Radio-telephones for Everyone

(see page 40)

ALSO IN THIS ISSUE:
Minimum $ Hi-Fi...Build a VTVM...Simple

www.americanradiohistory.com
TEST 5 TUBES in 4 SECONDS each... ACCURATELY!

WITH THE NEW ADVANCED ENGINEERED

precise
MODEL 116

Gm. & Em. ULTRAFAST TUBE & TRANSISTOR TESTER

PRECISE MODEL 116K in kit form $69.95
PRECISE MODEL 116W factory wired $119.95
Incl. Carrying Case & Cover

Servicemen know the Precise Model 111 (the winner in an independent survey) easily rates "the finest tube tester in the field" at any price, BUT FOR AN ON THE JOB QUICK-TEST...the fastest, most accurate is the PRECISE Model 116.

What's more you test tubes the foolproof method inherent in the famous Precise Model 111.

Did you ever wish you could plug in 5 of the same type tubes at once and check each one individually by rotating a switch? YOU CAN WITH THE PRECISE MODEL 116—Plug in 5 if tubes and let them heat up at once and then check each one separately by rotating the TUBE BANK switch. ACTUALLY CHECK 5 TUBES IN 20 SECONDS, 4 SECONDS PER TUBE.

The Precise Model 111 taught the lesson that IF amplifier tubes (like the 6BC5 or 6AU6) should be tested for Gm (mutual transconductance) while the power amplifiers (like the 6L6) should be tested for Em (emission)—that's ULTRAFAST Model 116 test! It checks each section of each tube separately... by rotating the FUNCTION SWITCH... each triode of a dual-triode is checked individually...each diode and the triode of a duo-diode-triode is separately tested and not lumped as in other testers...and a pentode is tested as a pentode—not a diode TRANSISTORS, SHORTS, GAS, LIFE, Em, Gm etcetera can be tested with the Precise Model 116.

You can inexpensively extend the Precise Model 116 to test filament current, etc. The Model 116 gives an accurate, ultra-fast (3 basic knobs for testing) check of television tubes!

No Surplus—An etched panel—beautiful Moleskin covered wood carrying case and cover and specially simplified instructions makes the PRECISE MODEL 116 THE FINEST FAST-CHECK TUBE TESTER AND DOLLAR EARNING TRAVELING COMPANION A TV SERVICEMAN EVER HAD.

Not yet at your distributor. Order NOW to insure early delivery.

SEE YOUR LOCAL DISTRIBUTOR FOR PROOF OF WHAT WE OFFER—OR WRITE US FOR DOCUMENTARY RESULTS OF AN INDEPENDENT SCIENTIFIC SURVEY.

WRITE FOR CATALOG PE 6-6

precise DEVELOPMENT CORP. OCEANSIDE, NEW YORK, U.S.A.
I WILL TRAIN YOU AT HOME FOR GOOD PAY JOBS IN RADIO-TELEVISION

America's Fastest Growing Industry Offers You Good Pay—Bright Future—Security

I TRAINED THESE MEN

"Started to repair sets six months after enrolling. Earned $15 to $15 a week in spare time." —Adam Kranik, Jr., Sunnyside, Pennsylvania.

"Up to our necks in Radio-Television work. Four other NRI men work here. Am happy with my work." —Glen Peterson, Bradford, Ont., Canada.

"Am doing Radio and Television servicing full time. Now have my own shop. I owe my success to NRI." —Curtis Stath, P. O. Box 248, Madison, Iowa.

"Am with WCOC. NRI course can't be beat. No trouble passing 1st exam. Radio-phone license exam." —Jesse W. Larson, Mendon, Mississippi.

"By the time I graduated I had paid for my course, a car and testing equipment. Can service toughest jobs." —J. C. Strittenberger, New Boston, Ohio.

Available to Veterans Under G.I. Bills

You Learn by Practicing with Parts I Send

Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I furnish to build many circuits common to Radio and Television. As part of my Communications Course you build many circuits, including low power transmitter shown at left. You put it "on the air," perform procedures required of broadcast operators. With my Servic- ing Course you build modern Radio, etc.; use Multimeter you build to make money fixing sets in spare time while training. You can stay at home keep your job. Learn Radio-TV in spare time at low cost. Mail coupon for book showing other equipment you build and keep.

The Tested Way to Better Pay!

Radio-TV Needs Men of Action—Mail Coupon

Without obligating you in any way, I'll send an actual lesson to prove that my training is practical, thorough; 64-page book to show good job opportunities for you in Radio-TV. Terms for NRI training are as low as $5 a month. Many graduates make more in two weeks than total cost of training. Mail coupon now. J. E. SMITH, President, National Radio Institute, Dept. 6FD4, Washington 9, D. C. OUR 40TH YEAR.

Good for Both—FREE

MR. J. E. SMITH, President, Dept. 6FD4, National Radio Institute, Washington 9, D. C.

Mail me Sample Lesson and 64-page Book, FREE. (No salesman will call. Please write plainly.)

Name.............................

Address............................

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

Mail coupon today to...

POPULAR ELECTRONICS is published monthly by Ziff-Davis Publishing Company, William S. Ziff, Chairman of the Board, 1946, 108 East 45th St., New York 17, N. Y. Entered as second class matter, August 27, 1954, at the Post Office, Chicago, Illinois. SUBSCRIPTION RATES: One year U.S. and possessions, and Canada $5.00; Pan-American Union Countries $8.00; all other foreign countries $10.00.

June, 1956
Two Are What’s Baked Baffle Maximum Simple Transistorized Geiger Counters

The SWL’s Receiver Phono-Plug Variable

Tools The Tuning the Short Letters from POP’tronics Bookshelf 22

Carl Famed Enclosure Disc Secret Economy Index

Radio Aboard Operation England “Missile Master” DX TV

New Typewriter Perfect Servant of Life Class

Your and and Our Readers 28...John T. Frye 8

DEPARTMENTS

POP’tronics Bookshelf 22

Letters from Our Readers 28

Out of Tune 32

Tuning the Short-Wave Bands 61

Transistor Topics 76

After Class 86

The Transmitting Tower 94

Tools and Gadgets 99

Tips and Techniques 100

(Also see page 6)

1956 by Ziff-Davis Publishing Company. All rights reserved.

Average Net Paid Circulation 205,193

JUNE 1956

VOL. 4—NUMBER 6

ASSISTANT PUBLISHER

EDITORIAL DIRECTOR

Oliver Reed, W1ETI

MANAGING EDITOR

G. P. Ferrell

TECHNICAL EDITOR

H. S. Renne

FEATURE EDITOR

Norman Eisenberg

ASSOCIATE EDITORS

H. H. Fantel

M. C. Magna

ART EDITOR

A. J. Reich

CONTRIBUTING EDITORS

H. Bennett

I. E. Garner, Jr.

H. S. Brier

H. Pollock

J. T. Frye

R. F. Turner

ART DEPARTMENT

Frank Soydes (Director)

J. A. Gallovensk M. Whelpley

W. K. Vahslng

ADVERTISING DEPARTMENT

NEW YORK (MU 7-8080)

L. L. Olsen—Advertising Director

Wm. G. McKey—Advertising Manager

Burt Covitt

CHICAGO (AN 3-5200)


LOS ANGELES (Finley 8043)


Member

Audit Bureau of Circulations

ZIFF-DAVIS

PUBLISHING COMPANY

W. B. ZIFF (1898-1953) FOUNDER

Also Publishers of RADI0 & TELEVISION NEWS

Editorial and Executive Offices

366 Madison Ave., New York 17, N.Y.

PRESIDENT

B. G. DAVIS

VICE-PRESIDENTS

H. J. MORGANROTH M. FROELICH

SECRETARY-TREASURER

G. E. CARNEY

CIRCULATION MANAGER

M. MICHAELSON

BRANCH OFFICES

Chicago (1), 64 E. Lake St.,

Los Angeles (14), Room 412

215 W. 7th St.

SUBSCRIPTION SERVICE:

All communications concerning subscriptions should be addressed to Circulation Dept., 64 E. Lake St., Chicago 1, Ill. Include your old address as well as new—enchuse it possible to address label from a recent issue of this magazine. Allow at least 4 weeks for change of address.

CONTRIBUTORS:

Contributors are advised to retain a copy of their manuscripts and illustrations. Contributions should be addressed to the New York, Editorial Office and will not be acknowledged, unless accompanied by a stamped, self-addressed envelope. All contributions will be handled with reasonable care, but this magazine assumes no responsibility for their safety. Any copy accepted is subject to whatever adaptations and revisions are necessary to meet the requirements of this publication. Payment covers all authors’ authorized, contributed, and contestant’s rights to the title and the use of the material accepted and will be made upon acceptance. All photos and drawings will be considered as part of material purchased.

POPULAR ELECTRONICS
Train in Great Shops of COYNE for better jobs in

ELECTRICITY or TELEVISION

ELECTRONICS

RADIO—COLOR TV

TWO TOP OPPORTUNITY FIELDS

Whether 17 or up to 45 years of age, train the Coyne way for a better job and a real future in ELECTRICITY—ELECTRONICS or TELEVISION—RADIO, fields that offer a world of opportunities. Train on real, full-size equipment at COYNE where thousands of successful men have trained for over 57 years—largest, oldest, best equipped school of its kind—established 1899. No advanced education or previous experience needed. Employment service to graduates.

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

MAIL COUPON FOR FREE BOOK


B. W. COOKE, President
COYNE ELECTRICAL SCHOOL
500 S. Paulina St., Chicago 12, III., Dept. A6-71H
Send BIG FREE book and details of your training offer. This does not obligate me and no salesman will call. I am interested in:

( ) Electricity-Electronics ( ) Television-Radio

Name__________________________
Address________________________
City_________________ State_______

B. W. COOKE, President
COYNE TELEVISION HOME TRAINING
500 S. Paulina St., Chicago 12, Dept. A6-HT7
Send Free Book and details on how I can get Coyne Quality Television Home Training at low cost and easy terms.

Name__________________________
Address________________________
City_________________ State_______

Mail Coupon for Free Book

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

COYNE Television
Home Training Division
500 S. Paulina St., Chicago 12, III.
Dept. A6-HT7

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

COYNE TELEVISION SCHOOL
A TECHNICAL TRADE INSTITUTE OPERATED NOT FOR PROFIT
500 S. Paulina Street, Chicago 12, Dept. A6–HT7

Send Coupon for Free Book

YOU CAN QUICKLY BE DOING INTERESTING PROFITABLE WORK LIKE THIS

Coyne—the Institution behind this training—... the largest, oldest, best equipped technical trade school of its kind. Founded 1899.

June, 1956
A craftsman is known by the tools he uses. Because "American Beauty" stands for fine tools, put one in your shop and do a finer job of soldering.

Used by the country's leading radio, TV and electronics manufacturers on production lines. Quality-built for a lifetime of service — a pleasure to use. A size and shape for every job.

Available at your electronics supply store or write direct to —

AMERICAN ELECTRICAL HEATER COMPANY

Detroit 2, Michigan
NOW — while the Television-Radio-Electronics industry is expanding at the fastest rate in history — is the time for you to prepare for a top-pay lifetime job ... or your own profitable business.

New TV stations are going up constantly ... sales of TV sets are breaking all past records ... new products are being announced almost every day ... new plants are springing up to meet the heavy demand for these products.

Trained men are needed urgently. The head of CBS-Columbia product service department estimates that the industry will need 200,000 service men by 1959. The best jobs will go to the men who are ready for them. Right now is the time for you to prepare yourself. Delay can be costly.

STUDY NEWEST DEVELOPMENTS

My training covers all the latest developments in the fast-growing Television-Radio-Electronics industry. You learn about FM — RADAR — COLOR TV — TRANSISTORS — PRINTED CIRCUITS, etc.

CHOOSE FROM THREE COMPLETE COURSES covering all phases of Radio, FM and TV

1. Radio, FM and Television Technician Course — no previous experience needed.
2. FM-TV Technician Course — previous training or experience in radio required.
3. TV Cameraman and Studio Technician Course — advanced training for men with Radio or TV training or experience.

EARN WHILE YOU LEARN

Almost from the very start of your course you can earn extra money by repairing sets for friends and neighbors. Many of my students earn up to $25 a week ... pay for their entire training with spare time earnings ... start their own profitable service business.

MAIL THIS COUPON TODAY!

Mr. Leonard C. Lume, President
Radio-Television Training Association
Dept. E-6C, 32 East 19th Street, New York, N. Y.

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

(PLEASE PRINT CLEARLY)

Name ____________________________ Age _______
Address ____________________________
City __________________ Zone ______ State ______

I am interested in: ∑ Radio-FM-TV Technician Course ∑ FM-TV Technician Course ∑ TV Cameraman & Studio Technician Course

Mail coupon today for your FREE samples. Get ready to earn your own money in Television today!
Specially designed for use in IF amplifiers, regenerative receivers, switching circuits and high frequency oscillators. The Raytheon CK768 Transistor has high frequency response, low Ic, low collector capacitance, and will average 28 db gain in 455Kc IF amplifiers. The low Ic makes the CK768 also useful in DC amplifier service.

The Raytheon CK768 is built to the same high standards of quality and performance that have made Raytheon Transistors first in the field. Today, there are more Raytheon Transistors in use than all other makers combined.

The new Raytheon CK768 is available only from your Raytheon Tube Supplier.

Price $1.50 Each

Send 50¢ to Raytheon, Dept. P7, for booklet containing over 50 Practical Transistor Applications.

Geniuses at Work

FOR AN HOUR Carl and Jerry had been working away on separate projects at opposite ends of the workbench in their basement laboratory. Each was too stubborn to ask what the other was doing, but the puzzled glances each of them sneaked at the other’s equipment from time to time revealed how great was the strain. Finally Jerry cracked.

“So, okay; I give up. What are you doing with that timer clock, making a time bomb?”

“Not at all,” Carl answered, taking off his horn-rimmed glasses and wiping them with a very dubious-looking handkerchief. “You know what a large charge I get out of these bright, warm, sunny, sparkling summer mornings. I don’t want to miss a single one of them, and this timer clock I built from that article in the May, 1955, issue of Popular Electronics will make sure that I won’t. A 110-volt a.c. electric gong that used to be in a fire station is plugged into the ‘turn on’ outlet on the back of the timer and converts it into an electric alarm clock that nobody, but nobody, can ignore.”

“At the same time,” Carl continued, “you know that my second love is sleeping, and nothing gripes me quite so much as to have that gong bounce me out of bed only to discover it’s a cloudy or rainy morning good only for staying in the sack. What I’m doing now is taking out insurance against such a revolting development. This sun-battery photocell will be mounted outside my window where the rays of the rising sun can shine directly on it. Leads will go from the cell to a sensitive relay whose contacts close only when direct sunlight falls on the cell. These contacts are inserted in one of the leads going to the gong, and—”

“I get it,” Jerry broke in, admiringly. “If it’s a cloudy day, the relay contacts will stay open and keep the timer from ringing the gong; but if the sun is shining, then the timer clock will wake you—and doubtless the rest of the household—at the time for which it is set. My boy, you’re a real brain!”

“Really nothing,” Carl said, with airy
2 IMPORTANT DEVELOPMENTS
OF INTEREST TO EVERY
HIGH FIDELITY ENTHUSIAST IN THE COUNTRY

Collaro ANNOUNCES

1. NEW MODEL RC-456 - the first 4-speed high fidelity record changer for 78, 45, 33⅓ and 16⅚ rpm.

2. NEW LOW PRICE of $34.50* - the lowest in the field for a recognized high fidelity changer.

The New RC-456 Features:
Manual Operation
Automatic Intermix
Pre-Wired for Easy Installation

...plus all the other features that have made Collaro the fastest growing changer in the field.

*less cartridge — slightly higher West of Rockies

For complete details, write to Dept. GF-18
ROCKBAR CORPORATION, 650 Halstead Ave., Mamaroneck, N.Y.

Made in England

June, 1956
CARL & JERRY (Continued from page 8)

modesty. "What are you doing there?"
"Well," Jerry said hesitantly, "I guess you might say I was making a mug-trap."
"You're not getting through to me. Try another wavelength."

"IT'S THIS WAY," Jerry explained. "My Uncle Walter, who lives off a farm just south of town, has something very funny going on in his henhouse. About every other night, something or somebody—probably the latter—goes into the henhouse, tears up the hens' nests, and scatters them all over the floor."

"Why do you say it's probably 'somebody'?"

"Because my uncle thinks that only a human being would be able to unfasten the rather complicated latch on the door. He says, too, that if it were a fox or a skunk or a weasel, such an animal would kill the chickens and eat them; but all the mysterious visitor does is scare heck out of the hens. They're so nervous that their egg-laying is falling off."

"A hen with a nervous breakdown is something I've got to see," Carl said with a grin; "but where do you fit into all this?"

"Uncle Walt, who realizes I'm an electronic genius, wants me to help him catch the critter, or at least to find out what it is. He doesn't want to use any ordinary kind of trap because he suspects that maybe kids are doing the mischief, and naturally he wouldn't want to hurt them. At the same time, he doesn't want just to sit around and have his prize hens scared silly."

"What've you got in mind?"
"I can show you a lot easier than tell you. Why don't you go out to Uncle Walt's with me and stay all night? You can tell your mom I invited you."

"It's a deal! Wait until I get my leg-power hot rod, and I'll be right with you. I've got to see this Strange Case of the Harassed Hens to a finish."

Carl's mother had no objection, and soon the boys were riding their bikes toward the farm. As was always the case when something interesting was in prospect, they didn't use the seats of the bicycles much, and they soon arrived at the prosperous-looking farm of Jerry's uncle. Uncle Walt was a tall lean man with bright blue eyes set deep in a lined and weathered face. After Jerry had introduced Carl and explained that he was going to stay all night, the man turned to his nephew and said, "Well, how about it, Marconi? Are you all set to give our mysterious visitor his comeuppance?"

"I think so, Uncle Walt. If you don't
Better Training for a Brighter Future!

You get laboratory type PRACTICAL EXPERIENCE from your own HOME LABORATORY. Work over 300 projects.

You build and keep a 5-INCH OSCILLOSCOPE and VACUUM TUBE VOLTMETER. Helps you EARN while learning.

Wonderfully effective, exclusive HOME MOVIES help you grasp important points faster, easier, better.

You may also build and keep a 21 INCH TV SET. DTV offers another home training without the TV set.

Here is one of the most effective ways to OPEN THE DOOR to opportunity in TELEVISION-ELECTRONICS

Your future is the most important thing in your life! Give it every advantage you can. Find out about the wonderfully promising years facing YOU in America's great, billion dollar field of Television-Electronics... once you are properly trained.

And you can now get the very training industry wants, either by attending DTV's wonderfully equipped Chicago laboratories—one of the nation's finest—or by getting laboratory type training in your spare time at home. Remember—you receive more than just home training from DTV. You get training that has profited from the knowledge and experience gained in preparing thousands of men in DTV's Chicago laboratories.

You get training that includes all of the wonderful features shown to the right. You learn-by-reading from lessons... you learn-by-seeing from DTV's exclusive, remarkably effective visual training MOVIES... you learn-by-doing from many shipments of electronic parts.

EMPLOYMENT SERVICE

And upon completing either the Home Program or Chicago Laboratory Training, you get the SAME EFFECTIVE EMPLOYMENT SERVICE that has already helped thousands of men to a real job or their own profitable business in Television-Radio-Electronics.

Little wonder so many men express amazement at the results secured through DTV. There's NOTHING ELSE like it! See for yourself. Mail coupon today for the fascinating story about DTV. There's no obligation. The time to act about your future is...NOW!

The DeVRY Technical Institute
4141 Belmont Ave., Chicago 41, Ill.

"One of America's Foremost Electronics Training Centers"

DeVRY TECHNICAL INSTITUTE
4141 Belmont Ave., Chicago 41, Ill.

FORMERLY DEFOREST'S TRAINING, INC.

Here and above, are typical views of DTV's great Chicago training center—attended by many students from the United States, Canada and the Hawaiian Islands. These men can here to benefit from one of the finest, practical laboratory training, of the kind—not only in Television and Radio—but also in Industrial Electronics, Nuclear Instrumentation, and other highly promising branches of today's great, billion dollar Electronics field.

June, 1956
CARL & JERRY (Continued from page 10)

mind, Carl and I will get busy right away setting up the—the—the device."

"Be my guests, boys!" Uncle Walt said with a grin, waving toward the neat, well-painted chicken house. "I'll go and start the milking."

"FIRSt," Jerry said, as he started unloading the cardboard box he had brought along, "we'll mount this normally closed Microswitch on the door jamb so that its contacts are held open by the closed door, and so that the contacts will close just as soon as the door starts to open. As you can see, the switch is inserted in one wire of this line cord, which will go from an outlet socket inside the chicken stable to the rotary solenoid fastened to this board with the camera."

"Hold it! What exactly is a rotary solenoid?"

"It's a solenoid that twists a shaft through an arc of several degrees when current is applied to it, instead of moving a plunger as the ordinary solenoid does. The little arm fastened to the rotating shaft connects through this small spring to the shutter release of the camera. And notice that at the end of the little arm's
Cast your ballot for a successful future!

256 I.C.S. COURSES

Whether you stand at a machine or sit at a desk...whether you're making $75 a week or $75 hundred a year...whether your interest is Power Plants or Paper Pulp, Advertising or Electronics...chances are I.C.S. has exactly the course you need to get ahead.

I.C.S. is not only the oldest and largest correspondence school. It also offers the most courses. 256 in all. Each one success-proved by graduates who rose to top technical and administrative positions. Chief engineers, Superintendents, Foremen, Managers. Executive assistants.

I.C.S. Courses cover bedrock facts and theory plus practical, on-the-job applications. No skimping. Texts are prepared by leading business and industrial authorities working with I.C.S. editors and educators. They are constantly being reviewed and revised in line with current developments.

As an I.C.S. student, you study in your spare time, set your own pace. No time lost getting to class or waiting for slower students to catch up. If you wish, I.C.S. will make progress reports to your employer. You win recognition as a "comer," one who is ready to move ahead. Thousands of students report pay increases and promotions within a few months of enrollment. All graduates win the coveted, approved I.C.S. diploma.

3 FREE BOOKS! Check the subject that interests you in the coupon below. I.C.S. will rush you (1) a special book outlining your opportunities in this field, (2) the 32-page gold mine of career tips, "How to Succeed," (3) a sample I.C.S. lesson (Math.) demonstrating the famous "I.C.S. Method." "X" MARKS OPPORTUNITY.


I. C. S., Scranton 9, Penna. Member, National Home Study Council

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 23622E, Scranton 9, Pennsylvania

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

CIVIL, STRUCTURAL ENGINEERING
- Civil Engineering
- Construction Engineering
- Highway Engineering
- Reading Struc. Blueprints
- Sanitary Engineering
- Structural Engineering
- Surveying and Mapping

DRAFTING
- Aircraft Drafting
- Architectural Drafting
- Electrical Drafting
- Mechanical Drafting
- Mine Surveying and Mapping
- Tubing Drawing and Estimating
- Structural Drafting

ELECTRICAL
- Electrical Engineering
- Electrical Maintenance
- Electricity (Contr. Contracting
- Illuminating

HIGH SCHOOL
- Commercial
- Good English
- High School Subjects
- Mathematics

(Partial list of 256 courses)

Name:

City: Zone: State:

Occupation:

Age:

Address:

Working Hours:

June, 1956

Canadian residents send coupon to International Correspondence Schools, Canadian, Ltd., Montreal, Canada...Special tuition rates to members of the U.S. Armed Forces.

www.americanradiohistory.com
CARL & JERRY (Continued from page 12)

travel it flips this toggle switch from on to off.”

“Two questions: why use the spring, and what does the toggle switch do?”

“The first thought of any experimenter or technician worth his salt is to protect his equipment against possible damage, and that’s the function of both the spring and the switch. This rotary solenoid is very fast-acting, and I was afraid it might injure the camera unless a shock-absorbing linkage was used between the arm and the shutter release. Also, this solenoid is intended only for intermittent use and would overheat and be destroyed if current were allowed to remain on it for a long period of time, as would happen if the door of the chicken house were left ajar. The switch is in series with the Microswitch and takes the voltage off the solenoid after it has done its job of tripping the camera. What’s more, with this switch in the off position, the door can be opened without tripping the camera—an important factor in setting things up, testing, or using the door during daylight hours when we don’t need to have the trap set.”

“Where will the camera be placed?”

“Back inside this box to protect it from the weather. The lens will be focused on the door, and when the solenoid trips the shutter, the synchronized flash will light up the whole area, providing us with a fine ‘mug-shot’ of whoever or whatever is fooling with the door.”

Carl walked slowly around, studying the layout from all angles.

“I see only one thing wrong,” he finally remarked. “If the prowler is human, the firing of the flash bulb is bound to show him where the camera is. What’s to prevent his taking camera, evidence, and all along with him?”

“That’s using the old hat-rack!” Jerry applauded. “Since it’s my camera, that worried me, too. But I’ve got the solution right here.” As he said this, he reached down into the cardboard carton and pulled out an electric bell. “This bell will be connected across the line cord going to the solenoid. It’ll be behind the Microswitch but ahead of the toggle switch. That way it’ll start to ring as soon as the door is opened, and will keep on ringing until the door is closed or until we come out and shut it off. Beast or human, it would have to be an iron-nerved character to stick around with this bell clanging away.”

WITH THE PLAN clearly in mind, the boys set to work and completed the installation in short order. They put the box in place and connected it all up. Then, Carl walked to the door and tried out the new device. When the bell rang, it startled him so much that he forgot to ring it for a moment. But he soon remembered and started ringing it, and then opened the door, and when the solenoid trips the shutter, the synchronized flash will light up the whole area, providing us with a fine ‘mug-shot’ of whoever or whatever is fooling with the door.”

Irish GREEN BAND Recording Tape
Now Made by FERRO-SHEEN Process
WITH NO HIKE IN PRICE

Tape recorder owners can now enjoy the benefits of Ferro-Sheen for not a penny more than they would pay for ordinary coated recording tape. That’s the significance of the announcement that Irish brand Green Band is being made by the Ferro-Sheen process. Ferro-Sheen is the exclusive Irish tape manufacturing process which astounded the audio world when it was introduced 18 months ago and has rendered ordinary coated tape old-fashioned, if not obsolete. Irish Ferro-Sheen process tape has the smoothest and most homogeneously bonded magnetic oxide surface of any recording tape ever made. It ends your worries about gumming up your recorder heads with the abrasive, easily shed oxide coating of ordinary coated tape. It improves the signal-to-noise ratio on all tape recorders. It gives you unprecedented fidelity because the mirror-smooth Ferro-Sheen surface makes for vastly improved head-to-tape contact, resulting in improved high-frequency response. It is simply the best-engineered tape in the world.

If your favorite dealer does not have Irish Ferro-Sheen process tape, write directly to the manufacturer. You should write in any case, because Irish will send you free of charge (and without any obligation) an illustrated booklet on “How Magnetic Tape Is Made,” as well as the Irish Comparator Card, which shows at a glance “Which Tape has the Smoothest Surface.” Address all inquiries to ORRadio Industries, Inc., Opelika 10, Alabama.

POPULAR ELECTRONICS
Another great advance in HOME STUDY TRAINING. Let National Schools of Los Angeles, a practical Technical Resident Trade School for over 50 years, train you at home by Shop-Method, for today’s unlimited opportunities in ALL 8 BRANCHES of the Television, Electronics, Radio Industry.

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

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

EARN AS YOU LEARN! Many of our students earn their entire tuition and more in Spare Time jobs we show them how to do while learning. YOU GET GRADUATE ADVISORY SERVICE, TOO.

L. J. ROSENKRANZ
President of NATIONAL SCHOOLS

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

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

IN CANADA: 811 W. Hastings St., Vancouver, B. C.

NATIONAL SCHOOLS
4000 S. FIGUEROA ST., LOS ANGELES 37, CALIF.
187 N. L. SALLE ST., CHICAGO 1, ILL.

NATIONAL SCHOOLS
TECHNICAL TRADE TRAINING SINCE 1905
Los Angeles, California

GET FAST SERVICE — MAIL NOW TO OFFICE NEAREST YOU!

NATIONAL SCHOOLS, DEPT. RZG-66
4000 S. FIGUEROA ST. OF LOS ANGELES 37, CALIF.
187 N. L. SALLE ST., CHICAGO 1, ILL.


NAME
ADDRESS
CITY
STATE

FREE!
Fully illustrated “CAREER” BOOK in TV, Radio, Electronics, AND actual Sample Lessons — yours at no cost, no obligation. SEND COUPON NOW TODAY!
CARL & JERRY (Continued from page 14)

housing the camera at one side of the door where it would be most likely to get a good profile shot of anyone looking down at the latch. When everything was in place, Jerry flipped the toggle switch on the camera mounting board to off and plugged the line cord into a receptacle inside the building. Instantly the electric bell began to ring loudly; but it stopped when the door was closed. Jerry thrust a bulb into the flash gun mounted on the camera and called to his uncle who was just going to the house with a brimming bucket of milk dangling from each arm:

"Uncle Walt, will you want to go into the chicken house any more during the evening?"

"Nope, I'm all through in there; so you can set your trap. Then you boys come on up to the house and wash up for supper. It ought to be about ready."

After one more final inspection of the wiring, Jerry flipped the toggle switch to on and the boys followed Mr. Bishop to the house. There, Mrs. Bishop, who looked a lot more like a club woman than a "typical" farm wife, served a fine country meal consisting of golden-brown store-dressed fried chicken, ready-mixed light biscuits covered with plenty of good yellow margarine, and a dessert of commercially quick-frozen strawberries spread over large mounds of luscious vanilla ice cream from the local ice cream plant.

This huge meal and the outdoor exercise the boys had had made them so sleepy that they were barely able to stay awake until nine o'clock. Right after that, they all went to bed.

IT SEEMED to Jerry that his head had barely touched the pillow before he found himself sitting bolt-upright in bed, staring into the darkness, while the distant ringing of a bell came through the open window. Nimblly he hopped out on the floor and switched on the light, only to discover that Carl was already tugging his pants on over his pajamas.

"Sounds like we got a rat in our trap," Carl grunted, as he tried to wriggle a bare foot into his shoe.

The boys pounded down the stairs and out into the barnyard. The bobbing circle of light from Mr. Bishop's flashlight guided them to the hen house where Uncle Walt, a double-barreled shotgun cradled in the crook of his arm, stood looking at the open door of the building.

"Whatever the thing was, it took off when the bell started to ring," he told the wide-eyed youths; "but if your contraption

---

**DO-IT-YOURSELF**

**HIGH FIDELITY CRYSTAL DIODE AM TUNER KIT**

The Miller No. 565 Tuner Kit is the result of masterful engineering and careful planning. Previously sold only as a factory assembled unit the tuner has received overwhelming acceptance by the most critical audiophiles, and is far superior to all other such tuner kits. Only recently have materials become available which make possible the construction of extremely high "Q" coils. Coils used in our tuner have a "Q" in the order of 600. Assembly and wiring of this tuner is not difficult. Step by step instructions with exploded views, pictures and circuit diagrams are supplied with each kit.

**No. 565**

The No. 565 tuner kit is fully guaranteed. Buy with confidence from your Radio and TV Parts Distributor. It is one of the lowest priced quality tuner kits on the market.

**Net Price $14.70**

J. W. MILLER COMPANY
5917 S. MAIN ST., LOS ANGELES 3, CALIF.

50 Wingold Ave. Toronto 10, Ont., Canada

**POPULAR ELECTRONICS**
Men 17-55!
Here's a New Opportunity For You!

Prepare at Home for a Profitable Career in Automation Electronics

Get in on the Ground Floor of this Fast-Moving Field

Want a better job? More money? Better working conditions? These are the things that can come to a man when he has a skill to offer, especially when that skill is in a newer field where ground floor opportunities often lead to well-paying positions. Such a field is the Electronic applications to Automation—and what a field!

Many plants, large and small, in various parts of the country are looking for ways of using automatic electronic control equipment to help turn out a better product and at lower cost. This equipment must be designed, installed and maintained—calling for well-trained men. That's where you may come in!

You need no special technical experience. No previous knowledge of Automation Electronics...to prepare for a future that can be bright and more secure. For now there is a proved way to get this important know-how. Mail coupon for complete details. Men 17 to 55 preferred.

What is Automation Electronics?

Simply stated, this refers to the marvelous electronic controls that will help regulate the many important processes in the modern, automatic factory—as well as other amazing automatic equipment in plants, offices and elsewhere. It is a gateway to some of the most desirable opportunities in the amazing, newer field of Automation.

A New Training Program!

As one of the leading organizations of its kind, the DeVry Technical Institute has years of experience in teaching Electronics, Televisions, and Radio. So it is only natural for this training institute to develop a new program to prepare men for good jobs in instrumentation—as well as in the design, installation and maintenance of Electronic controls— as applied to Automation.

Employment Service

Following the same proved method used to train thousands of other men, you get valuable practical experience from actual electronic equipment. You also receive well-illustrated texts and effective moving pictures to show important basic principles—a wonderful home training advantage! To top that off, DT I provides actual employment help when you have completed the training—all of which can open the way to many new and exciting opportunities.

Member of National Home Study Council

Mail This Coupon Today!

DeVry Technical Institute, Dept. PE-6A-M
4141 Belmont Avenue, Chicago 41, Ill.

I would like further information about the newer Electronic opportunities in Automation, also facts on how you may help me to prepare.

Name ___________________________ Age __________

Street ___________________________ Please Print __________

City ___________________________ Zone State __________

1012 DT I's training is available in Canada

June, 1956

DeVry Technical Institute
Chicago 41, Illinois

Formerly DeForest's Training, Inc.
CARL & JERRY (Continued from page 16)

worked, you should have his calling card inside the camera."

An examination with the aid of the flashlight revealed that the toggle switch had been flipped to off, indicating that the camera shutter had been tripped. Jerry removed the camera from the board and advanced the film to the next exposure.

"It's only two a.m.; so we may as well go back to bed," Uncle Walter suggested, as he closed and latched the door. "I'll see you young buckaroos at breakfast."

For a few minutes after getting back in bed, Carl and Jerry were too excited to go to sleep. But they soon calmed down and drifted off into slumber. They knew nothing more until Jerry's Aunt Enid knocked at their door and told them that breakfast was ready.

THE BOYS bolted their breakfast pancakes and sausage in short order. They paused only long enough to take a couple of pictures of Mr. and Mrs. Bishop, "just to finish off the roll" as they unflatteringly put it, before they hopped on their bicycles and headed back for town and the darkroom Carl had fixed up in a corner of his basement.

Inside this room, with the safelight turned on, Jerry removed the roll of Verichrome film from the camera, stripped off the backing paper, and attached clips to the ends while Carl filled one tray with developing solution, another with clear water, and a third with hypo. A quick check with a thermometer showed that by
New radio transceiver by VCA for only $69.75 per unit complete

At last, you can get a quality loud-speaking radio transceiver at half the usual cost. It's the new Vocaline Model JRC-400. Featuring everything you expect in a transceiver for the Citizen's Band. Vocaline still is only $69.75 per unit.

Operating on AC or DC, Vocaline uses a 115 volt AC or 6 volt DC power source. Rugged, compact, lightweight (4 lbs.), it has a good range often up to 10 miles, along unobstructed line of sight.

Since Vocaline has a fixed frequency (Citizen's Radio Band), you need no operator's license, only a station license, available to any citizen 18 or over.

Sound interesting? Simply fill in coupon on right for folder and name of nearest dealer.

Vocaline Radio Transceiver Model JRC-400
Federal Communication Commission approved transceiver (type approval No. CR-423) for Class B Citizens Radio Service.

Unit Specifications
Frequency: 465 Megacycles; RF Power Input: 2 Watts; Power output: 1/3 Watt; Amplitude Modulated Radio Telephone: Power Consumption: 18 Watts AC; Power Supply: 117 Volt AC or 6 Volt DC: (12 Volt on special order) Tubes: 6AV6, 6AF4A, 6AS5; Weight: 4 lbs.; Dimensions: 9" x 6" x 5"; Accessories:—Ground Plane Antenna (for interior to exterior communication) VCA part #GP-4 $7.95 ea. extra.

Vocaline Company of America, Inc.
101 Coulter Street
Old Saybrook, Connecticut

Please send folder and name of nearest dealer.

Name
Address

June, 1956
CARL & JERRY (Continued from page 18)

one of those happy coincidences that do happen occasionally, the solutions were exactly at 68 degrees. Carl passed the strip of film through the clear water a couple of times and then began to seesaw it gently and methodically through the tray of developing solution. After a couple of minutes, Jerry, whose hand had been bobbing up and down with the movement of the film as he tried to make out the emerging negative pictures, muttered:

"We didn't draw a blank, anyway; there's something on every frame."

After a couple more minutes of passing the film through the developer, Carl transferred it to the clear water for a few passes and then began to seeisaw it through the tray of hypo. When he had done this for several minutes, he stopped and turned on the white light.

"By golly, it's a midget burglar!" Jerry declared, looking over at the negative which was third from one end of the strip of film Carl had developed.

"Burglar, my eye!" Carl said with a grin.

"That's a coon, and a big fat one at that. All coons have that distinctive mask-marking around the eyes. There's something around his neck I can't make out on the negative. Let me finish fixing, washing, and drying the film. Then we'll make a print so that we can really see the details."

A

N HOUR LATER both boys were examining a fine large print of the raccoon, which must have been staring directly at the camera when the flash bulb went off. It was standing on its hind legs, and its little paws still had hold of the latch. Around its neck was a leather collar with a metal plate fastened to it.

"That must be a pet coon," Jerry said. "I'll run upstairs and tell Uncle Walter, and see what he knows about it."

In a few minutes, he came back into the darkroom with a broad grin on his face.

"The mystery is solved. Uncle Walt says that the coon is a pet of a boy who lives on the next farm. It's so tame that they just let it run loose like a dog. It must have been prowling around Uncle Walt's farm when it discovered how to open the chicken house door—coons are very clever about things like that—and then had itself a real ball scaring the hens. This was so much fun, evidently, that the coon came back and did it again every night or so. Uncle Walt called the boy, and he promised to keep Mr. Coon tied up at night."

"Another victory for the electronic coon hunters!" Carl remarked, starting to put away the developing materials.
RCA offers you the finest training at home in Radio-TV electronics, TV servicing, Color TV

SEND FOR THIS FREE BOOK NOW!

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

RCA Institutes, Inc., Home Study PE-66
350 West Fourth Street New York 14, N.Y.

Without obligation, send me FREE CATALOG on Home Study Courses in Radio, Television and Color TV. No salesman will call.

Name
Address
City Zone State

IMPORTANT

Before signing up for any Radio-TV course, be sure to write for RCA Institutes CATALOG before signing up for any Radio-TV course.

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

June, 1956

www.americanradiohistory.com
POPULAR SAMS BOOKS FOR THE EXPERIMENTER • AMATEUR • TECHNICIAN

Sams books cover every phase of Electronics for the experimenter, student, service technician and engineer. Listed below are a few of the many valuable Sams books. Ask for FREE Book List describing all titles available.

USE THIS HANDY ORDER FORM

- Transistors. The first complete, practical book on Transistors and their application in TV-Radio-Electronics. Explains theory, circuitry, installation, testing techniques and servicing. 100 pages; 5½ x 8¼"; illustrated $1.50
- So You Want to Be a Ham. Shows you how to get your license and acquire equipment. Covers: Conquering the Code, Getting Your Ticket, Going on the Air, etc. 196 pages; 5½ x 8¼"; illustrated $2.50
- Basic Radio Manual. Complete course covers theory, definitions, components. Includes section on actual projects that translate theory into practice. 246 pages; 8½ x 11"; illustrated $5.00
- Basic TV Manual. Covers all phases of TV set operation and design from picture tube to antenna. Includes project section demonstrating theory in action. 312 pages; 8½ x 11"; illustrated $5.00
- Atomic Radiation, Detection and Measurement. Helps you understand nuclear science and its applications. Covers circuitry and operation of all types of detection devices. 200 pages; 5½ x 8¼"; illustrated $2.00
- Practical TV Servicing. Shows how to install antennas, align sets, how to adjust and tune every part of the audio and video sections; includes data on UHF and Color. 400 pages; 5½ x 8¼"; illustrated $4.25
- Radio Receiver Servicing. Covers all basic receiver types—gives time-saving hints for solving common troubles, such as dead set, weak set, noisy set, etc. 192 pages; 5½ x 8¼"; illustrated $2.50
- Tape Recorders. Explains recorder theory, tape characteristics, how recorders work; covers motorboard mechanism, drive motors, volume indicators, bias oscillators, amplifiers, magnetic heads, equalization circuits. 176 pages; 5½ x 8¼"; illustrated $2.75

HOWARD W. SAMS & CO., INC.

Order from any Radio & TV Supplier-Wholesaler, or mail to Howard W. Sams & Co., Inc., Dept. 14-P6, 2901 E. 49th St., Indianapolis 8, Ind.

Send books checked above. My (check) (money order) for $_________ is enclosed.

