous, 1531 Ida, Wichita, Kansas.

FINGERNAIL Size-Up Method 25¢. Wayne's, Box 3, Jefferson, Iowa.

"WINEMAKING," "BEER, Ale." Strongest methods. Illustrated. $2.20. Eaton Beverage Supplies, Box 1242-C, Santa Rosa, California.

EXPERIMENTERS! New "Experimenters Directory" names other experimenters wishing to contact you, share ideas, exchange information. Directory $1. Literature free. A. Brand, publisher, Sycamore, Illinois.

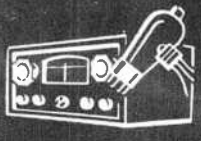
BOOK 200 Electric Stunts $1.00. Cuttziff, 875 Arastradero, Palo Alto, Calif.

"SWISS Musical Movements. Mechanical-Electrical. Spielman, 131 West 42nd, New York 36"

"HOMEBREW Guide" Complete Illustrated Instruction Manual, $2.00. Supply Catalog Included. CalBrew Supplies, Box 1005-J, Seaside, California.

WITH a few dollars worth of basic tools and the book "Electronic Experimenter's Manual" to guide you, explore the wonderful world of electronics experimentation. Book features ten big sections, exciting projects to build and use. $4.95. Electronics Book Service, One Park Avenue, New York 16, New York.

"COMPUTERS and How They Work" is must reading for career-minded students and electronics pros who want a more complete knowledge of the computer field. A great book $4.95. Electronics Book Service, One Park Avenue, New York 16, New York.



SELL YOUR USED EQUIPMENT Through POPULAR ELECTRONICS' Classified Columns!

The 400,000 purchasers of **POPULAR ELECTRONICS** are always interested in good used equipment or components. So, if you have something to sell, let PE readers know about it through our classified columns. It costs very little: **just 60¢ a word,** including name and address. Minimum message: 10 words.

For further information write: Martin Lincoln, POPULAR ELECTRONICS, One Park Avenue, New York 16, N. Y.

POPULAR ELECTRONICS
December 1961 Advertisers' Index

ADVERTISER	PAGE
Airex Radio Corporation	102
Allied Radio	13, 93
America Institute of Engineering & Technology	100
Audio Devices, Inc.	1
Blonder-Tongue	24
Browning	8
Bud Radio, Inc.	38
Burstein-Applebee Co.	105
Capitol Radio Engineering Institute, The	29
Central Technical Institute	85, 86
Cleveland Institute of Electronics	7
Commissioned Electronics, Inc.	100
Conar Instruments	12
Coyne Electrical School	91, 110
Cushcraft	112
DeVry Technical Institute	5
E.C.I. Electronics Communications, Inc.	2nd COVER
EICO	40
Electronics Book Service	107
Esse Radio Company	112
Fisher Radio Corporation	21, 23
General Radiotelephone Company	99
Gonset	33
Grantham School of Electronics	11
Greenlee Tool Co.	38
Grove Electronic Supply Company	34
Hallicrafters Company	83
Hammarlund Manufacturing Company, Inc.	4
Heath Company	88, 89
Holt, Rinehart & Winston, Inc.	10
Hy-gain Antenna Products	9
Indiana Technical College	105
International Crystal Manufacturing Co., Inc.	3
Johnson Company, E. F.	97
Jones Electronics Co., Inc., M. C.	28
Key Electronics Company	110
Kuhn Electronics, Inc.	96
Lafayette Radio	26, 27
Micro Electron Tube Co.	94
Milwaukee School of Engineering	95
Mosley Electronics, Inc.	96
Moss Electronic, Inc.	3rd, 4th COVER
National Radio Company, Inc.	31
National Radio Institute	103, 104, 112
National Technical Schools	35, 36
Newport Manufacturing Corp.	102
Olson Electronics	87
Picture Tube Outlet	100
Polytronics Lab Inc.	20
Progressive "Edu-Kits" Inc.	101
R.A.E. Society	39
RCA Institutes, Inc.	16, 17, 18, 19
RTS Electronics Division	15
Rad-Tel Tube Co.	120
Radio Shack Corp.	25, 109
Rek-O-Kut Co., Inc.	32
Rider Publisher Inc., John F.	98
Saxitone Tape Sales	100
Scientific Development Corporation	37
Scott Inc., H. H.	106
Sleep-Learning Research Ass'n	109
Superscope, Inc.	22
Tech-Master	112
Terado Company	34
Texas Crystals	111
Transvision Electronics, Inc.	113
Tri-State College	109
Trinidad State Junior College	112
Tru-Vac	108
Turner Microphone Company, The	30
University Loudspeakers, Inc.	14
Valparaiso Technical Institute	105
Vanguard Electronic Lab.	105
Western Radio	109
Xcelite, Inc.	94

