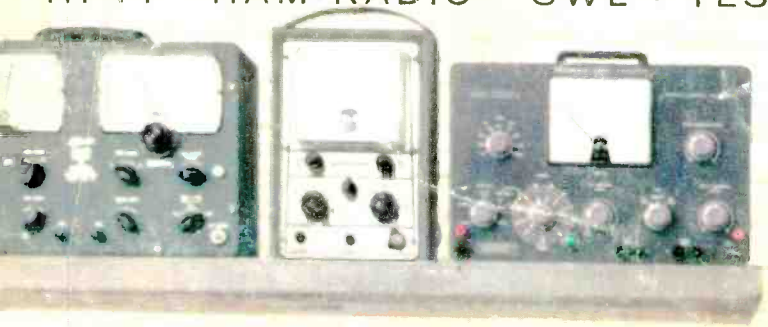
Two-Way Radio for Everyone

POPULAR ELECTRONICS

MARCH 1959

35 CENTS

HI-FI · HAM RADIO · SWL · TEST GEAR

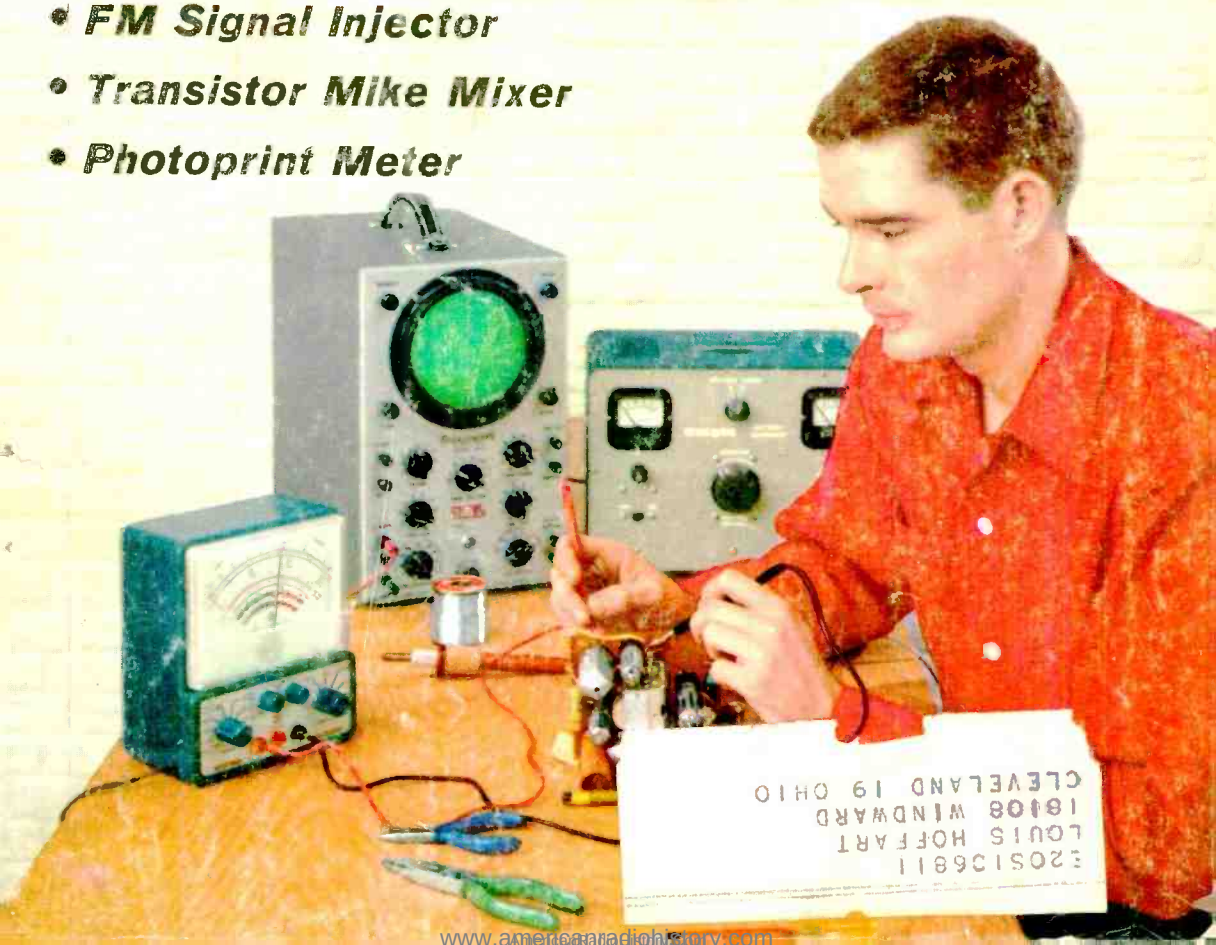


Trouble-Shooting The AC/DC Radio

(see page 69)

How to Build an:

- *FM Signal Injector*
- *Transistor Mike Mixer*
- *Photoprint Meter*



another "first"...from the first name in high fidelity turntables—a RONDINE turntable with hysteresis motor* at

$49.95 net

REK-O-KUT RONDINE K33H KIT

*Hysteresis motors are used in professional broadcast and recording studios. Specifications: Single-speed (33⅓ rpm). Crown-Spindle Belt Drive. Assembles in 30 minutes or less with ordinary tools. Built-in strobe disc. Noise level: 52db. $49.95 net turntable only. Tonearms — from $27.95; Bases — from $10.95; Mounting Boards from $4.95.

REK-O-KUT

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TURNTABLE ARMS

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Rek-O-Kut Co., Inc.
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38-19 108th St.
Corona 68, N.Y.

Please send complete information on the new Rondine K33H Kit with hysteresis motor.

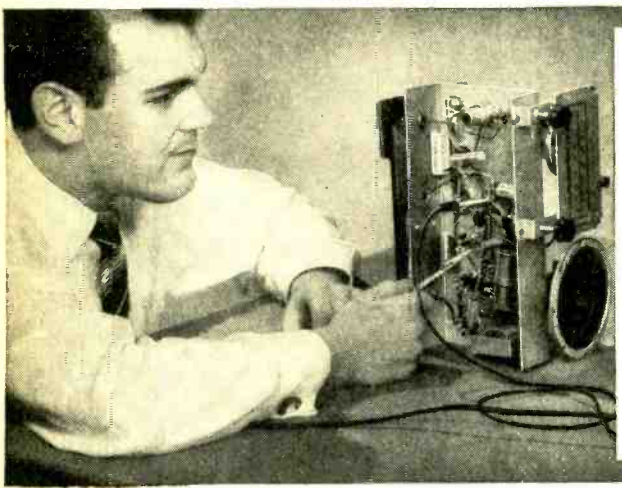
Name _____

Address _____

City _____ Zone ____ State _____

Rondine—the Hysteresis Line...Engineered for the Studio...designed for the home!

For a Successful Career in Radio-Television



Train at Home in Spare Time with N. R. I.

OLDEST and LARGEST

Home Study Radio-Television School

N.R.I. Trained These Men

ENGINEER STATION WHPE

"Thanks to NRI, I operated a successful Radio repair shop. Now I am an engineer for WHPE." VAN W. WORKMAN, HIGH POINT, NORTH CAROLINA

QUICK SPARE TIME CASH

"Knew nothing about Radio-TV when I enrolled. After 15 lessons started repairing sets. My future looks bright." DONALD B. ACKERMAN, MINNEAPOLIS, MINNESOTA

HAS OWN TV BUSINESS

"Quit my job to do Television work full time. I love it and do all right financially." WILLIAM F. KLINE, CINCINNATI, OHIO

Prosperous Fast Growing Industry Offers You GOOD PAY-BRIGHT FUTURE-SUCCESS

It's the trained man who gets ahead—gets the better job, drives a better car, lives in a better home, is respected for what he knows and can do. For a job with a future—find out how you can train at home for Radio-Television.

TODAY'S OPPORTUNITY FIELD

Training PLUS OPPORTUNITY is the ideal combination for success. And today's OPPORTUNITY field is Radio-Television. Over 125 million home Radios plus 30 million sets in cars, plus 40 million TV sets mean big money for trained Technicians. More than 4,000 Radio and TV broadcasting stations offer interesting and important positions. Color television, portable TV sets, Hi-Fi, assure future growth. Find out about NRI. Since 1914—for more than 40 years—NRI has been training ambitious men at home in spare time for Radio-TV. With NRI 50-50 method, you study basic principles AND learn by practicing with actual equipment NRI furnishes. You learn with your hands and your head. You get dependable training, backed up by the reputation of the oldest and largest home study Radio-TV school.

ADD TO YOUR INCOME SOON $10-$15 A WEEK IN SPARE TIME

Soon after enrolling many start earning extra money fixing sets. Many open their own full time Radio-TV shops after getting NRI Diploma. MAIL COUPON. Get FREE Sample Lesson and 64-page Catalog showing equipment supplied, outlines of courses, opportunities in Radio-TV. Price is low—terms easy. Address: **NATIONAL RADIO INSTITUTE, Dept. 9CD4, Washington 16, D. C.**

You Learn Servicing-Broadcasting at Home—By Practicing with Kits N.R.I. Sends

Nothing takes the place of practical experience. That's why NRI training is Learning-by-Doing. With Servicing Course you build Radio shown at top and other equipment. With Communications Course you build Transmitters at left and other equipment. Catalog shows all equipment you get.

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POPULAR ELECTRONICS is published monthly by Ziff-Davis Publishing Company, William B. Ziff, Chairman of the Board (1946-1953), at 434 S. Wabash Ave., Chicago 5, Ill. Second-class postage paid at Chicago, Illinois. Authorized by Post Office Department, Ottawa, Canada, as second-class matter. **SUBSCRIPTION RATES:** One year U.S. and possessions, and Canada $4.00; Pan-American Union countries $4.50, all other foreign countries, $5.00.

POPULAR ELECTRONICS

MARCH 1959

VOLUME 10 NUMBER 3

Special Features

Audio and High Fidelity

Electronic Construction Projects

Amateur and SWL

Features and Electronic Developments

Departments

POPULAR ELECTRONICS

Average Net Paid Circulation 267,136

This month's cover photo by Joe Petrovec
Equipment courtesy of Allied Radio, EICO, Heath, Lafayette Radio, Moss Electronic, and Precise Development

ZIFF-DAVIS PUBLISHING CO., One Park Ave., New York 16, N. Y. William B. Ziff, Chairman of the Board (1946-1953); William Ziff, President; W. Bradford Briggs, Executive Vice President; Michael Michaelson, Vice President and Circulation Director; Hershel B. Sarbin, Secretary; Howard Stoughton, Jr., Treasurer; Albert Gruen, Art Director.

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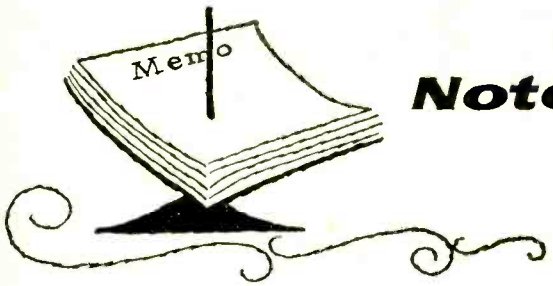
COMING NEXT MONTH

(ON SALE MARCH 24)

Our April issue (and cover) will feature a home-built sound level meter that can be constructed for about $17.00. You'll find it ideal for use as an applause meter, a noise meter, or for balancing out a stereo hi-fi system. It compares with professional sound level meters that sell for over $200.00.

The Novice hams will be in for a treat . . . complete plans for a 25-watt input, 15-meter transmitter that will make possible world-wide DX'ing.

A real scoop! A two-tube (plus rectifier), low-cost stereo amplifier that provides up to 10 watts output on each channel. Impossible? Not at all. Don't miss the complete construction details on a "simplexed" stereo amplifier.



Notes from the Editor

''NEW LOOK'' COMING. Beginning next month POPULAR ELECTRONICS will be printed on finer, whiter paper. To our readers, this will mean much cleaner and sharper diagrams and pictures. To our advertisers, it will mean a better display of their fine products.

This upgrading of paper will not reduce the number of pages in your issue. On the contrary, we are adding many more pages so that we can expand our coverage of your favorite topics, including space electronics and nucleonics. These changes are made possible by your loyal support of POP'tronics, and the efforts of your editors to improve your favorite magazine.

SHORT-WAVE MONITORING CERTIFICATE. Short-wave listeners are one of the most enthusiastic groups of hobbyists in the world. They contribute to the furtherance of international friendship and also provide valuable information which is used in the study of radio propagation.

POPULAR ELECTRONICS feels that the SWL's are long overdue for some kind of recognition. Consequently, we have had attractive Monitoring Station Certificates prepared which will be issued to active short-wave listeners who meet certain basic requirements. Each SWL who receives a certificate will also be assigned his own identifying station letters.

This is the first time a nation-wide registration of SWL's has been attempted, and we're sure it will be a big success. The registration form and additional information are on page 85.

ATOMIC POWER PLANTS. Nucleonics is fast becoming a byword in American industry. But because certain nuclear reactions can take place faster than electronic devices can stop them, the development of one of the most promising types of power reactors--the fast breeder--is bogged down in controversy.

For this reason POPULAR ELECTRONICS is publishing the first national magazine article on a bitter debate that may affect the whole course of nuclear development in America. It is a dramatic story involving not only the future of industry and technology, but the lives and health of millions of Americans. See ''Are Atomic Power Plants Really Safe?'' on page 41.

ELECTRONICS IS BOOMING. Despite the recession, the electronics industry set a new sales record in 1958, according to David R. Hull, President of the Electronic Industry Association. Manufacturers' sales amounted to $7,700,000,000, exceeding 1957's record total by $100,000,000. Sales outlook for 1959: well over eight billion dollars.

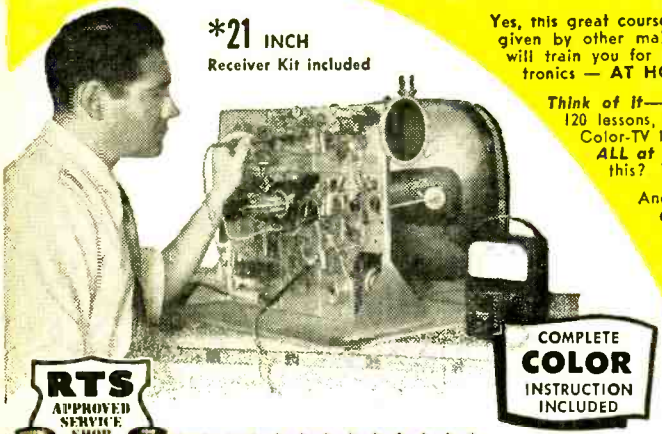
These figures serve to point out once again the astonishing growth and vitality of the electronics industry. It seems to me that this rapidly expanding field offers our young people golden opportunities for interesting, challenging, and profitable careers.

Oliver Read

AT LAST!

RADIO-TV and ELECTRONICS TRAINING

....AT A PRICE YOU CAN AFFORD!



Yes, this great course costs *far less* than *any* training of its kind given by other major schools! Radio-Television Training School will train you for a good job in Television or Industrial Electronics — **AT HOME IN YOUR SPARE TIME.**

Think of it—a complete training program including over 120 lessons, Fourteen Big Radio-Television Kits, Complete Color-TV Instruction, Unlimited Consultation Service . . . *ALL at a really big saving to you.* How can we do this? Write to us today . . . and find out!

And what's more — you can (if you wish)
OPEN YOUR OWN RTS-APPROVED AND FINANCED RADIO-TV SERVICE SHOP

We Want Many More Shops This Year

This 37 year old training organization — called RTS, that's Radio-Television Training School — wants to establish a string of Radio-TV Repair Shops in principal cities throughout the U. S. So far, a great many such shops are NOW IN BUSINESS AND PROSPERING. We are helping and training ambitious men to become future owners and operators of these shops in all areas.