Name__________________________
Address________________________
City___________________________Zone____State____
( outside U.S.A. priced slightly higher)


If you are an old-timer, little need be said about this latest edition of the "Handbook." If you are a newcomer to electronics or ham radio, one of your first investments should be in this "handbook." It is a composite volume of valuable schematics, construction features, and theory on antennas, transmitters, receivers, converters, and test equipment. This new edition contains additional material on simpler designs, with the Novice especially in mind.

The "Handbook" is also a storehouse for information on tubes, transistors, and other miscellaneous data. Over 1350 illustrations have been used, plus 122 basic formulas. The index alone consumes 13 pages.

Recommended: For every electronics experimenter and budding ham who wants to "get his feet wet."


There is a great tendency among radio technicians and hams to compare this "Handbook" with the "Handbook" published by the American Radio Relay League. Inevitably, a comparison has established that both books are valuable; and although they appear to cover similar fields, they are often worlds apart. This book is a true "Californian" approach to ham radio and practical electronics. The ideas and circuits it presents are vital and unusual.

Unlike the ARRL "Handbook" (which is revised yearly and brought up to date), the previous edition of this volume appeared in 1951. All topics are new, and practically every single design will be food

POPULAR ELECTRONICS
Send for FREE booklet and get the BIG PAY in RADIO-TV-ELECTRONICS

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

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

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

ELECTRONICS IS SCREAMING FOR MEN LIKE YOU!

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

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

"Two openings in our Field Service... aircraft electronics... starting salary is $500 and up..."—North American Aviation, Inc., Columbus, Ohio.

COUNTELESS POSITIONS MUST BE FILLED

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

ALL YOU NEED IS ADVANCED TECHNICAL TRAINING

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

MAIL THIS COUPON TODAY!

CAPITOL RADIO ENGINEERING INSTITUTE
Accredited Technical Institute Curricula—Founded in 1927
3224 16th St., N.W., Dist. 126C, Washington 10, D. C.

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

CHECK ☐ Practical Radio Electronics Engineering
##### FIELD OF
☐ Broadcast Radio Engineering (AM, FM, TV)

##### GREATEST INTEREST
☐ Practical Television Engineering
☐ Practical Aeronautical Electronics Engineering

Name

Street

City

Zone

State

Check: ☐ Home Study  ☐ Residence School  ☐ Korean Veteran

June, 1956
for thought. We are particularly impressed
with the clear-cut drawings, captions that
say things, and the concise, tight, informa-
tion-packed pages.

Recommended: For all hams, engineers, and
technicians.

"ELECTRONICS FOR EVERYONE" by
Monroe Upton. Published by The Devin-
Adair Co., 23 East 26th St., New York 10,
Electronics, in its countless applications,
has become so important and universal in
modern life that it is a subject no longer
in the exclusive domain of the technician
and engineer. As the title of this book
suggests, it is for everyone. The author,
who operated his own ham station in 1914,
is eminently qualified to develop this
theme, having practically grown up with
the industry and served personally in many
capacities—from building a broadcast sta-
tion in Shanghai to acting as a disc jockey.
Assuming no electrical knowledge on
the part of the reader, this book takes its
audience from the very simple to the more
complex phases of electronics. The text is
engagingly written and amply illustrated.
Much of it is genuinely stimulating, such
as the chapter entitled "Do We Inhabit a
Magnet?" While this volume is no substi-
tute for a more technical groundwork in
electronics, it will certainly put the be-
ginner on speaking terms with most elec-
tronic terms and phenomena.

Recommended: For the general reader
interested in electronics; for the more ad-
vanced technician as a stimulating sum-
mary of the field.

"ELECTRONIC CIRCUITRY FOR INSTRU-
MENTS AND EQUIPMENT" by Milton H.
Aronson. Published by Instruments Pub-
lishing Co., 845 Ridge Ave., Pittsburgh 12,
Most of the basic concepts, terms, com-
ponents, and circuitry that are used in
electronics are discussed in this informa-
tion-crammed volume. Readers casting
about for a technically written "first" book
might do well to consider this one. It
opens with a discussion of the "Electrical
Nature of Matter" and concludes with
"Military Electronics." Between these two
sections, it touches on vacuum tubes, am-
plifiers, transistors, oscillators, test equip-
ment, television, and several other sub-
jects.

This is a heavy order for one book, and
this volume is by no means the last word

HIGH-PAY CAREERS
IN ELECTRONICS—TELEVISION—RADIO
Await Men with COMPLETE Training!

Nationally-recognized, accredited Central training is designed to
get you into high-paying career positions in the shortest possible
time. In addition, Central’s "Progressive Plan" is so arranged that
each phase of training you complete qualifies you for a more im-
portant, better-pay position. In just a few short weeks you are
qualified for certain basic jobs. Then, with every additional training
phase that you complete, you qualify "up the ladder" for more
advanced types of positions. Central offers complete Electronics-
TV-Radio training leading to an Associate of Science degree, and
qualifying you as an Electronics Engineering Technician!

Thousands of Central graduates have been placed at almost every technical
level in the electronics industry. Free nation-wide placement service.

3 PROVEN TRAINING PLANS
(Choose the one that fits your requirements)

1. HOME STUDY COURSE (with 9 kits of equipment)
   —Qualifies you for diploma, FCC license, and a variety
   of electronics jobs (or transfer into advanced resident
   training).
2. HOME STUDY-RESIDENT COURSE (with 9 kits of
   equipment)—Home study, followed by short period
   of resident training. Qualifies you for diploma, FCC license,
   and a wide variety of Electronics-TV-Radio positions (or
   continue with advanced resident training). An accredited
   technical institute curriculum.
3. FULL RESIDENT COURSE—Qualifies you for Asso-
   ciate of Science (A.S.) degree and top-pay employment
   opportunities as Electronics Engineering Technician. Part-
   time employment opportunities available for students while
   training. An accredited technical institute curriculum.

Don’t limit yourself! Get the facts on Centrals complete
training that can take you just as far as you want to go in
the electronics technician field. Send coupon today for FREE
brochure on your opportunities in Electronics.

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

CENTRAL TECHNICAL INSTITUTE
Dept. A-66, 1644 Wyandotte St., Kansas City 8, Mo.
Tell me more about how you can qualify me for a high-pay Electronics career.

Name_________________________Age________
Address______________________Phone_______
City__________________________State_______
If Korean veteran, give approximate discharge date_________
Lafayette Brings You Super Values!

AN R/C RECEIVER COMPLETELY ASSEMBLED AND WIRED INCLUDES TUBE READY TO OPERATE!

2 TRANSISTOR POCKET RADIO KIT

Packed into a 3 3/4" x 2 1/4" plastic case. This 2 Transistor plus crystal diode radio kit offers many surprises, utilizing a revolutionary detector circuit; with transformer coupled audio stage, gives you both ease and excellent selectivity. Pull in distant stations with ease with more than enough earphone volume. This kit comes complete with two transistors, instruction leaflet, logotype, Ampradio transistor, audio transformer, resistors, condensers, plastic earphone, etc. including schematic and instructions. KT-48A Complete Kit less earphone. Net 11.80 MS-200 New Super Power Dynamic Earphone, Ideal for Transistor Circuit Imp. 8000 ohm. D.C. 2500 ohm. 3.95

TRANSISTOR CODE PRACTICE OSCILLATOR KIT

For those interested in mastering the international code, an audio tone oscillator is essential. The circuit of this transistorized feedback oscillator has the simplicity of the new generation of transistors and the selectivity of the vacuum tube, and requires only a minimum of attention and a small area of service. It may be used either as a transceive oscillator or as a tone oscillator. Complete with resistors, condensers, Masonite Board, etc. and Schematic Diagram. KT-72.............Net 2.99 Cannon SCI-Single Headset.........Net 1.13

NEW! EXCLUSIVE REVOLUTIONARY DESIGN TRANSISTOR 2 GANG MOBIL HET CONDENSER— 1/2" x 1" x 1" THE SMALLEST SUPER HET VARIABLE CONDENSER IN THE WORLD!

Lafayette does it again with this new super 2 gang midget variable condenser. An exciting and proven innovation in the transistor parts field! Manufactured for top performance in transistor super-het circuitry, it measures only 1/2" x 1" x 1". Has 2 gangs specifically designed for transistor super-hets—10 to 208 mmf capacitance on the antenna section, and 10 to 100 mmf on the cut oscillator section. Self contained trimmers. Tunes through 180°. Entirely enclosed in a transparent plastic case! The smallest complete 2 gang variable for super-hets in the world! Offers unlimited possibilities to the experimenter. MS-270.............Net 1.95

MATCHED MS-265—Occ. Coil........Net .79 Ea.
COIL SET MS-272—Ant. Coil........Net .95 Ea.

365 MMF SINGLE GANG SUPER MIDGET VARIABLE CONDENSER

For exceptional performance in TRF and experimental transistor and sub-miniature circuitry, 10 to 300 mmf single gang. Enclosed in transparent plastic case. 1/2" x 1" x 1". MS-274.............Net 1.25

NEW! ALL-PURPOSE DYNAMIC EARPHONE

• For radio and tv listening
• For subminiature, miniature and transistor receivers

A sensitive all-purpose earphone designed for your listening pleasure. Combines the range of a dynamic earphone with the performance of its special magnet to give you excellent reproduction. Lightweight and equipped with ear support that slips comfortably over your ear. You can relax! The support is practically invisible—the earphone won't slip out—it can't fall off. Ideal for use with tv and radio sets, amplifiers, miniature and transistor receivers etc. Complete with 3 ft. cord. A super value for the price.

MS-278—3600 ohm impedance, 1600 ohm DC resistance, with phone tip plugs........Net 1.95
MS-277—600 ohm impedance, with phone tip plugs. For Silent Radio and TV Listening or Viewing........Net 1.95
MS-273—1000 ohm impedance, 1000 ohm DC resistance, with subminiature phone plug and matching phone jack........Net 2.39
MS-279—6 ohm impedance, with subminiature phone plug and matching phone jack. For Silent Radio and TV Listening or Viewing........Net 2.39

A truly sensational value in a superbly designed and constructed hand-tube R/C receiver. Operates on popular exam-free 27.255 MC remote control band. Extremely efficient and dependable, this amazing receiver has more than adequate sensitivity for a range of approximately 1 mile. Outstanding for economy of operation, its minimum life with initial 324 tube is several thousand hours! Ingeniously constructed for unmatched stability of performance, and to withstand unusual vibration and shock. Requires only 1 volt A battery, one 45 volt B battery and 24" antenna lead. Size: 1/4" x 1-15/16" x 8". Weight 3.3 oz. F-203.............Net 7.95

TRIPLE PURPOSE SLIM CRYSTAL MICROPHONE

• May be hand-held, stand mounted or suspended by lavalier cord!
• Frequency 60-10,000 CPS
On-Off Switch

A tremendous value! Unique design, only 4¾" x 1½" dia. Comes complete with swivel adapter to fit almost any style microphone stand, and lavalier cord and bracket which leaves both hands free. Smooth wide range response. Locking type on-off slide switch. Detachable 7 ft. cable and connector. Shpg. wt. 2 lbs. PA-31.............Net 5.95

Lafayette Catalog

FREE 132-Page

Send FREE 132-Page Lafayette Catalog

Name
Address
City State

BOSTON 19, MASS., 113 Federal St.
NEWARK 7, N. J., 74 Central Ave.
DALLAS 10, TEX., 111 Main St.
BRONX 56, N. Y., 242 E. Fordham Rd.

Include postage with order.

June, 1956

25
"SCOPE CONNECTIONS" by V. L. Walker. Published by The Triplett Electrical Instrument Co., Bluffton, Ohio. 29 pages. Paper bound. Price, $2.00.

Basically an instruction booklet for use with Triplett's Model 3441-A oscilloscope, this volume may have wider value as a general introduction to the use of oscilloscopes for test purposes. It contains several examples of how to check a variety of typical circuits.

Recommended: to all 'scope users.


The multivibrator is a fairly recent development in electronic circuitry. Variations of this "relaxation oscillator" are to be found in television, radar, oscilloscopes, and dozens of other types of equipment.

The unique design and functioning of these circuits are explained in this little volume, which is designated as No. 166-7 in the publisher's "Review Series." Its four chapters are devoted to basic principles and the three main types of multivibrators; the bistable, the mono-stable, and the a-stable. Circuit action and practical uses are given for each type.

Recommended: for the serious student or technician whose work involves contact with these circuits.

Free Literature Roundup

AN ATTRACTIVE little volume entitled "High Fidelity Especially For You" is available on request from The Heath Co., Benton Harbor, Mich.

PLANNING A CAREER as a TV service technician? A booklet called "Suggested Accreditation Program for TV Receiver Service Technicians" should interest you. Standards for accrediting servicemen, tools and test equipment, and educational requirements are discussed. Free copies are available from Radio - Electronics - Television Manufacturers Association (REMA), 777 14th Street, N.W., Washington 5, D. C.
YOU can make MORE MONEY with an FCC LICENSE

What is the FCC?  

How will a license help me?

How can I get my FCC License?

Will Cleveland Institute help me get a job?

get the answers to the above questions FREE!

FIND OUT HOW:

An FCC license insures your future

The entire industry needs technicians

Cleveland Institute guarantees license

the CIRE Job Finding Service will work for you!

Your FCC license and CIRE diploma will qualify you for the really fine jobs in Electronics.

Write today for complete information

NO SALESMAN WILL CALL

GET ALL 3 FREE

FILL OUT COUPON BELOW AND MAIL IT TODAY

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk PE13, 4900 Euclid Bldg., Cleveland 3, Ohio

I want to know how I can get my FCC ticket in a minimum of time. Send me your FREE booklet, "How To Pass FCC License Examinations" (does not cover exams for Amateur License), as well as a Sample FCC-Type lesson and the amazing new booklet "Money-Making FCC License Information." Be sure to tell me about your Television Engineering Course.

PLEASE PRINT CAREFULLY

NAME

AGE

ADDRESS

CITY   ZONE   STATE

For prompt results, send air mail. Special tuition rates to members of the U. S. Armed Forces. Electronic Training Available To Canadian Residents.
Altec Lansing 401A
Power Capacity — 14 watts
Impedance — 8 ohms
Resonance — 75 cps
Voice Coil Diameter — 1"
Depth — 3.5/8"
Frequency Response — 60 to 10,000 cycles

In public address or paging systems requiring a number of speakers to be operated at low levels, the Altec Lansing 401A is your best choice. Offering the highest quality available in inexpensive 8" loudspeakers, the 401A has a frequency response of 60 to 10,000 cycles—well beyond the ordinary performance of public address speakers.

The low price of Altec's 401A also allows you to install more speakers for the same investment. At only $13.20, the Altec Lansing 401A is your best buy—and your best choice—for high quality, low-level performance in any public address or paging system.

LETTERS
FROM OUR READERS

What Happened to R/C?

- I recently became interested in R/C, and a friend of mine gave me some old issues. Really swell reading, but what happened to the great plans you apparently had on editorializing this field?

E. C. Wesley
Katonah, N. Y.

- What has happened to your R/C Notes column? It did not appear in the March or April issues.

Kenneth Rooney
Chicago, Ill.

Readers Wesley and Rooney (plus many others) will be pleased to know that the R/C column will be back in an early issue. At the same time, we hope to publish at least one feature a month on novel R/C installations, new receiver and transmitter designs, and equipment tests.

Mobile Telephone

- How about publishing an article on how the telephone companies install and maintain mobile private telephones? I think it would be very interesting.

Norval Verger
Greenville, Miss.

This task has been assigned to a staff writer and he reports being hard at work (probably to impress the editor). However, a story is scheduled and we are sure that many readers will be surprised at the radiotelephone services now available to the general public.

Can Anyone Help?

- I am in need of information on plastic laminations of the type used to preserve documents. There must be electronic methods in use, but I've been unable to uncover any sources of information. Could your readers give me a helping hand?

J. Jecmen
Memphis, Tenn.

Still They Come

- How about plans for a long-wave converter? I would like to receive the 200- to 400-kc. band where the CAA offers weather broadcasts every 30 minutes.

R. D. Brigham
Ames, Iowa

- I have been reading POP'tronics since it started, but have yet to see anything on the subject that interests me most—long-wave DX. I've seen a few high-priced sets, but really want either a converter or a 4-tube receiver. Also, could you give us a log of possible DX stations below 400 kc.?

C. K. French
Louisville, Ky.

As mentioned in our May issue (page 20), we will be publishing some material on long-wave DX and equipment in the early fall issues. A staff
July, the famous RADIO TELEVISION CYCLOPEDIA! It answers today’s television problems on servicing; alignment, installation, etc. In easy-to-find ABC order, cross-indexed. Use this 7-volume RADIO-LIBRARY FREE for 7 days; get the valuable Servicing Book ABSOLUTELY FREE!

Send NO MONEY! Just mail coupon for 7-volume set on 7 days free trial. We’ll include book of 100 TV-Radio Patterns and Diagrams. If you keep the set, pay $2 in 7 days and $2 per month until $24 plus postage is paid. (Cash price, only $22.95.) Or you can return the library at our expense in 7 days and owe nothing. YOU BE THE JUDGE. Either way, the book of TV-Radio Patterns is yours FREE to keep! Offer is limited. ACT NOW!

FREE BOOK—FREE TRIAL COUPON!

Educational Book Publishing Division
COYNE ELECTRICAL SCHOOL
500 S. Paulina St., Dept. 66-P.E
Chicago 12, Ill.

Address
City
Zone State

YES! Send 7-Volumes "Applied Practical Radio-Television" for 7 days FREE TRIAL per your offer. Include TV-Radio Patterns & Diagram Book FREE.

Name
Age

Where Employed:

Check here if you want library sent C.O.D. You pay postman $2.95 plus C.O.D. postage on delivery. 7-day money-back guarantee.

Amateurs! Manufacturers! Hams! Distributors! EVERYONE BUYS TUBE MART TUBES! write for new free transmitter ... Special Purpose ... Receiving Tube List!

LOWEST TUBE PRICES

ALL TUBES UNCONDITIONALLY GUARANTEED FOR 1 YEAR

Take your pick! Any Assortment!

TUBES

41c ea.

Quantity Buyers! 100 Tubes -- $38.00

FREE POSTAGE on all prepaid continental U.S.A. orders. 25¢ handling charge on all orders under $5.00. 25¢ Deposit on all C.O.D.’s. Subject to prior sale.

Prescott 3-0330

TUBE MART DISCOUNT HOUSE

The Laketo Bldg. Passaic, N. J.

June, 1956

29
Learn at Home
in your spare time
to Fix Electric Appliances

Better Pay—More Opportunities
Get into a field where there is important work and opportunity for the trained man. Millions of electric appliances are sold every year. Every wired home now has an average of 8. Many of them need service and repair. Owners pay well to have them fixed quickly, properly. This is your opportunity for a better job, your own part time or full-time business. NRI can give you the training you need, at home, in your spare time.

A Way to Extra Money
Soon after starting you will be able to earn extra cash fixing toasters, clocks, fans, vacuum cleaners, etc., for neighbors and friends. Keep your job while learning and earning. Put spare time to work for you. Work in your basement, garage, spare room. You'll be amazed how easily, quickly you, too, can start earning many extra dollars. NRI shows you how. Even before you finish training your spare time earnings may pay for the course and equipment.

NRI Sends Tester to Learn and Earn
You need proper equipment to service today's automatic appliances. With this course you get parts to build professional type, multi-use Appliance Tester. You learn to use it. Takes guess work out of servicing. Mail coupon for: FREE book and Sample Lesson. See how easy it is to learn. Find out about NRI— a school that for more than 40 years has been training men, through home study, for success, good pay jobs. Our reputation, record, experience back up this course. Write now to: Electric Appliance Training, NRI, Dept. D4F6, Washington 9, D. C.

FREE Lesson and Book
Mail this NOW!

NATIONAL RADIO INSTITUTE
Dept. D4F6, Washington 9, D.C.

Send me Lesson and Book Free. No Salesman will call.

[Name] [Age]
[Address]
[City] [Zone] [State]

APPROVED MEMBER NATIONAL HOME STUDY COUNCIL

writer has been assigned this project, while one of our Contributing Editors is working up several designs for converters. Keep watching—it's coming around the corner!

Oabbit Oabbit Oabbit
- Tuning down to the low end of the broadcast band on my portable. I found someone sending "OABT OABT OABT" over and over in Morse code. Could anyone enlighten me as to what this station was doing? I last heard it on March 30th from about 7:30 until 8:15.

S. SVERLING
Chelsea, Mass.

Any volunteers?

HI-FI—Speakers, Enclosures, etc.
- The bargain speaker idea described by Jack Coriell (December, 1955) really works! I've built three of these setups. How about some more dope on mounting more than one speaker in the cabinet?

DON VAN METRE
Ventura, Calif.

- I just finished making the bargain speaker arrangement described by Coriell in your December issue. The results were nothing short of amazing. I never saw or heard a 5-tube superhet issue such sounds. Even with the volume very low, I heard every bass note.

HAROLD R. PLUE
Hamilton, Ont.

- I built the $2 speaker baffle in your November, 1955, issue. I used two scrapped Celotex bulletin boards; and since Army barracks have studs on the interior, I added two pieces for sides. The enclosure can be placed just about anywhere and sure does a fine job.

ROBERT J. FEWING
Aberdeen, Md.

- I became interested in electronics about the same time that you began publishing POP'tronics. I especially enjoy the hi-fi antics of Carl Kohler. Will you people see about a construction article on a good hi-fi AM tuner?

BROOKS ROGERS
Amarillo, Texas

- The $2 speaker baffle with an 8" Electro-Voice speaker gives results as good as I have heard from speakers in the most expensive wooden cabinets. I'm sold. I see no reason for a fancy enclosure.

ROY POULSEN
Kingston, R. I.

Our hi-fi audience seems to be growing by leaps and bounds. Look to POP'tronics for the latest dope on new components and money-saving ideas.

Fumalux Lighter Data
- In response to the question posed by Mr. Mochar (April, 1956, page 12), I have found that the lighter is marketed in the United States under the name "Magna Lux." It uses a single lead-acid battery cell at 2 volts. It can be recharged if the sealed case is punctured to permit the hydrogen to escape. I also used this small puncture to add water with a hypodermic needle. The charger
Men with mechanical skills: measure yourself against this yardstick

Mechanics Creed

Upon my honor I swear that I shall hold in sacred trust the rights and privileges conferred upon me as a certified mechanic. Knowing full well that the safety and lives of others are dependent upon my skill and judgment, I shall never knowingly subject others to risks which I would not be willing to assume for myself, or for those dear to me.

In discharging this trust, I pledge myself never to undertake work or approve work which I believe to be beyond the limits of my knowledge; nor shall I allow any superior to persuade me to approve aircraft or equipment as airworthy against my better judgment; nor shall I permit my judgment to be influenced by money or other personal gain; nor shall I pass as airworthy aircraft or equipment about which I am in doubt, either as a result of direct inspection or uncertainty regarding the ability of others who have worked on it to accomplish their work satisfactorily.

I realize the grave responsibility which is mine as a certified mechanic, to exercise my judgment on the airworthiness of aircraft and equipment. I, therefore, pledge unyielding adherence to these precepts for the advancement of aviation and for the dignity of my vocation.

This challenging creed has made the U. S. Air Force the finest technical service in the world. If you are a man who feels a deep sense of satisfaction from the knowledge of a job well done, the U. S. Air Force offers you a rewarding and exciting life. Skills you acquire in the Air Force will help you choose and succeed in your future career.

YOU GO PLACES FASTER ON THE ALL VOLUNTEER TEAM

THE U. S. AIR FORCE

June, 1956
can be a simple selenium rectifier working from the 6-volt side of a filament transformer. Charge it at 90 ma. and 2.2 volts until the current drops to 10 ma.

ARTHUR L. HELLING
Port Lavaca, Texas

"Proximity Detector" Works

The "Proximity Detector" by Paul Harvey (April, 1956) was terrific. For a long time I've been looking for a device of this type. It's extremely sensitive. I built the simpler version and it works very well.

ROGER R. MUSSRAY
Los Altos, Calif.

Thermistor Fire Alarm

I was quite surprised that you would recommend a fire alarm system that operates from the a.c. power lines. This leads to a false sense of security, as in many homes fires start in the power lines and the fuses immediately blow.

BURT GASTEN
Madison, Wis.

Good point, Burt, but we feel that batteries would be even worse. It is far simpler to let batteries run down and not replace them. All in all, the a.c. line-operated device is safer, although Mr. Pollack is working on a modification which may provide a foolproof solution to this problem.

Tachometer Completed

I recently completed building the portable tachometer described in the May, 1955, issue. I want to thank you and your staff for making the diagram so clear and easy to follow. This was my first attempt at any electrical work and I'm pleased with the results. So far it has been checked out perfectly.

R. W. LORThRIDGE
Chicago, Ill.

Tape Correspondence Clubs

I own a tape recorder and in the past few months have become deeply interested in tape correspondence. Are there any other readers of POP'tronics interested?

HOWIE FISHER
Syracuse, N.Y.

Yes, Howie, there are, and a feature article is scheduled for an early issue on just this fascinating hobby. We will publish addresses of all the leading tape correspondence clubs at that time.

Out of Tune

Signal Tracing on a Low Budget (March, 1956, page 56). In the wiring diagram, remove the jumper between pins 2 and 3 of the magic eye tube V3. The connections from pin 2 to the B+ line (at R7) should be removed and a line substituted from pin 4 to R7. The pictorial diagram does not include the jumper, but does show the B+ line improperly connected.
You do not need the slightest background in radio or science. Whatever is interested in Radio & Electronics because you want an interesting hobby or a business or a job with a future you will find 'the Edu-Kit' a worthwhile investment. As an extra from a letter that we received from John L. 4th St., Madison, Wis., has spent many pleasant hours in constructing the radios from the schematics in your book, and have learned a great deal from them. Being as I am interested in Radio, I consider the money spent for your course as a wise investment. I have learned more, from your course, than I did from an expensive course.

Many thousands of individuals of all ages and backgrounds have successfully used the 'Edu-Kits' in more than 26 countries throughout 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.

The 'Edu-Kits' are used for courses of study, extra-curricular activities, industrial personnel training and rehabilitation. The 'Edu-Kit' is used by the school districts, technical Schools, Jr. Colleges, Universities, Industrial Education, Rehabilitation, Military, United Nations Educational, Scientific and Cultural Organizations (UNESCO) and numerous adult, radio and young peoples groups and clubs. The 'Edu-Kit' is also popular with servicemen and veterans throughout this country and abroad.

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 method of "Learn by Doing". Therefore you construct, study, practice trouble-shooting—all in a closely integrated program designed to provide an all-encompassing, thorough and interesting background in radio, theory, function and wiring of these parts. Then you build and operate these radios. With this book you will have stations, and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques, and operate the radio. And at every new level, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

The Progressively Educated Radio Technician can do the following:

- **Service Others:** You will learn trouble-shooting and servicing in a progressive manner. You will produce radios that will give you confidence. You will learn symptoms and causes of troubles in home, portable and car radios. You will learn how to use the professional Signal Trace, the Signal Trace and the dynamic Radio & Electronic Tester. When you are finished the professional Signal Trace is your own. You will be able to do any 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.

- **Automobiles:** Yes, a member of your family can or should own an automobile. Your car will be more dependable, safer and easier to service.

- **Business:** Develop your abilities in the field of electronics while you are working in other fields of business. Your technical knowledge will serve you well in almost any line of business.

- **Hobbies:** You can develop a hobby in radio, electronics, television, phonographs, and phonograms in your spare time.

- **Vocational Training:** The "Edu-Kit" is a valuable aid in all vocations that deal with electronics equipment.

- **Entertainment:** The "Edu-Kit" will provide you with the means of entertainment in your home. You can build a complete home entertainment center.

- **Homework:** The "Edu-Kit" will provide your children with a background in science and electronics. They will be interested in other fields of study. They will gain confidence in their ability to do a job and do it well.

- **Industrial Training:** The "Edu-Kit" is the ideal method of training employees in an industrial plant. The product of many years of teaching and experience. The "Edu-Kit" will permit experienced engineers to train an entire group of workers in the complete field of electronics.

- **Education:** The "Edu-Kit" is an excellent educational tool. It is used in schools, colleges, universities, and vocational schools for many years. It is also used by the United Nations Educational, Scientific and Cultural Organizations (UNESCO) and numerous adult, radio and young peoples groups and clubs.

- **Military Training:** The "Edu-Kit" is used by the Armed Forces of many countries employing higher line voltages. 210-250 Volt AC, 125 Volt DC, 25 Volt AC, and 110 Volt AC.

- **Government:** The "Edu-Kit" is used by many Government agencies, including the United States Government. The "Edu-Kit" is used by the United States Government, the United Nations Educational, Scientific and Cultural Organizations (UNESCO), and numerous adult, radio and young peoples groups and clubs.

- **Business:** The "Edu-Kit" is used by many businesses, including the United States Government, the United Nations Educational, Scientific and Cultural Organizations (UNESCO), and numerous adult, radio and young peoples groups and clubs.

- **Education:** The "Edu-Kit" is used by many educational institutions, including the United States Government, the United Nations Educational, Scientific and Cultural Organizations (UNESCO), and numerous adult, radio and young peoples groups and clubs.

- **Military Training:** The "Edu-Kit" is used by the Armed Forces of many countries employing higher line voltages. 210-250 Volt AC, 125 Volt DC, 25 Volt AC, and 110 Volt AC.

- **Government:** The "Edu-Kit" is used by many Government agencies, including the United States Government. The "Edu-Kit" is used by the United States Government, the United Nations Educational, Scientific and Cultural Organizations (UNESCO), and numerous adult, radio and young peoples groups and clubs.

- **Education:** The "Edu-Kit" is used by many educational institutions, including the United States Government, the United Nations Educational, Scientific and Cultural Organizations (UNESCO), and numerous adult, radio and young peoples groups and clubs.

- **Military Training:** The "Edu-Kit" is used by the Armed Forces of many countries employing higher line voltages. 210-250 Volt AC, 125 Volt DC, 25 Volt AC, and 110 Volt AC.

- **Government:** The "Edu-Kit" is used by many Government agencies, including the United States Government. The "Edu-Kit" is used by the United States Government, the United Nations Educational, Scientific and Cultural Organizations (UNESCO), and numerous adult, radio and young peoples groups and clubs.

- **Education:** The "Edu-Kit" is used by many educational institutions, including the United States Government, the United Nations Educational, Scientific and Cultural Organizations (UNESCO), and numerous adult, radio and young peoples groups and clubs.

- **Military Training:** The "Edu-Kit" is used by the Armed Forces of many countries employing higher line voltages. 210-250 Volt AC, 125 Volt DC, 25 Volt AC, and 110 Volt AC.

- **Government:** The "Edu-Kit" is used by many Government agencies, including the United States Government. The "Edu-Kit" is used by the United States Government, the United Nations Educational, Scientific and Cultural Organizations (UNESCO), and numerous adult, radio and young peoples groups and clubs.

- **Education:** The "Edu-Kit" is used by many educational institutions, including the United States Government, the United Nations Educational, Scientific and Cultural Organizations (UNESCO), and numerous adult, radio and young peoples groups and clubs.
The features you want are now EASY TO OWN

Operator-Designed and Laboratory-Engineered for Amateur Communications

High Selectivity and Rejectivity
Precisely tunes the signals you want, even at high frequencies. Rejects unwanted signals and undesirable noise.

Easy Tuning and Smooth Operation
Unique two-speed control knob provides smoother, accurate tuning and scanning.

Mechanical and Thermal Stability
Highly stable components and construction prevent frequency shift or drift.

Structural Rigidity and Strength
Heavy steel chassis, cast aluminum panel and rugged steel cabinet assure stable, long-life service.

MODEL 4301
SIDEBAND DETECTOR-SELECTOR

New RME 4301 provides easy-to-tune, stable SSB reception of both carrier present and carrier suppressed types. Plugs directly into the RME Model 4300 receiver or easily connects between IF and audio stages in any other communications receiver. Built-in power supply. Size: 10 in. high, 8½ in. wide, 10 in. deep. Net $75.00

Model 4302-Matching Speaker in enclosure. Net $17.50

This completely new receiver includes many deluxe features usually found only in higher priced models. It provides injection control of the beat frequency oscillator. Particularly useful for CW and SSB reception.

Large, evenly graduated, illuminated dial covers all six amateur bands from 1.76 mc to 29.8 mc (160 thru 10 meters). Unique differential 75:1 or 1:1 ratio tuning control. Plates in tuning condenser are triple-spaced to reduce drift and microphonics. Selectivity control with four positions. IF curve is 2.8 kc wide without crystal filter, attenuation 60 db down at 7 kc above or below the desired frequency. Crystal filter has phasing control for variable rejection of unwanted adjacent signals. Excellent image rejection. High sensitivity of 2 microvolts for 10 db signal-to-noise ratio. Temperature-compensated. Drift is negligible after 20-minute warm-up. Extreme stability allows single sideband reception with or without adapter. ANL. Antenna trimmer permits peak adjustment, 4-position function switch. Two coaxial jacks for SSB adapter. 4-ohm speaker terminals. Transmitter relay control.

Centrals include: Dual-speed tuning, AF gain, BFO pitch, BFO injection, antenna trimmer, calibration adjust, band selector, RF gain on-off, function switch, 3-position receive-standby-transmit switch, 4-position crystal selectivity control, crystal phasing-rejector control, ANL. Size: 10 in. high, 16½ in. wide, 10 in. deep. Finished in attractive Instrument-gray.

117 volts, 50-60 cycle AC.

To own the 4300 means more QSO's! See your EIB-RME distributor or write for Bulletin No. 240-E66.

RADIO MFG. ENGINEERS, INC.
DIVISION OF
Electro-Voice INC.
BUCHANAN, MICHIGAN

AMATEUR NET
$194

www.americanradiohistory.com
For the non-technical and budget-minded: an easily assembled low-cost music system

With prices on most consumer items steadily rising, and interest in hi-fi doing the same, there is—in many quarters—a mistaken notion that unless you're prepared to spend upwards of $250, you can't have hi-fi. Fortunately for the budget-minded, this is not so. To be sure—the more you spend, the better equipment you are likely to get. However, components are available for a complete radio-phono system costing less than many people spend on a phonograph alone.

This is no theoretical pipe-dream. It's something you can pick up and carry home from the audio shop. Each component has been studied by impartial experts. The system has been assembled, played, and tested. It works.

Another thing: the components are finished units, not kits. They require no real effort or technical skill to set up. For those who can do their own carpentry, or have the skill to build tuners, amplifiers, and speaker systems—kits are fine, and provide remarkable hi-fi values. But there are millions of music lovers who have neither the skill nor the inclination to get involved with soldering iron and schematic. What they want is a system that will enable them to hear their favorite radio programs—or listen to records—with good audio quality but a minimum of fuss and bother. Almost equally as many might like to hear their tapes—either home-recorded or commercially produced—played with a measure of fidelity not afforded by the low-priced "all-in-one" tape recorder. And some, perhaps, are fed up with the hash
Record player fits onto base by means of three spring-mounted bolts. Screwdriver adjustment permits exact leveling for best operation. Instructions enclosed with player explain clearly how to do this as well as how to affix the small belts that link the drive and idler wheels. Turntable fits readily onto center spindle. Plug-in cartridge head fits onto tone arm. Shielded cable feeds signal to amplifier.

that the audio sections in their TV sets make up what is potentially top-rate FM sound. They might actually want to hear what their favorite singers or pianists really sound like. The system described here is the ready-made, low-cost, no-trouble answer to all these demands.

If you compare the performance of this system to that of a rig costing three to four times as much, you may hear the reason for the difference in price—or maybe not, depending on your own hearing tastes. Not everyone has the kind of hearing that responds favorably to 20,000 cycles at 80-db level. For people with less demanding ears, it would be nonsense to spend hundreds of dollars to capture such audio in the living room, where it might do little more than titillate one’s pet spaniel.

In any event, there is no doubt that the system will not capture the deepest bass and the highest treble. Also, its power capacity will be limited to normal listening level in a normal-sized room. At that, this system outperforms most of the radio-phonograph “combinations” of a few years back, and will equal—if not surpass—the performance of many current consoles that are now touted with blatant and, often, misleading claims.

Total cost of the system is $140.00—give or take a few—and the price includes the furniture-finished speaker enclosure. If you want the system for records only, without the FM tuner, drop $35. The components used are sold at most dealers, and specifications are available from the respective manufacturers (listed in the table on page 38).

Hi-Fi Standards Met. Cost was not the sole factor in selecting this system. The following standards also apply:

1. The system, as a whole, must be versatile and flexible, with inputs for both radio tuner and high-quality phono. Components should be compatible with each other as well as with additional program sources that may be added later (AM tuner, TV sound, and tape playback). As someone’s “first hi-fi,” this system might use a speaker whose performance is adequate but which can readily become part of a larger multiple speaker system if and when the owner decides on “speaker expansion.”

2. The record player must have provisions for shock-mounting, leveling, adjusting stylus pressure, and simple interchanging of cartridges. The turntable should run off a 4-pole motor and be reasonably free of annoying rumble. The pickup must have high compliance and a frequency response from about 40 to 12,000 cycles; a “dual purpose” type is recommended (with two styli—one for microgroove and one for 78-rpm discs) as an economy measure.

www.americanradiohistory.com
Input and output jacks on both tuner and amplifier are clearly marked. Signal connections are made with standard phono plugs fitted to shielded cables. Amplifier has "convenience a.c. outlet" on rear of chassis, for plugging in power line of one other component. It is a good idea to plug the tuner's power cord into this outlet, thus assuring that the tuner will be shut off when the amplifier is turned off. The record player shuts off automatically at the end of a record, so no such precautions need be taken with it.

3. To meet adequate standards of power ratings, the amplifier should have 10-watts output. Circuit design features, such as negative feedback, should be used to assure a flat response up to at least 15,000 cycles, with distortion not more than 3% at full output. The amplifier should include a built-in preamplifier-equalizer for magnetic phono pickups. Multiple inputs should permit several program sources to remain permanently plugged in. Output terminals must accommodate speakers at impedance ratings of 4, 8, and 16 ohms. Front panel controls should provide for an input selector and record equalizer, volume, treble, and bass controls.

4. The tuner must have enough sensitivity to receive local stations with a simple external antenna. Provisions for connecting such an antenna should be easy and accessible. Some kind of stabilizing feature should assure against drift. This need not be automatic frequency control (a.f.c.) but its effect should be similar. Since the amplifier has its own audio controls, the only controls needed on the tuner are an off-on switch and a station selector.

5. The speaker system's response must be wide in range and low in distortion to match the potentialities of the rest of the system—and still fall within the over-all price range. In this respect, it is only fair to point out that a better speaker system than the one listed here would probably make the system sound better. This, of course, can be said about most any audio system, regardless of cost. The one chosen is admittedly a compromise in terms of extreme frequencies. But it will sound clean and well-balanced over the vital part of

---

**Block diagram of the complete system shows correct connections for all signal leads and power cords. Arrows represent direction of signals from tuner and phono, into amplifier, and then into the speaker.**
Components for the "minimum $$$" hi-fi system, and suggested alternates, are listed in this table. No alternates for the tuner and speaker could be found in the same price range.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>MAKE AND MODEL</th>
<th>COST</th>
<th>ALTERNATE CHOICE COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Record Player</td>
<td>Garrard &quot;Model T&quot; (Garrard Sales Corp., Port Washington, N. Y.)</td>
<td>$32.50</td>
<td>$26.00</td>
</tr>
<tr>
<td>Pickup</td>
<td>G. E. RPX 050A (General Electric Co., Electronics Park Syracuse, N. Y.)</td>
<td>8.20</td>
<td></td>
</tr>
<tr>
<td>FM Tuner</td>
<td>Granco T-160 (Granco Products, Inc. 36-07 20th Ave. Long Island City 5, N. Y.)</td>
<td>35.00</td>
<td></td>
</tr>
<tr>
<td>Amplifier</td>
<td>Bogen &quot;Challenger&quot; HMF-10 (David Bogen Co., Inc. 29 Ninth Ave., N. Y. 14, N. Y.)</td>
<td>40.00</td>
<td>39.00</td>
</tr>
<tr>
<td>Speaker System</td>
<td>Lang BL-10 (Lang &amp; Taylor Inc. 100 Felton St., Waltham, Mass.)</td>
<td>25.00</td>
<td></td>
</tr>
</tbody>
</table>

When cartridge has been installed in tone arm, use knurled knob at arm's other end to adjust for correct pickup pressure, as recommended by manufacturer (in this case, 6 to 8 grams). To start a record, or cue it at any point, use the finger-lift provided on the shell to lift the arm and lower it gently to the record, as shown in the photo.

The audio spectrum. Another point: more speakers can be added later to create a multiple speaker system.

There is also such a thing as using "too good" a speaker for a given array of components. For example, a $600 Klipschorn used in this system would probably produce as much hum and noise as music in the low-frequency area.