Servicemen:

Look to Rad-Tel for the newest tube types

UP TO 75% OFF RAD-TEL'S Quality Brand New Tubes

1-year Guarantee

FAST ONE-DAY SERVICE

Every Serviceman Should Stock These Popular New Tube Types Offered by RAD-TEL

Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
	1G3	.79		6CE5	.57		7EY6	.73
	1J3	.79		6CK4	.70		12D4	.69
	1K3	.79		6CM8	.90		12DT5	.76
	2EN5	.45		6CY5	.70		12DT7	.79
	3DG4	.85		6DA4	.68		12DT8	.79
	3DK6	.60		6DT8	.79		12DW8	.89
	5AS8	.86		6EB5	.72		12EM6	.79
	5BT8	.83		6EM5	.76		12EN6	.78
	5CM8	.90		6EY6	.75		18FW6	.49
	5CZ5	.72		6GK6	.79		18FX6	.53
	6AX8	.92		6GN8	.94		18FY6	.50

EACH TUBE INDIVIDUALLY & ATTRACTIVELY BOXED & BRANDED RAD-TEL

Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
	0Z4	.79		6AF4	.97		6EW6	.57		12C5	.56
	1AX2	.62		6AG5	.68		6F5GT	.39		12CN5	.56
	1B3	.79		6AH4	.81		6F6	.69		12CR6	.54
	1DN5	.55		6AH6	.99		6FE8	.75		12CU5	.58
	1L4	.68		6AK5	.95		6GH8	.80		12CU6	1.06
	1R5	.62		6AL5	.47		6H6	.58		12CX6	.54
	1S2A	.76		6AL7	1.43		6J5GT	.51		12DB5	.69
	1S4	.59		6AM4	1.50		6J6	.67		12DE8	.75
	1S5	.51		6AM8	.78		6K6	.63		12DL8	.85
	1T4	.58		6AQ5	.53		6L6	1.06		12DQ6	1.04
	1U4	.57		6AR5	.55		6N7	.98		12DS7	.79
	1U5	.50		6AS5	.60		6S4	.51		12DU7	1.01
	1V2	.50		6AS6	.80		6SA7GT	.76		12DW8	.89
	1X2B	.82		6AT6	.43		6SG7GT	.41		12DZ6	.56
	2AF4	.96		6AT8	.79		6SH7GT	.49		12ED5	.69
	2BN4	.64		6AU4	.82		6SJ7	.88		12EG6	.54
	2EA5	.70		6AU6	.52		6SK7GT	.74		12EK6	.56
	2ES5	.68		6AU7	.61		6SL7GT	.80		12EL6	.50
	3A3	.76		6AU8	.87		6SN7GT	.65		12EZ6	.53
	3A4	.60		6AV6	.41		6SQ7	.73		12F8	.66
	3AF4	1.02		6AW8	.90		6T4	.99		12FA6	.79
	3AL5	.42		6AX4	.66		6T8	.85		12FM6	.43
	3AU6	.51		6AX5	.74		6U8	.83		12FR8	.91
	3AV6	.41		6AX7	.64		6VG6T	.54		12FX8	.85
	3BA6	.51		6BA6	.50		6V8	.86		12GC6	1.06
	3BC5	.54		6BA7	.84		6W4	.60		12J8	.84
	3BE6	.52		6BA8	.88		6W6	.71		12K5	.65
	3BN6	.76		6BC5	.61		6X4	.39		12L6	.58
	3BU8	.78		6BC7	.94		6X5GT	.53		12SA7	.92
	3BY6	.55		6BC8	.97		6X8	.80		12SF5	.50
	3BZ6	.55		6BD5	1.25		6Y6G	.65		12SF7	.69
	3CB6	.54		6BE6	.55		7A8	.68		12SH7	.49
	3CF6	.60		6BF5	.90		7AU7	.61		12SJ7	.67
	3CS6	.52		6BF6	.44		7B6	.69		12SK7	.74