RTS APPROVED SERVICE SHOP

Get your free book on the
FAMOUS RTS BUSINESS PLAN
find out how you can open
A REPAIR SHOP OF YOUR OWN

We supply and finance your equipment

When you are ready and qualified to operate one of our RTS-Approved TV Repair Shops ***WE WILL SUPPLY AND FINANCE EVERY BIT OF EQUIPMENT YOU NEED TO GET STARTED*** plus an inventory of parts and supplies. In other words *we will stake you* . . . **AN OFFER NEVER MADE BEFORE BY ANY TRAINING ORGANIZATION.** Under the RTS Business Plan you receive:

1. An electric sign for the shop front.
2. Radio and TV test Equipment.
3. Letterheads, calling cards, repair tickets, etc.
4. Basic inventory of tubes, parts, supplies.
5. Advertising and promotional material.
6. Plans for shop arrangement.
7. Instructions on how to go into business.
8. Continuous consultation and help.
9. The right to use RTS Seal of Approval, and the RTS Credo.
10. The right to use the Famous Trade Mark.

you build these and other units

RADIO-TELEVISION TRAINING SCHOOL
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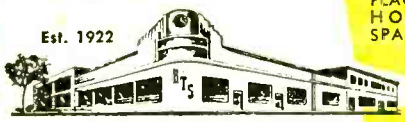
LOS ANGELES 37, CALIFORNIA



FOR UNSKILLED INEXPERIENCED MEN ONLY — WE TRAIN YOU OUR WAY!

We must insist that the men we sign up be trained in Radio-TV Repair, Merchandising and Sales by our training methods—because WE KNOW the requirements of the industry. Therefore, we will TRAIN YOU . . . we will show you how to earn EXTRA CASH, during the first month or two of your training period. YOU KEEP YOUR PRESENT JOB. TRAINING TAKES PLACE IN YOUR OWN HOME, IN YOUR SPARE TIME!

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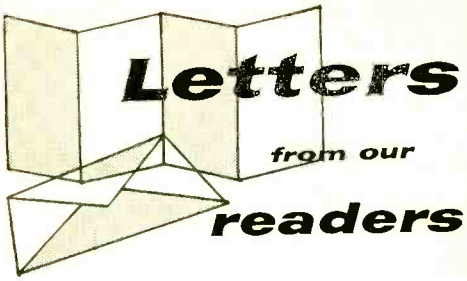
SEND ME FREE — all of these big opportunity books — "Good Jobs in TV-Electronics," "A Repair Shop of Your Own" and "Sample Lesson." I am interested in:

☐ Radio-Television ☐ Industrial Electronics (Automation)

Name _____ Age _____
Please Print
Address _____
City & State _____
300



TV DX

■ I live in the outskirts of Montreal. Last night (Nov. 4, 1958), while adjusting my television set, I noticed that there was a trace of a raster on Channel 4. I tuned in the station and the picture was almost perfect. When they announced the station, it was Channel 4, Minneapolis/St. Paul, Minnesota. After this discovery, I checked the

other channels and found the same thing, using only a small indoor antenna, on Channel 3. There I found that I could receive Mason City, Iowa with an almost perfect picture. Both of these stations are located almost 1000 miles away.

DAVID PARRISH
Baie d'Llofee, Quebec

You are not the exception. Many readers who stay up late often get 1000- to 2000-mile DX on their standard TV sets. Some make a hobby of photographing the station call letters. Try it. And if you get a good photo, how about sending it to us?

Some Like Fiction

■ I just finished reading "MRS." I began reading it as a technical treatise on a specific computer, but about halfway through I found I was reading a most enjoyable and imaginative work of fiction.

But a MRS is not as fanciful as one would think at first. The late John Von Neumann wrote some very excellent treatises on computers, including one which details a self-reproducing computer (see "The General and Logical Theory of Automata," page 2070, volume 4, of *The World of Mathematics*). Two books of interest in this field,

Learn Electronics

PREPARE FOR YOUR F. C. C. LICENSE—YOUR TICKET TO A BETTER JOB AND HIGHER PAY!

F.C.C. LICENSE—THE KEY TO BETTER JOBS

An F.C.C. *commercial* (not amateur) license is your ticket to higher pay and more interesting employment. This license is Federal Government evidence of your qualifications in electronics. Employers are eager to hire *licensed* technicians.

WHICH LICENSE FOR WHICH JOB?

The THIRD CLASS radiotelephone license is of value primarily in that it qualifies you to take the second class examination. The scope of authority covered by a third class license is extremely limited.

The SECOND CLASS radiotelephone license qualifies you to install, maintain and operate most all radiotelephone equipment except commercial broadcast station equipment.

The FIRST CLASS radiotelephone license qualifies you to install, maintain and operate every type of radiotelephone equipment (except amateur) including all radio and television stations in the United States, its territories and possessions. This is the highest class of radiotelephone license available.

GRANTHAM TRAINING PREPARES YOU

The Grantham Communications Electronics Course prepares you for a *FIRST CLASS* F.C.C. license, and it does this by TEACHING you electronics. Each point is covered simply and in detail, with emphasis on making the subject easy to understand. The organization of the subject matter is such that you progress, step-by-step, to your specific objective—a first class F.C.C. license.

CORRESPONDENCE OR RESIDENCE CLASSES

Grantham training is available by correspondence or in resident classes. Either way (residence or correspondence), we train you quickly and well—no previous training required. Even a beginner may qualify for his first class license in a relatively short time.

THREE COMPLETE SCHOOLS: *To better serve our many students throughout the entire country, Grantham School of Electronics maintains three complete schools—one in Washington, D.C., one in Hollywood, Calif., and one in Seattle, Wash. All schools offer the same rapid courses in F.C.C. license preparation, either home study or resident classes.*

This booklet **FREE!**

This free booklet gives details of our training and explains what an F.C.C. license can do for your future.

Upgrade Your Income with a First Class

F. C. C. LICENSE

HERE'S PROOF...

that Grantham students prepare for F.C.C. examinations in a minimum of time. Here is a list of a few of our recent graduates, the class of license they got, and how long it took them:

	License	Weeks
Donald E. Mason, 2659 Centinella, Santa Monica, Calif.	1st	12
Everett T. Bozard, 411 N. Wash. St., Alexandria, Va.	1st	12
Henry M. Best, 1003 Vermont St., Fremont, N. C.	1st	11
Harold V. Jones, P.O. Box 705, Alamogordo, N. M.	1st	13
Michael F. Aperio, 916 Townsend St., Chester, Pa.	1st	12
Earl A. Stewart, 3918 Modesto Dr., San Bernardino, Calif.	1st	14
Donald L. Leeburg, Box 1075, Anchorage, Alaska	1st	12
J. Milton Condit, 1312 N. 78th Street, Seattle, Wash.	1st	8
John R. Bahrs, 72 Hazelton St., Ridgefield Park, N. J.	1st	12
Richard Baden, 4226-37th St., N.W., Washington, D.C.	1st	12
James F. Stewart, 2618½ Prospect Ave., La Crescenta, Calif.	1st	12
Norman R. Cook, 130 Olive Street, Neodeska, Kans.	1st	12

GRANTHAM SCHOOL OF ELECTRONICS

WASHINGTON D.C.	821 - 19th Street, N.W. Washington, D.C.	(ST 3-3614)
HOLLYWOOD CALIF.	1505 N. Western Ave. Hollywood, Calif.	(HO 7-7727)
SEATTLE WASH.	408 Marion Street Seattle, Wash.	(MA 2-7227)

MAIL COUPON TO SCHOOL NEAREST YOU

(Mail in envelope or paste on postal card)

To: GRANTHAM SCHOOL OF ELECTRONICS

821-19th, NW Washington • 1505 N. Western Hollywood • 408 Marion Seattle

Gentlemen:

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

Name_____ Age_____

Address_____

City_____ State_____

I am interested in: ☐ Home Study, ☐ Resident Classes 83-C

Letters

(*Continued from page* 10)

both by Von Neumann, are: *Cerebral Mechanisms in Behavior,* John Wiley and Sons; and *The Computer and the Brain,* Yale Press. "The General and Logical Theory of Automata" was excerpted from *Cerebral Mechanisms in Behavior.*

I also enjoy Carl Kohler and friend wife, and look forward to his newest adventures.

DUDLEY GLASS III
Beverly Hills, Calif.

Glad you liked our MRS article. Every so often we will use fiction of this type.

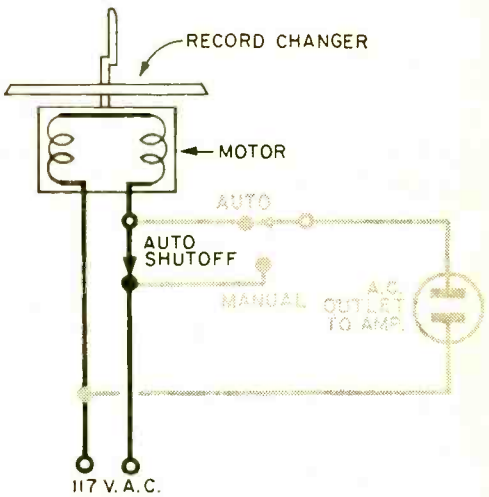
Thank You

■ As the result of a letter by Carl Thosand in the December issue of your magazine, our Patients' Library has received copies of POPULAR ELECTRONICS from three sources distant from Cincinnati—Brooklyn, N. Y., Atlanta, Ga., and San Gabriel, Calif. It is rare that our patients receive attention from such distant points and we are grateful for the kindness.

MILDRED SHADLEY AX
Patients Library
Longview State Hospital
Cincinnati 16, Ohio

A Better Way

■ I was very much interested in your article on the "Hi-Fi Slave" (page 77, September, 1958). I had recently added this feature to my rig but, being a cheapskate, I achieved the same results



with an s.p.d.t. switch, as illustrated. I mounted the switch and socket on the changer base, eliminating the need for a separate case.

ROY HUFFMAN
Chicago, Ill.

This is a good setup provided the changer Auto Shutoff *switch can handle the currents required. Unfortunately, high power amplifiers have a large current drain. Most phono* Auto Shutoff *switches cannot handle this load.* —30—

HOW WOULD YOU LIKE TO BREAK INTO ENGINEERING STARTING NEXT MONTH?

Your start in Engineering could mean higher pay, more interesting work, a real chance for advancement. Here's how to do it—fast!

A career in Engineering may be closer than you think, whatever your age or education or present job.

You know about the tremendous demand for engineers and technicians. But do you know how easy it is to get the training that will qualify you for this vital work, and how quickly you can advance?

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The moment you enroll for a course in Engineering you're in a position to change your job. I.C.S. Engineering Courses, for example, start you off with Basic Mathematics and Drafting. Most employers are quick to accept men who start technical training.

Your Advancement Is Rapid

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The I.C.S. method makes it possible for you to learn while you earn, to qualify yourself for upgrading step by step—from Draftsman to Detail Designer to Engineering Technician to full-fledged Engineer. It's a plan fitted to your needs, with personalized instruction and guidance, and, if you like, regular progress reports to your employer.

Mail Coupon for Free Books

If you are seriously interested in a fresh start in an opportunity-packed field, then mark and mail the coupon today. We'll send you *three* free books—(1) the 36-page career guide "How to Succeed," (2) Opportunity outlooks in your field of interest, (3) sample lesson (Math) demonstrating I.C.S. method.

For Real Job Security—Get an I. C. S. Diploma! **I. C. S., Scranton 15, Penna.** Accredited Member, National Home Study Council

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- ☐ Practical Lineman
- ☐ Professional Engineer (Elec)

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- ☐ Industrial Engineering
- ☐ Industrial Instrumentation
- ☐ Industrial Metallurgy
- ☐ Industrial Safety
- ☐ Machine Shop Practice
- ☐ Mechanical Engineering
- ☐ Professional Engineer (Mech)
- ☐ Quality Control
- ☐ Reading Shop Blueprints
- ☐ Refrigeration and Air Conditioning
- ☐ Tool Design ☐ Tool Making

RADIO, TELEVISION
- ☐ General Electronics Tech.
- ☐ Industrial Electronics
- ☐ Practical Radio-TV Eng'r'g
- ☐ Practical Telephony
- ☐ Radio-TV Servicing

RAILROAD
- ☐ Car Inspector and Air Brake
- ☐ Diesel Electrician
- ☐ Diesel Engr. and Fireman
- ☐ Diesel Locomotive

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- ☐ Combustion Engineering
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- ☐ Stationary Diesel Engr.
- ☐ Stationary Fireman

TEXTILE
- ☐ Carding and Spinning
- ☐ Cotton Manufacture
- ☐ Cotton Warping and Weaving
- ☐ Loom Fixing Technician
- ☐ Textile Designing
- ☐ Textile Finishing & Dyeing
- ☐ Throwing
- ☐ Warping and Weaving
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POP'tronics BOOKSHELF

"FUNDAMENTALS OF TRANSISTORS" by Leonard Krugman. Second Edition. Published by John F. Rider, Publisher, Inc., 116 West 14th St., New York 11, N. Y. 176 pages. Soft cover. $3.50.

The rapid changes in transistor technology have necessitated the bringing up to date of this text which originally appeared in 1954. Numerous portions of the original have been rewritten and a great deal of new material has been added. Theory, construction, and operation of various types of semiconductor devices are covered in detail. Clear illustrations aid the understanding of the concepts involved in transistor theory.

Recommended: to the design engineer, the engineering student, and the lab technician.

"MOST-OFTEN-NEEDED 1959 TELEVISION SERVICING INFORMATION" compiled by M. N. Beitman. Published by Supreme Publications, Highland Park, Ill. 192 pages. Soft cover. $3.00.

This book should be a gold mine of information for the TV serviceman. Schematic diagrams, alignment procedure, and servicing data on virtually all the popular makes of TV sets are crammed into its 192 pages. The chassis layouts and pictorial representations of printed circuitry should facilitate repair and adjustment of any of the sets included.

Recommended: to TV servicemen.

"ENGLISH-RUSSIAN RUSSIAN-ENGLISH ELECTRONICS DICTIONARY" published by McGraw-Hill Book Company, 330 West 42nd St., New York, N.Y. 943 pages. Hard cover. $8.00.

This book should be a big help in "keeping up with the Russians." In the past we

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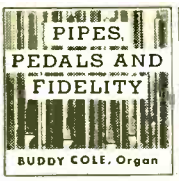

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Dealer's Address..... 275-2

CIRCLE 3 NUMBERS BELOW:

(Also indicate here whether you want your 3 records in stereo or monaural)

- ☐ STEREO L-50
- ☐ MONAURAL L-49

1	9
2	10
3	11
4	12
5	13
6	14
7	15
8	16

Bookshelf (*Continued from page* 14)

have been unable to read all the *published* Russian technical manuscripts, much less those which are secret. It will undoubtedly be a boon to translators and should enable us to keep in closer touch with Russian technical advances. Incidentally, the Russian word for *hi-fi,* in our imperfect translation, is VYSOKOKACHYECTBYENNY.

Recommended: as a reference work for people who have a technical bent and speak Russian and English.

"TELEVISION TUBE LOCATION GUIDE, Vol. 8," published by Howard W. Sams and Co., 2201 East 46th St., Indianapolis 6, Ind. 196 pages. Soft cover. $2.00.

Approximately 500 models of TV receivers produced in 1957 and 1958 are covered in this book, the eighth of a series of TV tube location guides. The chassis layout of each model is shown, with the type, location, and function of each tube indicated. A "tube failure" chart is included specifying which tubes may be responsible for various troubles. Series string filaments are diagramed in schematic form.

Recommended: as a valuable aid to TV servicing.

Free Literature Roundup

An interesting booklet entitled "Stereo Simplified" is available from Sonotone Corp., Elmsford, N. Y. It deals mostly with stereo pickup cartridges, but stereo amplifiers and speaker placement are covered. The illustrations are colorful and instructive.

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y., is offering a free chart listing American-made tubes that may be substituted for European tube-types. Servicemen and experimenters will find this chart valuable when dealing with European electronic equipment.