In any event, the speaker itself must be adequately baffled and physically separated from the housing used for the rest of the system.

The System. So, we are compromising, but not beyond the limits of good judgment, or decent audio standards. Ours is not the fabulous "dream system" of the millionaire. But neither is it the complete nightmare of a system that could, perhaps, be assembled for "just a little less" money.

We like to think of this rig as a down-to-earth hi-fi system, both in its ability to furnish entertainment in the home as well as in its cost to the consumer. The components, and their suitable alternates, are listed above.

Prices shown are approximate net prices, based on prevailing averages at representative dealers. Slight variations may be expected, depending on where you live, and possibly too on how much of a "break" your particular dealer can give you for buying everything all at once. The listing does not include a base or mounting board.

(Continued on page 112)

This layout of components shows how they may be placed on open bookshelves for proper installation without the need for expensive cabinetry. Units are spaced close enough to each other for convenience, but far apart enough to insure against mutual inductance hum, acoustic feedback, and overheating. Speaker sounds best in corner position. Wiring is hidden behind back panel of bookcase. Hint: a piece of low-cost Masonite fitted to the top shelf converts the shelf to a neat cabinet!
Phrases to be "memorized" by typewriter are stored in plugboard. Secretary can switch plugboard assemblies to change typewriter memory from business to Latin to medical phrases.

IN YEARS to come a secretary reaching the phrase "in accordance with" in a letter she is typing may simply press a foot pedal, strike the correct key, and the machine will rapidly type the phrase by itself. An experimental electric typewriter with a "memory" of 42 phrases has been in existence for some time.

When patents on the machine, which is called the "Wordwriter," were issued recently, the International Business Machines Corporation let the press take a look at it. Since the operator selects the phrases to be memorized, the machine makes every secretary a potential legal or medical stenographer, both scarce skills. The operator can set the machine to memorize those long Latin or scientific words and phrases she cannot spell.

There are two main parts to the Wordwriter. A standard electric typewriter modified with a solenoid attached to each key is one part. The memory apparatus fits inside the space occupied by the drawers in one side of a standard office desk. It consists of the plugboard memory, relays and crystal diodes, a voltage reference tube, and a selenium rectifier.

The typewriter portion can still be employed in the usual way. In use, paper is slipped into the Wordwriter and the operator types away until she comes to a frequently used phrase, one that has been memorized by the machine. After depressing the foot pedal that connects the memory to the typewriter, the typist strikes the key coded to the phrase. The memory apparatus then operates the Wordwriter at the rate of 150 words per minute, writing out the phrase and inserting a hyphen if a word breaks at the end of a line.

The Wordwriter was initially developed five years ago by a group of scientists working under R. R. Seeber, Jr. A pioneer computer designer, Mr. Seeber constructed the Wordwriter as a side-line. He works at IBM's Watson Computing Labora-

(Continued on page 106)
New Life
for Citizens Band

Would you be interested in a radio-telephone to call the wife, boy friends, or neighbor a couple of miles down the road? If so, a Citizens band radio transceiver may be just the answer. Various electronics manufacturers are becoming aware of this huge potential market and are striving to put personalized radio-transmitting equipment on the market.

First salvo has been fired by the Vocaline Company of America, Old Saybrook, Conn. with the introduction of its model JRC-400 transceiver. This combination receiver and transmitter operates in the Class B portion (around 465 mc.) of the Citizens radio band. As illustrated on this month's cover, the transceiver is self-contained and may be plugged into either the 117-volt a.c. house wiring line or into the 6-volt d.c. system of some automobiles. Twelve-volt models are also being made available to the public by the manufacturer.

A short antenna can be plugged directly into the transceiver, or the Vocaline company will supply a special ground plane antenna. Photos on this page show the transceiver being tested by the POP'tronics staff under license 2A1402.

Field tests proved conclusively that even the very low power of the transceiver could insure 100% reliable two-way communication in metropolitan areas for distances of 1½ miles. In favorable locations—where large buildings did not confine or screen off the signal—the communication range was extended to 3 miles. Tests in open country showed that weak signals at distances of 6 miles were fully readable without difficulty.

The Class B portion of the Citizens radio band is reserved for use by private citizens for short-range personal radio communications. Equipment for the Citizens band (radio-telephone) must meet specifications set forth by the Federal Communications Commission. To pass these specifications, the equipment must be examined and approved by the FCC in its laboratories. Because of this cumbersome arrangement (although fully justified), the design of Citizens radio equipment has for a number of years taken a back seat. The ice has been broken by the Vocaline transceiver, which brings Citizens band communication facilities within the reach of everyone's pocket.

After a manufacturer secures FCC approval, he may then produce identical units on an assembly line basis. The purchaser simply fills in Form 505 supplied with the transceiver, sends it to the FCC, and a station license is issued within a week or ten days. A license may be obtained by anyone over the age of 18.

Look for more reports on Citizens band equipment in early issues of POP'tronics.
Ham-Built R/C Tricycle Runs on Six-Meter Signals

Back from a ride in which he did nothing but relax and enjoy the fun is five-year-old Mark Behrens of Sheboygan, Wisconsin. The ride was given by Shirley Eggert, who operated the control box for the homemade tricycle. The vehicle, and its radio-control system, were designed and built by Robert Harkness, W9GZR. An electrical engineer with the Briggs Stratton Corp., Harkness exhibited his ingenious device at a "Do It Yourself" show sponsored by the Milwaukee Journal, a Wisconsin daily. Three controls, producing different tones, can be used individually or in combination to get the tricycle to go forward, turn left, turn right, back up, or honk its horn. The transmitter, which operates on six meters, has a range of up to two miles. It runs about 10 watts input to the final stage. Power for both the transmitter and control equipment comes from a six-volt dynamotor which is energized by an automobile-type storage battery. The receiver is a six-tube superhet- erodyne type. Other equipment used includes a thyratron tube, elaborate relay system, filter networks, a propulsion motor, steering mechanism, and a two-stage roller chain drive. The tricycle is made of wood.

Unmanned Weather Station Radios Data from Mid-Ocean

Early storm warnings as well as more reliable data on general weather conditions are foreseen as a result of a prototype marine weather station developed by the National Bureau of Standards. Built into a buoy that can be anchored at sea and left unattended for months, the device senses atmospheric changes, translates them into electrical signals, and broadcasts reports to authorities who may be located more than 800 miles away.

Completely automatic, the station uses five sensing elements for gathering information on air temperature, water temperature, barometric pressure, wind speed, and wind direction. Literally picking the air around it for data, the equipment then converts these impressions into three-letter groups of code. Coded signals are transmitted on a pulse-modulated carrier frequency of about 6 mc. These signals can be received on standard communications receivers. Each transmission lasts three minutes and is preceded by a three-letter group identifying the station. Made of aluminum and other non-magnetic alloys to avoid ill effects on the compass, the vessel carrying the rig is 20' long.

Last-minute check is made before the ocean-based weather station is put into use. Data is broadcast automatically at regular intervals during the day. Equipment is turned on and off by electronic timers. Primary power comes from 180 4FH dry cells connected in series-parallel to give 13.5 volts at 15 amperes. A rotary converter changes the low-voltage d.c. to 120 volts at 60 cycles to operate the power supply for the electronic components. Future models may employ a gasoline-powered generator and storage battery. The device is currently being used by the U.S. Navy Bureau of Aeronautics.

June, 1956
(A) Get a close look at the enemy.
(B) Don't stick your neck out.

Between these two motives lies the crucial conflict of a soldier on reconnaissance. On his mission, valor is no better than caution, for neither succeeds without the other. The closest view of the enemy is futile if he fails to report.

The Army recently revealed a way to sidestep this dilemma. Enemy positions are photographed by a pilotless aircraft small enough to be carried along by ground troops. Unlike conventional observation planes, this R/C aerial "photographer" is always under direct control of the men who need the information it gathers.

No landing strip is needed. The plane is jet-launched from a catapult. Then the ground operator guides the "drone" by radio control over the area to be surveyed. When the mission is completed, the drone is returned to the launching site, the engine stops, and a parachute lowers the plane gently to the ground. The exposed films are ready for immediate processing.

The drone has a wing span of 12 feet, can fly 228 miles per hour and climb at the rate of 3060 feet per minute. After the jet-assisted launching, it is propeller-driven by a gasoline motor. The camera can take either still photos or motion pictures from the air. Its photographic range is variable between a few hundred feet and several miles.

This new technique provides tactical commanders with aerial surveillance photographs in less than an hour's time. The officers can then deploy their troops on the basis of this up-to-date information. All personnel is saved for tactical missions. No lives are risked in reconnaissance.

New P. A. System Eliminates Double Hearing

All of us have at times been annoyed by "double talk" in a large hall or in a church where public address systems are used for amplifying sound. Since electricity travels much faster than sound in air, the voice from the nearest loudspeaker reaches us sooner than the actual voice from the speaker's rostrum or the pulpit.

Cologne Cathedral, one of the world's largest churches, now has a sound system that slows up the passage of the signal from one speaker to the next. As a result, the real sound and the amplified sound from any of the many speakers arrive at the listeners' ears simultaneously. This gives the impression that there are no loudspeakers at all, and all the sound seems to be coming directly from the pulpit. The illusion is enhanced by styling the loudspeakers (at the right of the photo) to blend into the cathedral's Gothic nave (at left). The circle marks the inobtrusive location of one of these speakers.
Would you be astounded to turn on your TV receiver and see a program from a station half-way across the continent? Probably not, because present-day TV relays provide daily entertainment in this fashion. But what would you think if you discovered that there were no relays involved—the program was really coming from that station hundreds of miles away.

Many viewers outside the metropolitan New York and Los Angeles areas have been treated to this thrilling experience. Distant (DX) television reception is now an accepted fact. No longer do viewers call the repairman and complain. They sit back and enjoy one of nature's most unusual freaks—TV reception where TV receives from stations halfway across the continent.

Two TV stations logged from Fresno, Calif. WJBK, Channel 2, Detroit, Mich., 2145 miles to the east, was received by means of sporadic E skip. KRLD, Channel 4, Dallas, Texas, 1350 miles southeast, was seen on 26 days in 1955.

Sporadic E skip loggings reported per month (right) from January through December, 1955, show frequency of DX TV reception. Such reception usually lasts from about five minutes to several hours (AIPA data). June, 1956
Meteoric effects on long-range TV reception are being studied at Stanford University with the assistance of this huge TV-type antenna.

Reception is not supposed to be possible. Engineers and scientists are alarmed over the increase in DX TV reception. The chart on the preceding page may give you some idea of how frequently TV stations are seen hundreds and thousands of miles from their so-called "service areas."

Standardization of TV equipment in North and South America has permitted viewers to see stations outside of their own continent. Scientists at the National Bureau of Standards and the Federal Communications Commission have predicted that sunspots will again affect TV reception. Increasing numbers of sunspots has been found to mean increased DX TV beyond 2000 miles from the transmitter.

Methods of Reception. All DX TV reception is usually accomplished by one of three means. During the late spring and summer months, the ionosphere contains clouds of high ionization called sporadic E skip. This provides fairly frequent reception of the low-band channels (2-6) from stations 500 to 1500 miles away from the receiver. Such reception is of good quality, lasting from five minutes to several hours. Variations of sporadic E skip have provided reception from stations as far away as 6600 miles. Distances of 2000 miles are not uncommon in summer.

The late spring and early fall usually finds a peak in DX reception via the lower atmosphere (up to 30,000 feet in altitude). Unlike sporadic E skip, where the wave is reflected from a thin cloud of electrons in the ionosphere high above the earth, this form of DX TV follows the curvature of the earth. It is due to the distribution of large masses of hot, humid and cool, dry air throughout the continent. TV viewers near lakes and oceans are generally the first to notice this "extended service area" DX. Weather effects on DX TV are noticed on all channels. The v.h.f. channels (2-13) are frequently extended to 300 or 400 miles, while the u.h.f. channels (14-84) may go as far as 250-300 miles.

Recently, TV DX'ers have observed "bursts" of reception over distances of 200 to 1000 miles. Scientists now think these bursts are due to meteors. Considerable research is taking place in an effort to track down the true cause of this peculiar effect. TV pictures in these bursts are generally good, but last from 2 to 15 seconds—often too short for positive identification.

Individual Results. No article on DX TV reception would be complete without a resume of some results of the individual DX'ers. One of the foremost is Robert Seybold of Dunkirk, New York. Bob's location provides him with an over-water path towards the midwest. He is able to see upwards of 35 stations every day at distances up to 350 miles on v.h.f. channels and 150 miles on u.h.f. channels. Bob has seen 270 stations in 44 states!

Another powerful DX'er is Bedford Brown of Hot Springs, Arkansas, who boasts of having seen 234 stations in 40 states. Bedford has seen 76 stations in a single day. His log includes visual identification of stations in Brazil, Argentina, and Venezuela.

Dick Lowry of Temple, Texas, has been DX'ing seriously for just over a year. His TV screen has been illuminated by 179 stations in 39 states. Also included are many stations on the high band (Channels 7-13) including Channel 9, XEQ, Mexico City, over 900 miles distant.

Ed Sparks of Odessa, Texas, also has seen a total of well over 150 stations. Ed's best DX haul included Channels 7, 9, and 11 from Cuba, across the Gulf of Mexico.

The author has seen 128 stations in nine countries. I think I hold the world's record for distance on both Channels 2 and 4, having logged Channel 2 from Rio de Janeiro, Brazil, in 1954, and Channel 4, Boston, WBZ, on June 5, 1955.

DX TV Club. Readers interested in learning more about DX TV may write to me at 4832 North Fruit Ave., Fresno, Calif. I will be pleased to tell you about a club which has been formed to collect DX TV reports for scientific purposes.

POPULAR ELECTRONICS
"MISSILE MASTER"

A SUPER-BRAIN for controlling America's super-weapons, the "Missile Master" is the country's first electronic system designed specifically for coordinating the use of NIKE antiaircraft missile batteries and other advanced Army weapons as they become available.

Built by Martin, the system can be used independently, or in conjunction with units of the recently announced Air Force semiautomatic ground environment area defense system (SAGE). Reliable and versatile, the Missile Master is the first integrated system for tying together all elements of antiaircraft missile defense—from target detection to target destruction. It consists primarily of an automatic data communications network and automatic data processing and display equipment.

The system locates and identifies aircraft, displays this data on giant-size screens, and sends instructions to the firing line. What's more, Missile Master operators observe what the weapons and men on the firing line are doing—and can correct errors, direct concentrated fire on a particular target, and prevent friendly aircraft from being hit by our own weapons.

The Missile Master relies heavily on intricate and ingenious electronic circuits to handle information and solve complex problems almost instantaneously. Combined with the judgment of trained operators, a single installation can weld a number of widely scattered guided missile batteries into a formidable defense force. Each system is housed in a two-story building. Nerve-center is the operations room where Army personnel at radar-type display consoles have a view of the over-all air situation for a given area.

Target information passes into a tracking system and is displayed on the consoles. Targets are selected and assigned to missile commanders for firing action. A special operator, known as the "friendly protector," assures that friendly targets are not fired upon.

Efficient use of each firing battery is assured by a target assignment system which avoids duplicating firing commands. Another part of the system makes sure that any data received by SAGE corresponds to the position of the targets as actually seen on the local radar. If SAGE data are not available, the tracking operators can spot their own targets.

The Missile Master was built by the Martin Company, Baltimore, aided by Airborne Instruments Laboratory of Mineola N. Y., and the American Machine & Foundry Company of N. Y.

June, 1956
Baked Baffle Claimed
Better than Wood

MAYBE this girl's pose means that the speaker enclosure supporting her stance sets a new fashion for hi-fi. Actually, the "Vibranon" goes farther than just fashion, being a serious and significantly new approach to an old audio problem. The first commercially available hi-fi loudspeaker baffle made of a totally non-resonant material, it resembles marble and is molded and baked.

The advantage over wood is that the new material simply cannot vibrate along with the speaker cone and thereby add false coloration to the tone of the speaker. Of course, heavily braced, thick wood panels won't vibrate either. But such sturdy wood construction is usually expensive. "Vibranon" claims equal or better results at much lower cost.

Design of the baffle is simplicity itself. It consists of only two slabs that fit in any corner. The two walls and the floor form the remaining sides of the baffle. Felt-lined edges assure airtight fit.

The baffle works on the bass reflex principle. Lows emerge from two openings at the bottom. Response reaches down to 35 cps. The absence of parallel surfaces prevents formation of standing waves, which keeps the baffle from booming.

Absolute rigidity of the marble-like material helps the speaker handle heavy transients, such as drum beats, without random vibration. With such help from the baffle, even inexpensive speakers sound amazingly clean.

The "Vibranon's" inventor, Mr. Mayeri, lived until recently in the isolated highlands of Persia, where modern science is still unknown. He became fascinated with electronics after coming to America a few years ago.

The enclosure, made by Techart Mfg. Co. of Brooklyn, sells for about $60—at Harvey Radio Co., 103 West 43rd St., and Duvant Sound Co., 88 West 55th St., New York, N. Y. (plus freight).

Scholarships for Electronics Students

WITH THE GREAT shortage of engineers in the electronics industry, more engineers must be trained to take care of the growing demands. The West Coast Electronics Manufacturers Association is tackling the problem in a practical dollar-and-cents way by sponsoring college scholarships leading to degrees in mechanical or electrical engineering. Degrees in physics are also sponsored.

During the current school term, twenty-five students are attending fifteen West Coast schools with financial aid from this fund. The scholarships are awarded to freshmen and sophomores picked by the deans of the engineering departments.

46
Economy Vacuum-Tube Voltmeter

By RICHARD GRAHAM

Half-price v.t.v.m. uses new approach in simple design to achieve good accuracy and stability

HOW IT WORKS

Basically, the circuit is a bridge in which each half of the 12AU7 forms one arm of the bridge. Potentiometer $R1$ forms the other two arms. Alternating voltage from the transformer is applied to two corners of the bridge formed by the junction of the two 12AU7 plates and $R4$. With no voltage input to the 12AU7 grids, the bridge is balanced by means of $R4$. Any positive voltage input to the grid (pin 2) of the 12AU7 will make the triode draw more current. This increased current causes the cathode voltage of that half of the 12AU7 to rise. Since the meter is across the two cathodes, a current will be read which is proportionate to the voltage placed on the grid.

The fundamental range of the meter is approximately 4.5 volts. This is the range over which readings will be linear. The 2.7-megohm resistor ($R1$) in the probe serves to multiply all ranges of the meter from multiples of six on the input to multiples of 4.5 (approx.) on the 12AU7 grid. Exact voltage calibration is accomplished by the voltage-adjust potentiometer, $R2$.

Since the fundamental range of the v.t.v.m. is approximately 4.5 volts, a 4.5-volt battery must be used for the ohmmeter section. The principle of the ohmmeter section of the v.t.v.m. is quite simple. The meter will read full scale regardless of the resistance in series with the 4.5-volt battery placed between grid and ground. However, if the grid is shunted by any resistance, the meter reading will fall by the amount of the voltage division between the resistor in series with the battery and the resistor shunting the grid.

THERE really isn't any need to expound the usefulness and versatility of the vacuum-tube voltmeter—it is one of the basic items of test equipment in setting up any shop, ham station, or laboratory. But the v.t.v.m. described here can be built for less than half the cost of the popular kits available today—assuming all new parts are used in construction.

Such economy is not accomplished at the sacrifice of performance but rather by keeping a sharp eye on all the electrical and constructional details. This v.t.v.m. has an input impedance of 12.7 megohms on all ranges. It has three d.c. voltmeter ranges of 0-6, 60, and 600 volts full scale. There are also three ohmmeter ranges, making measurements of 10 ohms to 10 megohms quite feasible.

The "Economy" v.t.v.m. utilizes a 0-1 milliampere meter which may be purchased for approximately $3.50. (Any 0-1 ma. meter may be used—the determining factor is mainly one of price.) The meter is of the moving-vane type and has an internal resistance of about 1000 ohms. If a moving-coil type of meter is used, a 910-ohm, ½-watt resistor should be placed in series with the meter when it is employed in the v.t.v.m.
Pictorial wiring diagram shows how various components are connected. Note particularly the wiring around switch S3 and shielded lead attached to R14.

Layout and construction details can be seen in the photographs. The v.t.v.m. is housed in an aluminum case which measures 7" x 5" x 3".

A big item in the economy of construction is the use of 5% resistors for the voltage divider and ohmmeter multipliers. It will be noted that some of the resistors in the voltage divider ohmmeter multiplier are in parallel—to achieve the exact calculated value. For example, one of the values called for was 900,000 ohms. Since this is not an RETMA standard value, two 1.8-megohm resistors—which are standard—were placed in parallel (see R5 and R6, R7 and R8).

The d.c. volt test lead should be a shielded cable. A three-foot length of single-conductor microphone cable is ideal for this purpose. The common test lead and the ohms test lead are made of standard rubber-covered test lead wire.

No jacks were used for the test leads since there is never any need to disconnect.
them. In fact, the general practice of using jacks at these points only leads to more difficulties such as poor contact, loosening up, etc.

The most painstaking operation in constructing the v.t.v.m. is making the meter scale. First, disassemble the meter by bending the four ears up on the back of the meter. Next, carefully remove the scale. Lay the scale on a piece of paper and fasten it temporarily in place with Scotch tape. Now, divide the scale into six equal parts—since the meter scales are to be multiples of six instead of ten. Use the meter readings listed in Table 1.

Transfer the scale calibration to a new scale which can be drawn on a white file card. Make an arc corresponding to the original meter scale arc. Draw lines to the seven division points; this will divide the scale into six equal parts. Now subdivide each of the six divisions into five equal subdivisions; these correspond to 0.2, 0.4, 0.6, and 0.8.

The next step is to draw in the ohmmeter scale. You can do it by referring to Table 2. Draw another arc for the ohmmeter scale just above the voltmeter scale. From the data in Table 2, a line is drawn

Table I

<table>
<thead>
<tr>
<th>MILLIAMMETER READING</th>
<th>NEW VOLTS SCALE CALIBRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.166</td>
<td>2</td>
</tr>
<tr>
<td>0.33</td>
<td>3</td>
</tr>
<tr>
<td>0.50</td>
<td>4</td>
</tr>
<tr>
<td>0.66</td>
<td>5</td>
</tr>
<tr>
<td>0.83</td>
<td>6</td>
</tr>
</tbody>
</table>

Table II

<table>
<thead>
<tr>
<th>NEW VOLTMETER SCALE READING</th>
<th>NEW OHMMETER SCALE CALIBRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOLTS</td>
<td>OHMS</td>
</tr>
<tr>
<td>.546</td>
<td>1</td>
</tr>
<tr>
<td>1.0</td>
<td>2</td>
</tr>
<tr>
<td>1.385</td>
<td>3</td>
</tr>
<tr>
<td>1.715</td>
<td>4</td>
</tr>
<tr>
<td>2.00</td>
<td>5</td>
</tr>
<tr>
<td>2.25</td>
<td>6</td>
</tr>
<tr>
<td>2.47</td>
<td>7</td>
</tr>
<tr>
<td>2.66</td>
<td>8</td>
</tr>
<tr>
<td>2.84</td>
<td>9</td>
</tr>
<tr>
<td>3.00</td>
<td>10</td>
</tr>
<tr>
<td>3.60</td>
<td>15</td>
</tr>
<tr>
<td>4.00</td>
<td>20</td>
</tr>
<tr>
<td>4.50</td>
<td>30</td>
</tr>
<tr>
<td>5.00</td>
<td>50</td>
</tr>
<tr>
<td>5.46</td>
<td>100</td>
</tr>
<tr>
<td>5.72</td>
<td>200</td>
</tr>
<tr>
<td>5.89</td>
<td>500</td>
</tr>
<tr>
<td>5.94</td>
<td>1000</td>
</tr>
<tr>
<td>6.00</td>
<td>INFINITY</td>
</tr>
</tbody>
</table>

June, 1956
Variable Power Supply for Experimenters

EVERY now and then a friend drops by with a small gadget he wants tested. In each case I have to use different plate voltages. It was quite a problem until I constructed a unit which will supply a variable d.c. potential from 50 to 350 volts and a filament supply of 6.3 volts a.c.

Potentiometer $R_3$ sets the d.c. output to any selected value. The 6.3-volt winding supplies filaments of the 6V6 and any other tube that requires it. Although the power supply is conventional, the metering circuit is a time saver for those who don't like the idea of installing a meter or dragging out the voltmeter each time the plate voltage is changed.

I used a 0-5 d.c. voltmeter purchased for $1.95 in a surplus store. With a d.p.d.t. toggle switch, d.c. voltages and milliamperes can be read with a flick of the switch. Resistors $R_1$ and $R_2$ are values needed with this meter, but any d.c. meter will work by changing $R_1$ to read milliamperes and $R_2$ to read d.c. voltages.

Any transformer and rectifier tube that is available will do; or local radio shops have old radios for $1.00 and up that contain all parts except the meter. Use your voltmeter and a milliammeter to check the unit before you rely on meter readings. —G. W. Pellerin, Jr.

Wiring diagram of power supply and parts list.

C1, C2—10-μfd., 450-volt elec. capacitor
C1H—110-ma. filter choke
R1—100-ohm, 1/2-watt resistor
R2—50,000-ohm, 1/2-watt resistor
R3—250,000-ohm potentiometer
S1, S2—S.p.s.t. toggle switch
S2—D.p.d.t. toggle switch
T1—350-0-350 power transformer
V1—6Y3-G tube
V2—6V6-GT tube
METER—0-5 d.c. volts
England Sets Up TV Training Center

LAST YEAR, commercial TV suddenly threw some spice in Britain's bland television diet. For the first time in the history of broadcasting in England, the government-sponsored programs of the British Broadcasting Corporation (B.B.C.) were rivaled by a newly licensed commercial TV network.

Since England had been among the earliest TV pioneers, sending out regular program schedules almost ten years before TV took over America, all the technical problems had been pretty well ironed out. The snag was in personnel. When the new commercial TV company more than doubled TV activity in England, there just weren't enough people who knew how to put a show on the air.

The answer to this problem has literally taken on concrete shape. The brand-new Marconi Television Centre now rises in downtown London, training a whole new generation of camera men, sound technicians, maintenance crews.

This TV school includes a fully equipped studio with a 2000 square-foot stage, the latest type cameras, video monitors and audio mixing consoles. There are also complete facilities for filmed TV programs, including film editing and sound dubbing machines. Even a remote pickup truck is available in training for on-the-spot coverage. TV producing firms wishing to train their own staffs in studio operation can rent both faculty and facilities of the Marconi Centre.

With the new Centre as its hub, TV studio work is a lively newcomer to the ancient and established trades of Britain. No doubt this first generation of young technicians will start for their new trade the tradition of workmanlike competence characteristic of British craftsmen.

June, 1956

Sound crew (top) learns to trail action on set with mike boom. Director points at low-hanging mike to warn against lowering the boom into the camera's field of vision. Cuing actors on different sets (center), the director coordinates switch-over with girl at control console, who selects one of four cameras from monitor screens over control room window (bottom).

Intricate camera innards (left) are unraveled by teacher for benefit of maintenance students. The show must go on: trained troubleshooters and standby equipment make sure that it does.
Turntable and tone arm of professional quality at reasonable cost are available as complete assembly or as separate components. Turntable (PK-100, net $49.50) uses 4-pole shaded motor, features variable adjustment at three speeds (33 1/3, 45, and 78-rpm). Wow is less than 0.2%, flutter less than 0.05%. Arm is viscous-damped (PK-90, $19.50 net), accepts all cartridges, will handle discs up to 16" in diameter. If dropped, arm cannot damage records.

AM-FM tuner features new "FM Rumble Filter," a 10-kc. AM whistle filter, and a cathode-follower output. Full Armstrong circuit (limiter-discriminator) is used. The "Rondo," (Model T-120) is only 3 3/4" high. Net price of $95.00 includes metal cage.

Low-cost 12" woofer handles 10 watts of power, has frequency response of 40 to 5000 cps ± 5 db, with resonant point at 60 cps (Model 12AIOL, $16.00 net). Fifteen-inch version handles same power but bass response extends to 30 cps, with resonance at 45 cps (Model 15A10L, net price $21.00). Either woofer may be used with company's Model 3A15T or 5A15T tweeter, or with any other tweeter of similar quality, to make a 2-way speaker system.

Record changer intermixes 12"-, 10"-, and 7"-diameter records and plays at standard three speeds. The "Renown" (Model RC-121) is Garrard's newest unit; it can be used as a manual player or fully automatic changer. Arm accepts any standard pickup. Four-pole motor is shaded and shock-mounted. Turntable is covered with rubber mat to minimize rumble pickup. Net price, $42.50 (less cartridge, 45-rpm spindle adapter, and mounting base).

Amplifier (Model 99-B) has power output of 22 watts, plus complete audio "front end." Control facilities include record preamp-equalizer, tape playback control, and all switching needed for hi-fi system. Response is 20 to 30,000 cps. Net, $99.95.

Bass reflex speaker enclosure with rear horn-loading can be built from kit containing pre-cut panels. Enclosure may be used in any position in room, can house any type—or combination of—speaker units from single-cone speaker to separate 3-way system. Model KEN-12 (shown in photo) is for 12" re-producers, sells for $39.75. Model KEN-15 houses 15" units, nets for $49.75. Both kits, known as "KwiKits," use 1/4" birch plywood.
Two Are Better Than One

Coaxial speakers and separate two-way systems are examined in the first part of a new series

By H. H. Fantel
Associate Editor

THANKS to recent advances in audio program sources, many home music systems have outgrown the single-unit, wide-range speakers on which most audio fans first cut their hi-fi teeth. Today’s records, tapes, and FM broadcasts furnish signals of such range and quality that only a multiple speaker system can do them full justice.

Just to set things straight at the outset, a "multiple speaker system" does not mean simply adding extension speakers to an existing speaker setup. It does mean using separate reproducers to handle different frequency ranges. A two-way speaker system divides the audio range into lows and highs for a woofer and tweeter, respectively. A further refinement is to divide the sound into lows, mid-range, and highs for a three-way system—woofer, squawker, and tweeter.

How does this division help? An orchestra uses separate instruments to produce different frequency ranges. To reproduce the orchestra’s full tonal range, a multiple speaker system imitates the original division of labor between the musical instruments. For instance, the three-way speaker system corresponds roughly to such instrument groupings as violin, cello, and bass viol—or, flute, clarinet, and bassoon. The idea is the same in each case: each instrument within the group can best handle a specific frequency band. You can’t get piping piccolo notes from a bass tuba, and you can’t squeeze deep growls from a flute!

Specialized Speakers. The optimum range of any speaker lies in the region near its natural resonance. Response grows weaker at outlying frequencies. Beyond certain limits, the speaker becomes mute. A single-unit speaker necessarily suffers from having to do two jobs at once—from having to stretch its response both ways from a single resonant point. Such a speaker may strike a good musical balance, but only at the sacrifice of extreme highs and lows.

No such compromise limits the performance of multiple speaker systems. Free from the over-all responsibility of the single-unit speaker, tweeters and woofers can be designed to specialize in treble and bass. Their widely spaced resonant points enable them to reach the extreme frequencies at both ends of the audio band.

Pushing out the frequency limits is only half the story. Since each speaker in a multiple system operates only within the relatively narrow band best suited to its design, it can cover this band with less effort and more uniform efficiency. The result is flatter and smoother response throughout.

IM Distortion. Contributing to listening pleasure perhaps even more than added range is the reduction of intermodulation (IM) distortion. This type of distortion often occurs in single-unit speakers where treble and bass are sounded simultaneously.
Different versions of the "dual cone" principle with mechanical crossover. Lower left, Altec Lansing "Biflex." Upper left, Electro-Voice "Radax." Center, University "Diffusione." Right, Stephens "Co-Spiral." These speakers use a single voice coil; cones are treated so that inner section reproduces highs, outer part lows.

from the same speaker cone. The treble then becomes modulated by the bass in much the same way that an r.f. carrier is modulated by the a.f. signal in a radio transmitter. The resulting sidebands clash against the music in subtle dissonance. Since its level is usually low, IM distortion may be hard to detect at first hearing. Yet, after long listening, it causes nervous strain—one of the chief factors in "listener fatigue." Multiple systems simply sidestep this IM problem by physically separating treble from bass.

**Dual Cone Speakers.** A two-way system consists of a woofer and a tweeter with a frequency divider or "crossover" to separate treble from bass and feed each to its appropriate speaker. The simplest—and generally cheapest—approach to two-way performance is the "dual cone" type of speaker. This type incorporates some, but not all, aspects of the two-way principle.

The dual cone speaker uses a single magnet and voice coil to drive two cones of different resonances. A light, stiff inner cone acts as tweeter while a larger, heavier outer cone handles bass. In some models, the two cones form concentric rings. A strip of soft material, known as a "mechanical crossover," lies between the two cones. It transmits the heavy bass thrusts but absorbs the rapid treble vibrations, thus providing an elementary sort of frequency separation between the two cones.

Speakers of this kind (e.g., the University "Diffusione," the Electro-Voice "Radax," Permoflux, Stephens "Co-Spiral," Altec Lansing "Biflex," etc.) offer excellent value in the $40-$50 class. They represent an economical compromise between a single-cone unit and the full two-way system which uses separate treble and bass drivers and an electrical crossover network.

**Coaxial Speakers.** The coaxial speaker is a complete two-way system with independently driven woofer and tweeter. The tweeter, either horn or cone type, nests inside the woofer. Coaxials therefore take up less space than separate woofer and tweeter components and require only a single cutout for mounting. Hidden within the housing, or enclosed in a separate box, are the coils and capacitors of a full LC crossover network. This electrical network separates bass and treble more accurately and effectively than the previously described mechanical crossover, enabling coaxial speakers to rival the performance of separate component systems. Among coaxials, the margin of quality largely remains with models featuring full LC crossover.

**Three-Way Speakers.** Some manufacturers, notably Electro-Voice, University, and Jensen, carry the coaxial principle...
a step further and produce "triaxial" speakers. These are neatly tucked-together three-way systems. The Jensen Model G-610 is the only speaker in this group that uses completely independent drivers for all three speaker elements. Others use a common driver with mechanical crossover for bass and mid-range, and a separate driver with electrical crossover for the tweeter.

**Crossover Networks.** Also called "dividing networks," these circuits divide the total frequency range into treble and bass channels. The network must keep bass out of the tweeter lest the heavy bass amplitudes damage the tweeter assembly and produce harsh sounds as well. Conversely, treble must be kept out of the woofer where it might cause IM distortion or simply burn up as heat because the heavy woofer cone cannot keep pace with rapid treble vibrations.

A complete crossover network, therefore, combines low-pass (inductive) and high-pass (capacitive) filters. A simple capacitor in series with the tweeter, sometimes found in low-cost installations, is somewhat effective but is not a true LC network. As a high-pass filter, it will help channel most of the highs to the tweeter and keep bass out of it. But it is—at best—a short cut; there is no inductance provided to intercept treble that might reach the woofer. The door is thus left open to whatever IM distortion may occur within the woofer range.

**Separate Speaker Components.** In their quest for the best, audio designers find limitless leeway in devising speaker systems consisting entirely of separate components. Freed from the restrictions of the coaxial frame, designers of speaker systems may use oversize parts to achieve greater power capacity and improved performance. Adding a "squawker" for the mid-range, and a "super-tweeter" for extreme highs results in a three-way or four-way system. The advantages of such a system lie in further reduction of IM distortion. The greater the number of speakers, the narrower the band to be covered by any single speaker. Hence, there is less chance for intermodulation within that band. Of course, these refinements are realized fully only when the rest of the hi-fi system (amplifier, tuner, and pickup) equals the quality of the speaker system. Such elaborate systems also involve more elaborate—and carefully designed—crossover networks as well as larger housings.

In a two-way system, the physical separation of the woofer and tweeter also precludes the possibility of acoustical interference between treble and bass, which sometimes besets coaxials—where the tweeter may lie directly in the path of low-frequency notes. The separate two-way system is ideally suited for the use of folded horn enclosures. The woofer may be located at the horn's apex, deep within the enclosure, while the tweeter is front-mounted for direct treble radiation.

*Basic tweeter types* are illustrated by examples below. Left, the Electro-Voice T-35 horn tweeter which relies on diffraction principle to spread highs. Center, Altec Lansing's 300-A; this horn tweeter uses multicellular construction to fan out highs. Right, Lorenz LP-65; in this cone tweeter, highs are spread from stiff, shallow, plastic diaphragm. Choice of a cone or horn tweeter is largely a matter of personal listening taste.

---

**Woofers** specialize in bass and form "bottom" half of two-way speaker system. This 12" University woofer has response from 40 to about 6000 cycles. Provisions are built in for frequency cutoffs at 700, 2000, or 5000 cycles. Other woofers are available in 8" and 15" sizes.
Speaker systems come in a variety of enclosures—from shelf-sized two-way "miniatures" with 8" woofers (suitable for small apartments) to four-way giants capable of filling the largest room with massive sound of astonishing realism. The price range is nearly as wide as the frequency range—from about $55 to several hundreds of dollars. There are good bargains at the bottom—and you still get your money's worth at the top.

**Home Assembly.** Perhaps the main attraction of separate speaker components is for the audio fan who assembles his own system. Liberty to try out different combinations of woofers and tweeters makes separate speaker components the natural choice for the hi-fi experimenter. One could, for example, compare various horn and cone tweeters to pick the type and model best suited to his own room acoustics. The separate—and independently mounted—tweeter (or tweeters) may be pointed at any desired angle. Remarkable realism often results from turning the tweeter away from the listener to let the highs reflect from corners or bounce off the ceiling. The sound then becomes diffuse and non-directional, and the listener feels pleasantly "surrounded" by the music. Separate tweeter level controls (included in most large systems) balance the proportion of highs and lows for any listening situation.

**"Growing" a Speaker System.** Flexibility in combining different woofers and tweeter components is also a money-saver. Audio fans who start with a single "wide-range" speaker can convert to a multiple speaker system without losing their original investment. After adding a new tweeter and crossover network, the old wide-range speaker may serve as a woofer. Later, if a larger woofer is desired, the original speaker still remains useful as a fine mid-range "squawk." In this way, the speaker system grows up gradually, keeping pace with the listener's own tastes and his limitations of budget.

Recognizing this interest on the part of many audio fans, some manufacturers have worked out such gradual "speaker expansion" programs in kit form. Speakers are bought and added one at a time until a complete three- or four-way system is assembled, thus distributing the load not only electronically but financially as well. These factory-planned expansion systems also assure the customer that all speakers and their crossover networks will be correctly matched.

**Picking Your Own Components.** The most adventurous among radio fans insist on experimenting more freely, combining different makes and types of speaker components for what they hope will be a unique and personal achievement. Therein, for many serious hobbyists, lies much of the excitement and reward of hi-fi.

Once he is on his own, there is no sure way of foolproofing the efforts of an audiophile. Yet, the following hints might avert costly blunders:

1. **Woofers, tweeters** (and mid-range unit, if any) must be "compatible" in terms of crossover frequency. Between them, the entire audio range must be covered continuously. If woofer response falls off below the frequency where the tweeter takes over, the resulting response gap plays havoc with the middle, imparting a strangely disembodied feeling to the sound. For smooth transition, a certain amount of overlap between speakers is desirable, as long as the woofer and tweeter are so positioned that no phase cancellation occurs in the overlap band.

Compatibility and non- compatibility are illustrated in the graph on page 54. If an already-present single-unit speaker is to be expanded into a two-way system by the
addition of a tweeter, the crossover frequency must be at—or above—the low-frequency cutoff of the tweeter. Other factors remaining the same, the lowest feasible crossover point will give the best performance, since it reduces IM in the woofer.

2. The crossover network itself must actually furnish the dividing frequencies and impedance ratings required by the speaker components. A tweeter designed to take over at 4000 cycles should not be connected to a network with a crossover frequency of 2000 cycles. Similarly, a network for an 8-ohm impedance might not do too well connected to a 16-ohm speaker. Commercial crossover networks are clearly labeled for correct connections.

3. Where no level control is provided for adjusting the relative output of woofer and tweeter, these speaker components should be about equally efficient, so that neither "outshouts" the other.

The use of more than one woofer and tweeter in two-way and three-way systems, various crossover values and their applications, matching components of varying impedance ratings, and general descriptions of typical three- and four-way systems will be discussed in later articles.

Low-Cost B Battery Rejuvenator

A 67½-volt B battery rejuvenator has been announced by Lafayette Radio, 100 Sixth Ave., New York 13, N. Y. This unit may also be used to replace a B battery when the voltage requirements are near a 117-volt a.c. source. The portable eliminator/rejuvenator is fused for additional safety. Known as the Model F-195, it measures 1¼" x 2½" x 1½" and is sold complete with a convenient 6' line cord. Experimenters using 67½-volt batteries will find that this unit adds many hours of life to their partially run-down batteries.