NOT AFFILIATED WITH ANY OTHER MAIL ORDER TUBE COMPANY

Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
	3DT6	.50		6BG6	1.66		7F8	.90		12SL7	.80
	3Q4	.63		6BH6	.65		7N7	.90		12SN7	.67
	3Q5	.80		6BH8	.87		7S7	1.01		12SQ7	.78
	3S4	.61		6BJ6	.62		7Y4	.69		12U7	.62
	3V4	.58		6BJ7	.79		8AU8	.83		12V6	.53
	4AU6	.54		6BK7	.85		8AW8	.93		12W6	.69
	4BA6	.51		6BL7	1.00		8BQ5	.60		12X4	.38
	4BC5	.58		6BN4	.57		8CG7	.62		17AX4	.67
	4BC8	.96		6BN6	.74		8CM7	.68		17BQ6	1.09
	4BN6	.75		6BQ5	.65		8CN7	.97		17D4	.69
	4BQ7	1.01		6BQ6	1.05		8CS7	.74		17DE4	.74
	4BS8	.98		6BQ7	1.00		8CX8	.93		17DQ6	1.06
	4BU8	.71		6BR8	.78		8EB8	.94		17L6	.58
	4BZ6	.58		6BS8	.90		8SN7	.66		17W6	.70
	4BZ7	.96		6BU8	.70		9CL8	.79		19AU4	.83
	4BZ8	1.10		6BX7	1.02		11CY7	.75		19BG6	1.39
	4CS6	.61		6BY5	1.15		12A4	.60		19C8	1.14
	4DE6	.62		6BY6	.54		12AB5	.55		19T8	.80
	4DK6	.60		6BY8	.66		12AC6	.49		19V8	.79
	4DT6	.55		6BZ6	.55		12AD6	.57		21EX6	1.49
	4EW6	.58		6BZ7	1.01		12AE6	.43		25AV5	.83
	5AM8	.79		6BZ8	1.09		12AE7	.94		25AX4	.70
	5AN8	.86		6C4	.43		12AF3	.73		25BK5	.91
	5AQ5	.52		6C8	.90		12AF6	.49		25BQ6	1.11
	5AT8	.80		6CB6	.55		12AJ6	.46		25C5	.53
	5AV8	1.01		6CG6	1.42		12AL5	.45		25CA5	.59
	5AZ4	1.41		6CF6	.64		12AL8	.95		25CD6	1.44
	5BC8	.79		6CG7	.61		12AQ5	.60		25CU6	1.11
	5BE8	.83		6CG8	.77		12AT6	.43		25DN6	1.42
	5BK7	.82		6CL8	.79		12AT7	.76		25EH5	.55
	5BQ7	.97		6CM6	.64		12AU6	.51		25L6	.57
	5BR8	.79		6CM7	.66		12AU7	.60		25W4	.68
	5CG8	.76		6CN7	.65		12AV6	.41		25Z6	.66
	5CL8	.76		6CQ8	.84		12AV7	.75		32ET5	.55
	5CQ8	.84		6CR6	.51		12AX4	.67		32L7	.90
	4CY5	.71		6CS6	.57		12AX7	.63		35B5	.60
	5EA8	.80		6CS7	.69		12AY7	1.44		35C5	.51
	5EU8	.80		6CU5	.58		12AZ7	.86		35L6	.57
	5J6	.68		6CU6	1.08		12B4	.63		35W4	.42
	5T4	.79		6CY7	.71		12BA6	.50		35Z5	60
	5T8	.81		6DB5	.69		12BA7	.84		36AM3	.36
	5U4	.60		6DB6	.51		12BD6	.50		50B5	.60
	5U8	.81		6DE6	.58		12BE6	.53		50C5	.53
	5V3	.90		6DG6	.59		12BF6	.44		50EH5	.55
	5V6	.56		6DK6	.59		12BH7	.77		50L6	.61
	5X8	.78		6DN6	1.55		12BK5	1.00		5744	1.50
	5Y3	.46		6DQ6	1.10		12BL6	.56		5763	1.00
	5Y4	.59		6DT6	.53		12BQ6	1.06		5784	1.50
	6A8G	1.20		6EA8	.79		12BR7	.74		70L7	.97
	6AB4	.46		6EB8	.94		12BW7	.78		7025	.69
	6AC5	1.05		6EM7	.82		12BY7	.77		84/6Z4	.46
	6AC7	.96		6EU8	.79		12BZ7	.75		807	.70
	6AF3	.73								117Z3	.61

SEND FOR FREE TROUBLE SHOOTING GUIDE AND NEW TUBE & PARTS CATALOG

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

RAD-TEL TUBE CO.

DEPT PE-1261 **55 CHAMBERS STREET, NEWARK 5, NEW JERSEY**

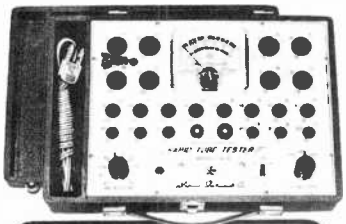
SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Superior's New Model 82A **A truly do-it-yourself type**

TUBE TESTER

TEST ANY TUBE IN 10 SECONDS FLAT!



Model 82A—Tube Tester
Total Price $36.50
Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

1. Turn the filament selector switch to position specified.
2. Insert it into a numbered socket as designated on our chart (over 600 types included).
3. Press down the quality button—

THAT'S ALL! *Read emission quality direct on bad-good meter scale.*

FEATURES:

• Tests over 600 tube types. • Tests OZ4 and other gas-filled tubes. • Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings. • Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence. • Dual Scale meter permits testing of low current tubes. • 7 and 9 pin straighteners mounted on panel. • All sections of multi-element tubes tested simultaneously. • Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82A will outperform similar looking units which sell for much more—and as proof, we offer to ship it on our examine before you buy policy.