"Soldering Simplified," an attractive 16-page booklet, explains the different types of solder, points out where each has its application, and gives recommended soldering techniques. Write to Kester Solder Co., 4201 Wrightwood Ave., Chicago 39, Ill. —30—

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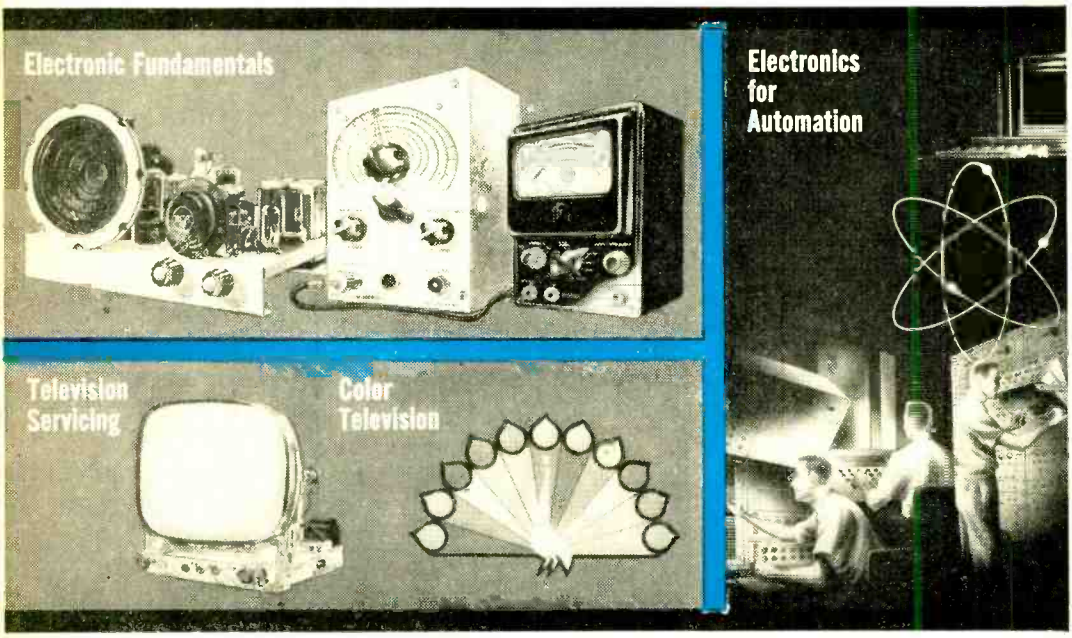

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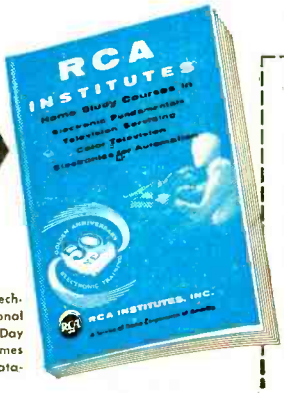

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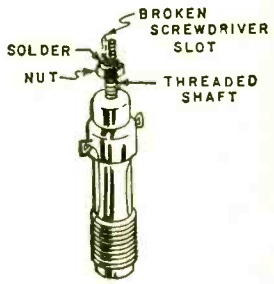
TIPS and TECHNIQUES

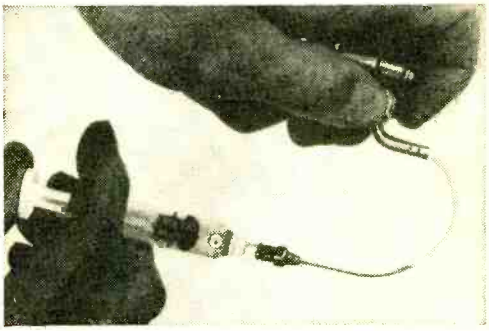
BROKEN SLUG-SHAFT REPAIR

When one of the tines of the screwdriver slot in the shaft of a slug-tuned radio or TV control, i.f. or ratio transformer, becomes broken, don't attempt to adjust the control with pliers—you'll just ruin the threaded shaft. Instead, turn a nut onto the end of the shaft as shown. This way you will be able to adjust the control with a nut-driver and have no difficulty at all.—*John A. Comstock, Wellsboro, Pa.*



FLEXIBLE OIL APPLICATOR

A vexsome problem often encountered by experimenters, servicemen, etc., is getting small amounts of liquids, such as lubricating oil, into hard-to-reach places. Where conventional oiling methods fall short, the



apparatus shown will give excellent results. Nothing is superior to a hypodermic syringe for delivering precise amounts of liquids. (The syringe in the photo, a plastic throw-away type, was obtained from a clinic.)

While the syringe-needle combination alone is suitable for many applications, the

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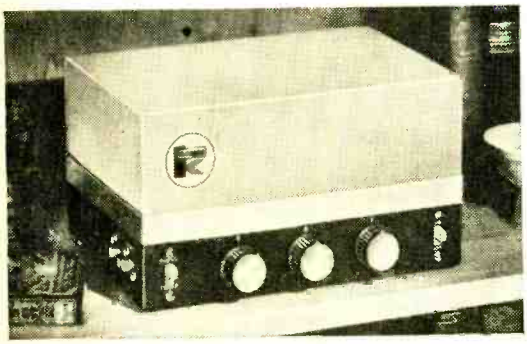

Top Value 12-Watt Complete Hi-Fi Amplifier Kit

Model Y-784 **$19.95** (less cover) **$2.00 down**

Never before has there been so much solid hi-fi value and quality performance at such low cost. **Guaranteed specifications:** frequency response, 30-15,000 cps ±1½ db at half power; less than 1% distortion at full power. **Has 15 db of inverse feedback.** With preamp stage equalized for magnetic cartridge; inputs for phono and tuner; separate bass and treble with boost and attenuation. 5 x 9¾ x 7" with cover (cover $3.95 extra). 7½ lbs.

Thrilling "Space Spanner" Receiver Kit

Model Y-259 **$18.95**

Thrilling 2-band receiver, easy to build, fun to operate—a terrific value. Bandswitch selects exciting short-wave, including foreign broadcasts, amateur, aircraft, police and marine radio (6.5 to 17 mc), and standard broadcast. Highly sensitive regenerative circuit. Built-in 4" PM speaker and beam power output for strong volume. Headphone jacks and switch to cut out speaker. Handsome cabinet, 7 x 10½ x 6". AC or DC operation. 7½ lbs.

there is a money-saving **knight-kit** for every electronic need

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60-Watt Stereo Amplifier
Stereo Deluxe Preamp
Stereo Control
18-Watt Amplifier
25-Watt Basic Amplifier
30-Watt Amplifier
FM-AM Tuner
FM Tuner
Hi-Fi Preamplifier
Speaker Systems, etc.

HOBBY KITS
"Span Master" 4-Band Receiver
"Ranger" Radios
Clock-Radio
Radio-Intercom
"Ocean Hopper" Radio
5-Transistor Portable
2-Transistor Pocket Radio
1-Transistor Radio
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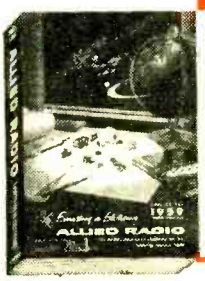

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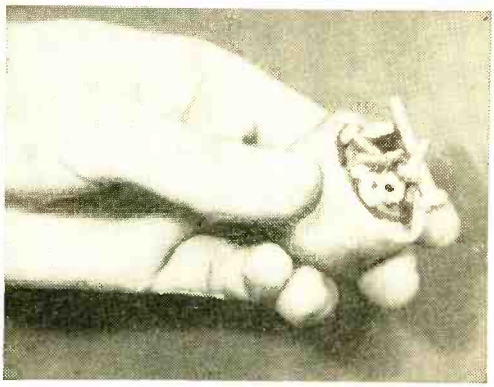
Tips

(*Continued from page* 18)

real "gimmick" is the length of flexible tubing. This tubing, a piece of #20 plastic spaghetti, fits snugly over a #19 hypodermic needle. When it is inserted into a curved oiling tube, the oil may be injected directly onto bearings. The graduations on the syringe make it possible to apply the oil with precision, thereby preventing damage to motors from over-oiling.—*Wm. B. Rasmussen, Prosser, Wash.*

PREVENT HARDWARE LOSS

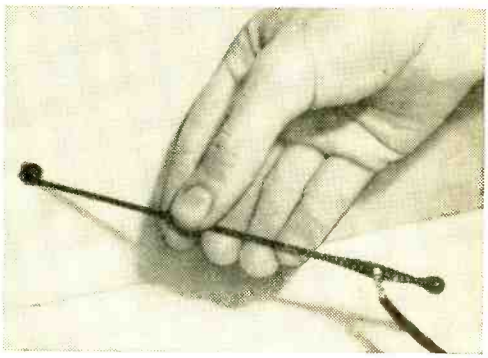
To avoid losing hardware when disassembling a piece of equipment, keep an old PM speaker magnet handy. A surprisingly large



number of nuts and bolts will cling to the catch-all magnet, preventing their loss or misplacement.—*Peter Barna, Wilmington, Calif.*

"NEEDLE" FOR THREADING WIRE

If you want to thread cables or wires through walls or floors, here's a hint you may appreciate. An old umbrella rib makes a giant "needle" that's ideal for such wire-



stringing jobs. You can hook the wire or cable through the eye at one end and thread it through the wall or floor with ease. If

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- ☐ Automation and Industrial Electronics Engineering Technology

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TYPE OF PRESENT WORK .....

EDUCATION: YEARS HIGH SCHOOL .....

OTHER .....

ELECTRONICS EXPERIENCE .....

Tips

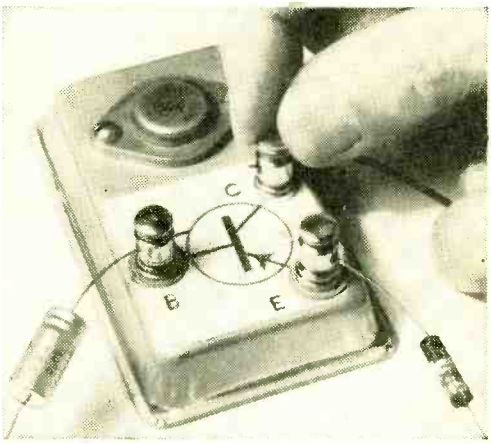
(*Continued from page 20*)

the cable is a heavy one, use a length of heavy twine between the cable and the needle.—*Charles A. Lang, San Francisco, Calif.*

GRAPHIC POWER TRANSISTOR MOUNT

Especially designed for use by transistor experimenters and hobbyists with any of the popular types of power transistors, this handy mount lets you make quick solderless connections to the transistor. It shows you where to make the connections; and the mount itself acts as a heat sink to help keep the power transistor cool.

A toy aluminum pan serves as a mount.



The transistor symbol can be drawn on a 1¾" square piece of heavy white paper, and cemented onto the pan. Wiring from the transistor to the binding posts is very simple. The writer used small phono cartridge clips to fit onto the transistor prongs tightly. If desired, you can get your clips from a standard 9-pin miniature tube socket, as described by Louis Garner on page 92 of the October 1958 issue of POPULAR ELECTRONICS.—*Art Trauffer, Council Bluffs, Iowa.*

CANNED TUBES WARM UP FAST

If you have a hard time locating a tube with an intermittently opening filament, here's a tip that might prove helpful. Invert a tin can over the suspected tube; if it is the faulty one, the canned-in heat will cause the tube to warm up fast and the intermittent will quickly reappear. Use a can that's just large enough to fit over the tube (a frozen orange juice can is fine). —*James A. Clifford, Detroit, Mich.* —30—

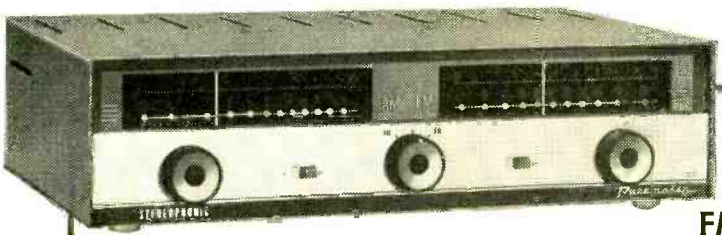
Now . . . a complete new line of low-cost stereo components

Looking for stereo on a small budget? Then listen to the new Pacemaker line of fine quality stereo components.

Here are stereo amplifiers and tuners to match, each designed with the features you really need for your listening enjoyment.

A product of Bell high fidelity engineering, Pacemaker offers you values galore . . . at the lowest cost of all. So, if you have been "putting off" the selection of stereo components for your home music center, start with a Pacemaker. Or, better still, add a Pacemaker to your present hi fi system . . . and make it *really* complete.

Your Bell dealer has it! Ask for a demonstration of the Pacemaker *you* want today.



New PACEMAKER Model 2222 FM-AM Stereo Tuner

Perfect match for your Pacemaker Stereo Amplifier

Now you can hear your favorite Stereo radio broadcasts with this one all-new stereo tuner, designed to match perfectly with your Pacemaker Stereo Amplifier.

The Pacemaker Model 2222 has separate FM and AM sections which can be tuned independently of each other. Automatic Gain Control in each section maintains equal volume of the signal going to the Amplifier. Selector switch provides monaural or stereo operation without changing output connections, automatically feeds any monaural program through *both* channels of your stereo amplifier; Automatic Frequency Control and Multiplex Output are also provided.

Here are the specifications:

FM SECTION — Sensitivity: 6 uv for 20 db signal to noise ratio. **Selectivity:** 6 db down at 200 KC.

AM SECTION — Sensitivity: 20 uv for 0.1 V output at 30% modulation

Tubes (10 Total): FM: 1, 6AB4; 1, ECC85/6AQ8; 2, 6AU6; 1, 6AL5; 1, 6AV6
AM: 1, 6BE6; 1, 6BA6; 1, 6AV6; 1, EZ80/6V4

Output (Both Sections): 2.5V @ 100% modulation

Size: 3⅝" H; 14¼" W; 10" D

all this for only $109.95*

Now there are two...

New *PACEMAKER* Stereo Amplifiers

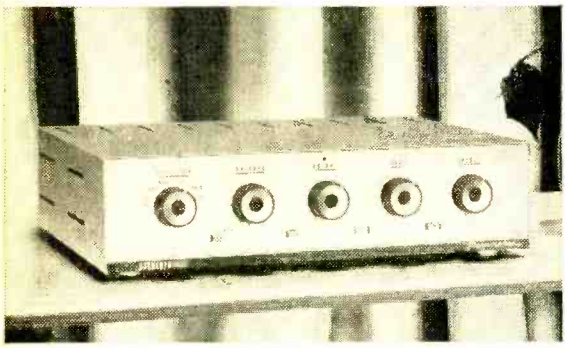
Model 2212 . . . only $69.95*

Low Cost Stereo Starts Here

PACEMAKER Model 2212

2 Channel • 14 Watts

Only Bell can offer you a Stereo Amplifier at this low, low price. Engineered for quality performance, this Pacemaker has Push-Pull output stages and full AC transformer operated power supply . . . Dual inputs for Ceramic Phono, Tuner and Tape Pre-amplifiers . . . One set of controls operates both channels simultaneously . . . Single Knob Balance for matching acoustical balance between speakers.



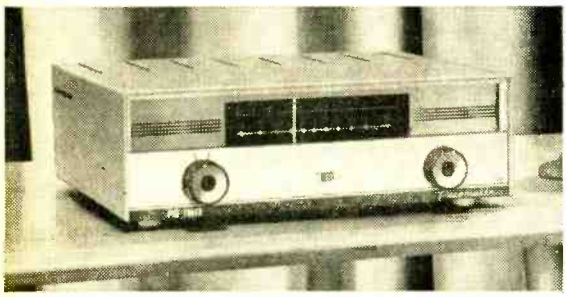
Model 2221 . . . still only $99.95* (with trade-in)

More Power . . . More Features

PACEMAKER Model 2221

2 Channel • 20 Watts

Here's a complete stereo amplifier with even more features for its low, low cost. A complete stereo Amplifier with inputs for stereo magnetic *and* ceramic phono, stereo FM-AM tuner and Stereo tape — from heads *and* pre-amplifiers. 10 watts power output *each* channel. A full 20 watts monaural through any speaker system. Makes the perfect match-mate for your Pacemaker Stereo Tuner.