Representative coaxials (reading from left to right, pages 56 and 57). Cutaway view of University 6201, in which the horn tweeter nestles within the frame of the surrounding woofer. The Lorenz LP-312-1, showing how the cone tweeter described in the text is mounted on a frame across the front of the woofer. Altec Lansing 604C speaker combines a 15" woofer with a multifraddual horn tweeter; crossover network is in separate box. Cutaway view of Jensen H-222, another example of a low-cost full coaxial. The Bozak B-207A utilizes two coaxially mounted cone tweeters.
Few gamblers would take bets on the way the wind might turn a week from now. Yet at the Weather Bureau in Washington, a giant gambler with a steel brain will soon lay four-to-one odds on just that kind of deal. Nobody minds, because every time he wins, the public benefits.

Like any skilled gambler, the Weather Bureau's electronic IBM computer is betting on a "system." Its system for predicting the weather is based on a "mathematical model" of the weather-generating layers in the atmosphere. Such a mathematical model is a sort of mental picture of a situation expressed in equations understood by the computer. The equations describe the situation not only "as is" but also take into account all possible ways in which the situation might change.

In our particular case, the "model" represents the air ocean over the United States. Its drifts and swirls are continuously charted and teletyped to Washington from 171 Upper Air Sounding Stations throughout the country. Since conditions must be graphed on several different altitude levels, the data represent a "three-dimensional chessboard" on which movement takes place up and/or down as well as sideways.

Readings of wind velocity, barometric pressure, temperature, moisture, etc., naturally vary from hour to hour. But the principle by which these factors interact to determine our weather stays always the same. This unchanging principle of atmospheric interaction is retained in the computer's magnetic memory.

With this vast background information always on hand and constantly "consulted" by electric scanning pulses, the computer develops current weather reports into predictions for the future.

Fast Figuring. Each prediction means a mass of math. The greater the number of factors considered, the more reliable is the forecast. The most accurate nationwide 24-hour weather forecast possible today involves about ten million calculations. On such a job, the weather outruns the weatherman. With a houseful of clerks buzzing away on ordinary desk calculators, reports might get out just in time for last year's newspaper.
Up to now, the main reason for the uncertainty of weather forecasts was the early deadline. There just wasn't enough time to do all the necessary figuring. Hence, hunches had to pinch-hit for mathematics. The new computer, performing 14,000 mathematical operations per second, clicks out the answer in 48 minutes. It is now possible for the first time to make accurate forecasts before the prediction turns into history.

On a trial run before installation, the machine astounded the members of the staff by spotting a brewing storm that they had missed completely. Senior weathermen were delighted to be "shown up" by the robot newcomer.

At present, the Weather Bureau computer grinds out weather maps for the next 36 hours. The computation of such a map takes only 105 minutes. Weathermen are now working to stretch the reliable prediction span to 72 hours. Even weekly and monthly forecasts may soon boast up to 80% accuracy. Basic research is busy defining the mathematical basis for such long-range prediction.

While ultimate hopes are high, immediate expectations must still be held in check. All weathermen know that after a major breakthrough scientific progress returns to its gradual pace. Initial operation of the new system must be evaluated, shaken down, and streamlined until reliable results can be taken for granted. Various mathematical models may yet have to be explored in terms of their theoretical limit of accuracy.

More Automation. As if all this weren't enough, weathermen are now teaming up with electronics engineers to make weather forecasts almost fully automatic. At present, information from outlying stations is fed to the computer on punched cards after the data come in on the teletype. To eliminate the time-consuming card punching, scientists are considering the possibility of telemetering weather data directly into the computer.

Weather signals from balloons aloft would be re-transmitted by ground stations over telemeter lines or relays. The computer could then continuously "keep posted" on atmospheric changes as they occur. Of course, the input section of the computer would have to be modified to "read" the telemeter signals instead of the punched cards. Even the most optimistic admit that this may still be far in the future.

Meanwhile, as an intermediate step toward automation, teleprinter machines have been designed to present their information directly in punched card form rather than in printed alphabet letters. Consequently,
the teletype information no longer has to be "translated" by hand into punched card code. This automatic coding eliminates the chance of human error misguiding the computer. Eliminating routine coding operations also saves time and frees personnel for more vital tasks.

Nature vs. Man. Floods and hurricanes taking their tragic toll remind us dramatically how human life is intertwined with the whim of the weather. From airline flights to scheduling baseball games, the modern community depends on accurate advance weather news. Less obvious, but reaching more deeply into our national life, are such long-range weather factors as crop prediction and water supply.

Like a giant hand, the force of weather grips the whole surface of our planet. Aside from occasional attempts at seeding rain clouds, the atmosphere still eludes human control. But the new electronic aids to meteorology take the surprise element from the elements. We are no longer quite so helplessly at their mercy.

When Mark Twain complained that "everyone is talking about the weather but nobody's doing anything about it," he could hardly have envisioned a huge maze of electronic circuits with feelers flung across a continent, converting climatic quirks into an almost sure pattern of predictability. And the rain and thunder gods of our ancestors would be even more amazed.

CD or Hi-Fi Crystal Set Offered by Heath

A SENSITIVE CRYSTAL set using two tuned circuits has been announced by the Heath Co., Benton Harbor, Mich. Attractively mounted in a black Bakelite case, the receiver is self-contained and has nothing to wear out or fail in service.

Sold as a complete kit with elaborate instructions, the Heath Co. feels that this unit will serve three purposes. A beginner can use the manual to understand the fundamentals of radio reception, the household can use it for Civil Defense and the hi-fi fan for excellent AM reception.

POPULAR ELECTRONICS
Tuning the Short-Wave Bands

with Hank Bennett

WE THOUGHT you might like to hear about the experiences of another steady s.w. reporter from New England, Paul Mathieu. Paul, who is 17, lives at 25 Chestnut St., Southbridge, Mass. He is a senior at Mary E. Wells High School in Southbridge.

Replying to our questionnaire, Paul says that he does his DX'ing on a Hallicrafters SX-28-A receiver, a 15-tube superheterodyne. To bring the signals into his shack, he uses an end-fed rectangular shaped long-wire antenna, about 40 feet above the ground and the same in perimeter. Supplementing this antenna are two 100-foot long wires oriented NE/SW and NW/SE. Additional equipment includes a homemade two-tube preselector, an antenna tuner, three-speed turntable, auxiliary audio amplifier, Admiral table model superhet, and a Sessions time clock and switch system.

Paul first became interested in radio in late 1954. He is a Novice, with the call WN1YZH, and hopes to obtain his General soon. His first foreign verification was from Radio Gonaïves, Gonaïves, Haiti. At one time he had a report to Radio Commerce, Port-au-Prince, Haiti, published in a Haitien newspaper in a radio column. He carries on a steady correspondence with Sr. Luis D. Carboné Mora, Director General of the Iquitos station of Radio Nacional del Peru.

Since 1954, Paul has logged a total of 92 countries, with 83 of them verified. He has heard 151 s.w. stations, with 112 veries. Paul's most prized veri is from Radio Tahiti in Papeete, Tahiti. When writing to the foreign stations, his letters are in English, French, Spanish, or Greek. Being able to read, write, and translate Greek has made him an invaluable reporter on the activities of the various Greek stations.

Paul writes that his favorite s.w. bands are 41 and 49 meters or, roughly speaking, 5900 to 7400 kc. His favorite s.w. stations are those of the Swiss S.W. Service because of the great variety of interesting programs and a usually reliable signal. His best DX includes Tahiti, Japan, Noumea, New Zealand, Lebanon, VLT6, the Forces Stations in Athens and Larissa, Greece, and Radio Mediterraneo, Valencia, Spain.

Radio clubs to which Paul belongs include the Newark News Radio Club and the Quinnebaug Valley Radio Club of Southbridge. He is also interested in photography, languages, and any kind of electronic experimentation.

In closing, Paul states that he would like to see more items on choice DX-bits, instead of so many reports on the stations that are generally audible without trouble even to an inexperienced DX'er.

Club Notes

One of the newer clubs at present is the International Shortwave League of Indianapolis, Ind. Editor and Publisher Joel Whitaker II writes that the club is currently undergoing changes in format but that shortly bulletins should be going out every month. The dues are $1.75 in North America; $2.50 elsewhere. Details can be obtained from Mr. Whitaker, 3156 N. New Jersey St., Indianapolis 5, Ind.

(Continued on page 116)
Secret Switch Paralyzes Radio

Wire jumper is soldered across the two terminals inside the plug. Drill two small holes through the cover of the plug (below) so that the plug can be fastened to a key chain by means of a small loop of dial cord or fish line.

Phone plug and socket, while small in size, are husky enough to carry 117-volt a.c. house current—or battery current—without heating. The above photograph shows how socket is mounted on the rear panel of a radio cabinet.

The "key" is plugged into the socket while the radio is in use. There is no danger of shock because the exposed part of the plug is well insulated, and the mounting screws of the socket are insulated from the socket terminals.

If you have a piece of radio or electronic equipment that you don't want anybody to use while you're away from home or shop, install the simple plug and socket shown in the photos above. The socket is connected in series with the power supply (either 117-volt a.c. or batteries) of the equipment to be protected. If you want to use the equipment, simply insert the shorted plug into the socket. When you leave, pull out the plug and take it with you. Mount the socket where it is not easily seen, and keep the "key" a secret!—Arthur Trauffer.

Phono-Plug to Phone-Jack Adapter

In experimental and test work, or for permanent installations, you will sometimes want to connect a phone plug to a phone jack. A shielded adapter can easily be made from junk-box parts—or for about 35 cents if you buy new parts—which will do this job quickly and efficiently.

Cut off a 1"-diameter metal container to a length of 1 1/4", using a fine-tooth thin-blade hacksaw, and smooth the rough-cut edge with a knife blade or sandpaper. Drill a 1/4"-diameter hole in the center of the bottom of the can, and then enlarge it to 5/8" using a rat-tail file. This 5/8" hole is for the threaded part of the phone plug. Solder a short length of insulated flexible wire to the center terminal on the phone plug. Then screw the plug into the 5/8" hole in the bottom of the can, and solder the plug to the can bottom with small dabs of solder at two or three spots. If you do not have an old phone plug, buy an Amphenol 75-MC1P plug (29 cents) and solder the wire to the center terminal on this plug.

A standard phono jack (about six cents) just fits inside the can lid. Drill the three necessary holes in the can lid, and mount the phono jack as usual. Now solder the wire from the center terminal of the phone plug to the center lug on the phono jack. The connection from the outside terminal of the phono jack to the outside shell of the phone plug is automatically made through the metal can, which acts as a shield at the same time. Be sure that the phono jack makes a good connection to the can lid, and that the can lid makes a good connection to the body of the can. For an even better job, you may want to solder the lid to the can.

Popular Electronics
A FEW of the many applications of wired-wireless control were mentioned last month in Part 1, and details were given on a suitable one-tube transmitter that would transmit on a single frequency or on one of several frequencies, so that several different receivers could be separately controlled.

You can build a receiver unit very cheaply because only eight or nine components, including the tube and the relay, are required. This also means that you can house it in a very small metal box, as the photographs show.

The receiver is connected across the power line and remains on standby duty until an r.f. signal is received via the line. A small gaseous triode, which draws current only when activated, is used as the trigger tube. Total standby current is such that the power drawn amounts to only ¾ watt.

**Construction.** Employ any convenient size box for the housing. The larger unit shown in the photographs uses an OA4-G, and was housed in an ICA #3817 cabinet, which measures 3” x 4” x 5”. This cabinet comes with a small chassis attached to the front panel. The smaller unit uses a 1C21 and was built into a 4” x 2” x 2 ½” LMB interlocking box.

Mount the ferrite antenna as shown in the interior views. Although the proximity of the metal cabinet will reduce its effi-

---

**Intercept W/ W transmitted signals with this inexpensive ...**

**HOW IT WORKS**

Two types of operation may be employed. Figure 1 gives the circuit of a controller whose relay is operated only during signal transmission, and Fig. 2 shows a unit which remains on after the transmitter has been switched off. Either an OA1-G or a 1C21 tube can be used. Each tube contains three electrodes: the cathode, starter-anode, and anode. A sufficiently high voltage between any two of these elements, which are surrounded by an inert gas, creates a glow-discharge.

Voltages applied to the tube electrodes in the controller circuit are such that ordinarily there is no conduction between cathode and anode. If, however, a sufficiently high voltage appears between the cathode and the starter-anode, the resulting glow discharge between these two elements instantly starts a cathode-anode discharge, and the relay is activated. Tube conduction occurs only on positive cycles of the line voltage, provided that the starter-anode discharge is still present. C3 and R2 smooth out the ripple to prevent relay chatter.

The no-signal voltage on the starter-anode is adjustable by means of R1 and R3. R3 is a potentiometer, and it acts as a sensitivity control. The preset voltage increases whenever an r.f. signal of the frequency that the loopstick, LI, and the capacitor, C2, are resonant to is received via the power line.

When you want to operate a device remotely and then leave it on for long periods, it is sometimes desirable not to have to keep feeding r.f. continuously over the power line. The circuit of Fig. 2 responds at the first instant of signal transmission, and thereafter continues to flow through the tube and relay coil whether a signal is still being transmitted or not. This is accomplished by supplying the tube anode with d.c. instead of a.c., as in the circuit of Fig. 1. This lock-in controller has the disadvantage that it must be manually reset by momentarily opening S1. The tube conduction continues for a brief period while C1 discharges.

---

By RICHARD J. SANDRETTIO

June, 1956
ciency somewhat, the effects are not too detrimental.

If you have a plate relay with a higher coil resistance than that specified, use it—exact value is not critical. If this substitution is made in the circuit of Fig. 1, some other experimentally selected values

Fig. 1. Circuit of the basic wired-wireless remote control receiver. See parts list below.

C1—0.03-µfd., 600-volt capacitor (see text)
C2—900-µfd., ceramic capacitor (see text)
C3—8-µfd., 250-volt electrolytic capacitor
L1—Ferrite core broadcast antenna coil
R1—27,000-ohm, 1/2-watt resistor
R2—150-ohm, 5-watt resistor
R3—25,000-ohm potentiometer
RL1—S.p.d.t. plate circuit relay, 2500-ohm coil (see text)
S1—S.p.s.t. toggle switch (see Fig. 2)
SRI—65-ma. selenium rectifier (see Fig. 2)
V1—OA4-G or 1C21 tube
1—Line cord and plug
1—Octal socket
1—Cabinet, 2" x 4" x 5" (ICA #3817) or 4" x 2\(\frac{1}{2}\)" (LMB) — see text
1—2-terminal tie point
1—Terminal tie point
Misc. machine screws, wire, solder, grommets, etc.

for C3 and R2 may be needed to obtain good filtering action.

Although the nominal value of 900 µfd. is specified for C2 in both diagrams, the needed value will depend on the tolerance and true capacitance, the control frequency, and the inductance of L1—which value varies among various ferrite antenna coils.

The needed value of capacitance—which will permit adjustment of L1 in order to tune the receiver to the control frequency—should be chosen by trial-and-error. This is not difficult because the control frequency (determined in Part 1) dictates approximate values to try: 1000 µfd. for 340 kc.; 1500 µfd. for 290 kc.; 1800 µfd. for 240 kc.; and 2700 µfd. for 190 kc. This capacitor, mica or ceramic, is connected but left unsoldered until the adjustment which follows shows it to be a workable value.

Adjustment. If you use a 1C21 tube, remove some of the black coating painted on the bulb so that an interior discharge can be seen. A rag moistened with lacquer thinner should do the trick. This procedure will not be necessary with the OA4-G.

Check the wiring carefully, then plug the unit into the power line. At one extreme setting of the sensitivity control, the tube will not conduct; at the other end of rotation, it will conduct. Adjust the control to a setting just below the point where tube conduction begins.

Next, plug the transmitter into the same outlet that the receiver has been plugged into, and set the transmitter to the proper control frequency. Although the receiver is probably far out of tune, the brute force of the adjacent transmitter should activate it. Tune the receiver by turning the loopstick screw adjustment in or out.

Reduce the sensitivity control setting to

Pictorial diagram of the basic receiver circuit showing how components are connected.
Using an OA4-G tube, this unit is housed in 3" x 4" x 5" cabinet. Note three-conductor plug which makes it possible to record by remote control.

a point where the tube just stops conducting prior to each tuning adjustment, so that any improvement will show itself by the tube's beginning to conduct again. It should be possible to reach a point where further adjustment in the same direction causes a reduction in sensitivity. If this does not occur, it means that C2 has not brought the coil within range of the control frequency. Try a slightly lower capacitance for C2 if the coil adjustment screw is all the way out (minimum inductance), or try a slightly higher value if the adjustment screw is all the way in (maximum inductance).

Another technique is to connect an r.f. probe of a v.t.v.m. across the ferrite antenna coil of the receiver unit, and use the meter indication for tuning. Remove the tube so that it will not affect the adjustment. However, a final adjustment should be made by the first method, and with the transmitter and receiver plugged into separate outlets. This is necessary because the v.t.v.m. and the tube have different loading effects on the circuit, and also because the location of the units affects the tuning slightly.

If more sensitivity is needed, the following two things can be tried. First, connect different values of capacitance, C1, (.022-.068 µfd, 600 volts) across the power line terminals in the receiver. One value may boost the signal pickup considerably. Second, try varying the number of turns of plastic hookup wire that have been wrapped around the transmitter coil.

Applications. The smaller unit shown in the photographs features a built-in receptacle and was designed to be inserted between an electric outlet and an appliance to be controller. The receiver will control a non-inductive load of 500 watts or an inductive load of about 150 watts. To control a heavier load, add another relay capable of handling larger loads.

The larger unit shown was equipped with a three-conductor Jones plug. Insert-

(Continued on page 108)
Radar Equipment Gets Boost from Iron Rust

RUST IS THE BANE of most equipment, but not so for radar. In fact, Sylvania engineers have found that iron rust can actually help the performance of a radar system. The iron-oxide composition of rust is used for making "ferrite isolators." These are "one-way windows" for radar signals—they pass the powerful transmitter pulse to the antenna, then they "look" the other way to receive the echo signal returning from the target.

What's more, tiny rods made of ferrite can themselves be used as radar antennas. A group of these rods causes a radar beam to scan an area like a searchlight—without need for the familiar giant reflector being continuously rotated.

The ferrite isolator (shown in photo at left) may also prove to be useful for extending the number of channels used in television, as well as improving telephone microwave relay systems for long-distance communication.

Amplifier Frees Both Hands During Phone Conversation

ANOTHER ONE of those "why-didn't-someone-think-of-it-before" gadgets is a transistorized amplifier recently announced by Fisher Research Laboratory, Inc., 1961 University Ave., Palo Alto, Calif. This device boosts voice signals going into—and coming out of—a telephone. Placing the telephone handset onto this unit permits you to hear your party, as well as talk back, from clear across the room. Both your hands are free to take notes, or continue eating your lunch, or consult the files—as shown in the photo.

Dubbed the "Telemaster," the device is also ideal for on-the-spot conferences, since all present can listen easily to an incoming call and participate directly in the conversation. An adjustable volume control on the "Tel-O-Master" boosts weak incoming signals to normal hearing level. Completely portable, the device requires no connections to the telephone or the electrical system. It is powered by miniature cells. Price is $69.50.

Catch This Train and You'll See a TV Show!

TV VIEWERS fearful of missing their favorite telecasts because of the need to catch a train will be able to travel and watch the screen too—if a system tried out on the Chicago, Indianapolis and Louisville Railway Company goes into general use.

Using a Crown antenna rotator and a TACO antenna, the receiver—installed aboard a car of the railroad—traveled from Chicago to Rome, Georgia, and back to Chicago. Video reception was reported as "good all during the trip."

Installation techniques used in the railroad car are said to be ideally suited for placing TV sets in boats operating on inland waterways. Technical details on the rig may be obtained by writing to either Crown Controls Co., Inc., New Bremen, Ohio, or to the Technical Appliance Corp., Sherburne, N. Y.
 LIKE MOST PEOPLE who can be in only one place at a time, we have often wished for an extra hand to do things around the house while we are asleep or away. We finally found a willing and reliable servant at very small cost in the form of an automatic time switch. These are some of its many tasks.

It regularly starts the automatic washing machine early in the morning—about 4 a.m. That's when there is plenty of hot water in the heater that would otherwise be idle through the night. Besides, after the family gets through with its morning showers, there usually isn't enough hot water left to do the wash. Best of all, the wife feels more cheerful when she finds the wash all finished and ready to be dried when she gets up in the morning.

In summer, we hook on the attic fan to draw in the cool early morning air. In winter, it can be used as a heater control.

When we're on vacation, the time switch acts as a burglar "discourager." Every night it switches a lamp and a radio on and off. "On" starts at sundown, and "off" at our normal bedtime. This system is cheaper and better at "fooling" would-be burglars than the light-controlled photoelectric switches that go on at sundown and off at sunrise. Most well-informed burglars would know that we don't stay up all night several nights in a row.

The switch is set in advance for a "program" containing up to 12 on-off periods a day. This program is repeated automatically every 24 hours—a cycle which matches the usual household routine. Some of the fancier time switches even permit a different program to be set up for each day of the week, and the entire weekly sequence will repeat indefinitely. An "override" switch allows manual "on" and "off" switching at any time without disturbing the automatic settings.

"Ready" Light. We started with a 24-hour Intermatic Time Switch Model TS60SP, obtainable by mail for about $8 either from Lafayette Radio, 100 Sixth Ave., New York, N. Y., or from Allied Radio Corp., Chicago 80, Ill. This switch is ready for operation when you unpack it.

However, we are a fairly absent-minded bunch and looked rather sheepish when we discovered why some of our carefully timed gadgets never started: the appliance switch itself had been "off" all along.

To guard against this possibility, we connected a neon lamp across the time switch contacts. This lights up whenever the appliance switch is closed, even if the time switch is open. In this way, it tells us that

By JAMES E. PUGH, Jr.

Heavy Duty Clock Timer Works Wonders

June, 1956

This wiring diagram shows the internal electrical connections in the heavy duty clock timer. The neon lamp, capacitor, and outlet receptacle are added parts.
The appliance is "ready" to go on when the time comes.

To make the neon lamp work properly, we had to make another modification. We discovered that the neon lamp would fire even if the switch on the connected appliance was open—due to the capacitance created by the connecting wires. To nullify this effect, we hung the capacitor C1 (.01-mfd., 400-volt) across the contacts.

Finally, for convenience, we added a male plug and cord and a female outlet receptacle.

The holes in the switch case for mounting the neon lamp and the output socket can be made either with a chassis punch or a large tapered burring reamer. Our neon lamp is a Drake Type 110 "Flush-lite," which requires an oblong mounting hole. This we made by drilling a series of 1/16-in. holes close together in a row, just inside the required outline. Then we knocked out the separations with a chisel.

The switch handles loads up to 35 amperes. The case should be grounded to the nearest water pipe by means of a wire and pipe clamp. Never ground the switch to a gas pipe. You should always ground heavy duty a.c. appliances to the nearest cold water pipe.

**Homemade Tube Socket Adapter**

There are times when the experimenter needs a source of voltage to test a new circuit. If he doesn't have a separate power supply, the alternative is to tap into the power supply of existing equipment. An easy way to do this is to insert an adapter into one of the tube sockets, replace the tube, then attach leads to appropriate lugs of the adapter.

Dismantle a metal tube by prying out the crimping locks that hold the base to the metal housing. Remove the wires from the pins by heating with a soldering iron. Then run lengths of heavy solid wire through the tube pins and solder into place. Set the tube socket over the tube base to align the key of the base and the key slot of the socket. Make sure that pin No. 1 of the tube base goes to lug No. 1 of the socket. Work the ends of the wires into the respective holes of the socket lugs and solder.

The adapter is now ready to go. It can be used to tap filament and B+ voltages temporarily from a radio or amplifier. Or, by leaving the adapter in place, power can be supplied to a preamplifier or other equipment. —Wm. B. Rasmussen.
I HAVE a curious wife.

As long as I'm working on an ordinary project, such as dissecting a radio or tinker ing with the innards of a TV, I am left alone. But let me begin juggling the components of an off-beat experiment, and here comes Old Big Eyes on the double—usually ill-concealed behind the pretext of delivering hot coffee.

Her timing is so deadly that I'm faced with stretching credulity and admitting there's something to feminine intuition—or that I've innocently gotten myself hitched to a lady-telepath.

Meanwhile, I consistently get caught with my plans down.

Not long ago, I dreamed up a humdingerish notion which I figured would not only prove a boon to wearied parents across the land (for that matter, across the planet, maybe), but would also move electronics ten years forward on the domestic front. Lastly, I reasoned, I should most probably make enough out of the idea to retire.

This latter angle, alone, seemed reason aplenty to put the idea into a frame of actuality.

Quite simply, I planned to produce an R/C stroller for people who were sick and tired of pushing their offspring around the block. First, I invested in a second-hand washing-machine motor. Second, I pilfered Junior's stroller. And, third, I went to work with the intensity of a madman picking the funnyhouse lock.

Unfortunately, the Girl Psychic beamed my vibrations.

And here came the coffee.

"WHATEVER are you doing to the stroller?" She stared hard at the half-installed sequence-reversing, speed-control switch and the rest of the transmitting and receiving equipment . . . all the while pouring scalding java into my lap.

"Now what do all those crazy gestures mean?"

When my lap cooled sufficiently for my voice to return from the outer regions of agony, I stopped dancing around and began composing a reply. I have bitterly learned that women prefer anything to logic.

"Perhaps you may find it difficult to visualize yourself as being the lucky loot-

partner of a genius, much less a soon-to-be wealthy genius," I said carefully, "but you'll just have to acclimate yourself to these wonders and learn to put up with easy street."

She narrowed an eye at me.

"Boy, maybe you needed this coffee more than I thought."

I fought back a psychosomatic hiccup.

"No snow, you lucky kid," I chittered reassuringly. "The Kohler Radio-Controlled Stroller is the charming vehicle upon which the Kohlers are destined to ride to fame, fortune and a much higher tax bracket! I'm still undecided whether to let Popular Electronics or Life have the scoop of the decade.

"The original king-size imagination," she muttered to no one in particular. "Come off it. I just want to know why you see fit to tear apart a practically brand-new stroller when you're all the time howling about overhead and—"

She broke off—suddenly the picture of a
whole neighborhood a few months back?"
Sometimes I despair of her ever forgetting Frankie—that R/C robot. I had the modesty to blush and avert pain-filled eyes. I snapped a martyred expression on my map that could have earned me an honorary membership in the Barrymore clan, for effort if not professional quality. "That," I whimpered "was different. Not the same thing at all. Besides, the robot had a faulty escapement and this stroller is the last word in perfection."

She regarded the stroller as though it had just slithered out from under it's rock. "Look," I pleaded, trying logic as a last resort, "I've built a lot of R/C airplanes since then—"

"Lost a lotta them, too."

"—and, surely, you don't think I'd put our child in any machine that I wasn't absolutely certain was safe—"

"Child! You'll put the dog in that monstrous thing over my inert body, much less try luring our beloved Junior into that electronic bone-breaker!" Outraged Motherhood regarded me as though I had just slithered out from beneath my rock. "Honestly, the things you spend perfectly valuable time dreaming up! Honestly!"

"You said the same things about the TV-Babysitting-Scanner when I first brought it into the house," I protested. "Now, you wouldn't know what to do without it."

"That's different. That was—"

"Think of the thousands of steps electronics has saved you," I persisted, grimly determined to sell this bill of goods. "Look at the photoelectric doors on the garage, the pantry, the porch . . . their very existence sparing you needless effort and energy. And this intercom system. Electronics, again, making your life a paradise of saved-time compared to your mother's, your grandmother's, your greatgrandmother's, your—"

"I'm grateful, I'm grateful," she snarled. "Did you ever stop to think that electricity cooks our food? That it heats our house? That it allows you to run up fabulous telephone bills, have hot and/or cold water in unlimited amounts at a second's notice?" I glared mildly at this spoiled darling of super-civilization. "No, you never thought of poor, old overworked and faithful electricity as your best friend. You never gave electricity a decent chance. Serve you right if it refused to come in the house—the way you rave against it."

"Who?" She was a mite uncertain.

"Electricity," I said reverently, whipping off my cap and holding it over my heart while I leaped to attention. "It slaves for you, keeps your radio singing, your TV picture bright, floods your house with warm, yellow light, runs your automatic washer so you are saved from rough, red hands, keeps the scoff eatable in the refrigerator and the surplus scoff safe in the freezer . . . " I hesitated, flicking a tear from my cheek. "Yessir, good old, everlovin' electricity and you refuse to give it a chance."

Her lower lip began to quiver.

"W-Who refuses t-to give it a c-chance?"

I bussed her soundly. "That-a-girl! I know you'd see it my way!" I slurped the now-icy java. "You run in and let electricity put some heat in this chilly brew whilst I finish installing the batteries and motor in the Kohler Stroller, hey! There's also a little matter of adjusting my solenoid-controlled-brake-device to be solved before our little fortune wagon is ready to roll us to wealth." I gleamed the choppers at her. "Wouldn't want to start something I couldn't—haw, haw,—stop! Get it?"

"Oy," she moaned and took off.

FOUR DAYS LATER we were ready for the test-run.

"I still don't see why Junior should be cheated of the honor of being the very first passenger to enjoy a ride in the stroller that's going to make him a rich man's son," I complained as the Nervous Mother shoved Digger, our terrier-dachshund-collie—what-have-you into the seat of the stroller, fastening him there with the leash.


"No dice. Our agreement was to let Digger risk his life and if he survives—then, perhaps, Junior can have a ride. It's that or find some other sucker, genius." She took a firmer hold on the heir and (Continued on page 123)
As regular readers of this column know, for the past two years we have been delving into the musical treasures of the LP catalog, with a view towards building a sound basic library. For the most part, we have reviewed recordings that fall into the category of "standard repertoire," with an occasional foray into some "off-beat," more "esoteric" type of material to lend a little spice. From your kind letters, it would appear that this program has met with your approval. However, I have received a number of letters recently in which the writers expressed a desire for something a little different.

In essence, what these readers would like is a review of the works which would constitute a basic record library of a given composer. I have done something similar to this from time to time, as witness my surveys of the recorded works of Mendelssohn, Paganini and others. It really boils down to the question: what degree of selectivity does one apply to these surveys? From what I can gather, the readers would have me review only those works which are the most important and the most basic in the repertoire of a particular composer. I think this is a good idea, and we will give it a whirl.

Works of Debussy. This month we'll cover works which might constitute a "basic library" of Claude Debussy. Music of this great French composer has enjoyed increasing popularity with the passage of years... and deservedly so, for his is among the most beautifully melodic music ever written, with a quasi-mystical quality which gives much of his music a soft, dream-like, almost "other-worldly" sound. There are several of his works which could be considered his most famous.

In order of their popularity, these are:

- Clair de Lune, The Afternoon of a Faun, and La Mer. Needless to say, there are many recordings of each work in the LP catalog.

Clair de Lune. This is actually but one fragment from the piano work, Suite Bergamasque. It is a hauntingly lovely little work, which I think sounds best in its original piano scoring. Its popularity has given birth to countless transcriptions for many instruments and for orchestra. The orchestra is by far the least objectionable, some of the instrumental transcriptions going far beyond the bounds of good taste.

We will review the piano recordings of the work before the orchestral recordings in order to avoid confusion. Actually if one wants Clair de Lune as a distinct musical entity, it is necessary to accept it as part of some piano collection-type record, which means that you will have to take whatever other music is on the disc... like it or not. There are numerous examples of this type, some of which are absolute pianistic abortions. Fortunately, among the nine versions, there are four recordings which are reasonably good in

---

Tape Review

Richard Strauss—Don Juan
Till Eulenspiegel
Artur Rodzinski, conducting the Philharmonic Symphony Orchestra of London
Sonotape SW1017, 7" reel
7½-ips double-track, NARTB, $7.95

Here is another sensationally good-quality tape put out by Sonotape, Westminster's pre-recorded tape subsidiary. Rodzinski's Don Juan is a powerful, vigorous reading, with rather rough-hewn lines. His tempi are about right, his phrasing rather deliberate, and his dynamic shading very wide in compass. Till Eulenspiegel is well performed, although a little ponderous at times—a faster pace would have helped quite a bit. Soundwise, you have the typical fine string tone of the London Symphony, heard here in edgeless splendor, woodwinds that are breathily alive with presence. Brass which is richly sonorous and crackling bright on demand, and altogether awesome percussion—especially the snares and bass drum in Till Eulenspiegel. The beautiful passages for French horns, a recurrent motif in Don Juan, are superbly reproduced. Everything is ultra-wide range in frequency and the dynamic range is tremendous. No distortion was discernible. Acoustics were very spacious and the recording detailed, resulting in "big hall" liveliness with completely articulate orchestration. This is one of the best tapes yet produced and is highly recommended to you as a worthwhile investment.

—B. W.
both performance and quality of sound.

Best of the lot from the sound standpoint is the reading by young Leonard Pennario on Capitol P8312. This is a good, clean piano sound, recorded fairly close-to, but with enough reverber to sustain liveness. Transient response is excellent and "ringing," and hammer-action noise is at a minimum. It is modern, wide-range piano with excellent dynamics. The Pennario performance is fluent and graceful but lacks the warmth and suave polish noted with other mature artists.

Next in line is the reading by George Copeland on MGM 3024. This, too, is what must be described as modern sound, but it is also subject to a few of the ills that can crop up in the difficult task of recording the piano. The tone is rather thin and "wiry"... sounds like far too much emphasis on the high end, and there is some noticeable flutter here and there. However, the piano is very articulate and the acoustic perspective is the saving grace. Copeland is almost a carbon copy of Pennario... good technical command, an easy smooth manner of playing, but here again, a paucity of any real feeling.

Orazio Frugoni holds forth on Vox PL7700 in our third recording. Vox has done some good work recording piano, and while this is not one of the very top efforts, it has much to recommend it. This is an intimate close-focused recording, almost dry-sounding with the limited reverb. Sound is wide range in frequency and dynamics, subject to some transient distortion. However, the piano tone is very rich-sounding... and if you can ignore some of the more obvious faults in the recording, you will find this disc quite pleasing. Frugoni is somewhat fussy in his playing, but none can deny his technical facility, nor his grasp of the score. He manages to imbue his reading with considerable warmth, although falling short of some big-time virtuosi in this respect.

And—last but not least—we have the effort by the great Iturbi on Victor LM1167. This is a rather old recording, with many limitations but—oddly—with few defects that are downright pervasive and annoying. Cramped acoustics and frequency response result in a thin-toned sound which serves as a barely acceptable medium for the talents of Iturbi. As far as Iturbi's performance is concerned, it is by far the best. This is obviously a master playing, as one can perceive from the firm "big" tone, the delicacy of phrasing, the expressive dynamics. There is depth in his playing, and the score is projected with feeling... yet it avoids the saccharine statements that are the wont of many other artists. In spite of the limited sound, this is the best of the "Clair de Lune-for-itself" recordings.

As to the very best of all recordings of Clair de Lune, this will be found in the Suite Bergamasque on Angel 35067, as played by the incomparable Gieseking—Debussy specialist ne plus ultra. The sound of the recording is fairly good but is by no means outstanding. What it lacks soundwise is more than made up for by the incredible artistry of Gieseking. This is a passionately lovely utterance, a thing of unearthly beauty, with every facet of the score meticulously polished by Gieseking into a resplendent jewel of pianistic perfection.

And if sound quality is the paramount thing with you, here too you must get your Clair de Lune as part of the Suite Bergamasque, this time played by young Fried- rich Gulda on London LL754. It is top piano sound... wide in frequency and dynamics, no transient distortion, no wow or flutter or "hammer-action noise," and with appropriate acoustic perspective. Gulda's playing is quite acceptable, but like the other young men who have tackled this work, he is long on technical fluency and short on expressiveness, although not quite to the extent of the others previously mentioned.

For Clair de Lune transcribed for orchestra, you can have your choice of several recordings. If you like overdone sentimentality, Andre Kostelanetz is the past master of this school on Columbia CL798, with sound that is not particularly distinguished. Or if you want a fairly straightforward reading of the work, but with the absolutely gorgeous string tone of the Philadelphia Orchestra in a fine modern recording, then get Ormandy's version on Columbia ML4983. If you want reasonably good sound with the best performance, Stokowski is the man for you on Victor LM1154. No one can get more out of a romantic score than Stokowski. While he has often been criticized for taking certain liberties with the score in matters of tempo and dynamics, his readings always have a magic excitement of their own that justifies his alleged tampering. Well, I hope that settles the matter of Clair de Lune!

Afternoon of a Faun. Debussy's famous Prelude to the Afternoon of a Faun is taken from his ballet of the same name, which was commissioned by impresario Diaghalev as a vehicle for the great dancer, Nijinsky. This piece best characterizes Debussy's talent as an orchestral colorist, and is also most representative of the "mystic" element of his music. It is a supremely beautiful work, a lyrical rhapsodic piece with softly flowing line. The scoring (Continued on page 108)
Fuses and TV Sets

THE cheapest protection any electronic device can have is a fuse. As long as the correct fuse is used, you can rest assured that the equipment will be protected against any sudden surge of current which, in the absence of this simple safeguard, could easily destroy the equipment.

In television receivers, fuses, when used, are found in two locations. One position is in the power line which leads directly to the wall outlet. The fuse here has a rating of between 3 and 5 amperes and it is generally mounted in a fuse holder.

The second place in television sets where fuses are found is near the high-voltage section. This section can be identified by the perforated metal cage which is placed around it. In the few instances where the cage is not used, the high-voltage section can be located by tracing back along the high-voltage lead which brings the high voltage to the bulb of the picture tube. This lead connects either to the center of the bell-shaped section of the picture tube or, in the case of metal tubes, to the front rim of the tube.

Fuses which are used in this section of the receiver are either held in open clip-type holders or else possess pigtails which are soldered into the circuit. The clip-held fuses are readily changed; replacing the others is more troublesome. A pigtail fuse can be unsoldered and another soldered in its place. This takes time, however, and means that you must have a soldering gun or iron and some solder. A simpler solution is to let the defective pigtail fuse remain in the circuit. Then a special snap-on fuse holder can be placed over the defective fuse and another, good fuse inserted in the other side of the holder. In effect, this shunts the second fuse across the first and re-establishes the current path. Any radio parts jobber can supply the snap-on fuse holder.

When a television receiver becomes inoperative and it has been determined that power is being supplied to the set, the fuse is the first likely suspect. Most fuses can usually be checked visually by taking them out of the set and holding them up to the light. In a good fuse, the thin ribbon of wire running through the center of the unit will be visible and intact. There will be no breaks anywhere along the line and the glass container of the fuse will not be discolored. If there is any doubt, simply substitute another one.

There are two precautions to observe when changing fuses. First, and foremost, is the current rating of the fuse. This should never be exceeded. If the fuse is a 3-amp. fuse, as indicated by the inscription on the metal portion of its case, replace it with another 3-amp. fuse. Do not use a 4-, 5-, or 6-amp. fuse because each successively higher rated fuse affords less protection.

Second, never use a fuse with a voltage rating which is too low. Use one having the same rating as the one replaced. Fuse voltage ratings represent the upper limit of usefulness for a fuse at a particular voltage. For the normal 117-volt power line, a 3-amp. fuse should be used when the power required by the device falls between 150 and 250 watts. For a requirement of 250 to 350 watts, a 5-amp. fuse should be used; finally, for wattages between 350 and 450, the fuse rating should be 6 amps.  

Typical fuse used in the a.c. line of a television set.

A "snap-on" double-ended fuse clip which requires no special tools for installation.

June, 1956

---50---
Aboard a RADAR Picket Plane

New and powerful, the airborne radar built by General Electric is carried by this Lockheed long-range high-altitude reconnaissance scout, patterned after the Super-Constellation transport (Navy designation, W3-2; Air Force designation, RC-121). Radar antennas are mounted inside bubble-like structures ("radomes") atop and below aircraft's fuselage. Both Navy and Air Force use giant planes as flying radar stations off East and West coasts where they supplement the "radar fence," that guard against sneak air attack.

Phantom view of radar plane (above) shows main cabin where radar operators monitor displays on screens. Rotating "dish" antennas are housed in both upper and lower turrets. Information received is coordinated in Combat Information Center aboard aircraft. This flying CIC can plot course of enemy invaders and then direct our own fighter planes to repel any attack. According to G.E., the radar is twice as powerful as any previous airborne search unit.

High-flying radar stations will extend the detection range of existing land-based units whose beams do not bend over the horizon. Provisions built into the equipment permit its use in anti-submarine action, aeronautical weather reconnaissance, and navigational aid, in addition to its chief function of aircraft detection. About six tons of electronic equipment are carried on one plane, in addition to a crew of thirty men. At left is a special test rig built by G.E. at Utica, N. Y.; this mock installation simulates setup on plane, removes system's "bugs" before use in real situation is permitted.
Two dozen men live and work together in giant aircraft whose super radar system guards against sneak air attack.

Inside the main cabin, looking aft. Each operator is responsible for observing a particular segment of the total area being scanned by the rotating antennas. Weight and size of the equipment has been kept down, despite increased power. Chassis are readily removed for easy inspection and quick maintenance.