Model 82A comes housed in handsome, portable case. Only ..... **$36.50 Net**

SUPERIOR'S NEW MODEL 79 **SUPER-METER** **WITH NEW 6" FULL-VIEW METER**

A Combination **VOLT-OHM MILLIAMMETER**
Plus **CAPACITY, REACTANCE, INDUCTANCE & DECIBEL MEASUREMENTS**
Also Tests **SELENIUM & SILICON RECTIFIERS, SILICON & GERMANIUM DIODES**

Model 79—Super Meter
Total Price $38.50
Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

The model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development. It includes not only every circuit improvement perfected in 20 years of specialization but, in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes — components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

SPECIFICATIONS:

● D.C. VOLTS: 0 to 7.5/15/75/150/750 1,500. ● A.C. VOLTS: 0 to 15/30/150/300 1,500/3,000 ● D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes ● RESISTANCE: 0 to 1,000/100,000 Ohms, 0 to 10 Megohms. ● CAPACITY: .001 to 1 Mfd., 1 to 50 Mfd. ● REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms. ● INDUCTANCE: .15 to 7 Henries, 7 to 7,000 Henries. ● DECIBELS: —6 to +18, +14 to +38, +34 to +58. The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings. All Electrolytic Condensers from 1 MFD to 1000 MFD. All Germanium Diodes. All Selenium Rectifiers. All Silicon Diodes. All Silicon Rectifiers.

Model 79 comes complete with operating instructions, test leads, and streamlined carrying case. Use it on the bench—use it on calls. Only **$38.50**

We invite you to try before you buy any of the models described on this page and the following page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated 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, INC.
Dept. D-913 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

☐ Model 79 . Total Price $38.50 $8.50 within 10 days. Balance $6.00 monthly for 5 months.

☐ Model 82A...Total Price $36.50 $6.50 within 10 days. Balance $6.00 monthly for 5 months.

☐ Model TV-50A...Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ Model 70...Total Price $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.

Name .....

Address .....

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

All prices net, F.O.B., N. Y. C.

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Superior's New Model 70 UTILITY TESTER®

FOR REPAIRING ALL ELECTRICAL APPLIANCES and AUTOMOBILE CIRCUITS

Model 70—UTILITY TESTER
Total Price...$15.85—
Terms: $3.85 after 10 day trial, then $4.00 monthly for 3 months, if satisfactory. Otherwise return, no explanation necessary.

As an electrical trouble shooter the Model 70:

- Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Switches, Thermostats, etc.
- Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakages, etc.
- Will measure current consumption while the appliance under test is in operation.
- Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc.
- Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

As an Automotive Tester the Model 70 will test:

- Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

INCLUDED FREE *This 64-page book—practically a condensed course in electricity. Learn by doing.*

Just read the following partial list of contents: What is electricity? • Simplified version of Ohms Law • What is wattage? • Simplified wattage charts • How to measure voltage, current, resistance and leakage • How to test all electrical appliances and motors using a simplified trouble-shooting technique. • How to trace trouble in the electrical circuits and parts in automobiles and trucks.

Model 70 comes complete with 64 page book and test leads

Only $15.85

Superior's New Model TV-50A **GENOMETER**

7 Signal Generators in One!

Model TV50-A—Genometer
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

- ✔ R.F. Signal Generator for A.M.
- ✔ R.F. Signal Generator for F.M.
- ✔ Audio Frequency Generator
- ✔ Marker Generator
- ✔ Bar Generator
- ✔ Color Dot Pattern Generator
- ✔ Cross Hatch Generator

This Versatile All-Inclusive **GENERATOR** Provides **ALL** the Outputs for Servicing:

• A.M. RADIO • F.M. RADIO • AMPLIFIERS • BLACK AND WHITE TV • COLOR TV

R. F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

MARKER GENERATOR: The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency)

BAR GENERATOR: Pattern consists of 4 to 16 horizontal bars or 7 to 20 vertical bars.

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

CROSS HATCH GENERATOR: The pattern consists of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

Complete with shielded leads

$47.50 Net

TRY FOR 10 DAYS

BEFORE you buy! ***THEN*** if satisfactory pay in easy, interest free, monthly payments. See coupon inside.

We invite you to try before you buy any of the models described on this and the preceding page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time payment schedule details.)

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

FIRST CLASS
Permit No. 61430
New York, N. Y.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the U. S.

VIA AIR MAIL

POSTAGE WILL BE PAID BY —

MOSS ELECTRONIC, INC.

3849 TENTH AVENUE

NEW YORK 34, N. Y.