Model 2216 . . . only $69.95*

Enjoy your favorite FM broadcasts with this new

PACEMAKER FM TUNER

Add it to your present Hi-Fi System . . . match it with your AM Tuner for stereo . . . this new Pacemaker provides quality FM reception at a new low cost. Features include Logging Scale, AFC Switch, Multiplex Output, Built-in Line Cord FM Antenna, Drift-Free Circuit.

Also available: Pacemaker Model 2215 10 watt High Fidelity Amplifier. $55.00

**All prices shown include decorative cover. Slightly higher West of Rockies.*

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Please rush name of dealer where I can hear demonstration of Pacemaker Stereo Components.

NAME _____

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CITY _____ STATE _____

NEW products

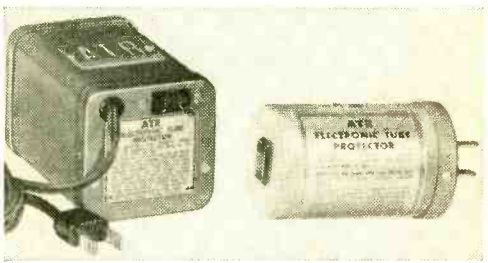
STEREO AMPLIFIER KIT

Quality Electronics, Inc., 319 Church St., New York 13, N. Y., has announced a complete stereo amplifier in kit form. The "Qual-Kit" Model STA-24 accommodates stereo tapes, records, and all types of stereo broadcasts, including multiplex. It features two 12-watt channels which may be paral-

leled to provide 24 watts of power for monaural applications. Controls include: ganged bass, treble, and loudness; stereo balance; mode; speaker selector; rumble filter. Each channel provides 4-, 8-, and 16-ohm output impedance. Price, $44.95. Case, $6.95.

TUBE PROTECTORS

Two models of a tube protector which eliminates the initial damaging surge of current through a cold filament have recently been placed on the market. Model 250 is housed in a metal container to be



plugged directly into a wall socket. Model 300 is housed in a steel case with rubber mounting feet and is equipped with a line cord. Either may be used with any electronic equipment having input wattage from 100 to 300 watts. Model 250, $4.95;

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NEW "CHOOSE-IT-YOURSELF"
VOCATIONAL TRAINING SYSTEM

U.S. ARMY

products

(*Continued from page* 26)

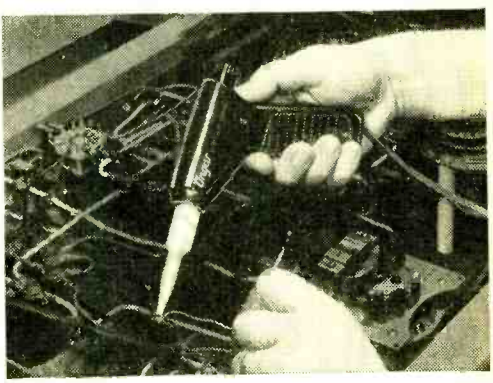
Model 300, $6.95. (*American Television and Radio Co.,* 300 East 4th St., St. Paul, Minn.)

INDOOR-OUTDOOR HI-FI SPEAKER

Ideal for use as an outdoor hi-fi speaker, the Electro-Voice "Musicaster" is also adaptable to indoor applications. It uses a back-loaded folded horn to extend bass response. Frequency response is from 60 to 16,000 cps. The Musicaster weighs just 23 pounds and measures 21½" x 21½" x 8½". Audiophile net price, $48.00. (*Electro-Voice, Inc.,* Buchanan, Mich.)

SOLDERING PISTOL

Featuring a hand-fitted grip together with light weight and perfect balance, the Ungar Model 260 soldering pistol comes equipped with a long-lasting 2½" tellurium copper chisel tip. Positive tip positioning and extra long reach combine to provide



"on target" soldering. The Model 260 is made with a tough, light-weight phenolic handle and has a full six feet of line cord. List price, $4.50. (*Ungar Electric Tools, Inc.,* 4141 Redwood Ave., Los Angeles 66, Calif.)

TAPE RECORDER KIT

The Heathkit TR-1A is a two-speed (3¾ and 7½ ips) tape deck with a frequency re-

products

(*Continued from page* 28)

sponse of from 50 to 12,000 cps ± 2 db at 7½ ips. Flutter and wow are held to less than 0.35%. The TR-1A may be mounted either vertically or horizontally and is designed for use with the Heathkit TE-1 tape preamplifier. Over-all signal-to-noise ratio is better than 45 db below normal recording level with less than 1% total harmonic distortion. Price for both TR-1A and TE-1 kits, $99.95. (*Heath Co.*, Benton Harbor, Mich.)

SIX-TRANSISTOR RADIO KIT

The "Sextette," a six-transistor radio kit, is being offered by *Superex Electronics Corp.*, 4 Radford Place, Yonkers, N. Y. It measures 2 15/16" x 5¾" x 1½" and features three i.f. transformers, push-pull audio output, and a.v.c. Printed circuitry facilitates construction. Net price, $25.95, including case.

40-WATT POWER AMPLIFIER

The Model 250 power amplifier, announced by *H.H. Scott, Inc.*, 111 Powdermill Rd., Maynard, Mass., features "Power-Balance" circuitry which permits full 40-watt output with only 0.5% harmonic distortion. Frequency response is flat from 12 to 40,000 cps. The Model 250 is designed to operate perfectly with reactive loads

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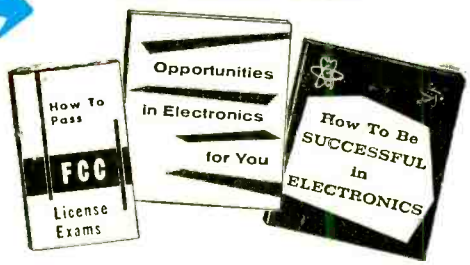

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In what branch of Electronics are you interested?.....

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

PE-49

products

(*Continued from page* 30)

such as electrostatic speakers or crossover returns. It measures 13" x 9½" x 7". Price,

east of the Rockies is $119.95 (case, $10.00), west of the Rockies $122.95 (case, $11.00).

CITIZENS BAND TRANSCEIVER

A remote-controlled transceiver designed for use on the citizens band, the Vocaline Model CUB-1/MT-1 consists of two units, the MT-1 transceiver and the CUB-1 remote control unit. The transceiver is supplied with 100 feet of 6-conductor control cable. Up to 400 feet of cable may be added if required. The CUB-1/MT-1 incorporates a

variable squelch control and a squelch on-off switch. Price, $179.50. (*Vocaline Company of America, Inc.,* Old Saybrook, Conn.)

TRANSISTOR HEARING AID

A compact three-transistor hearing aid has been announced by *Lafayette Radio,* Jamaica 33, N. Y. This battery-powered "economy model" measures 3" x 1¾" x ¾" and comes complete with earphone, two different detachable earplugs, spare battery, and a zippered case. Catalog #F-390. Price, $19.50.

—30—

matching Electro-Voice and all other high quality systems

Now, for the first time, you don't need two full-range speakers to enjoy the added third dimension of stereophonic sound . . . thanks to a new application by Electro-Voice engineers of a basic principle of acoustics. As early as 1934 it was verified that bass tones below 300 cps do not indicate the location of the sound source . . . therefore, these tones contribute no stereo effect. This is because the ear lacks the ability to qualify direction when sound wave-lengths reach 2½ feet or more between their pressure crests. The *entire* stereo effect relies upon the directional placement of sounds *above* this point. The second sound source in stereo, therefore, need only be a system designed specifically to reproduce that directional part of the audio spectrum above 300 cps. Based upon this fact, Electro-Voice engineers developed the STEREON, an uncompromised second channel loudspeaker to match even the largest bass producer . . . a compact, functional furniture piece allowing greatest placement flexibility for optimum stereo. The STEREON is designed to complement any full-range speaker by reproducing only those frequencies required for stereo, thus eliminating your need for a *second* expensive bulky enclosure.

HERE'S WHAT HAPPENS:

Low bass frequencies from *both* stereo channels are properly phased through the XX3 STEREON Control Filter and channeled into your present full-range speaker to utilize its full bass reproduction capabilities; the mid-bass, treble and very high tones are fed, one channel to your full-range speaker, the other channel to the STEREON . . . to give you full dimensional stereo . . . inexpensively, compactly.

Stereo—the Electro-Voice STEREON way—gives the impact and true-to-life spaciousness of the original performance . . . puts you in the best seat in the house.

(In larger rooms, by the way, when you'll want stereo with the scope and magnitude of the latest movie processes . . . you add-on two additional STEREONS, placing them inconspicuously around the room. The two central STEREONS simply parallel each of the channels and are adjusted to a slightly lower level to make a smooth sound picture . . . providing directionality and full depth . . . the ultimate in stereo.)

Hear the remarkably versatile Electro-Voice STEREONS demonstrated at your Electro-Voice show room. After one listening you'll agree that STEREONS are THE answer to stereo in *your* home.

GO-ON TO STEREON . . . FOR SUPERLATIVE STEREO NOW . . .

For more complete information on the Stereon and other Electro-Voice ways to go Stereo, write for free booklet on choosing stereo equipment.

STEREO'S STANDARD

Electro-Voice® **ELECTRO-VOICE, Inc.**
Buchanan, Michigan

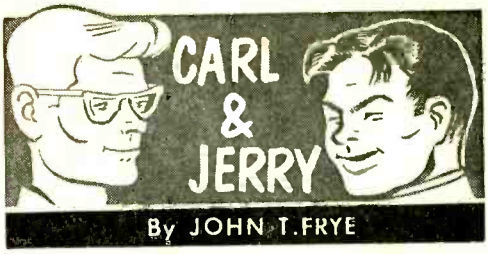
Foremost in Electro-Acoustics — *High Fidelity Loudspeakers and Enclosures for STEREO. Microphones, Phono-Cartridges and Public Address Speakers, Marine Instruments, EVI Professional Electronic Instruments and Military Material.*

STEREON III—3-way system for use with high efficiency systems. Employs MT30 mid-bass coaxial assembly and T35 VHF driver, built into integral 200 cps taper rate horn. Integral crossover network limits overall input to signals above 300 cps crosses over electrically at 3500 cps to Model T35 VHF driver. Flat response ± 2 db 300 cps to 19,000 cps. Two AT37 level controls at rear provide overall level match to full range speaker system. Quality match assured by individual control of "Presence" and "Brilliance" control. Available in mahogany, walnut, and limed oak. Size: 25" high, 17½" deep, 7½" wide. Shipping weight: 37 lbs. Net.....$129.50

STEREON 1A—Identical to Stereon III, for use with normal efficiency systems. Uses MT30B and T35B driver components. Shipping weight: 33 lbs. Net.....$99.50

XX3 STEREON CONTROL FILTER—For use with Electro-Voice Stereons. Uses matching transformer and crossover network components. All signal of 1st channel above 300 cps feeds Stereon; all signal below 300 cps from this channel is combined with full range output from second channel to utilize full bass reproduction capabilities of a single full range system. Input impedance from both amplifiers 8 ohms, output impedance 16 ohms nominal. Size: 5½" high, 4¾" wide, 5¼" deep. Ship. wt.: 8 lbs. Net $30.00

STEREO begins with the E-V totally compatible STEREO Cartridge—already the accepted standard.



He Went That-A-Way!

CARL AND JERRY were perched on the workbench of their basement laboratory listening to Carl's father as the big, pleasant-featured Mr. Anderson said:

". . . So when your mother saw that skunk go under our house, Carl, she was really 'shook' as you boys put it. She's threatened my life if we do anything to upset the little beast there because she still remembers how, when she was a girl down on the farm, her dad set the dogs on a skunk under the house. The whole family had to move out and live in the corncrib for a month."

"How do we know the polecat's still under there?" Carl asked.

"We don't. Possibly it's gone away. But we don't want to be 'half-safe' and close up that opening until we're sure. That's where I thought you electronic hot-shots could help. Can't you rig up some sort of electronic device that will let us know if the skunk comes out from under the house? I mean some sort of gadget that will sound an alarm if something comes *out* through that hole but will stay silent if something goes *in*."

Jerry's round face wrinkled in a frown of concentration. "Ye-s-s-s," he finally breathed, "*that* ought to do it!" He grabbed up a piece of chalk and began to sketch his plan on a blackboard.

"Here's a transistor with a high-sensitivity relay that I'll label *RL1* in the collector circuit. The transistor's biased so the relay is held closed. Notice we have a 1000-μfd. capacitor across the relay winding. Here's a selenium photocell. When a beam of light shining directly across the opening under the house falls on this cell, it generates a current that bucks out the transistor bias current. That causes the collector current to fall nearly to zero, and the relay opens. If anything interrupts the light beam, the collector current rises and the relay closes. The voltage across the relay coil charges

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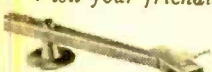

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Carl & Jerry (*Continued from page* 34)

the capacitor, and the discharge current from this capacitor keeps the relay closed for 30 seconds or so after the light beam has been restored. Okay so far?"

"Check!" Carl said promptly.

"Fine! Here's another relay-transistor-selenium cell/light source combination that's set up a yard or so from the wall of the house. The only difference is that it has no capacitor across the winding of *RL2*. This relay also stays open until its controlling light beam is broken. Then it closes; but, unlike *RL1*, it opens again immediately when the light falls on the cell again.

"Now the contacts of *RL1* and *RL2* are connected in series so both have to be closed simultaneously before current through them will actuate this heavy-duty relay, *RL3*. Relay *RL3* controls this solenoid. When the solenoid is actuated, it pulls out a pin that lets a gate fall down across the opening under the house. At the same time it turns on a switch that starts our tape recorder. An endless loop of tape on the recorder keeps repeating a warning message over and over."

"I think I get it," Carl said slowly. "If the skunk is outside now and goes under the house, nothing happens. He will break the beam that controls *RL2* first, but this relay will open again immediately after he has passed; consequently, when he breaks the beam of *RL1* and it closes, *RL3* is not actuated. On the other hand, if he tries to come out, *RL1* will close immediately when he pokes his nose out of the hole. It will stay closed as he comes on out and walks a step or so and breaks the beam of light controlling *RL2*. When this happens and *RL2* closes, *RL1* is still held closed by the discharging capacitor. That means *RL3* closes and works the solenoid that drops the gate, sealing off the opening under the house, and also starts the tape recorder to let us hear the 'all clear.'"

"Even I can understand that," Carl's father said with a broad grin; "and it sounds like a fine idea. How about letting me dictate the glad tidings on that loop of tape?"

"Sure thing," Jerry said as he took the cover off the tape recorder. "We'll leave the recorder in here and hook up another speaker outside the house. Then we'll hear the

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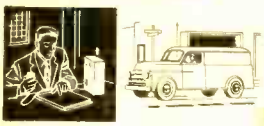

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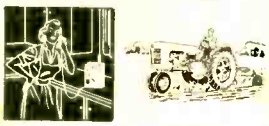

The solution to fast communication from the farm home to the field. Wonderful in an emergency.

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From ship-to-shore or from base camp to the scene of the hunt . . . an enjoyable accessory to any sport!

FOR THE HOME

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GENTLEMEN:

Please send me my copy of your free brochure on the Transceiver. Also your new 1959 Catalog.

NAME _____

ADDRESS _____

CITY & STATE _____

Carl & Jerry (*Continued from page* 36)

message whether we are inside or out."

Carl's father took the microphone in his hand and shouted in his great booming voice, "There goes the skunk! There goes the skunk!"