Radar operator, one of a large team of observers, studies screen of indicator scope. Displays on screen show "pictures" of distant planes, giving range and bearing. In recent maneuvers, carrier-based fighter planes played role of "enemy attackers" and were repelled by land-based fighters. "Enemy" carrier was "sunk" by defenders using data supplied by radar plane, whose crew never even saw the "attacking" carrier or its aircraft.

Information received on radar screens is coordinated and verified in another part of the cabin. These men maintain radio contact with other aircraft and with surface stations. Special apparatus automatically distinguishes between friendly and enemy aircraft, is virtually foolproof. Often these planes are used as part of a large force which includes blimps and ships.

June, 1956

Time out for coffee and ... A complete galley, as well as bunks, helps keep the crew well-fed and refreshed. Staying high in the air for 24 hours or longer, each aircraft carries two crews for all stations. The double staff assures that rested men are available at all times for any emergency. Planes work with each other and with ground forces.
FOR THE PAST few weeks, I've been reviewing the many letters and cards you fellows have addressed to this column. Your ingenuity is amazing, and your interest in experimenting is most gratifying. To all who have written...congratulations...and keep up the good work! And keep sending those letters and cards! After all, this is really your column and will be run just the way you want.

Today, the "transistor tinkerer" occupies a unique pioneering position, roughly analogous to those experimenters in the early days of radio who built their own receivers...or did without! Back in those days, a "cheap" vacuum tube cost more, in actual dollars, than even an expensive transistor does today...and each tube was handled with great care, as if it were a valuable jewel.

Yet regardless of cost, these early experimenters persevered in their hobby, and from their ranks came many of the engineers and technicians of today. In the same manner, from the ranks of the present-day experimenters will come many of the engineers, scientists and technicians of tomorrow. It may be that the Chief Electronics Engineer on the first Space Ship to land on the Moon...or on Mars...is reading this column today!!

Readers' Circuits. From your letters and post cards, it is apparent that most of you are interested in receiver circuits. But there is a growing interest in instruments and gadgets.

We have two interesting circuits this month...both of which are relatively simple and inexpensive to duplicate. One is a two-stage receiver, suggested by Frank Seidita of 268 Deysaw St., Brooklyn, N. Y. The other is a simple light meter, suggested by Joe Gabus of 51 Wawayanda Ave., Middletown, N. Y.

Two-Stage Receiver. Frank's receiver circuit uses one diode and two p-n-p junction transistors. Basically, it is a diode detector followed by a common-emitter amplifier direct-coupled to a modified common-base amplifier which, in turn, drives a pair of headphones. The direct-coupled feature is particularly interesting, for many development engineers are working with this type of circuit. Such an arrangement provides a simple, reliable circuit which requires
June, 1956

**Hi, fellows! If you’ve missed Trans Topics recently, there’s a good reason. The editing of this department has been shifted to a Contributing Editor of POPtronics, Louis E. Garner, Jr. During the transfer, it was necessary to suspend the department temporarily.**

“Lou,” as his friends call him, has been one of POPtronics’ Contributing Editors since the first issue, so you’ve probably seen many of his articles. He has published in many other semi-technical and technical magazines also, including our sister publication Radio & Television News. To date, between 150 and 200 of his articles have seen print, including more transistor application articles than any other technical writer in the nation has published. He authored the first elementary book on transistors, Transistors and Their Applications, and is currently working on another volume . . . The Transistor Circuit Handbook.

An avid experimenter and gadgeteer, Lou has his own laboratory facilities and has been working with transistors since the first units became available commercially. A private technical consultant as well as a writer, Lou has designed circuits, prepared manuals, developed new products, and given technical advice to a number of well-known firms, including one of the largest test equipment manufacturers in the world.

So, don’t worry about Trans Topics in the future. With Lou at the helm, you can expect this department to grow . . . and grow . . . and grow! ! ! !

The Editors

**UTC “DOT” is not much bigger than pencil’s eraser.**

**UTC “DOT” is not much bigger than pencil’s eraser.**

for the photocell while retaining the 3-volt battery in the transistor circuit. I would suggest trying a Burgess Y10 or U10 15-volt battery, connecting the positive side of the battery to the positive terminal of B1 and removing the photocell connection to this battery. The “free” lead of the photocell may be connected to the negative terminal of the 15-volt battery.

For a similar circuit, you might refer to Harvey Pollack’s article on the “Transistorized Light Meter,” appearing on page 43 of the January, 1956, issue of POPtronics.

**Experimenter’s Contest.** Here’s good news for you fellows who like to work up new circuits . . . now you can turn your ingenuity to profit. Lafayette Radio, of 100 Sixth Ave., New York 13, N. Y., is conducting a contest with a first prize of fifty dollars (that’s right—50 bucks) worth of merchandise, with five additional merchandise prizes worth ten dollars each. These prizes go to experimenters who submit the best new circuits to Lafayette based on the use of their Transistor Lab Kit plus a minimum of additional parts.

Incidentally, Lafayette’s Lab Kits are based on a series of articles which appeared in past issues of POPtronics.

The Experimenter’s Contest was originally scheduled to end April 30, 1956, but has been extended to give everyone a chance. Good luck!!

**Getting Smaller!!** Even the first transistors were very small compared, say, to vacuum tubes and other electronic components. But manufacturers have continued in their efforts to reduce the size of these “mighty midgets” . . . and they have been mighty successful!

Newest entry in the battle for smallness is Philco’s subminiature M-1 transistor. Designed for audio applications, this transistor is so small that more than 20 can be placed (Continued on page 108).
Underwater TV System

Performance of the swimming team at M.I.T. is judged by means of an underwater electronic camera. Developed from original designs by Professor Harold E. Edgerton of the Electrical Engineering Department at M.I.T., where a series of underwater cameras has been built during the past several years, this camera enables the swimming coach to study the actions of members of the team from all angles. Of special interest is the turn, when the swimmer reaches the end of the pool and reverses his direction. Faulty swimming strokes are easily spotted by the camera.

The actual camera was made to accompany an underwater television system. The flash camera is located so that it will view the same scene as the TV camera. When the observer sees the desired photo in the screen, he pushes a button to make the exposure on the underwater camera. Thus, he uses the TV system as a remote view finder.

The camera chassis slips out of the pressure tube for loading. A standard 100-foot roll of 35-mm. film is used, giving 800 35-mm. Leica size negatives. Two wires supply 115-volt, 60-cycle power to the camera and flash lamp. The exposure is made when the power circuit is broken. Then, when the circuit is re-established, the motor rewinds and the strobe recharges for the next flash. The shutter is electrically operated by means of a capacitor discharge into a magnet which drives the shutter blades.

Vacuum Tube Lamp

An unusual table lamp has been made from an obsolete radio transmitting vacuum tube by James F. Sutherland, of State College, Pa. The tube used as the lamp support in the photo below is a type 849. It was mounted upside down so that the brass base of the lamp socket shell could be soldered to the brass cap of the tube. Two brass bolts were soldered to the two filament pins, and the tube is held to the lathe-turned walnut base by two recessed nuts with washers. A push switch was installed in the walnut base, and the pull chain removed from the lamp socket.

Who's an IDIOT?

Don't use the word "IDIOT" loosely. It might—and does—stand for Instrument Lab Digital On-line Transcriber. This IDIOT can electronically transcribe more than three million items of information during an eight-minute test run. It's a special-purpose computer which is installed ahead of a general-purpose computer to convert jet flight test data from radio telemetrying language to computer language.
The SWL's Friend-
An Antenna "Peaker"

By FRANK H. TOOKE

A RE YOU LISTENING to the short-wave bands and wondering if that hunk of wire out back is doing a good job? Is your receiver losing some of its old pep? Well, take heart, because this little device may be the answer to your problems.

The majority of radio amateurs wouldn't think of putting a transmitter into operation without first tuning the antenna and "matching" it to the power amplifier. Yet few amateurs and even fewer SWL's ever think of taking similar care with their receivers.

Now, the author has no particular quarrel with a random length of receiving antenna. Properly installed and properly used, it works surprisingly well. First of all, though, we must realize that such an antenna nearly always presents a poor match to the receiver. The result is a loss in signal at the very spot in the receiving setup where it hurts the most.

You can prevent this loss by tuning your receiving antenna just as they do in the biggest transmitting stations—in a much smaller fashion, of course. Using the "Peaker," you can probably produce a free signal gain of one to three S-units—which is equal to the transmitting station increasing its power 15 to 20 times.

The sketches shown in Fig. 1 are the two antenna terminations possible with the "Peaker." Figure 1(A) shows the antenna connected to terminal 2, no connection to terminal 1, and the ground to terminal 3.

HOW IT WORKS

Under average conditions, the impedance of a random length antenna is either too low or too high to match the receiver input. The extent of the mismatch depends on the length of the antenna and lead-in, the frequency to which the receiver is being tuned, and the actual input impedance of the receiver at that frequency. For instance, if the length of the antenna plus its lead-in is equal to or near a quarter-wavelength or any odd multiple of a quarter-wavelength at the frequency being received, its impedance will be quite low.

The average commercially made receiver has a nominal input impedance of about 400 ohms. In practice, and with different makes of receivers, actual impedance will vary widely from this nominal value. The input impedance of home-built receivers is nearly always unknown. It can vary from a few hundred ohms for receivers using an antenna coupling coil to many thousands of ohms for receivers using a small capacitor from antenna terminal to the grid circuit of the first tube in the receiver. The latter type of input circuit cannot be used with this particular antenna tuner.

This simple device is a resonant circuit with switching facilities to permit its use in a series or in a parallel arrangement. By adjusting the coil tap and varying the capacitor, it can be made to cancel the reactance presented to it by a random length of antenna.

Top and bottom views of the "Peaker" show locations of antenna terminals. See wiring diagram on page 80 for details.

June, 1956
This is termed a series connection, because the coil, the variable capacitor, and the antenna-to-ground capacity are in series in the circuit. A series circuit is most useful when the antenna impedance is low.

Figure 1(B) shows the parallel connection. The antenna is connected to terminal 1, and a jumper wire is connected from terminal 2 to terminal 3. The coil, variable capacitor, and antenna-to-ground capacity are now in parallel. This connection is most frequently used when antenna impedance is high. Antennas that are very short will probably require such a parallel connection.

Try both the series and the parallel connection, and choose the one which performs best. It is reasonable to expect that a series connection will give the best performance at some frequencies and a parallel connection at others, even when the same antenna and receiver are used. In fact, the series connection and the parallel connection normally tend to follow each other alternately as one tunes continuously from one end of the short-wave spectrum to the other.

The antenna tuner and matcher has been designed for use with an average length antenna and an average receiver. It covers a frequency range of approximately 1.5 to 20 mc. Construction is simple, and the layout of parts and length of the leads are not especially critical.

The coil is 2" in diameter and consists of 32 turns of No. 20 solid tinned copper wire spaced to occupy two inches, i.e., 16 turns per inch. Spacing need not be exact. The link coil, L2, has 4 turns similarly spaced. It is located about 3/4" away from the grounded end of the tapped coil. Any coil form of similar dimensions may be used instead of the one pictured. The tap switch should have ceramic insulation. The coil is tapped at 4, 8, 12, 16, 20, 24, 28 and 32 turns from the grounded end. To make the diagram easier to read, only a few of the taps are shown in the wiring schematic.

If your receiver has an r.f. amplifier stage preceding the mixer, connect the "Peaker" output terminals to the antenna and ground terminals of the receiver. Connect your antenna to the "Peaker" in either the series or parallel connection as shown in Figs. 1(A) and 1(B). Vary the tap switch, S1, and the variable capacitor, C1, until maximum output is obtained from the receiver. The "Peaker" will work best around the 20-mc. end of its range with all but four turns shorted out, and C1 set with its plates almost full out. At the lower frequencies, say, around 1.5 to 3.0 mc, none or few of the turns will be shorted out.

If your receiver doesn't have an r.f. stage, the "Peaker" should be connected and used as described in the preceding paragraph—with one exception. Coupling is more critical in a receiver having no r.f. stage. When

(Continued on page 108)
DOES YOUR TV SET suffer from slipping sync? Is your soldering iron luke-warm when you want it red-hot? If so, you may be located in an area where the line voltage drops slightly during early evening hours. Cure these effects with a line voltage booster!

Boosters are available commercially, of course, but an ordinary filament transformer properly connected will do the job equally well. All you need do is hook up the transformer so that its secondary voltage will be added to the line voltage. The "economy" booster consists of little more than a 6.3-volt filament transformer and a switch to cut the booster in or out. The "de luxe" booster features a meter and two different boost voltages.

The "de luxe" booster is shown in diagram (A) and the pictorial diagram on page 82. The meter, M1, is connected across the receptacle, S01, to measure the voltage at the output of the booster. Switch S1, the line or boost switch, cuts the transformer secondary in or out.

The "economy" booster, assembled on a small aluminum box, can be built for under $5.

Under-chassis view of "economy" booster.

The "de luxe" booster has a clothesline cleat on the back panel to store line cord.
of the circuit and simultaneously connects or disconnects the line voltage from the primary. The transformer operates only when \( S1 \) is in the boost position.

Switch \( S3 \) selects the amount of the boost. Either 6.3 volts (at the secondary center tap) or 12.6 volts may be added to the line voltage, depending on its setting. A transformer with a 2-amp. secondary will handle any device drawing up to about 200 watts of power. It is a good plan to allow 1 ampere in the transformer secondary for each 100 watts to be drawn from the output of the booster. For example, a 10-ampere secondary will handle a kilowatt (1000 watts) of power. A slide switch, \( S2 \), mounted on the top of the cabinet, is used to disconnect the meter.

**Phasing the transformer** in a circuit of this type will either add voltage or subtract voltage—depending on how the transformer’s primary connections are made. When the transformer is adding voltage to the line, its secondary is said to be “in phase” with the line; when it is subtracting from the line, its secondary is said to be “in reverse phase” with the line.

What we want in a line voltage booster is the adding or in-phase connection. This

(Continued on page 127)

---

### PARTS LIST

**“De Luxe” Booster**
- \( M1 \) - 0-150 volt a.c. voltmeter
- \( S1 \) - D.p.d.t toggle switch
- \( S2 \) - S.p.s.t. slide switch
- \( S3 \) - S.p.d.t. toggle switch
- \( S01 \) - Chassis-type outlet receptacle
- \( T1 \) - 12.6-volt, c.t., 2-amp. filament transformer
- Aluminum box, 4" x 5" x 6"
- Power cord
- 4 1/2" rope cleat

**“Economy” Booster**
- \( S1 \) - D.p.d.t. toggle switch
- \( S01 \) - Chassis-type outlet receptacle
- \( T1 \) - 6.3-volt filament transformer, 2 or more amp. secondary rating
- 2-piece aluminum box, 1 5/8" x 2 1/8" x 4"
- Power cord

### HOW IT WORKS

The voltage booster is a demonstration of transformer action based on turns ratio. In each of the cases illustrated—see simplified diagram (C) on page 81—the voltage induced in the secondary is added to the voltage applied to the primary. This is an autotransformer action. The phase of the voltage generated in secondary is quite important. If the phase is not correct, the autotransformer effect will be to subtract the secondary voltage from the primary. This is sometimes referred to as “bucking” the primary voltage. In some locations where the line voltage is too high, “bucking” may prove of value to the constructor in keeping the line voltage under control.

**CAUTION:** Do not use the booster if the line voltage is actually 117 volts. The additional voltage may harm the equipment to which it is applied. Check the name plate of the device before using the booster. Allow one ampere in the secondary winding rating for each 100 watts of power to be drawn.

82

POPULAR ELECTRONICS
Famed Enclosure Now Comes As Kit

Many top-notch components formerly sold only ready-made at stiff prices are now obtainable in kit form for home construction. Latest item in this trend toward putting high-class equipment within reach of low-budget builders is the famous Electro-Voice “Aristocrat” corner loudspeaker enclosure.

The kit retains all the features that made the factory-finished “Aristocrat” a hi-fi favorite, yet the job of assembly has been remarkably simplified. As carpentry is a far cry from electronics, everything has been done to foolproof the job for the audio fan when he takes up the unaccustomed glue pot. All holes are drilled, the pieces marked, and hardware is supplied. The whole assembly job is broken down into twelve steps just complicated enough to hurl a challenge at your screw-driving talents. Stick to the instructions, and nothing really can go wrong. With two left hands, you’ll still be all right.

Superior Sound. Performance-wise, this enclosure is a true “aristocrat” of its breed. Fortified by all the traditional virtues of the horn family, the Aristocrat ranks near the top in efficiency, good damping, and absence of resonance boom. With a bit of cooperation from an able speaker, the bass really hits bottom. Corner placement, obligatory for this enclosure, helps push out more bass. The walls, converging in the corner, act as horn extensions. Hence, the size of the enclosure could be kept down to about 19” x 16” x 29” without skimping on low-frequency response. Moreover, corner placement assures uniform treble spread throughout the room and keeps reflected sound from bouncing directly back at the speaker. The net result is vibrant, full-throated Electro-Voice “Aristocrat,” now priced for low budget, is quickly put together in only twelve easy steps.
sonority in nearly any acoustic setting.

**Bottom Price.** Like the Shorthorn Kit described in our March, 1956 issue, the Aristocrat design is based on Klipsch corner horn patents. Yet unlike the Shorthorn, the Aristocrat's interior panels are angled to approximate an exponential horn flare. This pays off in uniform air loading of the speaker cone over a wider frequency range. Despite the more elaborate inner structure, the price is held down to about $36. With nothing cheap about the materials or workmanship, this clearly marks the kit as a bargain.

**Good Looks.** Unlike some other home construction kits, the Aristocrat comes out as a neat piece of furniture. With simple outlines and picture-frame molding around the attractive, wrinkle-free grille cloth, not even the fussiest hi-fi wife would evict the Aristocrat from her living room. The smooth plywood panels take any kind of furniture finish so you can be sure of harmony for the eye as well as for the ear.

**Speaker Choice.** The Aristocrat takes any 12" speaker, including coaxials. If you prefer, you can mount the separate components of a two-way system right on the speaker panel. All you have to do in that case is to saw an additional cutout for the tweeter. The hole for the 12" woofer is already pre-cut. This makes the Aristocrat adaptable to plans for gradual expansion of your speaker system.
USE of the telephone as an antenna is not a new idea. Back in the 1920's, some old-timers set a phone on a pie pan, then connected the pan to the antenna post of the radio and used capacity coupling to telephone lines as an antenna.

This novel crystal radio makes use of the same trick. It is built into a wooden box slightly larger than the base of the telephone. A thin metal plate is mounted on top of the box and connected to the input of the crystal circuit. When the phone is placed over the metal plate, it is capacitively coupled to the plate, and the telephone circuit is used as an antenna without any direct connections to the phone lines. Where increased sensitivity is required, an antenna jack can be used, allowing a wire jumper to be plugged in and clipped to the finger-stop beside the dial of the phone.

Two germanium diodes are employed, and there are three tip jacks for the earphones. One diode is connected in the conventional manner, and the other is connected to a tap on the coil. You can change from "broad tuning" to "selective tuning" by simply moving one phone tip from one jack to another.

The four sides of the wooden box shown in the photos are made from 2 1/4" x 1/4" walnut, and the top is 1/4" plywood. The plywood platform should be 1/8" or 3/16" below the top edge of the box, to keep the phone from sliding off. Size of the platform depends on the phone model; the platform shown measures 7 3/8" x 5 3/4".

Cut a piece of thin sheet metal, just the right size to fit on the (Continued on page 111)
AFTER

SOME FACTS ABOUT METAL LOCATORS

IF YOU'RE looking for a metal locator that will detect a U. S. dime under thirty feet of wet sand or a lost gold ring at the bottom of a salt-water bay—you're chasing a wild and elusive dream! The gadget that will do a job like this just hasn't been invented yet. All of which, naturally, brings up such pertinent questions as: Just how well do prospecting metal locators perform? What types are there? How do they compare? How much do they cost to build or buy? Let's take these questions one at a time.

Types of Locators. As a start, we should recognize the fact that metal detectors which are built to spot metal scraps in baked bread, nails and bolts in the stomachs of cows, or files in the pockets of convicts are also designated as metal locators. We are not concerned with these highly specialized units; our interest centers around prospecting and mineral locating equipment.

These generally fall into one of two broad classifications: the beat-frequency type which is the simpler of the two, and the field-distortion or reflection variety which can outperform the other but is more complex and costly.

Figure 1 illustrates a representative beat-frequency locator in block diagram form. Two oscillators turned to very nearly the same frequency are coupled to a mixer stage. After heterodyning and mixing in this stage, a difference frequency or beat-note is obtained. This audio tone is fed to an amplifier which passes the increased audio power to the headphones. Oscillator "A" is completely shielded to avoid the effects of outside influences; oscillator "B," however, is tuned by a wide-diameter search coil at the end of a long pole. The search coil is surrounded by a radio-frequency magnetic field which penetrates into the earth below to a degree

Fig. 2. This commercially available locator can be used to find objects as deep as seven feet. The instrument is carefully balanced so that it will not tire the operator.
determined by many factors (to be discussed farther on).

As long as there is no electrical conductor in the vicinity of the projected field, the beat-note heard in the phones is constant in pitch. Upon encountering a metallic mass of non-ferrous nature (gold, silver, platinum, copper, aluminum, etc.), the inductance of the search coil is reduced as a result of the eddy currents that are induced in the metal mass. Since the search coil is the tuning element of oscillator "B," the frequency of the latter rises, causing a sharp change in the pitch of the audible signal. Metals or ores containing iron have the opposite effect; the increased permeance in the area around the search coil raises the inductance and lowers the frequency of the associated oscillator, producing a variation of the beat-note in the opposite direction. Figure 2 shows a typical beat-frequency type of metal locator in action.

The field-distortion or reflection variety operates on a somewhat different principle: a separate transmitter and receiver are equipped with exposed coils, again of large diameter. The plane of the transmitter loop is oriented vertically with respect to the ground plane rather than horizontally as in the case of the beat-frequency version. The receiver pickup coil is placed at right angles to the other to minimize direct coupling between the units. This is illustrated in Fig. 3.

In operation, the controls are adjusted while the equipment is held over non-conducting ground so that the headphone tone is relatively weak and the visual indicator—a meter mounted where it may be read with facility—reads nearly zero. The loudness of the received tone is thus a function of the shape and magnitude of the electric field being radiated from the transmitting loop under conditions in which little external conduction in the form of metal masses is present. Upon approaching metal of any type, the field becomes distorted, such deformation destroys the balance set up in the initial adjustments and causes the headphone tone to become louder and the visual indicator to increase its reading.

**Performance Factors.** How well will a certain metal locator perform under a given set of prescribed conditions? A precise prediction of this kind is difficult if not impossible to make because so many factors affect its operation. The size of the metal mass or mineral deposit and the depth below ground are the primary considerations; the length of time a piece of metal has been buried, the type of metal it is, and the degree of mineralization of the soil are other significant factors. Let's dispose of of the last three and then give our attention to the size vs. depth behavior of typical locators.

Although it seems strange at first glance, the longer a metal mass is buried, the more easily it is detected. This is apparently due to the fact that metals attain a degree of association with the surrounding mantle rock due to chemical action; thus they extend their effective conducting areas. Captain Kidd's treasure would be easier to locate than would the buried gold of the hermit who died last year—all other things being equal, of course.

Native gold, silver, and copper are the most suited metals for this kind of geophysical investigation, metallic sulfides and...
sulfide ores such as galena (lead sulfide), chalcopyrite (copper sulfide), cinnabar (mercury sulfide), and molybdenite (molybdenum sulfide) are also good conductors. Iron ores do not, as a rule, provide the same sharp response as the others.

If the soil is heavily mineralized or very moist, the presence of metals or mineral deposits well under the surface is likely to be masked, making detection difficult. These conditions often make it impossible to use metal locators successfully in certain areas at any time. In others, the time of the year becomes a determining factor. Manufacturers approach performance details in a straightforward, scientific manner. Among the most satisfactory ways of specifying what one can expect from a given model is the performance curve. This is based upon the reaction of the metal locator to a given metal buried at various depths in normal soil. The minimum area required to provide a satisfactory aural and visual indication on the instrument is plotted against varying depths.

A performance curve for a beat-frequency type of locator is given in Fig. 4. The metal used in the preparation of this chart is a square sheet of copper; it ranges from three inches on a side to about 60 inches. For example, a sheet of copper measuring 12" x 12" (one square foot) would provide a satisfactory indication if it were buried no deeper than four feet under average soil. To detect a similar sheet at a depth of six feet, an area of well over four square feet would be required.

The superior performance of a heavy duty field-distortion type of locator is shown at a glance in Fig. 5. For one square foot of copper sheeting, the detection range is approximately 7½ feet under normal soil. When conditions are favorable, such a detector is capable of penetrating about 25 feet to large deposits of metallic ore or native metal.

**Cost Figures.** The figures given below have been compiled from a substantial sampling of manufacturers' literature. They do not represent exact prices:

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost</th>
<th>Range</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beat-frequency</td>
<td>$50</td>
<td>5'</td>
<td>3½ lbs</td>
</tr>
<tr>
<td>Beat-frequency</td>
<td>100</td>
<td>7'</td>
<td>8 lbs</td>
</tr>
<tr>
<td>Field-distortion</td>
<td>150</td>
<td>18'</td>
<td>11 lbs</td>
</tr>
<tr>
<td>Field-distortion</td>
<td>175</td>
<td>27'</td>
<td>24 lbs</td>
</tr>
<tr>
<td>Beat-frequency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kit</td>
<td>40***</td>
<td>6&quot;</td>
<td>5 lbs</td>
</tr>
<tr>
<td>Factory wired</td>
<td>80</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Depends on search head used.
** Comes equipped in either kit or factory-wired form with a general-purpose search head. Kits for "small object search head" ($3.85) and "large object search head" ($11.50) are available at extra cost as shown. Factory-wired heads are available at approximately twice the prices shown for the kits.

**QUIZ**

1. What is the difference in the indication given by a beat-frequency type of metal locator as compared with the field-distortion form?
2. How do the indications of the presence of ferrous and non-ferrous metals differ in beat-frequency locators?
3. Which has the greater range of penetration per lb. of carrying weight, the beat-frequency or the field-distortion type of metal locator?
4. Why might an attempt to use any metal locator after an extended rainfall meet with little success in many locations?
5. Why are the coils of a field-distortion type of locator oriented in planes at right angles to each other?

(Answers appear on page 127)
Radio Amateurs to Monitor Satellite

Low-cost v.h.f. tracking system planned for hams

CALLING all hams! You may have an important job to do in the not-too-distant future. How much do you know about Project VANGUARD and the "Mini-track" system?

Project VANGUARD is the code name for the earth satellite phase of the U. S. scientific program for the International Geophysical Year (1957-58). The VANGUARD satellite launching vehicle, being designed and built by the Martin Company of Baltimore under the auspices of the U. S. Navy, will be a finless, three-stage rocket about 72' long and 45" in diameter at its widest point. Launching and testing will take place at the Air Force Missile Test Center in Cocoa, Florida.

The first stage of the rocket ©, an improved Viking, serves primarily as a booster. The second stage ©, another liquid-fueled rocket, contains the complete guidance system for all three stages. The third stage ©, a solid-propellant rocket housing the satellite proper, is ejected from the second stage at the orbital altitude (200 to 300 miles above the earth).

Radio tracking will handle three jobs for the satellite: (1) prove that it is actually orbiting; (2) determine its precise orbit; and (3) measure what is happening within the satellite. The tracking problem is said to be similar to finding and following a golf ball thrown out of a jet airplane traveling at 60,000 feet with the speed of sound.

The "Mini-track" system of radio angle tracking developed by the Naval Research Laboratory is prepared to solve this problem. It utilizes a tiny transmitter within the satellite to send a beam of radio energy to receiving antennas at ground stations. By comparing the path length from the transmitter to one antenna with the length from the transmitter to a second antenna, the satellite can be located in its orbiting position. Similar measurements with another set of antennas help to fix the satellite accurately.

In the actual ground station layouts, there will be seven antennas. Data obtained from these antennas can be sent to a central computing facility within 20 minutes of receipt, and used there to determine the progress of the satellite.

The system, which will supplement optical tracking stations and also obtain scientific data telemetered or radioed back to earth, is expected to work despite weather conditions, clouds, seeing conditions, or the time of day. Details of a simplified version will be made available to radio amateurs at a later date so that they may join amateur astronomers in observing the satellite. And that's where you come in!

It has been predicted that during a satellite event the evening newspapers will publish three boxes on their front pages — one for baseball scores, one for horse race results, and one for the evening times and angles at which you can pick up the earth satellite.

June, 1956

89
What are you looking for in a Geiger counter? These two units feature light weight, small size, economy and simplicity—take your choice!

UNIT ONE
By James E. Pugh Jr.

You can enjoy prospecting for uranium if your equipment isn't so heavy that it bogs you down, and if you don't have to carry a set of spare batteries around with you because of the high current drawn by the equipment. Also, you'll probably be able to have more fun with your equipment if you haven't spent a fortune to build it. And if it is simple to construct and maintain, so much the better.

The first instrument to be described here was designed for your enjoyment—it takes full advantage of the small size, light weight and low operating cost of a transistor amplifier combined with a relatively cheap Geiger counter tube.

An ideal enclosure for this instrument is a 3" x 4" x 5" utility box. Total weight, including batteries, is less than 2½ lbs. The physical layout, shown in the photos, lends itself to easy assembly and is such that batteries can be easily replaced.

Exact layout is not critical, but the 300-volt battery takes up a large portion of the available space; so it is well to plan carefully in advance to make sure that everything fits.

Proper mechanical balance is obtained by locating the handle off center. This technique also allows more room for the controls on top of the case. The battery strap is mounted on one side of the bottom section of the case, and consists of a single strip of metal clamped to the battery by two long screws.

A simple mount for the counter tube can be fashioned from a sheet of ⅛" polystyrene 1½" x 4" and a 3" piece of ¼" i.d. polystyrene tubing. Cement the tubing lengthwise on top of the sheet about 3/16" from one end. Drill a hole at the other end of the sheet and mount a 2-terminal tie point at this same location, with a flat-head screw recessed flush on the bottom. Wrap a 3" x ½" rubber band around the 1B86 as in Fig. 2 (page 92), slip the assembly inside the plastic tube, and carefully solder the 1B86 leads to the tie point. Center the...
Transistorized Geiger Counters

Geiger tube assembly in the bottom of the case after the 300-volt battery has been installed, and cement in place with Polyweld "912" or a similar cement.

For the 1½-volt battery holder, modify a type HPC fuse holder as shown in Fig. 3. First, clamp the lug in a vise, pull the fuse holder outward to compress the internal spring, and cut off the shaft as close as possible. Disassemble the holder, and drill and tap the shaft as shown. Replace the original spring with a two-turn volute—or spiral—spring clipped from a medium-sized spring in a General Cement assortment.

Weighing less than 2½ pounds, the first unit is housed in a 3" x 4" x 5" utility box. Fuse holder is modified to take the 1½-volt penlite cell as shown in Fig. 3 on page 92. Placing the handle off-center makes for proper mechanical balance.

HOW IT WORKS

Two basic circuits for the first unit are shown in Fig. 1, one for an n-p-n transistor and the other for a p-n-p transistor. Aside from polarities, the circuits are identical and should provide equal performance, assuming that the transistors are equivalent. At the present time, p-n-p transistors are a little cheaper.

When a beta or gamma ray passes through the Geiger tube the gas in the tube ionizes and a small pulse of current flows through R1. This pulse is amplified by the transistor, and appears as a click in the headphones.

A potential of 300 volts is required for operation of the Geiger tube. This is provided by a special 300-volt battery. Although fairly expensive, the current drain is very low, and battery life approximates shelf life. The transistor itself operates on 1½ volts, and gives a gain of about 20 db. Here again, the current drain is very low—about 50 microamperes—which gives very long battery life.

High-impedance headphones will give good performance, but they must be of the magnetic type to provide a d.c. path for the collector circuit of TR1. The standard 2000-ohm units are satisfactory, but the Trimm 24,000-ohm style will give somewhat better volume.

Interior view (at left) shows location of important components and wiring details. As the 300-volt battery fills up much of the available space, care must be taken to make sure that everything fits—although the exact layout is not critical.

Mount a 4-lug tie point on one end of the case, as shown in the photograph above. Complete the wiring, including the 300-volt battery plugs, and solder all joints carefully. Excessive heat can permanently damage the transistor—grip the leads with long-nose pliers between the transistor and the point being heated, and don't remove the pliers until the joint has cooled.

Insert the battery in the fuse holder. Polarity will depend on the transistor used: for an n-p-n unit, insert the positive end first; reverse for a p-n-p unit. Plug in the

June, 1956
Fig. 1. Basic circuit for (A) n-p-n transistor and (B) p-n-p transistor. Parts list applies to both.

B1—300-volt battery (Eveready 493 or equivalent)
B2—1½-volt penlite cell (Burgess No. 7 or equivalent)
J1—Open-circuit phone jack (miniature)
P1—Phone plug to fit jack
R1—2.2-megohm resistor
S1—D.p.s.t. toggle switch
TR1—Type 2N35 or CK722 transistor (see text)
V1—Type 1B86 Geiger tube (Victoreen)
I—Pair of headphones (Trimm 24,000-ohm Featherweight)—see "How It Works"
I—Panel-mounted fuse holder (Buss HPC)
1—3" x 4" x 5" aluminum case (ICA Fleximount)
I—Handle (U. S. Eng. Co. No. 1010 or equiv.)
I—2-terminal tie point
I—5-terminal tie point
I—Set of battery plugs (Amphenol 71-1L and 71-1M)
I—Sheet of ¼" polystyrene, 4" x 1½"
I—¼" i.d. polystyrene tubing, 3" long
1—Coil spring (see text)
I—On-off switch plate
I—3" x ½" rubber band
Misc. wire, solder, machine screws, etc.

Fig. 2. How rubber band is wound around tube.

Fig. 3. The modification of the fuse holder.

Fig. 4. Schematic diagram and parts for second Geiger counter. A p-n-p junction transistor is used here.

B1—Two 1½-volt flashlight cells
C1—0.5 μfd., 1000-volt plastic sealed capacitor
(auditor used 600-volt rating, but higher rating is desirable)
R1—1-megohm, ½-watt resistor
S1—S.p.s.t. Microswitch or any snap-action spring-return switch
S2—S.p.s.t. toggle switch
TI—Small audio output transformer, such as 4000 ohms to 4-ohm voice coil (not critical)—almost any output transformer should operate satisfactorily
Gap—Altered 3-30 μfd. trimmer capacitor (see text)
TR1—CK722 p-n-p junction transistor
V1—Geiger counter tube (Victoreen 1B85 or Raytheon CK1026)
1—3" x 4" x 5" aluminum cabinet
I—Kitchen cabinet handle
Misc. wire, solder, terminal strips, phone jack, etc.

UNIT TWO

By Wayne Milburn

For extreme simplicity and economy of initial cost and maintenance, this Geiger counter is hard to beat. The two 1½-volt flashlight cells give excellent life as the current drain is about 100 microamperes and few parts are needed.

A novel technique is employed to produce the high voltage (800-900 volts) for the Geiger tube. D.c. from the battery is passed through high-voltage battery connectors, turn on the switch, and listen for clicks. With no uranium in the vicinity, you should get a background count of about 30 counts per minute.
through the voice-coil winding of an output transformer, and then quickly interrupted by the switch \( S_I \)—inducing a high-voltage surge in the high-impedance winding. This surge will have two polarities—one when the primary current starts flowing, and one when it ceases. The larger of the surges will break down the special spark gap, and will charge up capacitor \( C_I \). This high voltage is then used to operate the Geiger tube.

Heart of the device is the special spark gap, made from a small 3-30 \( \mu F \) trimmer capacitor. Unscrew the adjusting screw, remove the mica insulation, and replace the screw. Adjust the screw to the point where it rectifies the transformed voltage but will not arc back.

It is essential that \( C_I \) be charged to the proper polarity, as indicated in the schematic. Use a high-impedance voltmeter to determine polarity. If it is incorrect, reverse the voice coil leads in the transformer.

This arrangement should give 800-900 volts after 20 or 30 pulsings of \( S_I \), depending on the turns ratio of the transformer. Use a high-quality capacitor for \( C_I \), and make certain that it is well insulated from ground. A single charging should operate the Geiger tube for several minutes. An occasional push on the switch will then keep the counter in operation.

To provide comfortable headphone volume for the clicks, a transistor amplifier is included in the unit. It is direct-coupled to the counter tube, that is, the pulses of current from the counter tube also pass through the base-emitter circuit of \( T_R I \). \( R_I \) serves to protect the transistor in case of an avalanche discharge through \( V_I \). Magnetic headphones must be employed to provide a d.c. path for the collector circuit of \( T_R I \).

Although inexpensive and simple to build, this counter will give reliable indications of the presence of radioactive material. Try it out on your luminous dial watch to check its operation.

This unit, also housed in a 3" x 4" x 5" box, employs spark gap made from a trimmer capacitor.
THE TRANSMITTING TOWER

Herb S. Brier, W9EGQ

ONE OF the big thrills of amateur radio is working other amateurs far away and preferably in foreign countries. This is commonly called DX.

By staying up late, it is possible to work all over the United States on the 3.7- and 7.15-mc. Novice bands. But even when conditions are favorable, it is seldom possible to work foreigners on them—because the top halves of the 3.5- and 7-mc. bands are usually allocated to commercial services outside of North America. On the 145-mc. Novice band, over 50 miles is DX with low power and a simple antenna.

This leaves the 21.1- to 21.25-mc. band as the only possible one on which Novices can work much DX. Fortunately, it has been cooperating wonderfully well. In the past several months, many Novices have worked all continents (WAC) and over 25 countries on 21 mc.

To understand how these different bands behave, we need to know something of how radio waves travel through space—which, in turn, requires some knowledge of the ionosphere.

The Ionosphere. As the sun rises in the morning and shines down on the earth, it bombard the upper atmosphere with ultraviolet radiations. This causes some of the atoms in the gas molecules forming the atmosphere to lose electrons, thereby becoming positive ions. The electrons freed in this manner float around in the atmosphere or attach themselves to other atoms, converting the latter into negative ions. Thus, an electrically charged region is developed which extends from about 90 to 300 kilometers (55 to 190 miles) about the earth.

The intensity of its ionization is determined by several factors. Its daily maximum occurs at noon when the sun is highest, and its yearly maximum occurs in midwinter, when the sun is three million miles closer to the earth than it is in midsummer. In addition, when there are many spots on the sun—an indication of great explosions on the sun—upper-atmosphere ionization is high. We are now well into the upward swing of the latest sunspot cycle, which means that sunspot activity will continue to be high for the next several years.

At night, when the sun is in no position to bombard the atmosphere, ionization gradually decreases until—by dawn—the ionosphere has dwindled to a comparatively thin layer about 300 kilometers high. This decrease in ionization is greater in winter than in summer, because the nights are longer in the winter.

The importance of all this to amateurs is that the ionosphere is what makes long-distance, high-frequency radio communication possible. Radio waves normally travel only in straight lines. If it were not for the ionosphere, the signals radiated from our transmitting antennas would shoot out into infinite space, never to return. However, in traveling through the ionosphere, the difference in its electrical density gradually bends them back towards the earth.

Three things determine how much a radio signal is bent in the ionosphere. They are the frequency of the signal, the angle at which it arrives at the ionosphere, and the density of the ionization in it.

During the middle of the day, all signals radiated at any angle on frequencies as high as

KN4GHH at the controls of KN4CDZ, Winston Salem, N. C. With 30-watts input, this station has worked 44 states, Canada, Puerto Rico, Virgin Islands and Cuba. See "News and Views" (page 115) for details on KN4CDZ and its operator.
as 10 mc. will be bent back to the earth in the ionosphere. Those that arrive at an acute angle are returned at an equally acute angle to the earth near the transmitter. On the other hand, low-angle signals return to the earth many miles from the transmitter. It would seem, then, that signals radiated at low angles are best for long-distance work. This is true, but—

**D Region.** Below the ionosphere, another ionized layer, called the *D region*, forms as the sun rises in the morning and disappears as it sets at night. In a negative sort of a way, this region is almost as important as the ionosphere itself. Instead of bending high-frequency signals passing through it, the D region attenuates them.

The amount of this attenuation increases enormously as frequency decreases. For example, if a 7-mc. signal is attenuated 12 db (2 "S" units) in passing through the D region, a 3.5-mc. signal making the same trip will be attenuated 48 db (8 "S" units), while a 21-mc. signal will be attenuated only about 1.5 db. No wonder 3.5-mc. signals are a bit weak in the daytime!

Low-angle signals, traveling at a "slant" through the D region, are attenuated more than high-angle signals. This attenuation is so great that daytime range is limited to 100 miles or less on the 3.7-mc. band and to about 400 miles on the 7-mc. band. At night, though, when the D region disappears, signal strengths and ranges increase greatly on these bands.

At higher frequencies, low-angle signals get through the D region without excessive attenuation, even at midnight; therefore, they cover long distances. At the same time, high-angle signals at those frequencies pierce the ionosphere, resulting in a zone of no signal hundreds of miles wide between the transmitter and the areas where the low-angle signals return to the earth.

It is not unusual for signals to bounce between the earth and the ionosphere a couple of times in traveling long distances. In fact, the curvature of the earth and the height of the ionosphere limits the maximum "one-hop" distance that can be covered to 2400 miles; therefore, multiple hops are always required to cover greater distances. Of course, each bounce attenuates the signal a bit more. For this reason, it is always best to choose the highest frequency and the lowest angle of radiation usable over a given path at a given time, in order to deliver a strong signal to the remote receiver.

When sunspot activity is high, as it will be for the next several years, low-angle signals up to 30 mc. are useful for DX work from dawn to dark between early fall and late spring. During the summer, the maximum usable frequency drops below 25 mc., but it remains high enough to support 21-mc. communications in some direction during most of the daylight hours.

**Getting on 21 Mc.** A good antenna is the most important requirement for good results on 21 mc. As noted above, only low-angle signals are useful on the higher frequencies. The maximum usable angle of radiation on 21 mc. rarely exceeds 25°, and best results are had with angles below 15°.

In free space, a horizontal antenna would radiate equally well straight up, straight down, and at any angle in between. But when an antenna is mounted close to the ground, the power it radiates downward is reflected upward from the ground, to cancel or reinforce the power radiated at upward angles. Which angles are cancelled and which are reinforced depend upon the antenna height.

An antenna ¼-wavelength high has its maximum lobe of radiation centered around 32° above the horizon. One ¾-wavelength high has its lowest lobe of radiation centered around 20°, and one a full wavelength high has its lowest lobe centered around 12°.

At 21 mc., ¼-wavelength equals about 23', and a wavelength equals about 46'. Consequently, a minimum height of 35' is recommended for a 21-mc. antenna. A 45' height is better; less than 25' gives comparatively poor results.

Most center-fed 7-mc. antennas, especially if cut for the low-frequency end of that band, work quite well as three half-wave antennas on 21 mc. So do the "all-band" Novice antennas described in the *Transmitting Tower* for December, 1955, and on page 92 of the March, 1956, issue of *Popular Electronics*, assuming that they meet the height requirements.

A ¼-wave antenna for the 21-mc. band is only 22' 1" long, calculated from the formula: \[ L (\text{ft.}) = \frac{468}{F} \text{ (mc.)} \]. It may con-

---

In one week of operation, Joe Minyard, KN5DXL, Eupora, Miss., made 30 contacts in 13 states on 80 meters. He uses an AT-1 transmitter, an S-53A receiver, and a 135° "folded-dipole" antenna.

---

June, 1956
HELP US OBTAIN HAM LICENSES

In this section of the Transmitting Tower, the names of persons requesting help and encouragement in obtaining their amateur licenses are listed. To have your name listed, write to Herb S. Brier, W9EGG, 7% POPULAR ELECTRONICS, 386 Madison Ave., New York 17, N. Y.

W1 CALL AREA
Michael Drew, (13), 20 Maple St., Lisbon Falls, Maine. (What is the best equipment to start out with?)
Leonard Rock, 82 Franklin St., New Britain, Conn.

W2 CALL AREA
Richard Parini, (16), 1999 1st St., Raritan, N. J.
Jason Kaatz, 80-11 246 St., Bellerose 26, L. I., N. Y. (Will answer all letters)
Richard Biton, (14), 5 Nugent St., New Hyde Park, N. Y. (Theory, pen pals)
Fred Becker, Jr., 60 Stewart Ave., Riverside, N. J. (Wants help and ideas on building a receiver)
Scott Fitzgerald, 20 Alexander Ave., Montclair, N. J.
David M. Abramowitz, (19), 2977 Avenue W, Brooklyn 29, N. Y.
Steve Vadas, 17 Pleasant Ave., W. Caldwell, N. J. (Theory)
Robert A. Sherwood, 110 Vreeland Ave., Bergenfield, N. J. (Code)
Jay P. Sage, 99 Vreeland Ave., Bergenfield, N. J. (Code)
PFC Bruce B. Burpee, US 5199403, Co. D, 34th Sig. Bn., Corps, AFO 107, New York, N. Y. (Will soon be out of Army and wants to become a ham; wants suggestions for a modest station to start)
Peter Kohrs, 51 Bayview Ave., New Rochelle, N. Y.
Robert Tournier, Post Brook Farms, R.F.D. 1, Butler, N. J.
Alex Kahlous, 7 West 92nd St., New York 25, N. Y. (Pen pals)
John Hunter, Jr., 36 Atlantic St., Jersey City 4, N. J. (Code and theory)
Henry Meseles, 1472 43 St., Brooklyn 19, N. Y. (Will answer all mail)

W3 CALL AREA
Marshall Mackler, (15), 400 S. Sterling Rd., Elkins Park 17, Phila., Pa. (Wants to hear from other prospective hams and SWL's)
Gary Kaplan, 6721 Horrocks St., Philadelphia 49, Pa. (Wants pen pals)
Ronald Shelton, (14), 2911 W. Lanvale St., Baltimore, Md. (Pen pals)
Larry Herley, 425 S. Wood, Middletown, Pa. (Novice license)
Ed K. Shilts, 1183 Balmoral Dr., Allison Park, Pa. (Pen pals)
Thomas McCoy, R.D. 01, Brockway, Pa.

W4 CALL AREA
Rex Johnson, 403 E. College St., Griggsville, Ga. (Wants suggestions about kind of transmitter to get)
Norman Fink, (14), Rt. 10, Box 336, Roanoke, Va. (Radio theory and code, pen pals)

W5 CALL AREA
Jerry Johnson, (15), Box 506, Celina, Texas.
Bob Gilelly, 2502 W. Mulberry, San Antonio, Texas. (Wants pen pals, will answer all letters)
Mike Gilelly, 2502 W. Mulberry, San Antonio, Texas. (Wants pen pals, will answer all letters)
Donald Auderer, 6414 Texas Ave., Houston, Texas. (Wants help with Novice license, overseas pen pals)
Randall Caselman, 17 W. 6th St., Fayetteville, Ark. (Wants diagrams of 2-meter transmitters, letters from amateurs on 2 meters)
A/J C J. O. Akin, 2nd Recon. Tech., Ron., Sac, P.O. Box 20, Barksdale AFB, Shreveport, La.
James McVain, (17), 206 N. Schopmeyer, Gainesville, Texas. (Code and theory)
Bob Patterson, 310 11th St. South, Columbus, Miss.
David Holder, (15), 307 Aurora St., Houston 8, Texas. Phone: UN-4-3913. (Amateur radio)
Silas Dunn, (12), 712 South Cedar, Little Rock, Ark. (Code)
E. L. Purifoy, 826 Rock Is. Ave., E. Dorado, Ark. (Amateur license)
John Waddell, 9709 Pine Lake Drive, Houston 24, Texas.
Howard Wukas, Rt. 4, Box 449, Marshall, Texas.

W6 CALL AREA
Vernon James, (13), 1437 Berkeley Way, Berkeley, Calif. (He and two friends want to become Novices by December)
Joseph S. Kernohan, Box 165, Rio Dell, Calif. (Just home from U.S. Army in Germany)
Richard A. Hart, (31), 920 S. Pine St., San Gabriel, Calif. (Theory)
Charles J. Henderson, C/O P.O. Box 1025, Atascadero, Calif. (Wants to correspond with other hams)
Bill Rowes, 1241 McWood St., W. Covina, Calif. (Pen pals)
Walter Polland, 524 25th St., Hermosa Beach, Calif.
Robert Bonner, 1208, S. School St., Lodi, Calif. (Code)

W7 CALL AREA
Wayne Wright, WN7ZGO, 5703-110 S.W., Tacoma, Wash. Phone: LA-9242. (His Novice license is about to expire; needs help with code and theory)
Steve Ogard, 1600 N. E. 137th St., Portland 29, Oregon.
Ralph Goodwin, 214 So. 22nd St., St. Helens, Oregon.

W8 CALL AREA
William V. Jenkins, S.M. San., 1500 Blakessie St., Kalamazoo, Mich. (Recovering from TB in Sanatorium; has lots of time to study; needs a little help; will answer all cards and letters)
chrame, C/O Mrs. Hanley, 420 S.
Constantine, Mich. Phone: 3015
almost totally paralyzed as the re-
swimming accident when a child,
much to become a ham)
Joy Brower, (18), 5231 Second, De-
 troit, Mich. (Student at Wayne University; little help in both code and theory at test)
Kaser, (16), 304 Pine St., Mt. Vernon,
Ind. (Help on code and theory)
Gale, 19991 Garfield, Detroit 19, Mich.
and would like to hear from American
ars, pen pals)
Marchant, 16905 W. 12th Mile Rd.,
Oak, Mich. (Novice license)
Il Hafertepe (15), 290 Mohawk St., Cin-
mati 14, Ohio. (Help in radio theory)
Dennis Shesterkin, 19520 Georgia, Roseville,
Mich. (Help on Novice exam)
Ralph Omness. (14), 115 N. Bond St., Saginaw,
Mich. (Would like to receive letter from SWL’s)

W9 CALL AREA
Barry Weiss (13), 1833 Monroe St., Evanston,
Ill. (Help in getting his license)
Paul Parton (14), 1405 Meridian St., Anderson,
Ind.
Steve Lindsey (14), 430 W. 7th, Anderson.
Ind. (Code)
Richard Roessler (14), 221 S. Perkel, Colum-
bia, Ill. (Wants SWL penn’s)
James Bowater, 2751 S. Greeley St., Milwau-
kee 7, Wis. (Needs suggestions for getting an-
ter up in small yard; also help with code)
Mrs. Dixie Hinkle, 231 S. 65th St., Indian-
apolis. Ind. (Help and information in obtaining
Novice amateur license)
Duane Read, 606 E. Main St., Plymouth. Wis.

W0 CALL AREA
John Orcutt, Holyoke, Colo.
John Globokar, (15), Box 333, Bwabnk.
Minn. (Would like letters from licensed hams,
and also from any prospective amateurs)
Lee Van Dyke, 3708 South Hooker, Engle-
wood. Colo.
Ronald Muriett, 1660 50 Steele St., Denver,
Colo.
Kenneth Noll (16), Box 286, Monticello, Minn.
Help in obtaining Novice license, code. pen
pals)
Dennis James, 2655 Quebec St., Denver 7.
Colo. (Help in obtaining ham license)
Glen Meix (14), 319 E. Fir Ave, Perguson Falls,
Minn.

VE CALL AREA
J. M. Fitzgerald, 5417 Bannantine, Verdun
p2, Canada. (Interested in receiver and trans-
mitter and wants help in obtaining radio
amateur license)
Don Dorward, 78 Royal York Road, North
Toronto 18, Ontario (Code and theory)
Jim Spalding, 11302-103 St., Edmonton. Al-
berta.

To help prospective amateurs obtain their
Novice licenses, the Radio-Electronics-Tele-
vision Manufacturers Association offers a set of
code records (recorded at a speed of 33⅓ rpm)
and a Novice Theory Course for $10.00, post-
paid. The complete course or more information
on it is available from RETMA, Suite 600,
Wyatt Bldg., 777 Fourteenth St., N.W., Wash-
ington 5, D. C.

sist of a length of No. 14 or No. 12 copper
wire, split in the middle by an antenna insu-
lator four to six inches long, and sup-
ported on each end with similar insulators.
Feed it across the center insulator via 50-
to 75-ohm coaxial or “twin-lead” transmis-
sion line, and face it broadside to the di-
rections you are most interested in working.

Next to the antenna in importance comes
the receiver. To be honest about it, some
of the less expensive communications re-
ceivers available leave something to be de-
sired on 21 mc. However, either a prese-
lector or a converter ahead of them usually
improves their operation greatly on 21 mc.

If the receiver lacks a bit of sensitivity
on 21 mc. but is otherwise satisfactory, a
preselector (POPULAR ELECTRONICS, Febru-
ary, 1956, page 52) will overcome the de-
iciency. If it lacks both stability and sen-
sitivity or is hard to tune on 21 mc. but is
satisfactory on a lower frequency band, a
frequency converter may be employed to
convert 21-mc. signals to that band. A con-
verter may also be used to extend the cover-
age of a low-frequency receiver to higher
frequencies. Several suitable converters are
described in recent editions of the ARRL
and Radio Handbooks.

Finally comes the transmitter. Any of
the standard 2- and 3-tube Novice trans-
mitters are capable of transmitting strong
signals thousands of miles on 21 mc. when
feeding an efficient antenna.

Most of the transmitters use 7-mc. crys-
tals and triple frequency for 21-mc. output.
As the 21-mc. Novice band extends from
21.1- to 21.25 mc., crystal frequencies be-
 tween 7034 and 7083 kc. should be chosen.
Users of the Heathkit AT-1 transmitter
should note, however, that it requires crys-
tal frequencies between 5275 and 5310 kc.
for 21-mc. operation.

Code-Practice Oscillator
World Radio Laboratories, Council Bluffs,
Iowa, is now offering an improved version
of the WRL “Economy” code-practice kit
for $4.95. It uses a neon bulb in a relaxa-
tion-oscillator circuit and obtains its op-
erating power from the 117-volt, 60-cycle
power line. Assembling the kit takes about
an hour, and the finished oscillator delivers
a pleasing, well-keyed tone to a pair of
phones.

In my opinion, the “Economy” code os-
cillator is an excellent buy. A feature I like
especially about it is that, in spite of its
low cost, it employs an isolation trans-
former to protect the user from dangerous
shocks from the power line. If not already
on hand, phones and transmitting key may
also be obtained from WRL.

(Continued on page 115)
POKING AROUND the pole during an 18-month scientific expedition, Navy Task Force 43 will rely on "Grasshoppers" for weather information amid the ice desert.

The Grasshopper is a 200-pound robot weather station to be dropped from aircraft. Shedding its parachute after landing, the Grasshopper stretches six legs from its plump body to stand itself up on its nose. Then it sprouts a long whip antenna and starts sending out regular weather broadcasts.

It measures wind speed and direction, temperature, barometric pressure, and humidity, and automatically transmits these data. A preset timer triggers a new broadcast every six hours. Signals can be heard over a radius of 800 miles. The little robot sticks to its job for sixty days without outside help, nursing its batteries through the bitter cold.

The Grasshopper answers a special problem of the planned Operation "Deep-freeze," which will take Navy explorers to the South Pole as one of America's contributions to the International Geophysical Year. Little is known about the weather of the Antarctic, but high winds often make it impossible to parachute supplies from cargo planes. With "Grasshoppers" on weather vigil at their outposts, planes can be certain of being able to unload advance provisions over designated spots. No long flights will be in vain.

**Atom Fallout Area Forecast on Tube Face**

SAFETY is the constant concern in nuclear bomb testing. Every precaution is taken before any bomb is exploded on the test range to make sure that no radioactive material falls on inhabited areas in dangerous amounts.

The cathode tube face in the picture shows a fallout pattern predicted for a hypothetical bomb under certain wind conditions. The computer generating this image of the endangered area was described in our May, 1956, issue, page 40.

By placing a map over the tube face, the affected towns can be spotted immediately. Controls adjust this display so that it will be presented on the same scale as the map. The effect of an explosion can be predicted for distances up to 500 miles from ground zero. Radioactive strength of the atomic fallout at any point within this area is indicated by the brightness on the screen.

The computer figures the effect of twenty layers of different wind velocity and direction between the top and bottom of the atomic mushroom cloud. Thus, it marks the path of the radioactive particles as they sink down. Their final landing positions on the ground then build up the fallout pattern shown on the screen.
TOOLS and GADGETS

MOTOR MOUNTS FOR POWER TOOLS

Special motor mounts make it possible for a single electric motor to supply power to more than one power tool. The basic kit, quoted at $5.95 postpaid, consists of one male plate (to be attached to the mounting surface of your electric motor), and two female plates (to be attached in appropriate positions on separate power tools). Additional male and female mounting plates are available for the extensive use of one motor on many tools, or for adaptation of various motors. (Warren Williams Productions, 5247 West Adams Blvd., Los Angeles, 16, Calif.)

PORTABLE JIG-SAW ATTACHMENT

No. 550 "Arco Jig-Saw" is a portable jig-saw attachment with an adjustable circle-cutter and rip gage. The circle cutter assures perfect circles and holes of any size up to 20" in diameter, while the rip gage provides accurate widths of up to 10". For intricate patterns, the jig saw is simply guided over the cutting line while the automatic air blower blows sawdust away from the blade.

Capable of cutting plywood, plastics, metals —and even lumber up to 2 x 4's—the No. 550 attaches in one minute to any 1/4" electric drill. It has the same capacity and cutting speed as more expensive jig saws, yet is priced at $9.95. (Arrow Metal Products Co., 140 West Broadway, New York 13, N. Y.)

MINIATURE PM SPEAKER

Only 1 1/8" in diameter and 1 3/8" deep, the new Lafayette subminiature PM speaker for transistorized circuitry is claimed to be the smallest PM speaker produced to date. Total weight is 1 1/8 oz.

Frequency range and audio output are in excess of requirements for miniature personal portable radios. The magnet is Alnico 5—voice coil impedance, 10 ohms. Selling price, $1.95. A matching transformer, 2000 to 10 ohms, and measuring 3/8" x 3/8" x 1 1/4", is also available. (Lafayette Radio, 100 Sixth Ave., New York 13, N. Y.)

IMPROVED STROBOSCOPE

Rotation speeds of motors, machines, and phonograph turntables can be determined with the Berkshire Labstrobe Model 18-A. A small, light, inexpensive strobeoscope unit, it gives 60 brief flashes of light per second when connected to an ordinary 60-cycle power line. In the photo, it is shown being used with a Berkshire Phonostrobe disc to check the speed of a turntable.

This unit supersedes the Model 18, with no increase in cost ($9.95). It is similar in external appearance but the internal construction has been improved—resulting in more accurate centering of the lamp, and easier lamp replacement. (Berkshire Laboratories, 898 Bank Village, Greenville, N. H.)

NEW-TYPE ANNUNCIATOR

Unique but simple, the Modern annunciator is designed for a lifetime of service. Its white steel discs are drawn up by coils of No. 28 enamel wire and held with alnico permanent magnets. The numbers are reset by pushing up rod-moving magnets away from the white discs, causing the discs to drop. There is practically no friction and maximum buzzer oscillation on a.c. or d.c. current. (Modern Annunciator Mfg. Co., 59 Sullivan St., New York, N. Y.)

June, 1956
TIPS and TECHNIQUES

HOME-MADE SOLDERING "POT"

Soldering jobs frequently require joining untinned copper wires. They can usually be handled more easily by first tinning the wire. By using a "micro" soldering pot made from an empty 22-calibre rifle cartridge, you can accomplish such small tinning jobs with little effort.

The open end of the cartridge is flared slightly by inverting it over a suitable conical-shaped tool (thin-nosed pliers with the jaws closed work nicely) and tapping sharply. A length of iron wire about ten inches long is added, as shown, to provide a handle and base. The "pot" is then heated over a candle, gas, or alcohol flame, solder being fed in as it melts. Wire to be tinned is first cleaned with steel wool or fine sandpaper, then dipped into the molten solder.

Dip-soldering is also feasible with articles of suitable size and shape. Fresh solder must be added periodically to make up for losses and to maintain the layer of flux on the surface.

-W.B.L.

QUICK BATTERY-HOLDER CONNECTIONS

Experimenting with transistors? Try this dodge: solder small Fahnestock clips onto the lugs of the battery holders as shown in the photo. Quick connections can then be made to the holders without further soldering, and without using alligator clips or battery clips which tend to pull sideways and short against one another.

An Acme battery holder holding four size "AA" penlite cells is shown in the photo. By means of the Fahnestock clips, the cells can be quickly connected in series or in parallel, or the pack can be easily tapped for any voltage from 1 1/2 to 6. Many combinations of connections can be made. For example, the photo shows a connection giving 4 1/2 volts, with another giving 1 1/2 volts.

The Fahnestock clips can easily be soldered to the battery-holder lugs if you use a little soldering paste and plenty of solder. After soldering, clean the entire assembly with Ajax kitchen cleaner and an old, soft toothbrush; then rinse off with hot water.

-A.T.

SALVAGING WEAK "B" BATTERIES

Most radio "B" batteries come in units consisting of a number of separate 15- to 18-volt cells wired in series to give the necessary voltage. Often, one cell will deteriorate more rapidly than the others and build up a large internal resistance, making the entire battery seem dead. This is especially true if the battery has been allowed to remain on the shelf or in a radio which is not used very much. If you collect a number of old batteries, the defective units from each can be removed and the good cells rewired together in series to give usable units. Care must be taken to observe correct polarity when rewiring.

Cells can be checked by first taking a voltmeter reading to make sure that there is a potential difference of (at least) 15 to 18 volts between the terminals, and then shunting the battery with a resistance on the order of 10,000 ohms. The meter should read a constant 15 to 18 volts for a minimum of about five seconds.

-J.R.

TIN-FOIL AIDS TV RECEPTION

If the picture on your TV set is marred by interference from an FM station or any other nearby transmitter, here is an easy stunt that may effect an improvement.

Wrap a 2"x3" length of household aluminum foil snugly around the twin-line antenna lead where it is connected to the set. Slide the foil slowly along the twin line in the direction of the antenna while watching the TV (Continued on page 106)

POPULAR ELECTRONICS

100

www.americanradiohistory.com
NOW... there's a
GARRARD
Auto-Manual
Record Changer
for every
hi-fi system

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

New
RC 88
$54.50
Deluxe Changer

Full
manual and
automatic posi-
tions. True-turret drive... uses no belts.
4-pole "Induction Surge" motor. Fool-
proof Garrard Pusher Platform.

New
RC 121
$42.50
Net

Garrard's most compact, econom-
ical changer - fits any cabinet. Simpli-Mix Operation permits
stacking all record sizes together.

New
RC 98
$67.50
Super Changer

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

301
Turntable
$89.00
Net

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

Model T
Manual Player
$32.30
Net

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

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

To: British Industries Corporation
Dept. GF-356
Port Washington, N. Y.
Please send B.I.C. High Fidelity Plan Book.
Name
Address
City Zone State

June, 1956

www.americanradiohistory.com
Every Heathkit comes complete with detailed step-by-step instructions and large pictorial diagrams that insure successful construction—even for the beginner. Enjoy both the satisfaction and the economy of "building it yourself."

**Etched circuit vacuum tube voltmeter kit**

In addition to measuring AC (rms), DC, and resistance, the modern-design V-7A incorporates facilities for peak-to-peak measurements. These are essential in FM and television servicing.

AC (rms) and DC voltage ranges are 1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC voltage ranges are 4, 14, 40, 140, 400, 1400, at 4000. Ohmmeter ranges are X1, X10, X100, X1000, X10K, X100K, and X 1 megohm. A db scale is also provided. Polarity reversing switch provided for DC measurements, and zero center operation is within range of the front panel controls. Employs a 200 microampere meter for indication. Input impedance is 11 megohms.

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

**MODEL V-7A**

$24.50

SHIPPING WT. 7 LBS.

**MODEL MM-1**

$29.50 Shpg. Wt. 6 Lbs.
Heathkit 3" oscilloscope kit

ETCHED CIRCUIT

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

MODEL OL-1

$29.50 Shpg. Wt. 14 Lbs.

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

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

Heathkit signal generator kit

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

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

Heathkit grid dip meter kit

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

MODEL GD-1B

$19.50 Shpg. Wt. 4 Lbs.

Heathkit antenna impedance meter kit

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

MODEL AM-1

$14.50 Shpg. Wt. 2 Lbs.

Heath Company

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 5, MICHIGAN

June, 1956

www.americanradiohistory.com
Heathkit VFO KIT

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

MODEL VF-1 $19.50

SPECIFICATIONS:

Heathkit CW amateur transmitter kit

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

MODEL AT-1 $29.50


Heathkit COMMUNICATIONS TYPE all band receiver kit

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

MODEL AR-3 $27.50


HEATH COMPANY A SUBSIDIARY OF DAYSTROM, INC.
BENTON HARBOR 5, MICHIGAN
HEATHKIT ECONOMY 7-WATT HIGH FIDELITY amplifier kit

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

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

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

HEATHKIT BROADCAST BAND receiver kit

Model BR-2

Shipping weight 10 lbs. $17.50 Less Cabinet

You can build this table model radio and learn about radio circuit and parts during assembly. Complete instructions simplify construction, even for the beginner. Covers 550 to 1600 kc and features miniature tubes, 5½" PM speaker, and built-in antenna.

CABINET: Fabric-covered plywood cabinet as shown. Parts #91-9, shipping wt. 5 lbs. $4.50

HEATHKIT HIGH FIDELITY fm tuner kit

Model FM-3

$24.50

Shpg. Wt. 7 lbs.

Tunes from 88 to 108 megacycles and features sensitivity and selectivity not expected at this price level. Cabinet supplied with the kit. Built-in power supply and a stage of audio to insure adequate output. Easy to build from step-by-step instructions and large pictorial diagrams.

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

order blank

From

PLEASE PRINT

QUANTITY ITEM MODEL NO. PRICE

Enclosed find ( ) check ( ) money order for Please ship C.O.D. ( ) postage enclosed for pounds. On Express orders do not include transportation charges—they will be collected by the express agency at time of delivery.

ON PARCEL POST ORDERS insure postage for weight shown.

ORDERS FROM CANADA and APO'S must include full remittance.

June, 1956
picture for an improvement. What you are actually doing is using the inductance and capacitance of the twin line and the foil to tune out the interference.

When the point of best reception is found, squeeze the foil tightly around the twin line and tape it in place. Wrap a second piece of foil around the twin line on the antenna side of this point and move it along the line toward the antenna, as before, until a second point of improvement is found. Squeeze and tape this one in place. Additional foil may be added in the same manner.

WATCH THOSE SPEAKER GASKETS!

On most receivers, a rubber or fiber gasket fits into a groove on the chassis. The speaker is then forced slightly against this gasket. If the gasket is missing, or if it is damaged or twisted, any slight speaker noise will be amplified and vibrations may be set up. Therefore, make sure the gasket is installed properly before replacing the speaker.

—H.L.

Typewriter with a Memory

(Continued from page 39)

ory, located on the campus of Columbia University.

Mr. Seebert's initial concept called for a rotating magnetic-drum memory, the most common type of memory in use in computers today. The drums are coated with magnetic recording tape. Magnetic recording heads insert information on the drums, which rotate at about 3000 rpm. Due to the limited availability and high cost of magnetic-drum memories five years ago, Mr. Seebert turned to a simple and comparatively inexpensive plugboard memory. The plugboard is a half-inch-thick sheet of plastic about 18" high x 24" wide.

Not permanently mounted in the memory apparatus, the plugboards can be removed from their sliding frames much as a slide is inserted and removed from a projector. Therefore, a number of boards can be used with each Wordwriter in an office. A completely wired board is not too heavy for a woman to lift and press into the frame. When the plugboard is locked in the frame, male contacts in the back of the board are pressed into mating contacts in the frame.

If a larger capacity memory were employed, Mr. Seebert has reason to believe that a secretary could remember the keys coded to many times 42 phrases—perhaps up to 800 phrases. If the memory has a greater phrase capacity than the number of keys on the typewriter, two keys could be depressed at the same time to trigger the additional phrases over 42.—Mel Mandell.

ESSE SUMMER SPECIALS

SELSEYNs only $395 ea. $750 per pair

110 Volt 60 Cycle

Navy type 5 (approx. 6½" L x 5½" dia.). Original cost $180. Many interesting and useful applications such as remote tuning, beam rotators & indicators, wind direction indicators, etc. Simple to hook up to your home current. Low drain for continuous use. Don’t pass this value. Order motors, generators, transformers, and differentials all at this price. Ship. wgt. 6 lbs., ea. $3.95 Per pair. ... $7.50

RL-42 ANTENNA REEL AND MOTOR

BRAND NEW $1.95

10 for $17.50

100 CRYSTALS—All New—$6.95

All new assorted freq. in various types of holders. Many ham bands and not picked for a bargain. Any one worth the total price. 100 only. ... $6.95

BC-455-B Command Receivers

BC-455-B Used $3.95

New $5.00

K29/ARC-5 190-195 Mc. New $14.95

Transmitters:

4-4 Mc. Like New $6.95

3-3.3 Mc. Like New $4.95 150-156 Mc. Like New $17.95

KEROSENE OR GASOLINE HEATER

New—$6.95

The Evans blue flame heater with an output of approx. 50,000 BTU/ideal for garage or shack where not confined. Cost Government many times price. Size 10" dia. by 12" high. Shipped in original packing, 47 lbs. Your price, Brand New. ... $6.95

RADIOSONDE XMT F69/AMT-2

397 Mc. weather balloon job they are using for the RC models. Brand new with the tubes. Size 6½" x 5½" x 2½" - Ship. wgt. 5 lbs. $1.95

1/4 ARR-1 RECEIVER—$1.95

Close out of this popular 220 Mc. converter. New (demilitarized) with tubes. Ship. wgt. 6 lbs. $1.95

ESSE RADIO CO • 42 WEST SOUTH ST • INDIANAPOLIS 25, INDIANA

POPULAR ELECTRONICS
PICTURE TUBE SPECIALS!

Brand New—RCA Licensed—One Year Guarantee

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
<th>Type</th>
<th>Price</th>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>16DP4</td>
<td>$11.25</td>
<td>16DP4</td>
<td>$18.95</td>
<td>16DP4</td>
<td>$23.50</td>
</tr>
<tr>
<td>16DP4</td>
<td>$13.25</td>
<td>16DP4</td>
<td>$19.95</td>
<td>16DP4</td>
<td>$29.50</td>
</tr>
<tr>
<td>16DP4</td>
<td>$19.95</td>
<td>16DP4</td>
<td>$20.95</td>
<td>16DP4</td>
<td>$29.50</td>
</tr>
<tr>
<td>16DP4</td>
<td>$19.95</td>
<td>16DP4</td>
<td>$20.95</td>
<td>16DP4</td>
<td>$29.50</td>
</tr>
<tr>
<td>16DP4</td>
<td>$19.95</td>
<td>16DP4</td>
<td>$20.95</td>
<td>16DP4</td>
<td>$29.50</td>
</tr>
</tbody>
</table>

FREE BONUS OFFER!

A terrific Eico tube Tester or TV FM Sweep Generator FREE when you buy $200 worth of receiving tubes or more within 60 days at Solar. Tester or generator may be bought outright from Solar for $33.50.

ANTENNA SPECIALS

COMPLETE OUTDOOR $8.45
ALL CHANNEL CONICAL
NEW INDOOR ANTENNA $3.75
BRING IN UHF AND VHF. Use on top of TV. List $9.95.

USED TV SETS

<table>
<thead>
<tr>
<th>Picture tube guaranteed to work.</th>
<th>Table Model</th>
<th>Console</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 inch set.</td>
<td>$17.50</td>
<td>$20.00</td>
</tr>
<tr>
<td>12 inch set.</td>
<td>$22.50</td>
<td>$25.00</td>
</tr>
<tr>
<td>14 inch set.</td>
<td>$27.50</td>
<td>$30.00</td>
</tr>
<tr>
<td>16 inch set.</td>
<td>$32.50</td>
<td>$35.00</td>
</tr>
<tr>
<td>17 inch set.</td>
<td>$36.00</td>
<td>$38.50</td>
</tr>
<tr>
<td>19&quot;, 20&quot;, and 24&quot; Sets—Prices on request.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FAMOUS MAKE TEST EQUIPMENT!

| TUBE TESTER KIT          | $33.25   |
| VACUUM TUBE VOLTMETER KIT | $24.95   |
| FLIGHTBAC TRANSFORMER AND TOKE TESTER KIT | $21.75 |

ANTENNA SPECIALS

COMPLETE OUTDOOR $8.45
ALL CHANNEL CONICAL
FREE INTRODUCTORY Clip GIFTS

With every order of $15 or more—one 6SN7GT, one 6W4GT, 5 assorted resistors, 5 assorted attractively colored tube carbons; or with every order of $30 or more—RCA Cheater, 5 assorted resistors, one 6SN7GT, one 6W4GT, one 6K6GT and Vidaire, 2 set Coupler.

FREE BONUS OFFER!

A terrific Eico tube Tester or TV FM Sweep Generator FREE when you buy $200 worth of receiving tubes or more within 60 days at Solar. Tester or generator may be bought outright from Solar for $33.50.

PICTURE TUBE SPECIALS!

Brand New—RCA Licensed—One Year Guarantee

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
<th>Type</th>
<th>Price</th>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>16DP4</td>
<td>$11.25</td>
<td>16DP4</td>
<td>$18.95</td>
<td>16DP4</td>
<td>$23.50</td>
</tr>
<tr>
<td>16DP4</td>
<td>$13.25</td>
<td>16DP4</td>
<td>$19.95</td>
<td>16DP4</td>
<td>$29.50</td>
</tr>
<tr>
<td>16DP4</td>
<td>$19.95</td>
<td>16DP4</td>
<td>$20.95</td>
<td>16DP4</td>
<td>$29.50</td>
</tr>
<tr>
<td>16DP4</td>
<td>$19.95</td>
<td>16DP4</td>
<td>$20.95</td>
<td>16DP4</td>
<td>$29.50</td>
</tr>
<tr>
<td>16DP4</td>
<td>$19.95</td>
<td>16DP4</td>
<td>$20.95</td>
<td>16DP4</td>
<td>$29.50</td>
</tr>
</tbody>
</table>

FREE BONUS OFFER!

A terrific Eico tube Tester or TV FM Sweep Generator FREE when you buy $200 worth of receiving tubes or more within 60 days at Solar. Tester or generator may be bought outright from Solar for $33.50.

ANTENNA SPECIALS

COMPLETE OUTDOOR $8.45
ALL CHANNEL CONICAL
FREE INTRODUCTORY Clip GIFTS

With every order of $15 or more—one 6SN7GT, one 6W4GT, 5 assorted resistors, 5 assorted attractively colored tube carbons; or with every order of $30 or more—RCA Cheater, 5 assorted resistors, one 6SN7GT, one 6W4GT, one 6K6GT and Vidaire, 2 set Coupler.

FREE BONUS OFFER!

A terrific Eico tube Tester or TV FM Sweep Generator FREE when you buy $200 worth of receiving tubes or more within 60 days at Solar. Tester or generator may be bought outright from Solar for $33.50.

PICTURE TUBE SPECIALS!

Brand New—RCA Licensed—One Year Guarantee

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
<th>Type</th>
<th>Price</th>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>16DP4</td>
<td>$11.25</td>
<td>16DP4</td>
<td>$18.95</td>
<td>16DP4</td>
<td>$23.50</td>
</tr>
<tr>
<td>16DP4</td>
<td>$13.25</td>
<td>16DP4</td>
<td>$19.95</td>
<td>16DP4</td>
<td>$29.50</td>
</tr>
<tr>
<td>16DP4</td>
<td>$19.95</td>
<td>16DP4</td>
<td>$20.95</td>
<td>16DP4</td>
<td>$29.50</td>
</tr>
<tr>
<td>16DP4</td>
<td>$19.95</td>
<td>16DP4</td>
<td>$20.95</td>
<td>16DP4</td>
<td>$29.50</td>
</tr>
<tr>
<td>16DP4</td>
<td>$19.95</td>
<td>16DP4</td>
<td>$20.95</td>
<td>16DP4</td>
<td>$29.50</td>
</tr>
</tbody>
</table>

FREE BONUS OFFER!

A terrific Eico tube Tester or TV FM Sweep Generator FREE when you buy $200 worth of receiving tubes or more within 60 days at Solar. Tester or generator may be bought outright from Solar for $33.50.

ANTENNA SPECIALS

COMPLETE OUTDOOR $8.45
ALL CHANNEL CONICAL
FREE INTRODUCTORY Clip GIFTS

With every order of $15 or more—one 6SN7GT, one 6W4GT, 5 assorted resistors, 5 assorted attractively colored tube carbons; or with every order of $30 or more—RCA Cheater, 5 assorted resistors, one 6SN7GT, one 6W4GT, one 6K6GT and Vidaire, 2 set Coupler.
Transistor Topics
(Continued from page 77)

on a dime. The M-1 is hermetically sealed in a metal can. It is a germanium p-n-p junction transistor.

On the components front, United Transformer Corporation (150 Varick Street, New York 13, N. Y.) has introduced a new series of subminiature audio transformers. Called the Deci-Ounce Transformer series (DOT's for short), these units are hardly bigger than a pencil's eraser, having a volume of only 0.03 cubic inches. With an efficiency 30% greater than conventional transformers, they can be used at levels of 100 milliwatts.

Things-To-Come. There should be some transistorized auto receivers available this fall, more "hybrid" (part tube, part transistor) portable and home receivers, high-frequency (100-mc. and higher) transistors before the end of the year. . . . Other types of semiconductor devices are being developed and will be available—tetrode transistors, double-based diodes, more types of power transistors, and transistors using semiconductors other than germanium and silicon.

New Book. Interested in light-powered circuits? You'll want to get a copy of the new paper-bound booklet, *The Use of Selenium Photocells and Sun Batteries*, by John Sasuga. If not available locally, write to the International Rectifier Corporation, 1521 East Grand Avenue, El Segundo, Calif. . . . price is one dollar and fifty cents ($1.50).

This book is chock-full of information and features many practical circuits . . . with part values! Included are sensitive relays, photometers, unusual relays, light beam transmitters and receivers, charts, tables, etc.

New Transistor. As we go to press, Raytheon announces a new low-cost r.f. transistor, to be called the CK768, and which will retail at $1.50. Look for more dope in my next column on this item.

That's it for now . . . see you next month . . .

Lou

Wired-Wireless Receiver
(Continued from page 65)

This plug into a socket on a tape recorder that has been equipped with an electrically controlled clutch permits remote control of the playback or recording. In this way, you can record desired selections from radio or TV even though you may be busy elsewhere in your home.

A unit can be mounted inside a television set and the relay contacts wired across the loudspeaker terminals so that the speaker is short-circuited whenever the receiver is energized. Thus, you can sit across the room and silence a television commercial simply by flicking the nearby transmitter switch. When the picture clears up, switch the transmitter back to standby and the sound will instantly return.

The SWL's Friend
(Continued from page 80)

the tuner has an undesirable effect on the receiver's oscillator, this effect is called "pulling." Pulling is indicated when you can receive no stations with the "Peaker" connected. Sometimes the receiver may break into instability and howl. If you use fewer turns on the link coil, L2, or move L2 further away from L1, you can reduce the coupling and the pulling effect.

Disc and Tape Review
(Continued from page 72)

is mainly for strings and woodwinds, with flute and oboe solos quite prominent. Out of the 15 recordings in the LP catalog, only four can be considered as worth your attention.

The best-sounding version and, coincidentally, one of the best performances, is that of D. E. Ingelbrecht on Angel 35103. Ingelbrecht is generally considered the Debussy interpreter, and a "listen" to his reading is pretty convincing evidence in support of this reputation. In his meticulous attention to tempi, his expressive dynamics and carefully modeled phrasing, it is easy to perceive the study he has devoted to the work. He also manages to evoke some particularly splendid playing from his orchestra, and the result is a wholly beautiful performance. Soundwise, this is typical of Angel's best efforts . . . the string tone is that luminous, almost transparent texture that is so nicely suited to this type of repertoire, and quite clean and edgeless as an added virtue. Woodwind sound is gorgeous . . . and why shouldn't it be? After all, the woodwinds are a French specialty and here we have a French orchestra, playing French music, under a French conductor, and the recording was made in Paris! That certainly should have been enough inspiration! All this fine playing is cloaked in very live, spacious acoustics, wide frequency and dynamic range.

Next in line is Dr. Stokowski once again,
and on the same record as Clair de Lune—making this an exceptionally good buy. Stokowski's reading is typical of him . . . he brings out subtleties and nuances in the score wholly missing in the readings of many others, and above all, imbues his reading with a great deal of color and expression. Stokowski has always been an expert at getting good playing from an orchestra, and this disc is no exception . . . here we have typically lush string tone and good woodwind sound, too. Stokowski has a habit of using the top talent he can find for certain key instruments. I can well remember that if he planned to record a work which called for a lot of woodwind scoring, especially for flute, he would fly in people like Julius Baker—one of the world's great flute men—from Chicago or even further. The sound on the Stokowski disc is better than it should be . . . meaning that for the period in which it was made the general level from Victor was not as good. That's another facet of Stokowski which has contributed mightily to his success . . . he has a devoted interest in high-quality sound reproduction and has done much in the way of orchestral seating experiments and in microphone placements to add realism to his recordings. Frequency and dynamic range is fairly wide. Groove distortion, a fault of some early LP's, was not noticeable. Add nice live acoustics, and you have a disc of more than passable quality.