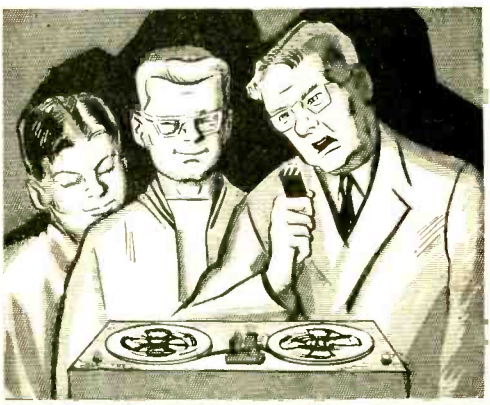
By chance this message filled the loop of tape exactly so that when the recorder was running the warning was repeated over and over without interruption.

"I'll run over and try to coax your mother down off the chandelier and explain that we have the situation well in hand," Mr. Anderson said, "while you boys start work on your direction-of-skunk-movement indicator."

IT DIDN'T take long for Carl and Jerry to assemble the comparatively simple apparatus. From long experience the two boys worked together smoothly and efficiently. They mounted the photocells inside mailing tubes to shield them from bright daylight. The light sources were 117-volt bulbs with simple reflectors and hoods to send the light directly into the ends of the mailing tubes. Since the lamp-to-cell distances were short, powerful lights were not needed. They arranged little fences so that an animal going in or out of the small opening in the house foundation would have to break both light beams in sequence. A light lattice-work gate was set so that it dropped in front of the hole when the solenoid pulled a prop out of the way.

By the time everything was finished, the sun had gone down. The boys sat on the front steps of Carl's house and enjoyed the unusually warm March evening as they

(*Continued on page* 94)



. . . Carl's father took the microphone in his hand . . .

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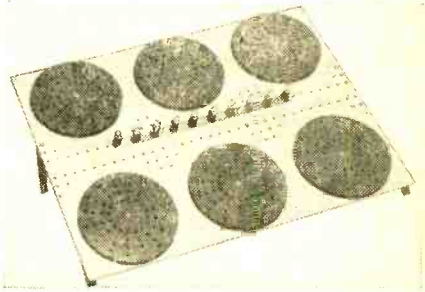

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The **GENIAC** Kit by itself is the equivalent of a complete course in computer fundamentals, in use by thousands of colleges, schools and industrial training labs and private individuals. Includes everything necessary for building an astonishing variety of computers that reason, calculate, solve codes and puzzles, forecast the weather, compose music, etc. Included in every set are seven books described below, which introduce you step-by-step to the wonder and variety of computer fundamentals and the special problems involved in designing and building your own experimental computers—the way so many of our customers have.

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TEXT PREPARED BY MIT SPECIALIST

Dr. Claude Shannon, known to the readers of **Popular Electronics** for his invention of the electronic mouse, that runs a maze, learning as it goes, formerly a research mathematician for Bell Telephone Laboratories is now a research associate at MIT. His books include publications on Communication theory and the recent volume "Automat Studies" on the theory of robot construction. He has prepared a paper entitled "A Symbolic Analysis of Relay and Switching Circuits" which is available to purchasers of the **GENIAC**. Covering the basic theory necessary for advanced circuit design it vastly extends the range of our kit.

The complete re-designing of the 1958 kit and the manual as well as the special book **DESIGN-O-MAT®** was created by Oliver Garfield, author of "Minds and Machines," editor of the "Gifted Child Magazine" and the "Review of Technical Publications."

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2) **Beginners Manual**—which outlines for people with no previous experience how to create electric circuits.

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We are proud to announce that over 20,000 **GENIACS** are in use by satisfied customers—schools, colleges, industrial firms and private individuals—a tribute to the skill and design work which makes it America's leading scientific kit. People like yourself with a desire to inform themselves about the computer field know that **GENIAC** is the only method for learning that includes both materials and texts and is devoted exclusive to the problems faced in computer study.

You are safe in joining this group because you are fully protected by our guarantee, and have a complete question and answer service available at no cost beyond that of the kit itself. You share in the experience of 20,000 kit users which contributes to the success of the 1959 **GENIAC**—with **DESIGN-O-Mat®** the exclusive product of Oliver Garfield Co., Inc., a Geniac is truly the most complete and unique kit of its kind in the world.

COMMENTS BY CUSTOMERS

We know the best recommendation for **GENIAC** is what is has done for the people who bought it. The comments from our customers we like best are the ones that come in daily attached to new circuits that have been created by the owners of **GENIACS**. Recently one man wrote: **"GENIAC** has opened a new world of thinking to me." Another who designed the "Machine that Forecasts the Weather" commented:

"Several months ago I purchased your **GENIAC** *Kit and found it an excellent piece of equipment. I learned a lot about computers from the enclosed books and pamphlets and I am now designing a small relay computer which will include arithmetical and logical units . . . another of my pet projects in cybernetics is a weather forecaster. I find that your* **GENIAC** *Kit may be used in their construction. I enclose the circuits and their explanation."*

Eugene Darling, Malden.

Oliver Garfield Co., Inc. Dept. PE-39
108 East 16th St., N. Y. 3, N. Y.

Please send me at once the **GENIAC** Electric Brain Construction Kit, 1959 model. I understand that it is guaranteed by you and may be returned in seven days for a full refund if I am not satisfied.

☐ I have enclosed $19.95 (plus 80c shipping in U. S., $1.50 west of Miss., $2.00 foreign). 3% New York City Sales Tax for N.Y. City Residents.

☐ Send GENIAC C.O.D. I will pay postman the extra C.O.D. charge.

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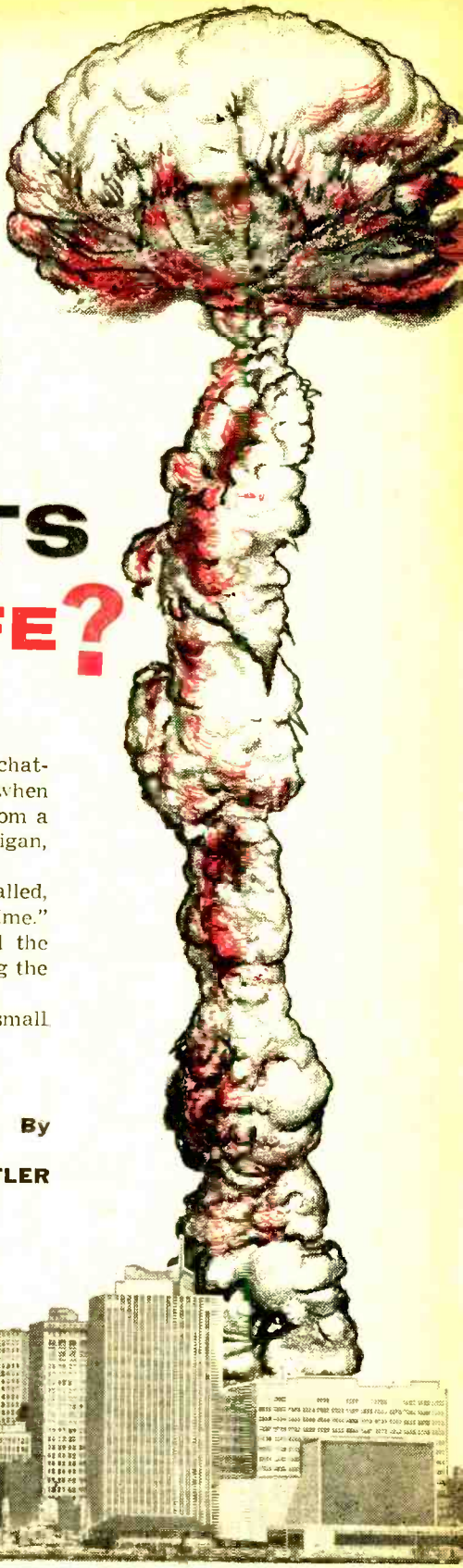


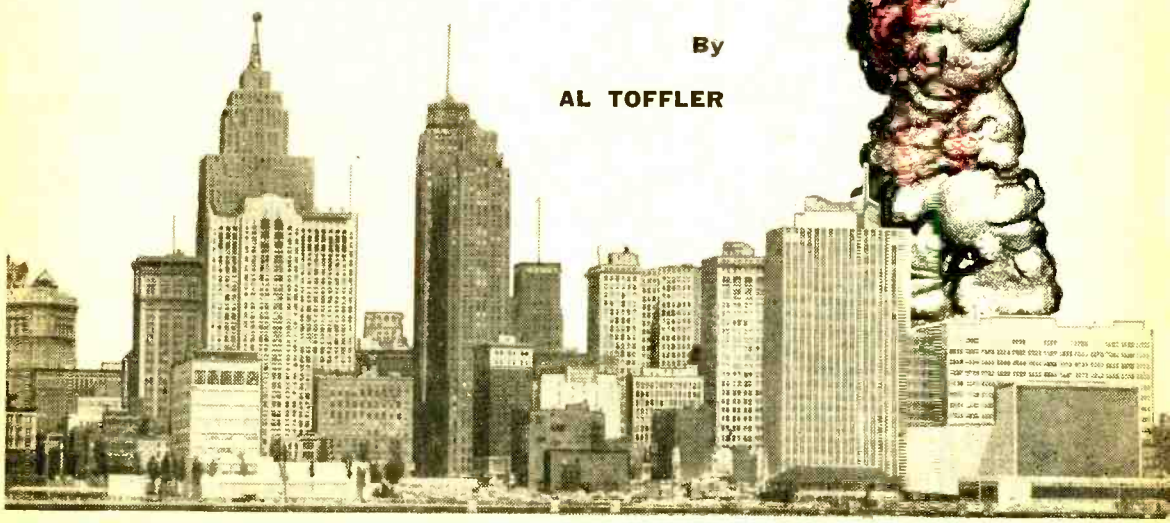
MRS. Lillian Nickerson was outside her house chatting with a neighbor at 6:00 p.m. last July 11 when she heard a sudden explosion. The noise came from a nearby limestone quarry, located at Trenton, Michigan, just south of Detroit.

"We paid no attention," Mrs. Nickerson recalled, "because they had been doing that for a long time." She referred to test explosions that had rocked the quarry every now and then for two years preceding the July blast.

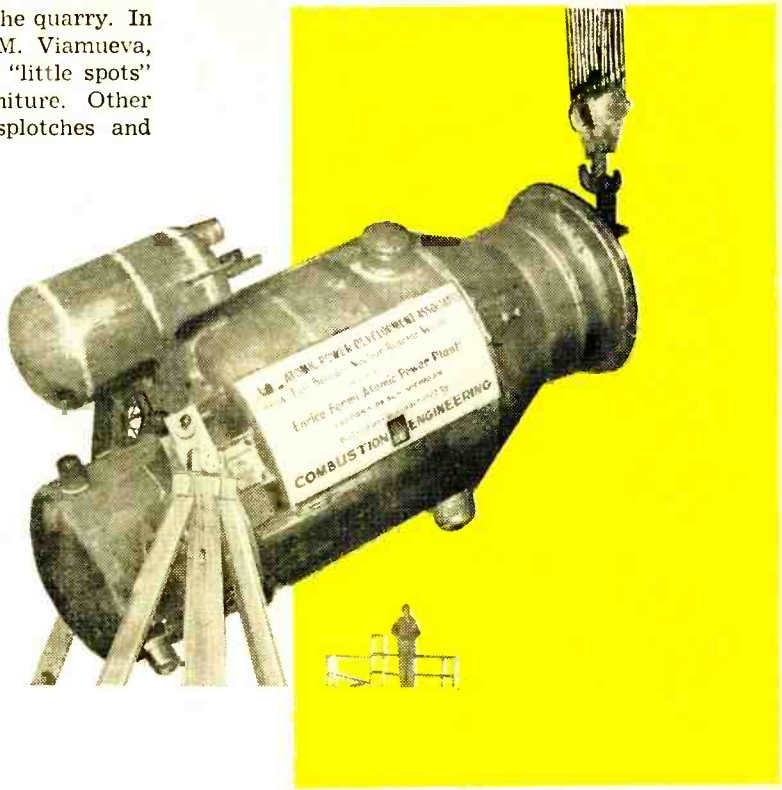
This time, however, Mrs. Nickerson noticed a "small

By

AL TOFFLER



cloud of dust" float up from the quarry. In a few minutes, Mr. Henry M. Viamueva, several houses away, noticed "little spots" appearing on his porch furniture. Other neighbors began to notice splotches and pockmarks on their cars. At the same time several children in the area began to complain of a burning sensation on their skins.



A shudder ran through the neighborhood. For two years Detroit had been hearing charges that it stood in danger of a nuclear explosion. Was this it?

For two years Atomic Power Development Associates, an offspring of the Detroit Edison Co. and the Power Reactor Development Corp., had been conducting some special sodium tests in a tank at the bottom of the quarry. The tests were part of preparations to build a giant "fast breeder" nuclear reactor.

After the "fall-out" incident, 500 residents of the community demanded that a stop be put to the tests. They appealed to both state and local authorities. Detroit Edison, through a spokesman, announced that the tests would continue.

Background. Detroit's fear of nuclear catastrophe goes back to 1956, when the Power Reactor Development Corp. (PRDC) announced plans to build a reactor on a 900-acre marshy site 30 miles south of Detroit.

The United Auto Workers Union, with 300,000 members in the vicinity, quickly charged that the reactor, if built, would constitute a serious menace to the lives and health of residents in Detroit, Toledo and nearby communities. Coming from the UAW, the charge was not likely to be ignored in the "Motor City."

Next, the UAW, joined by other unions in the AFL-CIO, insisted that the Atomic Energy Commission hold open hearings on the subject. This was the first time there had ever been a formal public discussion of the safety or danger of peacetime nuclear reactors.

The union based its case on the fact that the proposed PRDC plant would be a commercial-size "fast breeder"—a new type of reactor conceded by everyone, including the former chairman of the AEC, to be "the most hazardous of all reactors."

The stakes in the UAW-PRDC battle are high because the fast breeder is among the most promising of reactor designs. In addition to producing heat with which power can be generated, it produces fission products like plutonium. The great significance of this is that the plutonium by-product itself may be useful as nuclear fuel, offering the promise of a kind of perpetual motion in energy production at low cost.

But the number of "fast" reactors which have been built and tested is small compared to the number of other types of reactors. This means that experience with fast reactors is limited, and has been with reactors smaller than the PRDC reactor.

The PRDC argued in the hearings that "the evidence shows that the reactor as presently designed will very *probably* be

stable. The evidence also shows that the proposed start-up and operational testing of the PRDC reactor can be safely carried out and will *in all probability* establish the stability of the reactor, or at minimum will indicate feasible design changes."*

Experts on both sides discussed the particular problem of the fast breeder. They agreed that it is relatively dangerous because reactivity in the fast breeder can rise so fast that no electronic device can control it. Moreover, they said that the fast breeder uses a large amount of highly enriched fissionable material which under certain circumstances could reach critical mass and explode.

Radiation Products. If the reactor were to "run away," or if there were a loss of coolant, radioactive products might be released into the atmosphere where wind and rain could carry them thousands of miles. These radioactive products, in the words of one scientist witness, are "more toxic per unit weight than any other industrially known materials by a factor of a million to a billion." The possible effects of an explosion are almost beyond comprehension.

To forestall such a catastrophe, a huge inverted steel cup 119 feet tall and 72 feet across is to be built on top of the reactor. This is called the "containment vessel" and is supposed to contain the released gases in the event of an accident.

But what if the vessel fails? Nobody quite knows what would happen. Past Atomic Energy Commission (AEC) studies indicate that the resultant contamination could kill thousands of people and cause billions of dollars worth of damage.

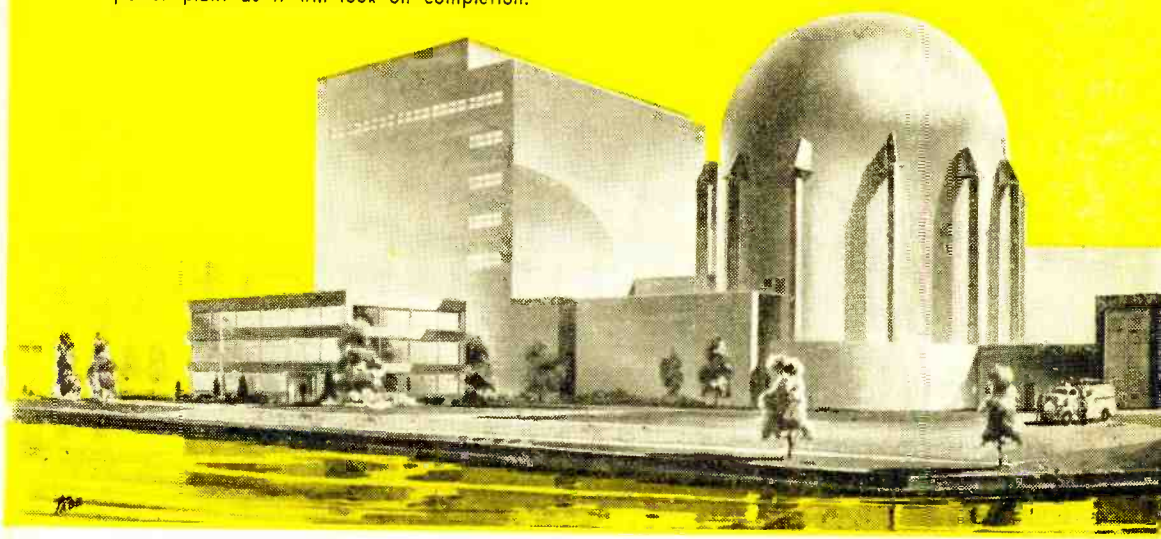
To back up its charges, the union presented evidence that the AEC's own Advisory Committee on Reactor Safeguards had warned not to give the go-ahead on the Detroit fast breeder reactor. The Safeguards Committee in June, 1956, stated: "There is insufficient information available at this time to give assurance that the . . . reactor can be operated at this site without public hazard . . ." Thus, when the AEC issued a permit to build the Detroit reactor, it overruled the advice of its own experts.

Reactor Accidents. The AEC was then reminded that accidents involving reactors had already taken place.

• In Idaho, in 1955, at a site located miles from any major population concen-

Atomic reactor vessel at left is being prepared for shipment to the PRDC plant.

Artist's concept of the 100,000-kw. atomic power plant as it will look on completion.



* Italics inserted by author.

tration, a fast breeder (much smaller than the proposed PRDC installation) went wild. It took five months before the reactor "cooled" enough for technicians to find out what happened.

- In Chalk River, Canada, an accident at a reactor forced the evacuation of the community and doubled radioactivity levels over New York State in 1952.
- At Windscale, England, a reactor "ran away" and dumped radioactive iodine over the countryside, contaminating milk supplies and livestock.
- At Oak Ridge, five days after the "fallout" incident aroused Detroiters, deadly radiation escaped from the Y-12 plant. Roadblocks were set up and radiation alarms sounded, indicating the possibility that a critical mass existed in or near the building. The area was evacuated. Eight workers wound up in the Oak Ridge Institute of Nuclear Studies Hospital.
- In Denmark, an American-made "containment vessel" turned out to be faulty and triggered a nation-wide uproar.

Also pointed out to the AEC was the fact that commercial insurance firms—experts on risk and liability—wouldn't provide the amount of insurance that even the PRDC thought necessary.

Hearings Continue. The PRDC continued to insist that its plans were "virtually" foolproof. It argued further that it only wanted to construct the reactor and that the reactor would not be put into operation until another permit was obtained from the AEC. Finally, it held that if its project were halted, the U. S. would fall behind in fast breeder technology.

The union demanded that the AEC rescind the construction permit. It argued that once the company had sunk 50 million dollars into the project, the pressure on the AEC to grant an operating permit would be intense. It urged the AEC to carry on fast breeder experimentation in some isolated region before allowing a company to build a fast breeder on the outskirts of a densely populated city.

The fight took on an international aspect following a report by Detroit Edison's own meteorologist which stated that the greatest dangers were posed to nearby beaches and to "that portion of Canada immediately across Lake Erie." Shortly afterward, three Canadian cities across Lake Erie from the reactor site formally demanded that Ottawa intervene "at the highest diplomatic level" to stop the project until absolute safety to their communities could be assured.

Another Explosion. This was the worrisome background that made the minor explosion on July 11 so symbolic. A few days later came an explosion of another kind—an explosion in print.

The union attorneys had charged earlier that the PRDC hadn't even conducted an investigation of the consequences of a "contained" accident. What the union didn't know at the time was that just such a study had been completed—and classified. After the sodium incident, the AEC declassified the accident study.

Prepared by explosion experts at the Naval Ordnance Laboratory in White Oak, Md., this report was a hair-raiser. Putting the probable maximum force of an explosion in the Detroit reactor at the equivalent of 1000 pounds of TNT, it indicated that such an explosion would shoot a 175-ton steel "plug" into the air like a gigantic rocket.

This plug, the report stated, "is a missile that has been shown to threaten the ability of the reactor plant to contain a nuclear excursion. The plug will be shot upward by gun action. . . ."

If this could happen, it means that the giant steel containment vessel might not be strong enough to protect Detroit in the event of an atomic accident.

By last August, the AEC examiner had taken millions of words of testimony from the union experts, PRDC scientists, outside nuclear physicists, and officials. As this is written, the Atomic Energy Commission, acting in this case as judge, jury and defendant, must decide once and for all if it made a mistake when it overrode its own Reactor Safeguards Committee and let the PRDC move ahead with its project.

Detroit, a little uneasy, awaits the verdict. —30—

EDITOR'S NOTE: Practically as this issue was going to press, we received notification from the Atomic Energy Commission (Report #TI-42) that the construction permit granted to the PRDC has been affirmed but with several amendments. The PRDC is now required to report at least every three months on developments pertaining to safety aspects of the project. Furthermore, a license to operate the reactor will *not* be granted until "reasonable assurance" has been provided that the health and safety of the public will not be endangered. Meanwhile, Detroit still waits and wonders.

INSIDE the PREAMPLIFIER

Part 2: Record Equalization

IF WE COULD record sound in its natural frequency balance, the job of the hi-fi preamplifier would be greatly simplified. Unfortunately, there are a number of technical reasons why this can't be done satisfactorily.

If the very low frequencies were fed to the disc recorder cutter at the same level as the middle frequencies, the extreme swings of the cutting stylus would cause "groove-kissing," echo, and various other playback distortions. On the other hand, if the high frequencies were fed in at the same level as the mid-frequencies, they would be so low in volume in playback that they would be largely drowned out by the surface noise of the record.

Therefore, in the recording process, the low frequencies must be reduced in level and the high frequencies boosted. In play-

By
JOSEPH MARSHALL

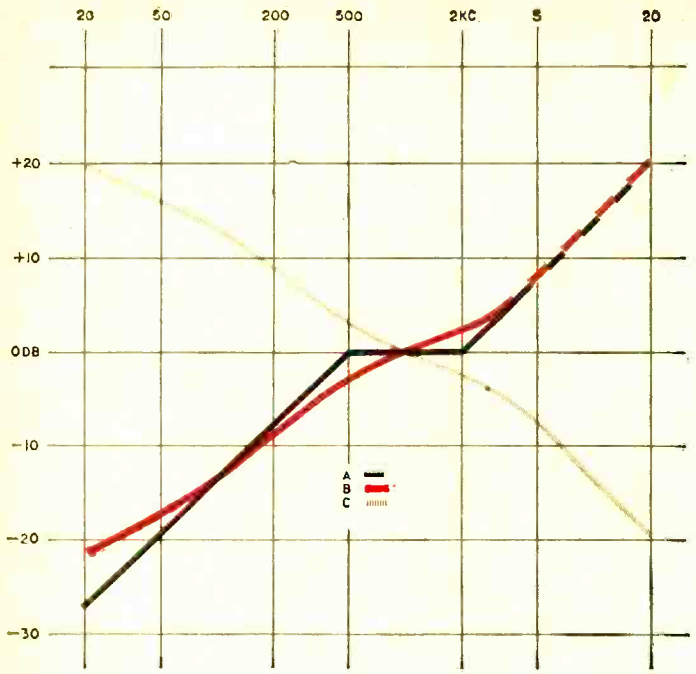


Fig. 1. The theoretical RIAA recording curve would look like Curve A. The actual curve, however, looks like Curve B. The RIAA playback curve is the reverse of the recording curve and is indicated by Curve C.

back, this process is reversed to restore the original balance.

RIAA Recording Curve. Modern methods of recording permit a flat frequency response to be cut into the disc in the range between 200 and 5000 cycles. Prior to the adoption of the RIAA (Recording Industry Association of America) standard curve in late 1955, different record manufacturers chose different points (called *crossovers*) at which to start attenuating and boosting the lows and the highs.

The low-frequency crossover varied from 200 to 800 cycles and the high-frequency crossover from 1000 to 5000 cycles. The general rate of cut or boost was the same in all cases, 6 db per octave. This means that at the low end the amplitude or level was halved as the frequency was halved; while at the high end the amplitude was doubled as the frequency was doubled. This 6-db-per-octave slope is still used because it is inherent or natural to certain audio components or processes, and can be easily achieved with relatively simple means.

In the standard RIAA curve, the low-frequency crossover is at 500 cycles and the high-frequency crossover at 2000 cycles. A theoretical curve with these crossovers and a 6-db slope would look like Curve *A* as shown in Fig. 1. Since it is not desirable, nor practical for that matter, to have sharp "knees" at 500 and 2000 cycles, in the actual RIAA curve these knees are rounded off somewhat.

There is one further modification. If we continued a 6-db-per-octave slope below 500 cycles all the way to the bottom of the audio range, we would end up with 28 db of attenuation at 20 cycles. This would present some serious problems. Very high amplification would be needed to reproduce the two octaves below 70 cycles. But in these last two octaves we have two serious sources of noise: 60-cycle hum and 20-30 cycle turntable rumble. To minimize these noises, it is desirable to flatten out the curve at its bottom end.

In the RIAA curve, the 6-db-per-octave rate of attentuation is stopped at around 100 cycles and the slope below that is greatly reduced. At 20 cycles the RIAA curve is only about 20 db below 1000 cycles. The final RIAA *recording* curve looks like the colored Curve *B*.

RIAA Playback Curve. The *playback* curve, in order to restore the original balance of the recorded material, should be exactly the reverse of the *recording* curve at every point, as indicated by the shaded Curve *C* in Fig. 1. To achieve this curve, we have to insert frequency-selective circuits

in the playback system. Let us see how such circuits are developed.

When we have a capacitor (*C1*) and a resistor (*R1*) in series as in Fig. 2 (A), the total impedance of the circuit will be different at different frequencies. The lower the frequency, the more opposition there will be to current flow. At the one frequency where the reactance of *C1* equals the resistance of *R1*, the signal divides equally across the two components. As the frequency goes lower, the reactance of the capacitor doubles each time the frequency is halved. This simple *RC* combination, as we will see shortly, can provide the 6-db-per-octave slope desired for equalization.

Now we want to flatten the slope below 100 cycles. To do this we simply insert another resistor (*R2*) across the capacitor, as in Fig. 2(B). For the RIAA curve, we choose *R2* to be equal to the reactance of *C1* at 70 cycles. The frequencies below 100 cycles now have two paths: (1) that provided by *C1*, whose reactance increases for lower frequencies, and (2) that provided by *R2*, which remains constant for all frequencies. Frequencies below 100 cycles find the path offered by *R2* more attractive than that offered by *C1* and therefore most of them take the "low road" through *R2*. Since the resistance path through *R2* is constant, the attenuation slope is flattened out below 100 cycles.

Above 500 cycles, the reactance of the capacitor becomes less significant; at twice the crossover frequency and above, the capacitor has no effect. If we could now vary the resistance of *R1* at high frequencies, we could influence the response at the high-frequency end. We can do exactly this by placing another, much smaller, capacitor (*C2*) across *R1*. See Fig. 2(C). As the frequency rises, *C2* presents an easier and easier path for the signal, and eventually acts as a short-circuit around *R1*.

We now have a circuit with two frequency-selective elements which can shape a response curve to the RIAA standard on both the *high* and *low* ends. In actual practice, you'll find a variety of series, series-parallel, and parallel circuits used whose

(*Continued on page* 111)

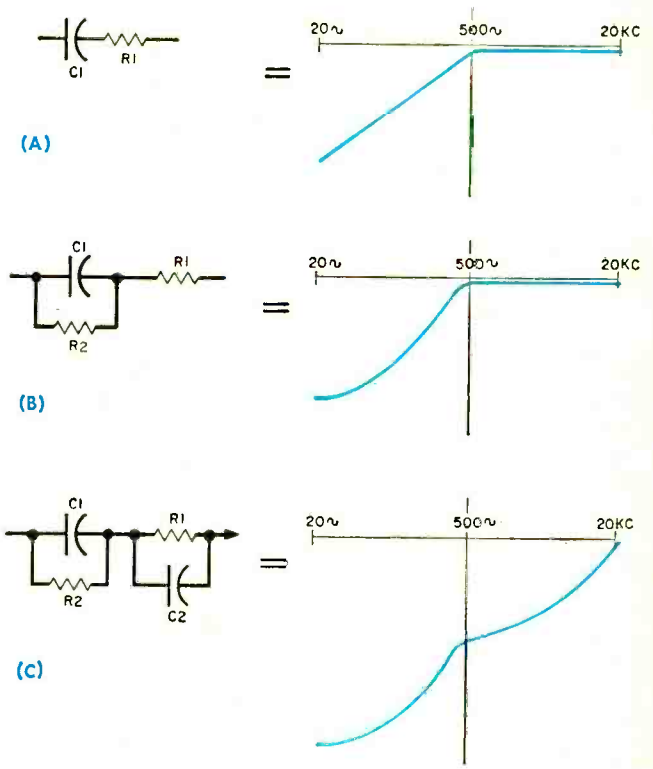
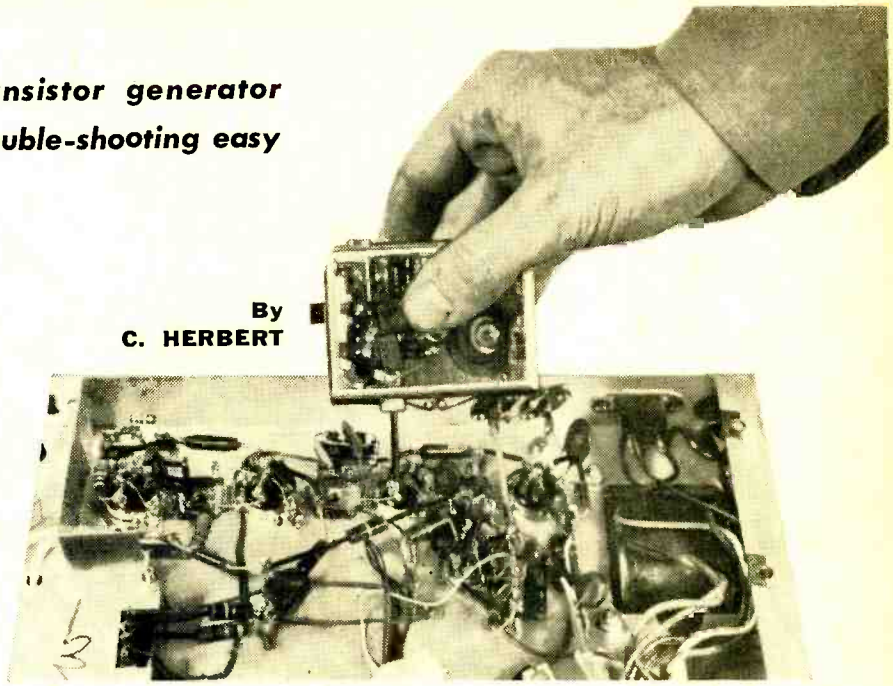


Fig. 2. Frequency response characteristics of different RC circuits. In (A), resistor R1 and capacitor C1 in series cause a drop-off in response below 500 cps. In (B), when another resistor, R2, is added in parallel with C1, the attenuation slope is changed. In (C), capacitor C2 is shunted across R1 and causes attenuation of frequencies above 500 cps. A circuit such as (C) inserted in a negative feedback loop around a stage will result in the stage having RIAA compensation.