The third disc in question has still another conductor whose name has long been associated with the music of Debussy. I refer to Ernest Ansermet, whose reading of "The Foun" is on London LD9031. One would be splitting hairs to prefer the Inghelbrecht or Stokowski performances over that of Ansermet, or vice versa. Ansermet's tempi are perhaps a shade faster, his dynamic shadings not as extreme, and in terms of orchestral balance he doesn't manage quite as well as the other two conductors. But these are very minor factors, and generally Ansermet's is a splendidly conceived and expertly executed performance. He has also been favored with some of London's fine sound—the strings being especially smooth and clean, and the important woodwinds having a very "live" breathy sound. Some inner groove distortion was the only thing that marred a generally good sonic picture.

The other disc for our consideration is part of a three-record album on Angel 3518C. Conducted by Igor Markevitch, a rising star in Europe, the album is entitled "Homage to Diaghalev," and consists mainly of the ballet music that was associated with his name. The sound is very
SAVE HOURS OF WORK

quickly make round, square, key and “D” openings with Greenlee Radio Chassis Punches

In 1½ minutes or less you can make a smooth, accurate hole in metal, bakelite or hard rubber with a Greenlee Punch. Easy to operate... simply turn with an ordinary wrench. Wide range of sizes. Write for details. Greenlee Tool Co., 2386 Columbia Ave., Rockford, Ill.

PERFECT for orderly SMALL PARTS STORAGE!

MULTI DRAWERS

LOW COST! INTERLOCK TO FORM CABINETS

Store easily lost, easily scrambled small parts in these sturdy, ALL STEEL parts drawers! Precision made, two-tone green enamel finish, card holder. SPECIAL PRICE—only $3.49 for package of 10, postpaid, standard size (5" x 2 3/4" x 2 1/4"). Also Giant size (11 1/2" long), fine for special tools, parts, etc., 6 for $6.49. Dividers available.

Unique key-slot system makes it easy to lock drawers at top, bottom, sides to form any shape cabinet. In any space! NO framework required.

Multi-Drawers, Dept. A9, Toleda Madison, Covington, Ky. Please send me sets of 10 std size Multi-Drawers @ $3.49, and dividers @ 3c ea. Send me sets of 6 Giant size Multi-Drawers @ $6.49, and dividers @ 7c each. Enclosed is my (check)(MO) for $ Sent postpaid in US (NO COD'S), guaranteed. Giant and standard sizes NOT interchangeable.

Name ________________________________
Address ________________________________

La Mer. Debussy's great tone poem, La Mer (The Sea), has had a good break on records, no less than six of the ten versions being reasonably hi-fi in quality. Any consideration of La Mer must begin with the Toscanini recording. This is one of the Maestro's truly inspired readings, and is about as thoroughly evocative a picture of the sea as anything that has ever been done. Toscanini has been the victim of some pretty miserable sound, and when La Mer first was released a few years ago, it left much to be desired in sonic values. About eight or nine months ago, the record was released with a better coupling (Iberia instead of Midsummer Night's Dream), and with sound which the Victor blurb claimed had been "enhanced" over the original quality. There is a considerable difference between them all right, but even so the end result is not what one would call tops in sound. Nevertheless, the sound is better, and the truly miraculous performance makes this a most desirable disc.

Coming after a top Toscanini performance is a tough spot to be in, but the second recording in question does not suffer too much by comparison, for it is our friend Inghelbrecht again and he defers to few people in matters of Debussy. This time he is on a Westminster disc, 5327, and the sound is near the top in the La Mer sweepstakes. Inghelbrecht's tempi are slower than the Maestro's, but otherwise he is not much at variance with the old man... at least as far as adherence to the formal score is concerned. The big difference is really in the sheer vitality of the Toscanini reading and in the fact that Toscanini had a much finer orchestra. Sound on the Westminster disc is quite good but not as spectacular as some of this company's other efforts. This one was evidently made while Westminster was still having troubles, as some overload distortion is noted in a few of the big climaxes. Outside of that, it is nice wide-range stuff with superb acoustic perspective. Strings are just a mite edgy for my taste, brass is good and bright, and there is fine intonation on the woodwinds and some heavy accurate percussion.

Number 3 man on the La Mer totem pole is Von Karajan on Angel 35081. This is supposed to be repertoire far outside the

POPULAR ELECTRONICS
ken of Von Karajan, but you wouldn't think so on hearing his reading, which is eminently satisfying. Sure, he has certain little mannerisms which annoy at times, and some of his ideas on phrasing give one pause, but by and large he gets a sound reading and some fabulous playing from his wonderful Philharmonia Orchestra. The sound is a sturdier, more vigorous type that than which is usual for Angel, and is in all aspects outstandingly good.

The remaining recordings of La Mery vary considerably in sound quality as well as interpretation. Ansermet on London LL388 gives a good reading with fair quality sound, Monteaux on Victor LM1939 does a splendid job with the Boston Symphony, and Mitropoulos gives an indifferent performance with rather lackluster sound. In nearly all these recordings, even a good performance has a tough time—because of the blazing intensity of the Maestro's reading. He has left a memorial in this work that will be hard to topple. If sound is number one with you, then you won't go wrong on either the Westminster or the Angel recording.

**Other Works.** Those are the three major—or perhaps I should say most popular—of the basic Debussy works. Here are others which I think should be in a good Debussy library.

I'll just mention what I think is the best recording of each: *Iberia,* a very exciting Spanish-flavored work of Inghelbrecht on Westminster 5327 (reviewed last month); *Nocturnes,* conducted by Antal Dorati on Mercury 50005; *Le Martyre de Saint Sebastian,* conducted by Ansermet on London LL1061; *Children's Corner Suite,* conducted by Andre Cluytens on Angel 35172; *Jeux-Poeme Danse and Epigraphes Antiques,* conducted by Ansermet on London LL992; *Dances Sacred and Profane,* performed by the Hollywood String Quartet on Capitol P8304; *La Damaoselle Bleue,* on Victor LM1907; *Pour le Piano,* with Gieseking on Angel 35065; and the *Quartet in G,* with the Budapest Quartet on Columbia 4668.

---

**Under-the-Phone Crystal Set**

(Continued from page 85)

top of the box, and cement the metal plate in position. Any thin sheet metal such as aluminum, copper, brass, or tin can be used.

The coil form is simply a plastic pill box 1 ¼" in diameter and 2 ¾" long. To make the coil, drill two small holes in the plastic box about ¼" from the bottom, and anchor No. 28 cotton-covered enamelled copper wire in the holes with a little cement. Leave about a 5" long pigtail in the end.

June, 1956
Build it Yourself!

Spinet, two-manual and three-manual electronic organs. Save hundreds of dollars with our easy-to-assemble kits. Designed to sound and look like a pipe organ.

Send $1.00 for "Organ Builders Manual." Full plans for home, church and concert models. Includes parts catalog.

LEARN

RADAR MICROWAVES
TRANSMITTERS
CODE TV RADIO

Philad. Wireless Technical Institute
1533 Pine St. Philadelphia 2, Penna.
A Non-Profit Corp. Founded in 1908
Write for free catalog "P"

GARAGE DOOR OPENER
Actuator Mechanism $24.50
EASY TO INSTALL, SAFE, RELIABLE
Write for information
P. E. HAWKINS CO.
631 PROSPECT KANSAS CITY 24, MO.

LEARN TELEVISION

"AT THE MOST PRACTICAL SCHOOL IN THE WEST"
WORLD-RENORED ARTS--USING MODERN SERVICING TECHNIQUES: UNDER QUALIFIED TECHNICAL INSTRUCTORS (SHRIFT RESIDENTS AND ROBBIE A. R. S. are not necessary. MATH OR THE- ORY--ALSO UP AND COLOR TV.
APPROVED FOR VETS--ENROLL NOW!
Day and Night Classes
Write for Free Literature
Dept. 2B

V. S. I. TELEVISION SCHOOL
4570 Firestone Blvd.
South Gate, Calif.

POPULAR ELECTRONICS KITS

COMPLETE KITS FOR ARTICLES
DESCRIBED IN THIS ISSUE
WRITE FOR PRICES

ALGERADIO ELECTRONICS CO.
236 N. Franklin St. IV 9-0808 Hempstead, N. Y.

of the wire for hooking up the coil later on. Wind about 88 turns and twist a small loop for the tap, then wind 30 more turns and anchor the end of the wire, leaving a pigtail about 6" long.

Drill a ¼"-diameter hole in the center of the bottom of the pill box, and mount the pill box to the side of the wooden box, using a round-head wood screw ¼" long and a washer. The coil should be mounted as close to the bottom of the box as possible to keep it away from the metal plate.

—Arthur Trauffer.

Maximum Fi . . . Minimum $$$

(Continued from page 38)

for the record player; if you cannot devise this yourself from templates supplied, or re-use an old one which you may have, you can buy one for very little.

The Components. The Granco FM Tuner, Model T-160, uses "coaxial tuning." This is a substitute for the conventional ganged capacitor used in the front-ends of most receivers. In the Granco, a variable capacitance is achieved by sliding two glass-like members one within the other. The temperature resistance of these members, plus a frequency-compensating capacitor in the oscillator circuit, helps stabilize the tuner and obviate the need for a.f.c. Once "warmed up," the set stays tuned to the station selected. There is some drift within the over-all range of the ratio-detected slope, but its effect is negligible (maximum drift of about 30 kc. within the over-all FM bandwidth of 150 kc.). A high-Q circuit assures adequate selectivity.

The tuner performs noticeably better with an antenna—and hooking some 300-ohm twin-lead to it (the length is not critical) is no task at all.

The record player is the manual kind, with no changing mechanism. This saves you space and money. If the majority of your records are LP's, you really have no need for a changer anyway. The extra money spent for a changer does not necessarily get you a better record player; it goes into the automatic mechanism that makes the "player" a "changer." The Garrard "Model T" uses a shock-mounted 4-pole motor. Its tone arm, with removable cartridge head and adjustable stylus pressure, is about as good as can be designed for a low-cost unit.

Either the G.E. or the Recoton magnetic cartridge will do very nicely as the phono pickup. The G.E. unit is the "swing-around" type for changing from micro-groove to 78-rpm stylus; the Recoton is the "turnover" kind. Each is fitted with two
NEW INDOOR ANTENNA
Brings in URF and VHF. Use on all types of TV.
List $9.95 ....... $3.49

Complete Outdoor
ALL CHANNEL CONICAL ANTENNA
Includes: 8 element antenna with crossbar, 5 ft. stainless, aluminum mast, choice of mount or 7 ft. wall bracket (state your need. 8 stand ults. 50 ft. of 300 ohm wire. List $13. $8.29

ANTENNA COMPONENTS
300 Ohm TV Lead-In Wire ... 2 ft. $0.45
7" Standard Coaxial Cable ... 2 ft. $0.36
5 ft. Aluminum Bendable Mask ... $1.62
7" Wall Bracket ... $0.99
Aluminum Chimey Mount ... $3.49
Plated Element All Channel Antenna ... $4.49

PICTURE TUBE
57" $9.95
8" $35.00
8" Mount All Channels ... $9.95
Brings value)
Six interchangeable soldering tips ($2.25 and get absolutely FREE)

Soldering Brush. Weller Soldering Tube Checker.

ATTENTION MEN!

FREE MONEY-BACK GUARANTEE Offer!
Send check or money order for this NEW handymen

Soldering Gun
and get absolutely FREE a complete kit of six interchangeable soldering tips ($2.25 value) in handy tube.

ATTENTION SERVICE MEN!
Be sure to give us the name of the distributor from whom you regularly buy.

ELECTRIC SOLDERING IRON CO., Inc.
★ Famous for quality soldering equipment since 1927 ★
7356 W. Elm St., Deep River, Conn.

June, 1956

113

Here is a new standard of versatility and flexibility never before possible! The LUGER'S many tip sizes and shapes (long, short, broad, narrow, curved, straight) reach heretofore inaccessible places. Long-lived, easily switched tips won't anneal, bend nor gather residue. The LUGER'S perfect balance is a pleasure to work with, won't tire you. Fast heating, its air-cooled handsome housing twin-lights your soldering; does things no other can do. You and your handymen friends will love it.

ORDER TODAY while limited offer lasts!
Model A Single Heat $9.95—Model B Dual Heat $11.95
The 1956 Model MIC-10 Geiger-Counter is a sensitive instrument embodying many new scientific principles. A unique, self-rectifying electrostatic generator furnishes the 900 volts required to operate the Geiger Tube. You may obtain only The Uranium Official Year Book (regularly $2.00) including our radio active source both for $1.50.

WESTWOOD RESEARCH & DEVELOPMENT LABORATORIES, INC.
14945 Ventura Boulevard
Sherman Oaks, California

☐ Enclosed is $19.95 for my MIC-10 Geiger-Counter including holster, radio active source, year book, & headphones.

☐ Enclosed is $1.50 for my Uranium Official Year Book, including radio active source.

C.O.D. ORDERS ACCEPTED

DISTRIBUTORS ENCOURAGED


DOUBLE THE PLEASURE OF YOUR HI-FI WITH A Linthrop TWIN EXTENSION SPEAKER

Here it is . . . a compact twin-speaker unit that connects in seconds to any hi-fi, phonograph, TV or radio, and brings the full tone of your set to any remote part of the house. Or use it in the same room for rich, full sound. Made by one of America's outstanding hi-fi speaker manufacturers, Beautiful light or dark wood cabinet containing an 8” woofers and 3/4” tweeter, frequency range 40-15000. 4 ohm impedance. Measures 20” wide x 10” deep x 8”/2” high. Finished with attractive grille cloth. ORDER DIRECT TODAY . . . send just $23.95 for complete unit postpaid and tax paid, with money back guarantee. Specify light or dark finish. Send check or money order to:

Linthrop MFG. CO.
23 SUMMER AVE., N.W.
GRAND RAPIDS, MICH.

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

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

ONLY $23.95 COMPLETE!

sapphire styli; the one used for LP's will serve adequately for perhaps 30 hours of play—at that time it might be best to replace it, preferably with a diamond point.

Both the amplifiers listed in the table compared favorably with each other against the standards set up. Both use similar output circuits: 6V6 tubes in push-pull, with negative feedback to an earlier stage. Equalization settings to handle most records are included. A little more could be desired in the treble and bass controls; these provide a usable range, but not the very wide kind you get in a more expensive amplifier. There is plenty of gain built into both of these units; a room 15' by 20' was filled with above-average listening level, with either volume control turned about one-third clockwise.

The BL-10 speaker system is the lowest priced complete speaker-and-enclosure package on the market. Slightly larger than a table-model radio, it is completely finished, polished, and covered on three sides with grille cloth. It may be used in any position and in any part of the room, with best results obtained by standing it on end on a shelf in—or near—the room corner. Connected to the rest of the system, its response is remarkably clean and level from about 55 cycles to 11,500 cycles. High-frequency lovers may want to add a tweeter for those elusive overtones, and it is quite easy to do so.

Another point: one BL-10 provides good, clean listening. Two, placed about ten feet apart, provide a sound quality that is rivaled only by much larger and costlier systems.

A Final Word. There it is: the budget-minded man's hi-fi system. We offer it as an example of economy shopping and careful component selection. While it may be "a good word" for many confused music lovers standing at the threshold of the world of electronics, it is by no means "the last word." Those who wish to compromise less can assemble better systems by spending proportionately more. Such systems, using representative components in various price brackets, will be described in future articles. We will also show how the present system can be improved by substituting better units discreetly.

The important thing in hi-fi is not necessarily to spend a lot of money, but to spend it wisely. "True-life adventures" with hi-fi components, now being researched by the POP'tronics staff, will provide systems to suit any taste and fit any budget—from this "lowest cost" system through the better systems, and up to a few installations that cost more than a new car. Watch for them!

POPULAR ELECTRONICS
The Transmitting Tower
(Continued from page 97)

News And Views

John Hugentober, WN8CSK (16), 1535 Northridge Dr., Cincinnati 31, Ohio, reports: "I have been on the air since last September and have worked 32 states and three countries, all on 40 meters. My transmitter is a converted ARC-5 "surplus" unit running 70 watts, my antenna is a doublet, and my receiver is an NC-100. My pet gripe is hams who do not QSL. I'd like a few pen pals, and I'll answer all letters received."

"Marty" Brody, KN2MDL (14), 42 Hemlock Lane, Roslyn Hts., N. Y., writes: "I have been on the air about nine months. In that time, I have worked 45 states and 17 countries in all continents. My best DX is Singapore (VS1) and Northern Rhodesia (VQ2). My transmitter is a Viking Adventurer running 50 watts and feeding a folded dipole antenna. My receiver is an NC-98. I'd like to recommend the 2I1-mc. band to more Novices. It is great for DX and interference is much less on it than on 3.7- and 7.15 mc. Also, I'd like skeds with Nevada, Utah and Montana."

From 33 Valley View, Tiffin, Ohio, Roger Shultz, KN8AJF, writes: "In two weeks on the air, I have worked 10 states, with five confirmed. My transmitter is a WRL Globe Scout running 25 watts to a 100' long-wire antenna. The receiver is an S-53A, and I have crystals for the 3.7-, 7.15- and 21.1-mc. Novice bands."

Terry Meyers, 314 Roosevelt St., Gary, Ind., is one of the several readers of the Transmitting Tower who report that their new AR-3 receivers work just as I said they would in the review in the February, 1956 Tower. Terry adds that reducing the i.f. tube cathode resistor (part 1-8) from 820 ohms to 150 ohms increases the usable sensitivity of his receiver tremendously, especially on the highest frequency range. It is a change easy to make and well worth trying.

Irving Boime, KN6QDK (15), 447½ N. Curson, Los Angeles 36, Calif., didn't waste any time getting on the air. "I've had my license for two weeks, and I've made 42 contacts in four states. I use an AT-1 transmitter and an S-76 receiver, and I have two antennas, an 80-meter doublet, and a 40-meter long wire. I'd like a few pen pals and some ideas for a 15-meter antenna."

Wayne Ashworth, KN4CDZ, 1920 Lyons St., Winston Salem 6, N. C., says: "DX is good down here, but not from Ark., N. Dak., Ore., and Me. These are the states between me and working all states on 40 meters. This is the only band I operate, but I am planning to try 15 meters soon. 1 run 30 watts to an 807 (small power supply) and use an S-38D receiver. My DX is Canada, Puerto Rico, Virgin Islands, and Cuba."

"Buzz" Sadler, WN3ERJ, 815 Holland Ave., Pittsburgh, 21, Pa., announces the Pittsburgh Novice Net (PNN), which meets on 7146 kc.

**WHICH TRANSMITTER KIT TO BUY?**

**JOHNSON MAKES A COMPLETE LINE OF TELEGRAPH KEYS, TOO. WRITE FOR FULL INFORMATION.**

---

June, 1956

---

E. F. JOHNSON COMPANY
3022 Second Ave., S.W., Winona, Minnesota

Please send me a copy of Bulletin 727, which describes the Viking "Adventurer" in detail.

NAME:

ADDRESS:

CITY:

STATE:

---

**$54.95**
GENIAC set up to do a problem in check valve research
Be careful before you answer. GENIAC (the first electronic brain construction kit) is equipped to play tic-tac-toe, cyber and anagram codes, convert from binary to decimal, reason (by syllogisms) as well as add, subtract, multiply and divide. Specific problems in a variety of fields—cartography, policy claim settlement, physics, etc.—can be set up and solved with the components. Connections are solderless and are completely explained in the manual. This covers the use of all components to solve different problems. You will find building and using GENIAC a wonderful experience: one kit user wrote, "This kit is a wonderful way of thinking to me." You actually see how computing, problem solving and game play interrelate ... you can be involved in the world of thinking and learning.

Any GENIAC kit sent to you in seven days for $20.95. If our technicians decide it is not possible to handle the problem for the usual $116.00 cost, and give you a receipt on the back of the GENIAC in seven days, your money will be refunded to you with the kit. If you are completely explained with templates, construction kit, Be careful before you answer. You think faster...
LIFETIME GUARANTEED TUBES

BRAND NEW PICTURE TUBES
- RCA Licensed.
- 1 Year Complete Unconditional Guarantee.
- Price: $11.95

NEW INDOOR ANTENNA
- Both vertical and horizontal.
- Indoor, brings better reception than most outdoor antennas. Use on 6, 7, 8, 15, 22, 25, 27, 30, 40, or 75.
- List Price: $9.95
- Yours for $3.29 each.

FREE BONUS BOX
With Every $25 Order
- 1 RCA Carrier Head.
- 10 Assorted resistors.
- 1 6AUG7 tube.
- 1 6CB6 tube.
- 1 68G6 tube.

FREE CLOCK RADIO
With Every $25 Purchase Within 30 Days.
Wakeman clock radio with famous KARLSON brand names. Your's for your satisfaction.

FREE GIFT CERTIFICATE!
With the purchase of any of our merchandise, future orders will be subject to the purchase of $55 or more.
This Gift Certificate cannot be used to obtain another certificate unless order is $55 or more.

USAGETV SETS
Picture Tube Guarantees To Work!
- Emerson, RCA, Philco, GE, etc., in a Dural-Craft or A-802, 12" SET.
- Table Model...$16.95
- Console Model...$19.95
- 12" SET...
- Table Model...
- Console Model...
- 16" SET...
- Table Model...
- Console Model...

Table Model...
- Complete...
- $22.95
- Console Model...
- $27.95
- Console...
- Complete...
- $31.00

All Parts Shipped F.O.B. HARRISON, N. J.

WE PAY ALL POSTAGE on orders shipped in USA, Territories and APO's. Send first order price of merchandise. Please include approximate postage on foreign shipments. All orders subject to prior sale. Add 25¢ handling on orders under $25.00. Quantity users write for special discount.

MAJOR BRAND TUBE CO.
Romoano Bldg. E5sex 4-1106 Harrison, N. J.

PEE WEE BATTERYLESS TUNLESS "LIFETIME" RADIO

REALY WORKS—FOR LIFE!
\textit{Without Tube, Batteries, Tuning, Ticking, Timeless!}\n- PEE WEE will never run down or burn out.
- PEE WEE is completely equipped with permanent radio components. Bought in Bands and APO's.
- PEE WEE is not a toy, but a really working, practical radio complete with speaker, storage battery, and automatic receiver, designed for years of trouble-free performance.

SEND ONLY $2.00 FOR FREE TUBE LIST—Order Blank—2 free Sample Tube Carton. We want YOU On Our Waiting List.

SPECIAL SURPRISE
Mention where you saw our ad and we will send you FREE three 6SN7GT's with any order of $10.00 or more.

KARLSON ULTRA-FIDELITY ENCLOSURES

FREE Send for copy of latest book "The Karlson Enclosure"

KARLSON ASSOCIATES, INC.
Dept. M 1610 Neck Road
Brooklyn 29, N. Y.

VHF AM-FM RADIO

Supersensitive sub-miniature tube set receives television, FM broadcast, CATV, and amateurs without antenna or ground. Tuned from 73 mc to 150 mc. Similar models available in frequency bands from 27 mc to 222 mc. Postcard size—measures only 2" x 2" x 3". Highest quality parts used. Specify battery or AC model. Use with any magnetic head-phone or can be connected to a similar unit as a head-phone output. Thousands in use by amateurs, experimenters, and city defense. Factory wired and tested. Comes complete with special tube type 6L3 pipe. 12v 60 ma power. Includes union. In kit form $1.68. Postage extra on COD orders. New transistor audio amplifier for extra loud reception only $2.00 including transmitter.

SPRINGFIELD ENTERPRISES
Box 54-E Springfield Gardens 13, N. Y.

LIFETIME GUARANTEED TUBES

- We guarantee to replace tubes labeled MAJOR BRAND forever. Each tube individually checked for "No Troubles" and "No Dead Tubs" in stock. Immediate Shipment. Free Postage On All Orders With Full Remittance.

HERE'S HOW LIFETIME GUARANTEED TUBES

- There are fewer "call backs" than there are "out of date" tubes. A "Peak Performance" testing in our fully equipped Testing Department before shipment guarantees quality.

- O24...0.43; CBB...0.82; BR4...0.82; ELY...0.42; 765...0.49; 189G6G1.15
- 1A87...0.43; 1G5T...0.57; BR3...0.82; EGY...0.40; 767...0.70; 244...0.39
- 1C56G1.4; 1V4...0.47; BR6C...0.47; 6EIT...0.45; 779...0.70; 250G6G7.8
- 1D52...0.41; 1GT...0.47; BR6G...0.45; 6E9G...0.45; 777...0.65; 254G6G4.3
- 12H7...0.49; 1ST...0.47; BRBB...0.45; 6E1G...0.45; 777...0.65; 254G6G4.3
- 12H6...0.49; 1ST...0.47; BRBB...0.45; 6E1G...0.45; 777...0.65; 254G6G4.3
- 12H7...0.40; 1ST...0.47; BRBB...0.45; 6E1G...0.45; 777...0.65; 254G6G4.3
- 12H7...0.40; 1ST...0.47; BRBB...0.45; 6E1G...0.45; 777...0.65; 254G6G4.3

We'll Send Free Tube List—Order Blank—2 free Sample Tube Carton. We want YOU On Our Waiting List.

SPECIAL SURPRISE
Mention where you saw our ad and we will send you FREE three 6SN7GT's with any order of $10.00 or more.

KARLSON ULTRA-FIDELITY ENCLOSURES

FREE Send for copy of latest book "The Karlson Enclosure"

KARLSON ASSOCIATES, INC.
Dept. M 1610 Neck Road
Brooklyn 29, N. Y.

June, 1956

Seal of Achievement

The Karlson enclosure represents a major achievement in acoustic cabinetry. Fully engineered in every detail, its frequency response, radiation characteristics, transient fidelity, and tonal integrity are without equal in the entire field of Audio. Even though this cabinet is small in size, and delicately styled to fit any décor, this amazing unit is capable of outperforming even a 30" horn. Its complete versatility and tonal balance make the Karlson Enclosure the finest requisite for those who must have the finest in High Fidelity.

There is a KARLSON for you
Examining transistor electronics by Arthur W. Lo, Richard O. Endres, Jakob Zovern, Fred D. Walhauer, Chung-Chih Cheng, all RCA engineers.

At last, here's an authoritative, practical book which rounds up all available information, ideas and techniques on transistors and presents this useful data to you in 529 illustrated, easy-to-follow pages! These RCA experts cover the whole field, from design and operation of transistors to their application. Much material is just released, printed here for the first time. Whether you're a beginner or seasoned vet, working in radio, TV, radio, computing, or allied fields, this complete new book will give you mastery of transistors and show you how to use this knowledge profitably and successfully!

Gives Complete Coverage. Including:
- Physical concepts (36 pages) — characteristics, parameters, equiv. circuits (46 pages) — basic amplifier configurations (50 pages)
- Low freq. amplifiers (45 pages) — hf-freq. amplifiers (39 pages) — power amplifiers (28 pages) — hf-freq. operation (17 pages) — oscillators (38 pages) — modulators & demodulators (12 pages)
- Tabular analyses of fundamental transistor networks & circuits — shows transistor, p-n junctions between transistor and vac. tube circuits — features practical circuits — plus much more valuable material and useful, workable techniques.

Mail now for Free Trial Offer!

Prentice-Hall, Inc., Dept. 5702-H1
Englewood Cliffs, New Jersey

Please send me a copy of TRANSISTOR ELECTRONICS for 10 days' FREE use. Within 10 days I'll either return book and keep it and remit $4 down (plus small postage charge) and then $4 a month for two months in full payment.

Name
Address
City
Zone
State

Save! Send $12.00 with this coupon and we pay postage. Same return and refund guarantee.

Do you use . . . make . . . or test anything in which electrons flow through wire?

THEN YOU MUST BUY THIS

2,000 OHM-PER-VOLT MULTI-TESTER

Ready to use! Not a kit!
Look at amazing low price!

$6.95

Even if you already have a multi-tester, you also should get this rugged, metal-based instrument for use in the dark. It's only to use for rough and tumble work and checking continuity.

Here's a complete "wiring" personality tester. 24/4" wide. 4" long and 1 1/4" thick. Scale width: 12/4"! Plus the hand. Complete with standard battery and test leads. Also accurness on voltage and current scales. AC or DC voltmeter 0-10, 0-50, 0-250, 0-500, 0-2,500; DC current: 0-250 microamperes, 0-100, 0-500, 0-1,000, 0-5,000, 0-10,000, 0-20,000; DC resistance: 0-1,000 ohms, 0-1 megohm. DB ranges 25 to plus 22. Plus 5 for plus 46. Well-damped D'Arsenal movement, with shunt dial and test leads. Use it to check AC or DC voltages, broken wires, radio tube heater, coil resistances, and corrosion under coatings. Full money back guarantee with instructions.

Full Money Back Guarantee with Instructions!

ARROW SALES, INC.
North Hollywood, Calif.

With news. At 1380, these two channels close; they re-open on 17,790 kc. and 17,840 kc. (FW) VLR6. 6150 kc., Melbourne, and VLT6, 6130 kc., Port Moresby, can be noted around 0420 with news and programs of local interest. (JB)

The 9615-kc. outlet opens at 0700 with "Waltzing Matilda" played on a xylophone and the Post Office Clock Tower Bells. This xmn runs to 0845 with news and music. (WC)

News to North America is broadcast at 2245, 0715, 0815, and 1030; to British Isles and Europe at 0330. (DB)

Austria — Radio Osterreich is still beaming a xmn to North America at 0600-0700 over OE138 on 25,615 kc. Power is said to be 20 kw; QRM is rough at times. Reports are requested. Address is The Austrian DX Club, Landgutasse 41/19, Vienna 10, Austria. (RH)

This station also transmits at 0200-0400 to South America on 25,615 kc. and to North America at 0520-0620 on 25,945 kc. (LM)

Azores — CSA93, Ponta Delgada, 4865 kc., can be heard at 1615 s/on. This xmn is in Portuguese. (FD)

Bulgaria — A new schedule in English from Radio Sofia lists 7670 kc. and 6070 kc. daily at 1800-1630 and 1645-1715. The 7000-kc. outlet is also used at 2000-2030 and 2200-2330. On Tuesdays, Thursdays and Saturdays, 9700 kc. opens at 1930 with a concert of Bulgarian music. (RH)

Brazil — Radio Rural is still under construction, and the stations on 6065 and 15,105 kc. are inactive according to a letter from "Ministerio da Agricultura." (WRH)

Brunei — XYY, Voice of Brunei, Rangao, 9543 kc., is heard at 0930-1015 as follows: 0930-0945, religious program; 0945-1000, news; 1000-1005, weather report; 1005-1008, balance of program. There is music to 1015 s/off. Interval signal is drums and gongs. This is an all-English program. (CS)

Dahomey — Radio Colonou is now scheduled as follows: on 1475 and 4870 kc. Wednesdays at 0640-0700 (Saturdays at 0740-0800), and at 1230-1500; on Sundays at 0530-0600 and 1230-1500, according to a recent verification. (WRH)

Denmark — OZF, Copenhagen, 9520 kc., reports that the "Saturday Night Club" is now operating at 2100-2200 with English for the last 50 minutes. There is some QRM on the East Coast from VOA. (LM, BH)

Dominican Republic — A weak station heard on 3375 kc. until 0000 s/off may be H14V, Bani. It has Latin-American music and many commercials. (WF)

England — The North American Service is as follows: at 1000-1215 and 1300-1600 on 15,310 kc. (GSP)

All programs are in English except Monday thru Friday when there is French at 1315-1325. (LM)

Egypt — Cairo is heard daily on 11,670 kc. in Arafat at 2300-0200 and again at 1200-1700 s/off. On Fridays, it stays open until 1715. This station has Portuguese for South America at 1830-1900 and Spanish at 2000-2030. At 1900-2000, an Arabic program is scheduled on 11,670 kc. to South America and on 6215 kc. to North America. (AB)

Formosa — English to North America from...
Taipei can be heard at 0000-0030 and 0130-0200 on 11,920 and 15,300 kc. (LM)

France—Paris on 9490A kc. has been noted with "Paris Star Time" at 1830-1900 Sundays in English. (SW, RR)

Paris has a listed channel on 9500 kc.

French Camerons—Radio Yaounde, 9270 kc., is operating at 1200-1600 with French news and music. They verify promptly. (JH, CS, RR, FB)

French West Africa—Radio Dakar, 4893 kc., is often noted opening in French at 0130; Latin-American and popular music is heard on this xmsn. (BV, GD)

Radio Conakry, French Guinea, operates on 6154 kc., and can be tuned around 0800-0815 in French. (RR)

Germany—Radio Liberation, Munich, can be heard at excellent levels some days on 3990, 7130, and 9565 kc. with programs in various

ABBREVIATIONS

A—About this frequency


BC—Broadcasting service or station kc.—Kilocycle

kw.—Kilowatt of power

mc.—Megacycle

QTH—Exact location

s/off—Sign-off of station

s/on—Sign-on of station

V—Verified frequency

xmsn.—Transmission from a radio station

xmttr.—Transmitter used by station

Russian dialects. Other listed frequencies are 6055, 6175, 7225, 9565, 9765, 11,780, 11,965, 15,255, and 15,395 kc., with varied Russian dialect programs put on by escapees from behind the Iron Curtain as the Free Voice of the Russian People. This station is operated by the American Committee for Liberation from Bolshevism, Inc., New York. The station wants reports on any frequency as well as reports on interference. (PM)

Deutsche Welle, Cologne, may—by this time—be operating as follows: to Far East on 15,275 kc.; Near East on 17,845 kc.; Africa on 11,795 kc.; South America on 11,795 kc.; and to North America on 9640 kc. The schedule reads: 0500-0800 on 15,275 kc.; 0930-1230 on 17,845 kc.; 1300-1600 on 11,795 kc.; 1700-2000 on 11,795 kc.; and 2300-2330 on 9640 kc. (TL)

Gold Coast—ZOY, Accra, 4915 kc., has an English program consisting of an Educational Forum at 1130-1155; news from the BBC at 1200-1215; s/off at 1216. (CS)

Greece—Athens is noted on a new outlet of 17,775 kc. at 1300-1330 with French and English to Western Europe. (RL)

Athens on 15,345 kc. is noted from 1400 s/on to 1500 s/off with news and commentaries. It identifies as Radiofonikos Statthmos Athinon Vrakeon Kimat. The Forces Station at Athens, 7422 kc., is still being heard from 0000-open to 0230-close with programs of Greek news, Greek and popular records, and others. It identifies as Edeo Athinae, Ken-

June, 1956
RADIO CONTROL Headquarters
For model airplanes, boats, cars, etc. FREE CATALOG "P."
No operator's license required. FREE—SEND FOR FCC FORM 505
Callate for Catalog containing all the latest in Model Control Transmitters & Receivers Kits Available.

Most POWERFUL 5 Watt TRANSMITTER—LOWEST PRICE.
Former 2 Tube V/MX, 8 circuit, with MAGIC TRAINING INDICATOR. Completely Tested, incl. 81/2 ft. Sest. Antenna, Remote "Click" Keying Switch, Beautiful Cabinet 12"x7x6", MODEL X...$24.95
MODEL X1...$25.95 9V Storage battery, charger, VIBR. pack & Bag...$29.95
2 METER: 150 Micro...$3.95; 500 Micro...$3.95
R/C TRANSMITTER & RECEIVER KIT...$27.95, M/C..5 Watt 2 Tube Simple Transmitter & Superpower Tube Simple Receiver. Perfect for Model Building. Mail order. $27.95
5 RES, Cond., SIGMA Relay, Incl. 60 V, $3.95
SIGMA IF Relay, RCD, 6 V, $3.95
Miniaturized VIBRATOR SUPPLY 6 Input/SOVC. 30 MA. $3.45
P.C. BOOKS, Model Control $1; Radio Control $1; Handbook $2.95; Mold O-Rings $1.75
SIGMA RELAY CONTROL $3.50
RELAY CONTROLL...$29.95
5 M/C...$39.95
Comm. Relay. H.Melbourne, Australia $12.50
TUBES: XPG, RXGL, 344, 345, IAG, 6K4—TRANSISTORS $9.
2-40 Circuit Future Tube Kit. Typewriter Battery, New Supply, Storage BATTERIES: 9V, 90V, 52.45, 2 Volts Via $1.25
2 Vol. $1.75
PORTABLE BATTERY CHARGER: 110 Vac., 9 Vol. 1/500 WATT. $3.95; Single 9 Volt $1.95
CODE Practice Oscillator 952: Single Head Set $1.95
6 V Ac. Time Delay Thermal Relay 5-180 Sec. $9.50
Electronic DRUGGUSCOPE, Slep, Mocf, w. 1021 Tube...18.95
Sensitif Sigma RELAYS 10,000 OHM SPT $9.50
LMB BOX CHASSIS OFFERS FREE
Inside LMB boxes
10 tested kit diagram projects for the builder. Each of these kit diagrams built by a recognized expert. Kit projects are complete circuit diagram, photo of project both front and rear photo. Rear photo shows wiring and parts. Data listing, complete parts list, and approximate cost. Complete to build except parts and your distribution. Ask your distributor for the list of LMB kit Diagram Projects. If he does not have them, write to LMB 101 Venice Blvd. Los Angeles 15, Calif.

ELECTRO-MECHANICAL SURPLUS FOR THE EXPERIMENTER

NEW LISTINGS

SOUNDTRONICS LABS
632 ARCH STREET
PHILADELPHIA 6, PA.

INVENTORS

If you believe that you have an invention, you should find out how to protect it. We are registered Patent Attorneys. Send copy of your Patent Booklet "How to Protect Your Invention," and an "Invention Record" form. All obligations. They are vouch for the asking.
McMORROW, BERMAN & DAVIDSON
Registered Patent Attorneys
349-M Victor Building
Washington 1, D. C.