This one-transistor generator makes FM trouble-shooting easy



By
C. HERBERT

FM Signal Injector

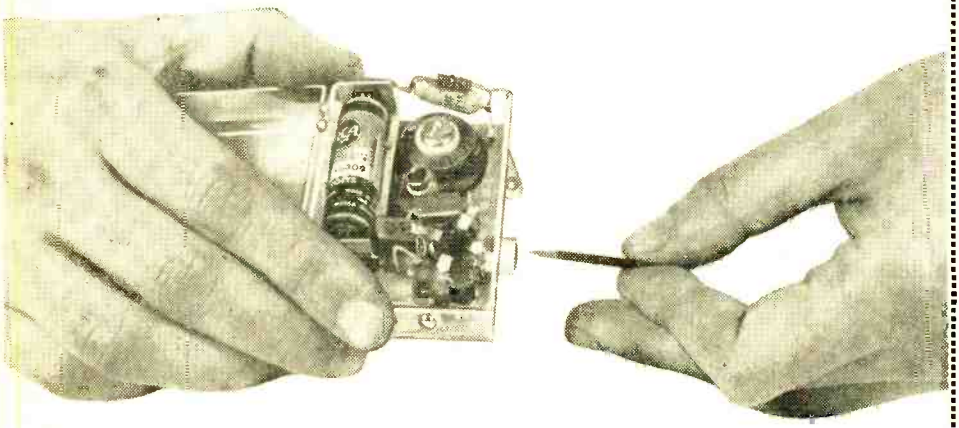
SIGNAL TRACING is one of the tried and true techniques of the amplifier or radio trouble-shooter. Tracing technique generally makes use of the broadcast signal and follows it from the antenna to the loudspeaker of the radio under check. Signal injection technique works in the other direction—starting from the output portion of the set, a signal is injected into each stage of the receiver working back toward the antenna. In either case, the receiver is checked under operating conditions, and the actual r.f. or audio signal is followed from point to point until the defective stage is localized.

While signal tracers and injectors for AM are fairly common, FM receivers have no such handy trouble-shooting tool available. The little one-transistor oscillator-injector described here has been designed to fill this long standing need. As can be seen from the photos and schematic, construction is simple, even though the theory is complex.

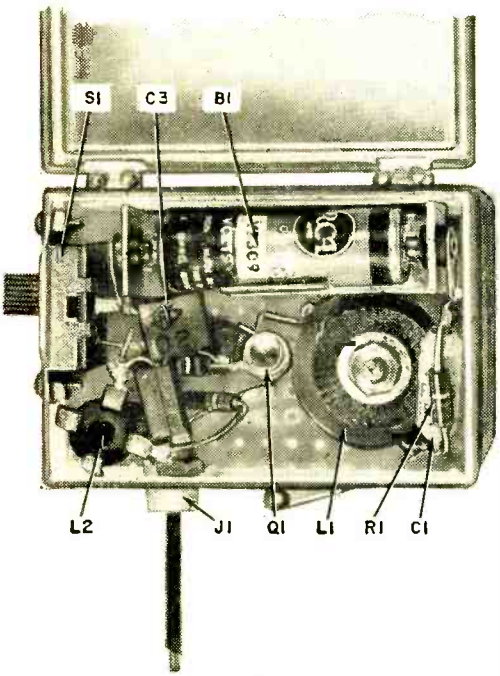
The small plastic case which houses the entire unit can be one of the commercially available boxes, or a plastic cigarette case can be commandeered for the purpose. A small piece of phenolic board serves as the "chassis" and flea clips are inserted to hold the parts in place. The battery bracket is screwed to the board with small self-tapping screws.

Align the output signal frequency of the injector by bringing the probe tip near or touching it to the grid or plate of a front-end tube in an operating FM tuner and adjusting the slug of *L2* until you pick up a high-frequency buzz. This buzz is the injector's signal at the 10.7-mc. frequency of the receiver's i.f. amplifier strip.

Once the injector is aligned, it is only necessary to touch the plug-in probe tip to the plate or grid of each succeeding stage in the i.f. strip, starting at the one nearest the detector stage. When the signal fails to come through, this will indicate either a badly misaligned or otherwise defective i.f. stage. FM trouble-shooting, once a chore, can be made ultra-simple with the FM signal injector.

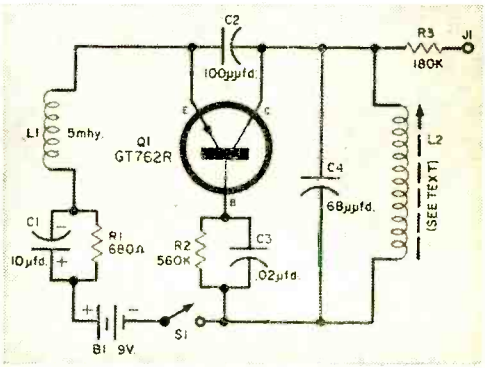


Plug-in probe tip was used in the author's model for convenience. Other arrangements are possible.



PARTS LIST

B1—9-volt battery (RCA VS309)
C1—10-μfd, 15-volt electrolytic capacitor
C2—100-μμfd. mica or ceramic capacitor
C3—.02-μfd. ceramic capacitor
C4—68-μμfd. mica or ceramic capacitor
J1—Pin tip jack
L1—5-mh. r.f. choke (Miller #659 or equivalent)
L2—10-mc. slug-tuned coil (Cambridge Thermionic LSM)
Q1—GT762R transistor (General Transistor)
R1—680-ohm resistor
R2—560,000-ohm resistor — *All resistors*
R3—180,000-ohm resistor — *½-watt composition*
S1—S.p.s.t. slide switch



Coil L2 in the schematic above can be either a commercial unit or wound of 20 turns of #26 enameled wire on ⅜" slug-tuned coil form.

HOW IT WORKS

Transistor *Q1* is a *p-n-p* unit serving as a 10.7-mc. r.f. oscillator. The feedback which results in oscillation is from collector to emitter through a 100-μμfd. capacitor (*C2*). The oscillator circuit formed is overdriven and periodically blocks, the *RC* network formed by *R1* and *C1* determining the blocking frequency. When the blocking takes place, the voltage between collector and base shifts, which changes the capacity from collector to base. Since this capacity is part of the tuning circuit formed by *L2* and *C4*, a frequency shift takes place and FM modulation results.

By MORRIS M. RUBIN

The EAR and High Fidelity

Hi-fi's "ultimate consumer," the ear itself works like a miniature hi-fi system

IN THE WORLD OF HI-FI, with its tweeters, woofers, tuners, amplifiers and so on, it is easy to forget that all of these are servants of one master, the Human Ear. One can almost visualize the great and noble Ear sitting in the midst of this host of hi-fi components, receiving their services like a feudal baron receiving the produce of his serfs.

Hearing Is Believing. Starting at the dawn of life as an humble part of a fish's respiratory organ, the ear has developed into a most remarkable instrument. Stop for a moment and think of the widely differing sounds that it is called on to recognize: the breathing of a sleeping baby, the roar of a jet plane and the magnificence of a symphony orchestra.

When the hi-fi fan talks of highs and lows, of distortion and peaks, of recording and playback, he is speaking of attempts to feed his ear a *select sample* of the multitude of different sounds it can recognize.

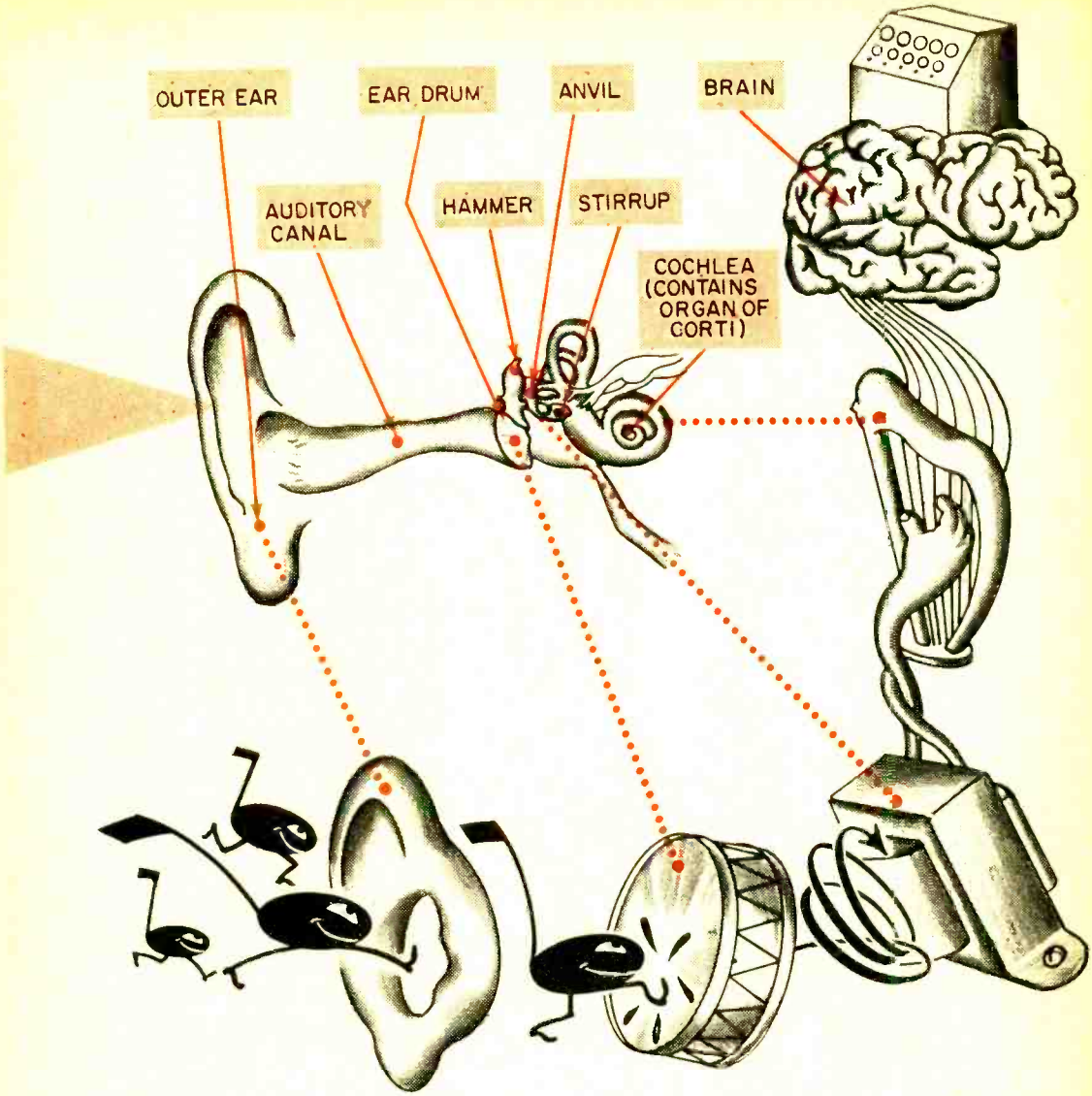
Let us imagine someone sitting in a comfortable chair in his living room, about to listen to a Tchaikowsky piano concerto on his hi-fi rig. The opening chords are played. He immediately recognizes them as having been produced by a piano. How does he do it?

To answer this question, we must know something about how the ear works.

The Ear in Three Parts. The ear is made up of three main sections, the outer, the middle, and the inner ear.

The outer ear is what we see sitting on the sides of our head. Anatomists call it the *pinna*. It is probable that in days gone by we could move the pinna to judge sound direction. But now it remains motionless and just collects the sound. From the pinna the sound proceeds down a passage called the *auditory canal* (a distance a little less than an inch) to the eardrum.

The eardrum marks the beginning of the middle ear. It is shaped like the cone of a loudspeaker, and works roughly the same way, but in reverse. (The loudspeaker cone



Various parts of the human ear perform many functions analogous to those performed by musical instruments and electronic devices.

couples mechanical vibrations to the air; the eardrum couples air vibrations to the mechanical parts of the ear.) Attached to it is a bone called the *hammer* which is connected to another bone called the *anvil* which in turn is connected to the *stirrup*. These three bones form the *ossicular chain* and work in a Rube Goldberg fashion, with one bone activating the next. The base of the stirrup, the last element in this series-connected mechanical circuit, fits into the *oval window*, the entrance to the inner ear.

In the inner ear we find the *cochlea*, where the real work of separating the lows from the highs is carried on. This snail-shaped, tapering coil narrows down from its widest part at the oval window to an apex.

Sound waves travel into the outer ear and strike the eardrum. The eardrum responds to the pattern of sound waves in very much the same way that a voice coil and speaker cone respond to a pattern of electrical impulses. Submicroscopic vibra-

tions of the eardrum are transmitted to the ossicular chain. This chain acts like a mechanical step-up transformer, matching the impedance of the eardrum to the higher impedance of the liquid in the cochlea. The gain of this system is about 20.

The stirrup moves in the oval window and sets up a vibration of the liquid in the cochlea canals. This in turn shakes the membrane holding the *Organ of Corti* which, through its nerve cells, analyzes the movements of this liquid. The pattern of vibrations transmitted by the liquid to the Organ of Corti almost exactly matches the original sound wave pattern.

Organ of Corti. This is the "heart" of the hearing system. The Organ of Corti floats on the flexible membrane separating the lower canal from the cochlea canal. It is to this structure, which contains about 25,000 specialized sensory nerve cells, that the designers of communication and high-fidelity equipment direct themselves. This is where the auditory nerve connects the ear to the brain.

As even the largest and most complicated computer cannot duplicate the complexity of human thought, not even the finest and most expensive microphone can match the ear's ability to discriminate between a variety of sounds. The function of the Organ of Corti can be easily understood when it is compared to the action of a piano. The long heavy piano strings make low-frequency sounds when they are struck and the thin shorter strings produce the higher notes.

Similarly, the cochlea is wide at one end and narrow at the other. Since the Organ of Corti responds to the vibrations of the liquid in the canals, it is easy to see that it will pick up low-frequency vibrations at its widest end where there is the most fluid, and the high frequencies at its narrow end where there is little fluid.

The Organ of Corti works in precisely the same way as does a microphone. It converts the mechanical energy of sound vibrations into electrical impulses. Thus, sound is analyzed in the cochlea, the report is sent via the auditory nerve to the brain, and there it is interpreted. The brain thumbs through its files, calling upon its vast store of memories and associations and says, "This is the sound of a piano—no question about it!"

Music for Two Ears. Within the past few years, the ear has acquired a new but worthy servant—stereophonic reproduction of sound. No matter how hi the fi of a record or a playback instrument, the ear cannot be fooled into thinking that a sound is "real" if its source is a conventional monophonic one.

A monophonic system will serve the ear many delicacies of loudness, frequency, and so on, but the meal falls flat without the spice of spacial perception. Stereophonic reproduction adds this last, but almost indispensable, spice.

Both ears receive the same sound stimulus only if the sound is produced from a source directly in front of the listener. Any deviation to one side will cause the sound wave patterns reaching each ear to be slightly different. This can be visualized with the help of the following example.

Think of two small boats rocked in the wake of a passing ship. They are both responding to the same wave pattern, but one may be at the crest of one wave while the other is at the trough of another. Sound waves also have what might be called troughs and crests. Because of the difference in distance from the sound source caused by ears being on the opposite sides of the head, each will receive the sound wave at a slightly different point. One ear will get a stimulus that is a tiny bit closer to the crest than that received by the other.