POPULAR ELECTRONICS

120

dricos Radiofonikos Stathmos Enoplon Dynameon Ellados, signotitos; 1300 kiliodio, 230 metra, kai 7422 kiliodio, 40.43 metra. (PM, URDXC)

Guadeloupe—FG6AH, Basse Terre, 7430 kc., has a French news and music program at 1800-1835. It identifies as Ict Radio Guadeloupe with a guitar interval signal. This 100-watt transmitter is seldom heard due to C.W. QRGM. (CS)

Guatemala—TGWA, Guatemala City, 9760 kc., is noted at 1845-1900 and 2345-0000, with an English session at 0030-0100. (MO)

Haiti—4VEH, Cap Haitien, can be heard Saturdays and Mondays with "Listener's Mailbag" on either 9656 kc. or 9666 kc. (both used). Times are 0930 on Saturday and 2030 on Monday. For a while, 4VEH had to operate on one-third power because of a burned-out tube. (BR)

India—All-India Radio, Delhi, 11,640 kc., is being heard at 0840-0930 in an English session, with news at 0840. Remainder of program comprises Oriental music and talks on India and her people. Identity is: This is the External Service of All-India Radio. (BV, TL)

Indo-China—in a letter, Mr. Jean Varnoux, Director of Radio France Asie, writes: "I have the honour to inform you that the Vietnamese Government has decided to establish a state monopoly of broadcasting. This decision involves the cessation of broadcasts by Radio France Asie ..." As a result, "RFA" has completely closed down. (WRH, BE)

Israel—The Voice of Zion presents an English news program on Fridays at 1645 on 9008 kc. (G) Aid)

Italy—Rome, 9570 kc., has a Tuesday night feature enjoyed mostly by the YL SWL's called "A Talk on Italian Fashions" which is on the air at 1910 following the announcements. (LM)

Jordan—Amman, 6060V kc., can be heard at 0000-0045 with an Arabic program including music. It has been noticed on a Monday in English at 0600-0700. It announces as Huna Hashemite Jordan. (CS)

Madagascar—FJQA, Tananarive, 9515 kc., has English at 2230-0030, 0400-0600, and 1000-1230 in parallel with 6172 kc. Radio Australia reports that the 3242-kc. outlet is also active. (JH, MC)

Moruittus—Forest Side, 15,032V kc., is being heard at 2200-opening to close around 2315-2330. The first hour is French and music, with English world news program from 2300 to 0/s/o. (GF, ER)

Mozambique—CR7BF, Lourenco Marques, 11,740V kc., is noted at 2315-2330 with an English musical session. Reports go to P. O. Box 594, Lourenco Marques. CR7BG, 15,285 kc., is noted at 2315 on Sunday with exercises in Afrikaans and possibly Swahili. (BT, KA, ER)

Netherlands—Radio Nederland has been experimenting on 11,950 kc. and 9745 kc. on Sundays at 1100-1230, with 5-kw. power. (CN)

The station also operates to North America daily at 1645-1725 and at 2130-2210 on 9590 and 11,730 kc. The earlier xmsn follows the 1730 Dutch language program to Canada. (GA, DK, VS)

Pakistan—The Lahore station of Radio Pakistan is operating on S.W. (according to a QSL from 39 Empire Road, Lahore) at 2100-
**SHORT-WAVE CONTRIBUTORS**

Gary Alexander (G.A.), Charleston, Iowa  
R. A. F. Brown (AB), Raleigh, N. C.  
Bill Berger (BB), Fairvax, Okla.  
Ray Buraglio (RB), Valley Stream, N. Y.  
Floyd Backus (FB), Richmond, Va.  
J. R. Brownell (JJ), Vancouver, B. C.  
Jim Cumpie (JC), Sherman, Texas.  
Joe McGregor (MC), New Britain, Conn.  
William Currell (WC), Toronto, Ontario  
Doug Day (DD), Kellogg, Montana  
Gerry Dexter (GD), Waterloo, Iowa  
Bill Evans (BE), Port Arthur, Ont.  
Greg Ferguson (GP), Charlotte, N. C.  
Phil Pinkle (PF), Burbank, Calif.  
Stuart Fuller (SP), Jordan, N. Y.  
William Flynn (WF), Burlingame, Calif.  
Fred Gatz (FG), Lancaster, N. Y.  
Bill Hutchinson (BH), Baltimore, Md.  
James Hart (JH), Irvington, N. J.  
Robert Hatter (RH), Syosset, N. Y.  
George Ingraham (GI), Philadelphia, Pa.  
David Knapton (DK), Cobourg, Ontario  
Jane & Roger Legge (RL), McLean, Va.  
Ted Leveque (TL), Bracebridge, Ontario  
Charles Maxam (CM), Baldwinsville, N. Y.  
Louis Marcarel (LM), Medford, Mass.  
Paul Mathieu (PM), Southbridge, Mass.  
Gordon Nelson (GN), Inglewood, Calif.  
Phillip Morris (MO), Fairfax, Okla.  
Bernard Brown (BR), Derby, England  
Emmer Riggale (ER), Massillon, Ohio  
J. N. Rodriguez (JR), Guanare, Venezuela  
Dave Ramey (RR), Atlanta, Georgia  
Rolan Riker (RR), San Bernardino, Calif.  
Bill Roemer (WR), Bowling Green, Ky.  
Charlie Sutphen (CS), Toledo, Ohio  
Dale Smith (DS), Athens, Pa.  
Jerald Saval (JS), Revere, Mass.  
Larry Selman (LS), Brooklyn, N. Y.  
Vincent Staffo (VS), Herkimer, N. Y.  
Brian Tandrow (BT), Northridge, Calif.  
John Beaver (BV), Pueblo, Colo.  
Steve Wilhelm (SW), Brooklyn, N. Y.  
World Radio Handbook (WRH)  
Universal Radio DX Club (UDXDC)

kc., and OBX4Q, 15,180 kc. (reported 15,197 kc.) at 0600-0900, P.O. Box 1711. (CM)

*Radio Nacional del Perú* is an easy station to hear around 2230 with Spanish news and music on 9562 kc. This is OAX4T. (JS)

*Portugal*—Lisbon is noted on a new channel of 21,495 kc. at 0600-0800, dual to 17,880 and 21,700 kc. (RL)

*Ryukyu Islands*—The VOA Relay Station on Okinawa is scheduled on 7160 kc. at 0530-1200 and 1700-1730 to East Asia. Reports go to Voice of America, VOA Relay, Box R, APO 239, San Francisco, Calif. (DD)

*Solomon Islands*—VQQ2, Honiara, is reported operating at 0200-0300 daily on 5960 kc. with 100 watts. West Coastners might be able to log this one. (WF)

*Spain*—Radio Leon, which formerly operated on 6993 kc., is now on 6950 kc. according

June, 1956

2230 on 3915 kc., 0130-0330 on 6075 kc., 0630-0830 on 6030 kc., and 0845-1200 on 3335 kc. The station is eager to receive reports. No IRC required. Power is 1 kw. (WRH)

This has been heard in Ohio at 1030-1130 with English announcements. (CS)

Pakistan is noted at 1415 with English to Turkey; to United Kingdom at 1500 on 11,800, 7010, 9645 kc. It is also heard at 1930-2000 on 15,255 and 11,885 kc. with English news at 2000. (LM, BE, BB)

**Peru**—Radio El Sol, Lima, is scheduled with all-Spanish programs over OBX4Q, 5970

---

**LEARN basic electricity electronics**

The Easy "Picture Book" Way!

Just Released: The fabulous ILLUSTRATED Training Course now used by the U.S. Navy!

You Learn by Pictures

Over 25,000 Navy trainees have already learned Basic Electricity and Basic Electronics this easy, "Picture Book" way! Now, for the first time, YOU can master the basics of Electricity and Electronics with this same "Learn-by-Pictures" training course! Over 17 simple, easy-to-understand drawings explain every section; these "teaching" pictures actually make up more than half the entire course! No other Basic Electronics or Basic Electronics course in America uses this revolutionary illustrative technique! You learn faster and easier than you'd dream possible.

**A Complete Idea on Every Page**

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

**Everyday English—A Course Anyone Can Understand**

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

**10 Complete Volumes**

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

**Home Study Without Correspondence**

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

**10-Day Examination—Money Back Guarantee**

Send today for these exciting new training courses—you risk nothing. When you receive the volumes, examine them in your own home for 10 full days. If, at the end of that time, you're not completely satisfied, simply return the books to us and we'll gladly refund your full purchase price! Total cost for either 5-volume course is only $9.00. In Canada, prices approximately 5% higher.

**ORDER TODAY!**

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

**JOHN F. RIDER PUBLISHER, INC.**  
480 Canal Street, N.Y.C.

I have enclosed $_____. Please send me:  
3-vol. Basic Electronics set @ $6.90 set.  
5-vol. Basic Electricity set @ $9.80 set.  
2 vol. Basic Electronics @ $4.90 each.  
2 vol. Basic Electricity @ $5.90 each.  
3 vol. Basic Electronics @ $5.90 each.  
2 vol. Basic Electricity @ $5.90 each.  
3 vol. Basic Electronics @ $6.90 each.  
2 vol. Basic Electricity @ $6.00 each.

*Return set if you don't understand it! I may return the books in 10 days, and receive a complete refund of the full purchase price if I am not satisfied.*

Add state or city sales tax where applicable.

Name

City & State

---

**www.americanradiohistory.com**
ing to Radio Denmark. This station belongs to the Red De Emisoras Del Movimiento (R.E.M.). Nearly every reporter sent notes on Radio Nacional de Espana, Madrid, 9360 kc. The 12,000-kc. channel is no longer in use; 6122V kc. runs dual to 9360 kc. North American programs are at 2215-2300, 2315-0000, and 0015-0100, all different.

Sweden—SBP, Stockholm, 11,705 kc, is noted at 2055-2110 with news and weather at 2100; press review and music at 2105; all English. (JC)

SBT, 15,155 kc, has news and music in English to S.E. Asia until 2200; after that time they broadcast in an Eastern language. (TL)

Syria—The schedule for Syria is as follows to the Near East: at 0030-0100 and 0330-0530 on 7145 kc. in English; at 1530-1830, in English at 1530-1630 on 9555 kc. (LM, SF, FG)

Tahiti—Papeete, 6135 kc, is being heard at 2300-0100; in Tahitian with island music and some gongs until French begins at 0000 with music and commercials. Main announcement is at 0015 when they play part of the "La Marseillaise" and announce in French as Radio Diffusion-Television Francaise; Tahitian drums are followed by a 200 kW Radio Tahiti, La Voix de la Francaise. (GN)

Tangier—DUX Radio is heard from 1330 to 1445-close with popular records and Swedish announcements. Interval signal is The Swedish Rhapsody. QTH is Proveogrammet, P. O. Box 6622, Stockholm 6, Sweden. (BR, FB)

WTAN, the Voice of Tangier, is using a 10-kw. Phillips xmtr. in addition to the 2 1/4-kw. xmtr. All evening broadcasts are on 9490 kc. Schedule reads: various languages at 1500-1530 daily (1500-2015 Sundays and Fridays). In English: Sunday, 1630-1730; Monday, 1600-1800; Tuesday, 1600-1745; Wednesday, 1530-1800; Thursday, 1530-1800; Friday, 1530-1815; Saturday, 1630-1730. All English xmsns are beamed to the British Isles. The smaller xmtr is used mornings. (LM, SF, FG)

IBRA Radio operates weekdays at 1145-1400 (Wednesday and Thursday, 1145-1300) and at 1415-1700 (Wednesday and Thursday, 1345-1700) on 9782 and 11,947 kc.; on Sundays at 0745-1045 on 15,245 and 11,718 kc., at 1430-1700 on 1768 and 9782 kc. Xmsns are beamed to Central and Northern Europe. QTH is IBRA Radio, Lutton, Beds., England. (WR)

USSR—Radio Moscow has news at 2000, 2100, 2200, 2300, 0000; sports programs at 2015, 2145, and 2345. "Farms and Farming" is on at 2115 and 2230. (LS)

Radio Mukden, Mukden, Manchuria, is noted often at 0800-0900 with Chinese programs, on 6525 kc. Radio Tashkent, Tashkent, Uzbek, on 6824 kc., is noted around 0949-1000 with identity signal. English news and other programs are heard until 1030. (PF)

Venezuela—YVZM, Maracaibo, 9530 kc, is the outlet for Radio Popular, Ecos del Zulia and Radio Mara. Current schedule is 0830-1530. YVLK, Radio Rumbos, 4970 kc, features the "Supper Club" on Monday thru Friday at 1730-1830, the "Breakfast Hour" at 0630-0730. Another English program is "The Early Bird" from YVKE, 4890 kc. Radiofisusora Venezuela can be heard at 0530-0730 with music and news. (JR)

Windward Islands—The Windward Islands

122

POPULAR ELECTRONICS
B/C Service, Grenada, B.W.I., is now on a new outlet on 17,745 kc., replacing 11,830 kc. It operates at 1700-2115 except Saturday in parallel with 3395 kc. (RL)

Yemen—Sanaa, 11,904 V kc., is heard at 0915-1000 in Arabic with Arabic music, partially readable on parallel 9705 kc. This is best noted Mondays when HKJB is silent. It announces as Huna Sana. (CS)

Zanzibar—Radio Zanzibar, 4795 kc., signs on at 0900 with the anthem "March of Sultan." announcements are in Arabic and English. Musical religious program is heard at 0900-0915; a mailbag in English and native language at 0915-0930; request records, mostly London records, are tuned until 1000 s/off after repeat of opening announcement. This one takes very sharp tuning to log. (CS)

Aero—Some of the boys have been having good luck on the Aero Channels. Phil Finkle, for instance, has logged Rangoon, Chungking, Singapore, Hong Kong, Bangkok, and Bombay on 8845 kc. between 0855-0910. 

Operation Chaos

(Continued from page 70)

cast a pity-loaded glance at Digger, huddling miserably in the stroller.

"00000000000000000000" stated the big coward.

"Gopple," observed Junior enviously.

"Well, the weight-factor's about the same — so, here goes! Good luck, Digger, old boy, old boy, old boy!" I jabbed the start button on the portable transmitting unit and the stroller cruised smoothly up the sidewalk.

"See!" I gloated. "It works like a charm!" "Well, I hate to admit it," said Loser Girl, "but I guess you've stumbled onto something all right."

"Dun & Bradstreet!" I rejoiced, jabbing the reverse button and bringing the stroller back, "we are here! Now shall we let Junior crowd in beside the noble Digger and show off our Stroller Of Tomorrow in the park?"

"That might be fun!" agreed Fair-Weather Girl.

HALF-WAY through the park, a fortune slipped through my fingers. Just like that. Without warning, the stroller shot forward at increased speed, described a figure-eight on two-wheels and disappeared across a lawn—Junior gleefully waving his fat little arms and Digger howling like an anguished banshee.

"Gross Gott!" I gasped, desperately working every button on the transmitter. "It just can't be!"

"'Y-You fiend!" screamed the Stricken Mother, "You've done it again! Only this time my baby is in the monster!"

I snapped the transmitter's off button. "Relax," I tittered, hysterically. "They can't have gone far. The center of gravity June, 1956
is too low, on that thing with the heavy electric motor in it, to tip over—and I've cut the signal—so it should be stalled nearby." Together, we raced across the lawn, neatly hurling all the Keep Off The Grass signs. "I still don't understand it, though."

... probably... smashed... against... a... tree..." panted the Pessimistic Mother, her face pale with visions of tragic whirling through her mind. "... should... have... had... my... head... examined... letting... you..."

Ahead, a group of citizens burst out of a crosswalk, running for their lives. Behind them came the stroller—Junior grinning evilly at the frightened escapees and Digger baying a stream of canine mental-agony.

"Turn it off!" shrieked the Wild Woman at my side. "TURN THAT THING OFF, WILL YA?"

"IT IS OFF!" I bellowed despairingly.

The sprinters and the pursuing stroller vanished down another crosswalk. We galloped forward again, peering vainly in all directions for our son and his runaway steed.

"Look out, Fred, here it comes again!" shrialed a matron from the safety of a tree to which she had scrambled. Fred joined her without comment or waste motion just as the stroller thundered out of the bushes.

I tackled it—madly jerking wires loose at random and we bumbled to a stop.

"Beeble!" protested Junior irritably.

"NO BROKEN BONES." I observed, handing Junior to the Distraught and Weepy Mother. "But let's evaporate before all concerned pull themselves together and pin the rap on us."

We took to the scenery... pronto.

Hitting the street, I heard the crackle of static and the metallic-voice of a communications-radio.

"Good lord!" I whispered hoarsely. "They must be throwing a police net around the park! You two run for it! Digger and I will hold them off until—"

"It's only a taxicab, silly."

"Oh." My blood unfroze and resumed coursing.

"Why do you suppose the stroller went so crazy if you turned off the transmitter?" asked Missus Curious, now that sonny-boy was safe in her arms and my project a miserable failure. "You sure can't sell anything that gets out of control and stays that way. Not to this mother, anyway!"

"All right, all right!" I rasped peevishly. "I'm resigned to facing a life of labor. You've made your point. I don't know why it stayed out of control. There's no explainable reason for it. There was absolutely nothing wrong with my transmitter or my receiver—and this is a brand-new, guaran-
teed sequence-switch, so it couldn't be anything remotely connected with the equipment."

We plodded on in silence. My arms began to ache from pushing the extra-heavy stroller.

"Well, I don't want to sound like an interfering wife—"

Then—it hit me ... hard.

"Interference," I muttered. "Sure. Interference!"

I raced back to the parked taxi.

"Do you happen to know what band your company operates those sets on, Mac?" I pointed to the crackling radio.


"Know the watt-output, by any chance?"

"Yeh. About two-hunnert fifty."

"Thanks, Mac," I said glumly. "You just solved a slight mystery and limited my R/C plans, in the future, to small model airplanes in the countryside."

AFTER I explained the situation—my puny five wattage against all the city communication systems—Missus Wife was pleased and had the temerity to suggest I give the electronics field a rest and turn to other things. Chess was her advice. Chess, because she plays a mean bishop. Not to mention that I seem to have a penchant for always trading my queen for one of her pawns.

And, then, I got a terrific idea. Why not R/C Chess? Complex, perhaps, but certainly not beyond the determined abilities of a real electronics enthusiast.

I'm laying out the preliminary schematics now.

And here comes that coffee again.  

Juno, 1956
INDEX

TO VOLUME 4

Jan.-June, 1956

AMATEUR RADIO AND SWL

Building an All-Band Preselector (Tooker) 52 Feb.
Building a "Regenode" Receiver (Tooker) 51 Jan.
Dual-Band Novice Antenna (Stoner) 92 Mar.
Four Dollar Frequency Standard (Johnson) 50 Feb.
Jim Caukins Learns to Tune In a Single-Sideband Station (Marriner) 53 Mar.
Radio Amateurs to Monitor Satellite 89 June
Sputnik Endurance Meter (Stolberg) 93 Mar.
S-Meter for Your Receiver (Stoner) 92 Mar.
The SWL's Friend—An Antenna Peaker (Tooker) 79 June
Use a "Q-Multiplier" (Brier) 81 May

BOOK REVIEWS

A-M Detectors (Schure) 16 Apr.
Automatic Garage Door Control (Richards-Lawrence) 65 Mar.
Beam Antenna Handbook (Orr) 14 Apr.
Color Television Receiver Practices (Dean) 20 Feb.
Crystal Oscillators (Schure) 20 Feb.
Dictionary of Facts and Crafts (Stapenburgh) 26 May
Electronic Circuitry for Instruments & Equipment (Aronson) 24 June
Electronic Motion Pictures (Abramson) 20 Jan.
Electronics for Everyone (Upton) 24 June
Frequency Modulation (Schure) 18 Feb.
Hi-Fi Annual & Audio Handbook (Radio & Television News) 24 May
Limiters and Clipppers (Schure) 26 May
Magnetic Recording (Begun) 25 May
Multivibrators (Schure) 26 June
Operation TV (Madas) 24 Jan.
Planning Built-in Hi-Fidelity Systems for the Home (Allied Radio) 65 Mar.
Practical Radio and Electronics Course for Home Study (Benjamin) 65 Mar.
Practical Radio Servicing (Marcus & Levy) 18 Feb.
Radio Philatelies (Rosen) 14 Apr.
Radio Projects (Marcus) 28 May
Scientific American Books (Scientific American) 14 Apr.
Scope Connections (Walker) 26 June
Shoot TV and Radio Trouble Fast (Cislin) 20 Jan.
Synchrons, Self-Synchronous Devices and Electron Twins (Crown) 24 May
Tape Recorders—How They Work (Westcott) 28 May
Television—How it Works (Johnson) 28 May
The Radio Amateur's Handbook (American Radio Relay League) 22 June
The Radio Handbook (Editors & Engineers, Ltd.) 22 June
TV Consultant (Cislin) 65 Mar.

DEPARTMENTS

Carl & Jerry (Frye) 66 Jan., 68 Feb., 68 Mar., 69 Apr., 8 May, 8 June
Disc and Tape Review (Whitty) 68 Jan., 73 Feb., 67 Mar., 71 Apr., 75 May, 71 June
Transmitting Tower (Brier) 64 Jan., 64 Feb., 73 Mar., 88 Apr., 80 May, 94 June
Tuning the Short-Wave Bands (Bennett) 68 Jan., 66 Feb., 88 Mar., 86 Apr., 69 May, 61 June

ELECTRONIC GADGETS

An Amazing Converter (Tooker) 70 Apr.
Build This Novel Signal Blinker (Greenlee) 79 May
Build Your Own Line Voltage Booster (Blackford) 70 Apr.
Compass Galvanoscope 94 Feb.
Electronic Banjo (Garnner) 61 Feb.
Electronic Coin Tossing (Braunbeck) 55 Jan.
Electronic Gadgets for the Gardener (Ford & Chernol) 57 May
Emergency Crystal Receiver (Trauffer) 60 Feb.
Homemade Tube Socket Adapter (Bassmussen) 68 June
Inexpensive Time Delay Relay (Becker) 64 May
Make Your Own Electronic Thermometer (Pollack) 62 Apr.
Miniature Tone Generator (Tooker) 71 May
Miniature Tuning Capacitors 57 Feb.
More Power from Sun Batteries (Pearce) 52 May.
Phone-Plug to Phone-Jack Adapter 62 June
Radios Made from Hearing Aids (Edson & Bossetti) 52 May
Safeguard Your Home with a Thermostat Fire Alarm (Pollack) 49 Mar.
Secret Switch Paralyzes Radio (Trauffer) 62 June
Simple Guitar Amplifier (Vicenst) 61 May
Simple Proximity Detector Works Like Magic (Pollack) 65 Apr.
The Perfect Servant (Pugh) 67 June
Three Ideas for an Emergency Receiver (Trauffer) 83 May
Tubeless Audio Amplifier (Turner) 92 Feb.
Under-the-Phone Crystal Set (Trauffer) 85 June

FEATURE ARTICLES

Aboard a Radar Picket Plane 74 June
Assembling the Image Orthicon 34 Jan.
Audio on Ice (Fermoni) 38 Mar.
 Betting Safe on the Weather (Reid) 56 June
Carry Your Own Piano (Marriner) 61 May
Compuer with Memory Speeds Inventory 41 May
Electric "Brain" Guards Cargo's 36 Jan.
Electric Realism in Disneyland (Norman) 44 Apr.
Electronics Maps Brain Waves (Atkinson) 38 Feb.
Motor Analyzer Speeds Auto Repairs 46 May
Needed Electronic Inventions (Lawrence) 29 Jan.
New Life for Citizens Band 40 June
Profit from Your Electronics Hobby 34 Apr.
Radar on the Highway (Tooker) 35 May
Solving the Jet Crash Mystery (Kent) 46 Apr.
Submarines—Are We Open to Sneak Attack? (Morgan) 33 Feb.
Telemetering a Heart Beat 45 Apr.
Trenosonde Intercontinental Weather Balloon (Morgan) 42 Apr.
Typewriter with a Memory (Mandell) 38 June

GEIGER COUNTERS

Amplify Those Geiger Clicks (Louis) 50 Apr.
Simple Transistorized Geiger Counters (Pugh & Milburn) 90 June

HI-FI

Adding Tape to Your Hi-Fi System (Lanier) 74 Mar.
Audio Audit (Eisenberg) 82 Jan.
Audio Oscillator for Hi-Fi Testing (Turner) 78 Feb.
Baked Baffle Claimed Better than Wood 46 June
Clubs Provide Good Records for Less $55 79 May
Dig That Reel Flat Response! (Kohler) 93 May
Four Components Make Simple PA System (Trainer) 62 May
Hi-Fi Hybrids (Fantel) 86 May
Hi-Fi in a Chest of Drawers (Machs) 75 Feb.
Hi-Fi in the Home of Martin Block 73 Jan.
Home Recording Disc 85 May
Horns—Folded and Loaded (Fantel) 78 Apr.
Introducing the "Octahedron" (Owens) 74 Apr.
Loudspeakers—Fact and Theory (Fantel) 76 Jun.
Maximum Fl...Minimum $$$ (Eisenberg) 35 June

POPULAR ELECTRONICS
More on Tape Recorder Hookups (Dubbe)... 76 May
Muscle Distribution System for Home .......................... 87 Feb.
Famed Enclosure Now Comes as Kit ............................ 53 June
No Confusion . . . Just Bottling! (Fantel) ....................... 92 Feb.
Recommended Tape Recorder Hookups (Lanier) ................ 62 Apr.
Resonators—Large and Small (Fantel) .......................... 81 Mar.
Selecting Your “Phonogenic Music” (Fantel) ................... 87 Jan.
Shorthorn Kit is Hi-Fi Bargain (Norman) ....................... 69 Mar.
The Mark II—A $3 Speaker Battle (Weems) ...................... 48 May
Turning Out the Turntable ...................................... 73 Apr.
Two Are Better Than One (Fantel) .............................. 58 June
What's New in Hi-Fi ........................................... 74 May 52 June

MISCELLANEOUS

Baner Box (Kohler) ............................................. 47 Mar.
German Electronics Moves Again ............................... 56 May
Giant Console Controls America's Voice ....................... 41 Feb.
Helicopters—Electronics' New Workhorses ...................... 82 May
I Married a Superheterodyne! (Kohler) ......................... 96 Feb.
"Kilocycle Rops" ............................................. 38 Jan.
Lab on Wheels .................................................. 39 Apr.
"Missile Master" .............................................. 45 June
Music on the Rails ............................................ 41 Jan.
New Trade Winds for the Electronics Experimenters ....... 64 May
Operation Chaos (Kohler) ..................................... 85 June
Sonic Alarm Spots Anything That Moves ....................... 45 Mar.

RADIO CONTROL

Drones Put R/C into War Games (Morgan) ..................... 31 Apr.
Household Remote Control With Wired-Wireless (Sandretto) 56 May
Radio Waves Guido Driverless Tractors ........................ 70 May
Receiver for Wired-Wireless Control (Sandretto) ............ 63 June

TELEVISION

DX TV Reception Makes New Hobby (Cooper) .................. 43 June
England Sets Up TV Training Center ........................... 51 June
Fuses and TV Sets (Rivers) .................................... 73 June
Keep Checking That TV Antenna (March) ...................... 55 May
New TV System Turns Night Into Day .......................... 41 Apr.
Shoot to Kill—TV Commercials! (Garner) ..................... 42 Feb.
TV Show Features "Wires and Pliers" .......................... 37 Apr.
TV's Trial by Torture (Quirk) ................................ 41 Mar.

TRANSISTORS

Five New Jobs for Two Transistors (Garner) ................. 54 Apr.
Power Supply for Transistor Experiments (Tucker) ......... 47 Feb.
Transistor Portable with a Punch (Turner) .................... 42 May
Transistor Projects for the Beginner (Garner) ............... 31 Mar.
Transistorized Light Meter (Pollack) .......................... 43 Jan.

WORKSHOP PRACTICES

Add Your Own Low-Voltage Windings .......................... 54 May
Chassis Are Where You Find Them (Johnson) ................. 73 May
Economy Vacuum-Tube Voltmeter (Graham) .................... 47 June
How to Assemble a Multimeter (McCafferty) .................. 59 Feb.
How to Use Ohm's Law (Louis) ................................ 88 Feb.
Make Your Own Self-Generating Photocell (Turner) ....... 62 Jan.
Mounting Boards Simplify Wiring (Ferres) .................... 97 May
Potentiometer Boxes Speed Circuit Experiments (Turner) .. 68 Apr.
Review Your Soldering Habits ................................ 60 Apr.
Roll Your Own Capacitors (Robberson) ......................... 60 Jan.
Signal Tracing on a Low Budget (Turner) ...................... 56 Mar.
Simple Rectifier Tester Uses Neon Lamp (Turner) .......... 72 May
Toolshop Twists and Turns (Leeper) .......................... 60 Mar.
Variable Power Supply for Experimenters (Pellotin) ........ 50 June

Line Voltage Booster
(Continued from page 82)

connection isn't easy to determine while you're doing the wiring, so the best way to proceed is to do all the wiring but make the transformer primary connections temporary. Then set switch S3 to the 12.6-volt position, S1 to line, and plug the booster into an a.c. outlet. Note the meter reading.

Now switch S1 to boost. The meter reading should increase, indicating that the transformer secondary voltage is being added to the line. If the meter reading decreases when S1 is set to boost, unplug the booster and reverse the two transformer primary (black) leads.

An "economy" booster will be sufficient in a large number of applications, since 6.3 volts of boost is all that is required. The circuit is shown in wiring diagram (B). In this particular model, the transformer has a 3-amp, 6.3-volt secondary and can be used to boost the line voltage to any device requiring up to 300 watts of power.

The transformer may be phased in exactly the same manner described for the de luxe model using a TV set plugged into the receptacle and phasing the transformer for maximum picture size when the booster switch is set in the boost position.

Other uses for line boosters are almost as great as the number of appliances designed to be plugged into an a.c. outlet. A booster is especially effective when used with voltage-sensitive appliances, such as electric food mixers, sewing machine motors, electric fans, hand power drills, etc. Photographic darkroom enthusiasts will find a booster just what the doctor ordered for keeping the enlarger or contact printer lamp up to full brilliance.—B. W. Blackford.
FOR SALE

TUBES-TV, Radio, Transmitting And Industrial Types At Sensibly Low Prices. New, Guaranteed 1st Quality Top of the Line. Write For Free Catalog or call Walker 5-7000, Barron Electronics Corp., 512 Broadway, New York 12, N. Y.

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-PE, Hicksville, N. Y.


SECRET Beam Tune! New! Krolls Radio, Seymour, Wisconsin. FREE to non-commercial non-soldiers. For use in antenna installations. For action and a fair deal write B. F. Gensler, W2LNJ, 56 Crosby St., N. Y., 12N, N. Y.

WANTED


REPAIRS & SERVICING

KITS constructed calibrated repaired professional workmanship. A. Morse, 213-02, 75 Avenue, Flushing 64, N. Y.

BUSINESS OPPORTUNITIES

TO $100.00 Weekly. Sparetime, Home Operated Mail order Business. Successful "Beginner's" Plan. Everything Supplied. Lynn, 10420-E National, Los Angeles 34.

VENDING Machines—No Selling. Operate a route of coin machines and earn amazing profits. 32-page catalog free. Parkway Machine Corporation, Dept. 12, 715 Enson St., Baltimore 2, Md.


$70 WEEKLY—home, spare time. Simplified mail bookkeeping. Immediate income—easy! Audix, 34757T, Los Angeles 34.

MAKE $100 weekly spare time, with your Tape Recorder. Send 25c. LP Discs Made From Tapes: 10—30 minutes, $4.25; 12—45 minutes, $5.75. For other speeds write Artistic Sound, 24110 Rensselaer, Oak Park 37, Michigan.

EMPLOYMENT INFORMATION

JOBS—High Pay. South America, the Islands, USA, foreign countries. All trades. Clerical, labor, engineers, drivers, others. Women also. Fare paid. Application forms. For Information write Section 923, National Employment Information, 1020 Broad, Newark, N. J.

INSTRUCTION

ENGINEERING Degrees earned by home study. American College of Engineering (University of the West) Box 27724 (D), Hollywood 27, Calif.

TAPE RECORDERs


ARMY Field Telegraph Set, New including Key, Head- phone, Manual, Carrying Case $10 postpaid. Surplus, Box 118, Jersey City 4, N. J.


INVENTIONS WANTED


REPAIRS & SERVICING

KITS constructed calibrated repaired professional workmanship. A. Morse, 213-02, 75 Avenue, Flushing 64, N. Y.

BUSINESS OPPORTUNITIES

TO $100.00 Weekly. Sparetime, Home Operated Mail order Business. Successful "Beginner's" Plan. Everything Supplied. Lynn, 10420-E National, Los Angeles 34.

VENDING Machines—No Selling. Operate a route of coin machines and earn amazing profits. 32-page catalog free. Parkway Machine Corporation, Dept. 12, 715 Enson St., Baltimore 2, Md.


$70 WEEKLY—home, spare time. Simplified mail bookkeeping. Immediate income—easy! Audix, 34757T, Los Angeles 34.

MAKE $100 weekly spare time, with your Tape Recorder. Send 25c. LP Discs Made From Tapes: 10—30 minutes, $4.25; 12—45 minutes, $5.75. For other speeds write Artistic Sound, 24110 Rensselaer, Oak Park 37, Michigan.

EMPLOYMENT INFORMATION

JOBS—High Pay. South America, the Islands, USA, foreign countries. All trades. Clerical, labor, engineers, drivers, others. Women also. Fare paid. Application forms. For Information write Section 923, National Employment Information, 1020 Broad, Newark, N. J.

INSTRUCTION

ENGINEERING Degrees earned by home study. American College of Engineering (University of the West) Box 27724 (D), Hollywood 27, Calif.

TAPE RECORDERs


POPULAR ELECTRONICS

RATE: $0.60 per word. Minimum 10 words required. August issue closed June 4th. Send order and remittance to: POPULAR ELECTRONICS, 360 Madison Avenue, N. Y. C. 17.
WANTED

Willing to pay cash for Early Phonographs with outside horns

WANT Cornet (illustrated), Double Bell Wonder, Victor Types A, C, D, E, and O, Monarch Special, and Improved Monarch. Also Edison Tin-foil [replica] machine and his Idealia, Excelsior, Treadle Phonographs. Want early Bell-Tainter, American Gramophones and Graphophones. Also catalogues or old literature on phonos made prior to 1906. Want unusual machines and coin-in-slot cylinder phonographs. Need a few early reproducers (sound boxes) for Victor, Columbia, and Edison. A few duplicate Edisons and graphophones are now available for sale or trade.

Send clear snapshot and full information to Box 50, RADIO & TELEVISION NEWS, 366 Madison Ave., New York 17, N. Y.

EVERYBODY'S SHOOTING COLOR!

NEW—the world's first Annual devoted exclusively to color photography—including the largest collection of color photographs ever published in a single issue! Features work by such masters as: Basch, Eisenstaedt, Elisofoh, Feingersh, Halsman, Karsh, Penn, Peskin, Rawlings, Weegee...

PLUS:
- Tips on Using Color Creatively
- Cameras for Color
- Color Films
- Color Exposure Outdoors
- Color Exposure Indoors
- Color Filters
- Home Movies in Color
- 25 Ways to Improve Your Slide Shows

AND—
“The Future of Color”
—a symposium by experts

June, 1956
PRE-VACATION BARGAINS!
GET READY FOR SUMMER FUN!
SUN-POWERED RADIO KIT
$8.88 COMPLETE

ANY $1 ITEM FREE WITH EACH $10 ORDER!

[Box Unchecked]

- 12 AC-DC LINE COILS, for electronic equipment. Molded plugs, snag up now! Wt. 1 lb. Reg. $1.
- 7 ROLLS OF WIRE. Seven stranded, assorted colors. Wt. 1 oz. Reg. $1.
- 1 TUBULAR ELECTROLYTIC, Assortment of popular values, 40 to 10,000 µuf. Wt. 2 lbs. Reg. $1.
- 100 TERMINAL STRIPS. Assorted, insulated, precision instrument and equipment types. 10 styles, 940 pieces. Wt. 6 lb. Reg. $1.
- 10 PANEL SWITCHES, micro, cam, momentary, push and pull, panel variety. Wt. 1 lb. Reg. $1.
- DEIOD KIT 1. Four of the most used types, IN21, IN22, IN23, IN24. Shop one set. Wt. 4 oz. Reg. $1.
- 60 TUBULAR CAPACITORS. Soldered, assorted values, 1 to 1,000,000 µuf. Wt. 2 lbs. Reg. $1.
- RF FILTERS & CHOKES. 20 types RF coils, chokes & 4 styles 95944c%12 & 1.0 to 10,000 µuf. Wt. 2 lbs. Reg. $1.
- 20 DIFFERENTIAL RESISTORS, 4.7 mmf. to 10,000 µuf. Specify values; duals, lead-in. Wt. 2 lbs. Reg. $1.
- PRINTED CIRCUITS. 20 values, 3 ohms to 12,000; 5 to 50,000. Carded & tubular types. Wt. 2 lbs.

Telechron CLOCK-TIMER
Reg. $10 only $3.33
Turns radio, TV, lights "ON" or "OFF" within 12 hours. Instructions incl. Wt. 3 lbs.

FREE! GIANT BARGAIN FLYER!

TO ORDER Check items wanted. Return entire ad with check or MO. Include sufficient postage and C.O.D. orders. 20% down. Rated, net 30 days. FE-6

Name_____________________
Sreet_____________________
City______________________
Zone __________ State ______

Enclosed $____ for items; $____ for postage.

LEKTRO SPECIALTIES
28 Gardiner St. CHELSEA 50, MASS.

Visit our salesroom at 131 Everett Ave., Chelsea

ADVERTISER'S INDEX

ADVERTISER PAGE NO.
Algeradio Electronics Co. ...112
Aired Radio Mfg. Co. ...113
Altec Lansing Corp. ...128
American Electrical Mfr. Co. ...126
Austen Craft ...124
Bailey Technical Schools ...109
British Industries ...101
Capitol Radio Engineering Institute ...23
Central Technical Institute ...102
Cincinnati Ventilating Co. ...110
Cleveland Institute of Radio Electronics ...25
Loye Electrical Scho. ...24
DeVry Technical Institute ...11, 17
Electric Soldering Iron Co. ...113
Electro-Voice ...34
Electronic Instrument Co., Inc. (EICO) ...12
Electronic Measurements Corp. ...112
Electronic Organ Arts ...112
Empire Merchandising Co. ...116
Esse Radio Co. ...100
Goodeart, R. E. ...118
Grantham School of Electronics ...122
Greene Tool Co. ...113
Byro Electronics Co. ...129
Harvey Radio ...10
Hawkins Co., P. E. ...118
Heath Company ...102, 103, 104, 105
Hershel Radio Co. ...32
Indiana School of Electronic ...124
International Correspondence Schools ...13
Johnson Co., E. F. ...117
Karlson Associates ...11
L.M.B. ...129
Lafayette Radio Corp. ...10
Lektro Specialties ...130
Linthrop Mfg. Co. ...114
McMorrow, Herman & Davidson ...129
Maier Grand Type ...10
Marin School, Dan. ...116
Midway Company ...122
Miller, Gustave ...14
Miller Co., J. W. ...16
Moss Electronics Distributing Co., Inc. ...3rd & 4th Columns
National Radio Institute ...13
National Schools ...15
Nikmak Thorne Co. ...122
Orradio Industries ...14
Pacific States University ...125
Philadelphia Wireless Technical Institute ...127
Photography Annual ...128
Precise Development Co. ...2nd Cover
Precision Electronics ...125
Precision Radiation Instruments, Inc. ...122
Precision Hall ...122
Progressive "Eda-Kits" Inc. ...33
RCA Institutes ...21
Radio TV Training Association ...6
Raleigh Manufacturing Co. ...6
Rider Publishing Co., John F. ...13
Rintone Books ...8
Rockcore Corporation ...9

Sams, Howard W. ...10
Science Kits ...115
Solar Semiconductors ...107
Soundtronics Labs ...20
Stere Electronics Supply ...20
Springfield Enterprises ...117, 124
Stanley Electronics ...20
TAB ...13
Tech-Master Products Co. ...113
Teltron Electric Co. ...113
The Tabe Mart ...113
Trincis Junior College ...122
U. S. Air Force ...21
V.S.I. Television School ...121
Vanderbilt Technical College ...125
Vocaline Co. of America ...19
Western Radio ...124
Western Television Institute ...121
Westronics Corp. ...121
Westwood Research & Development Lab. ...114
Whitehall Pharmaceuticals Co. ...119
World Radio Labs. ...119
YMCA Trade Schools ...125

P R I N T E D I N U. S. A.
P O P E R A T I O N A L E L E C T R O N I C S
The FIRST Pocket-Sized
VOLT-OMH MILLIAMMETER

USING THE NEW "FULL-VIEW" METER

71% MORE SCALE AREA!!
Yes, although our new FULL-VIEW D'Arsenal type meter
occupies exactly the same space used by the older standard
2½' Meters, it provides 71% more scale area. As a result,
all calibrations are printed in large easy-to-read type and
for the first time it is now possible to obtain measurements
instead of approximations on a popular priced pocket-sized
V.O.M.

FEATURES
★Compact—measures 3½'' x 5½'' x 2½''
★Uses 'Full View'—2½'' accurate, 850 Microamperes D'Arsenal type meter
★Housed in round-corner, molded case
★Beautiful black etched panel Depressed letters filled
with permanent white, insures long-life even with
costant use.

Superior's New Model 770-A

A COMBINATION VOLT-OMH MILLIAMMETER PLUS
CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:
D.C. VOLTS: 0 to 7.5 15/75 150/750
0 to 3,000 Volts
A.C. VOLTS: 0 to 15/30 150/300 1,500
3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/
1,500/2,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to
1.5/15 Amperes

ADDED FEATURE:
Built-in ISOLATION TRANSFORMER
reduces possibility of burning out
meter through misuse.

SUPER-METER

A COMBINATION VOLT-OMH MILLIAMMETER PLUS
CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:
D.C. VOLTS: 0 to 7.5 15/75 150/750
0 to 3,000 Volts
A.C. VOLTS: 0 to 15/30 150/300 1,500
3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/
1,500/2,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to
1.5/15 Amperes

ADDED FEATURE:
Built-in ISOLATION TRANSFORMER
reduces possibility of burning out
meter through misuse.

NO INTEREST OR FINANCE CHARGES ADDED!
If not completely satisfied, you are privileged to return
the Tester to us, cancelling any further obligation.

CUT OUT AND MAIL TODAY!
Superior's New Model TC-55

Streamlined FOR

Superior's new Model TV-11

Standard Professional

TUBE TESTER

The Experimenter or Part-time Serviceman who has delayed purchasing a higher priced Tube Tester, The Professional Serviceman who needs an extra Tube Tester for outside calls. The busy TV Service Organization, which needs extra Tube Testers for its field men.

- You can't insert a tube in a wrong socket. Separate sockets are used, one for each type of tube base. * "Free-point" element switching system Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the 'top-cap'. * Checks for shorts and leakages between all elements. Provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. * Elemental switches are numbered in strict accordance with R.M.A. specification. The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system.

- Free-moving built-in roll chart provides complete data for all tubes.
- Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.
- NOISE TEST: Phone-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

Model TC-55 comes complete with operating instructions and charts and streamlined carrying case.

$26.95

Superior's new Model TV-11

TUBE TESTER

- Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bonton, Hearing Aid, Thyatron Minatures, Sub-miniatures, Neovis, Sub-minors, Preeminence fuse types, etc.
- Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
- The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

FREE Service - The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

$47.50

SHIPPED ON APPROVAL
NO MONEY WITH ORDER — NO C.O.D.

FIRST CLASS
Permit No. 61430
New York, N. Y.

BUSINESS REPLY CARD
No Postage Stamp Necessary if Mailed in the U. S.

POSTAGE WILL BE PAID BY —
MOSS ELECTRONIC DIST. CO., INC.
3849 TENTH AVENUE
NEW YORK 34, N. Y.

We invite you to try before you buy any of the models described on this and the preceding page. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time-payment schedule details.)

NO INTEREST OR FINANCE CHARGES ADDED!
If not completely satisfied, you are privileged to return the instrument to us, cancelling any further obligation.

SEE OTHER SIDE
CUT OUT AND MAIL TODAY!