Sound in 3D. In order to satisfy the ear's demands for more "realistic" sound reproduction, engineers have developed a sound system that instead of having only one sound source has two. But just adding an extra loudspeaker to a monophonic hi-fi system will not give the ear the sensation of space perception.

Each speaker, in order to produce stereophonic sound (that is, sound with the dimension of space perception) must send out a message that varies slightly from the message sent out by the other speaker. Each ear then receives a different stimulus and the reproduced sounds will become "three-dimensional." The brain combines the two differing sounds into a composite three-dimensional image.

The ear will, no doubt, demand further attention and more varied entertainment as time goes on. But let us not forget that even this ruler of the world of sound is in the service of a greater master—the incredibly complex and wonderful *human mind.*

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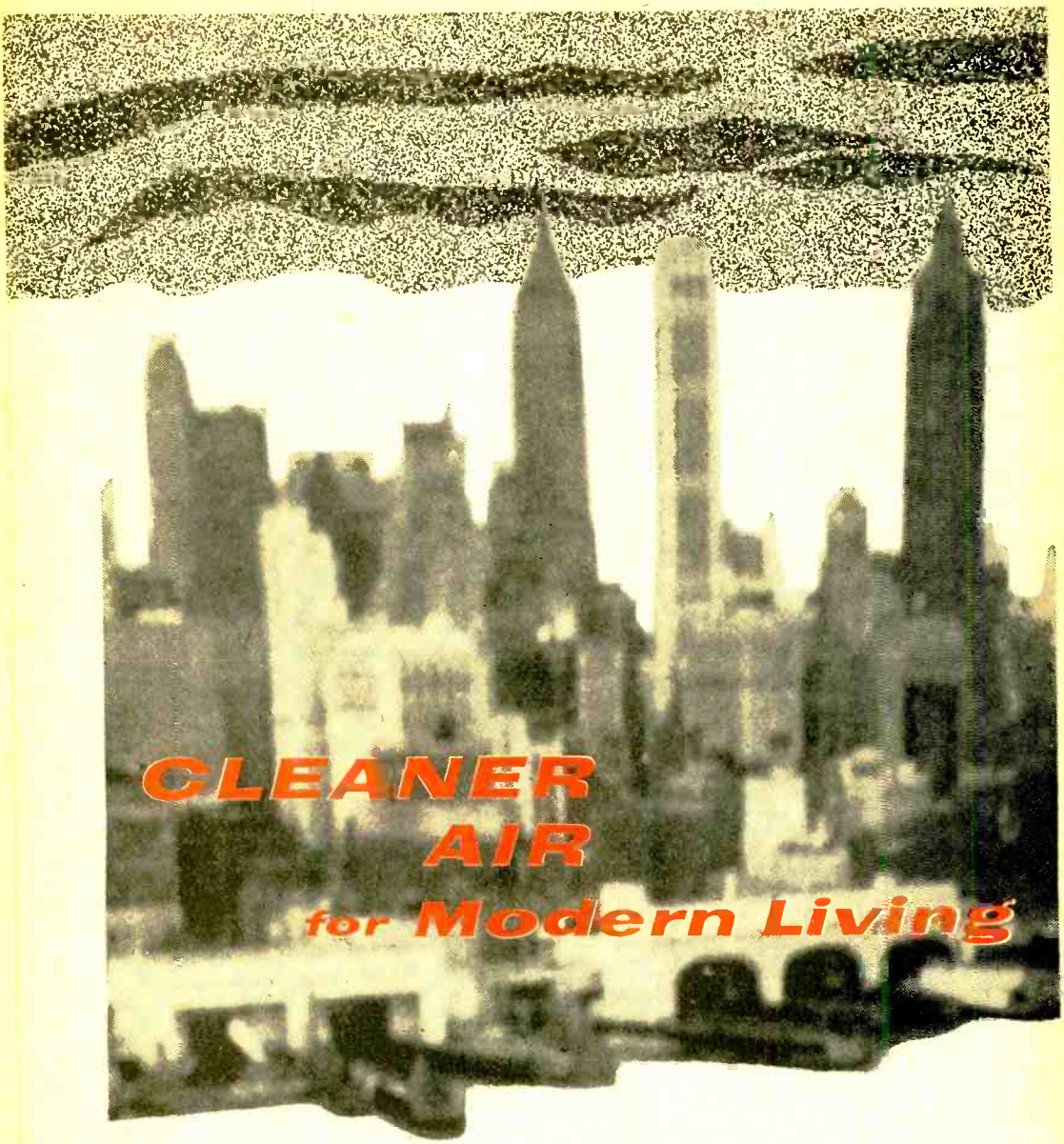


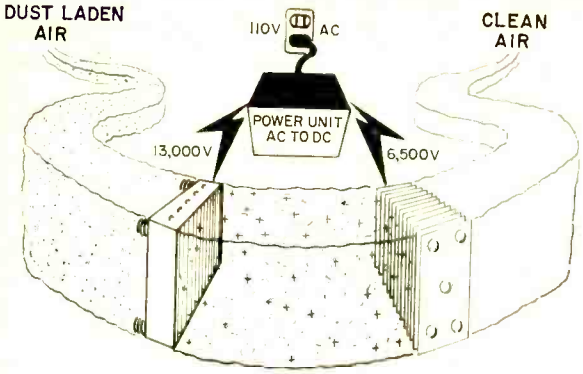
CLEANER AIR for Modern Living

Electronic air cleaners filter dust, smoke, even germs!

WHAT'S IN the "fresh" air we breathe? Actually, it's not quite as "pure" as it seems. It contains smoke, dust, fumes, pollen, lint, bacteria, viruses and silicates—to name just a few of its ingredients.

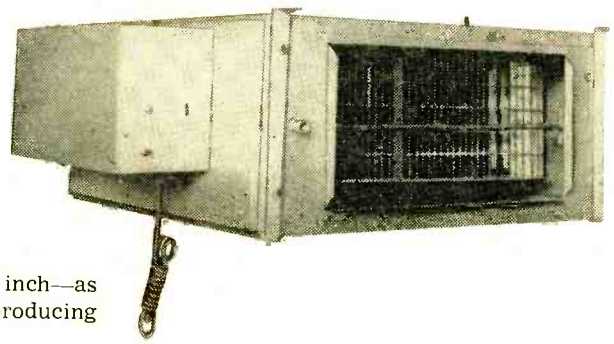
We learned to control the temperature of air, its humidity and its distribution. Now we're learning to clean it—electronically. At least half a dozen firms (Westinghouse, Dollinger and Air-Maze, Trion, American Air Filter, and Minneapolis-Honeywell) have already introduced electronic air cleaning systems to combat air pollution.

All airborne particles have the ability to



Dust-laden air flows through electronic air cleaner system as shown at left. Given a positive electrical charge, the dust particles become positive ions which are attracted to the negative collector plates. After being collected, the dust particles can be washed away by a water spray.

This home-sized unit, the Westinghouse Model PH-124, is designed to clean the air electronically in six rooms or less.



stain. But 50% of the stains are caused by particles smaller than three microns. These are particles too small to be removed by most conventional air filters. Present electronic air cleaning equipment can ionize and remove all known particles—including viruses—down to a thousandth of a micron in size. This is about 25 millionths of an inch—as small as any known disease-producing germ.

Electronic Air Cleaning. The application of a few basic laws of physics makes it possible for the electronic air cleaner to deliver a high-voltage knockout to every particle of dust and other foreign matter passing through it.

An atom, as any present-day schoolboy can tell you, consists of a positively charged nucleus surrounded by negative electrons. As dust atoms flow into the electronic air cleaner, they pass through a 13,000-volt electrostatic "field." Here they receive a positive charge. This overbalances the negative charge surrounding the atom and makes it a positive ion.

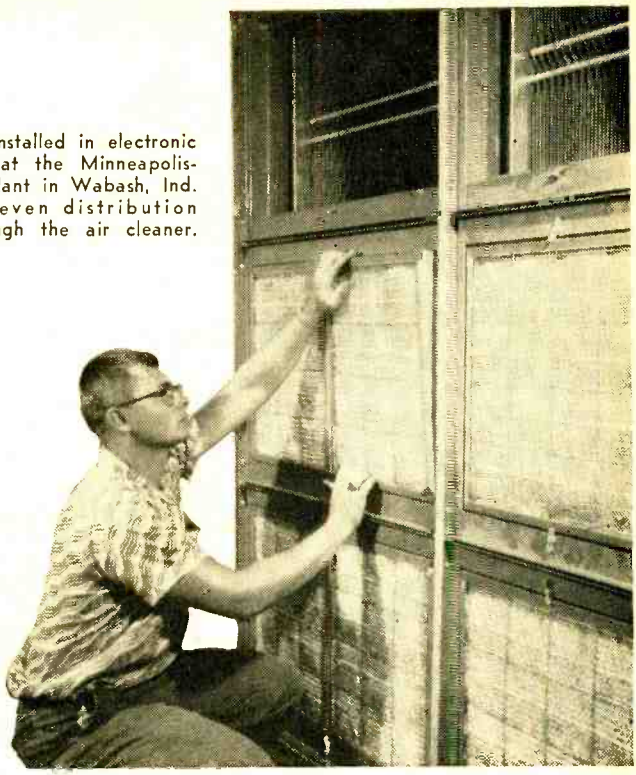
According to physical law, like electrical charges repel each other; opposite charges attract each other. Thus, the positive-charged ions are attracted to negative-charged collector plates. After being collected on the negative plates, the dust particles are automatically washed away by a water spray.

Advantages over Filters. Despite the proven efficiency of electronic systems, two factors have held up their broad-scale adoption until recently. First, and perhaps most basic, the need for really clean air has not been sufficiently recognized. Certainly it hasn't been dramatized as has the problem of water pollution, except, of course, in special regional instances.

Also, it's been fairly easy to sell inexpensive devices to filter the air. Since these devices get quite dirty and have to be replaced from time to time, the average consumer figures that they are doing a good job. But filters perform as their name indicates: they filter the air; they do not clean it.

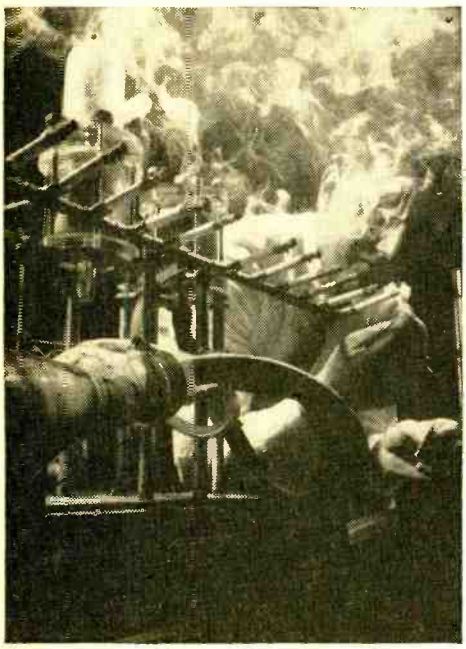
Further, although electronic air cleaning is not a new idea, it wasn't until a short time ago that prices were brought low enough to make it practical to put such equipment to work solving air cleaning problems. Prices for home-sized units start at about $350 and range up to over $8000 for high-efficiency commercial systems.

Because of the newness of such equipment, little economic data has been gathered that compares the operating costs of electronic air cleaners with mechanical filter types of air conditioning. One big advantage of electronic units, however, is that they do not require replacement; they are designed to last the lifetime of the buildings in which they are installed. Me-



Dry filter installed in electronic air cleaner at the Minneapolis-Honeywell plant in Wabash, Ind. It provides even distribution of air through the air cleaner.

"Robot lung" in a Minneapolis-Honeywell research project smokes 12 cigarettes at once. Test results are used in the design of new air cleaners.



chanical units require periodic replacement of filters.

High Cost of Dirt. The real economics of electronic air cleaning come to light when you consider the high cost of dirt in office buildings, stores, hotels, apartments, banks, insurance companies, and other commercial and industrial establishments.

For example, the Northwestern National Bank of Minneapolis spends $12,500 a year just to have the inside windows of its office building washed. An additional $10,000 a year is required to pay for washing the interior of the walls.

In a study of 624 office buildings, it has been found that owners spend 57 cents per square foot per year to keep the rental space clean enough for occupancy. This represents 23% of the entire operating cost.

Soiled merchandise represents losses of from $100,000 to $500,000 in department stores even though dust covers are placed over all goods every night. Macy's, Bloomingdale's, and Saks Fifth Avenue in New York, as well as some leading department stores in other parts of the country, have installed electronic air cleaners to reduce these losses.

Future Prospects. Minneapolis-Honeywell foresees an annual market of $90,000,000 in electronic air cleaning in three years. It would seem that this estimate is not an unrealistic one. For reasons of health, as well as economics, electronic air cleaning should soon achieve a degree of consumer popularity equal to that now enjoyed by home air conditioners. -30-

Radar Target for Boats

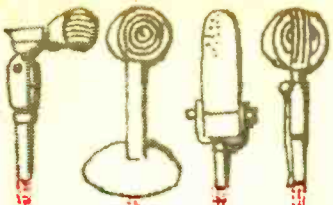
Small boats need no longer worry about being seen on a big ship's radar scope if they have one of the new radar targets being made by Reynolds Metals. The target, which should be hung on the mast, makes a big blip on a radar screen when the radar beam hits it from any direction.

Welding with Sound

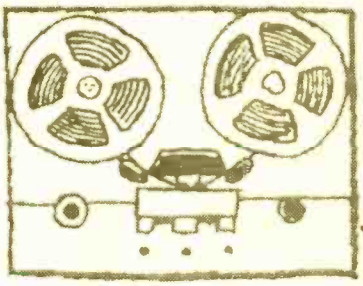
Sound waves, well above the upper limit of human hearing, are welding together two thin strips of aluminum in this experimental ultrasonic seam welder developed by Westinghouse. A continuous weld is formed by the two metal wheels which produce 20,000 vibrations per second. There is no heat —the ultrasonic waves fuse the strips directly together.

Electric Eye Spots Trucks

A photoelectric receiver spots "over-height" trucks at the entrance of the Lincoln Tunnel in New York City. Any truck over 13' high automatically breaks the pencil-thin pulsed beam, causing alarms to ring and traffic lights to turn red. The pulsed beam is synchronized to avoid tripping the alarm by reflected light.



One-Transistor Microphone Mixer

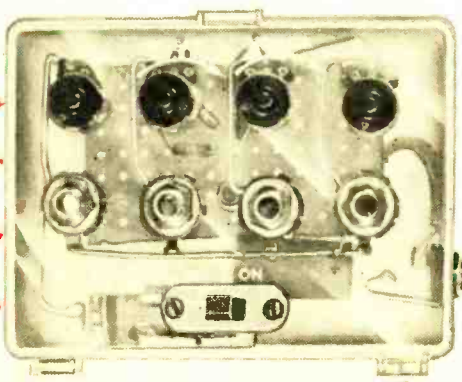


By
HERB COHEN

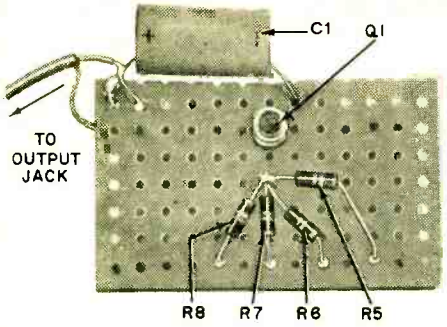
For tape recording fans— this simple mixer provides multiple inputs and wide frequency response

THE tape recording fan and hobbyist is often at a loss when he wants to feed more than one microphone into his recorder. Recording a small choral group or a guitarist who sings along with an instrument, for example, makes the use of two or more microphones mandatory. Professional microphone mixers, even for inexpensive recorders, sell for about $30 and up, and are sometimes hard to justify cost-wise because they are only used occasionally.

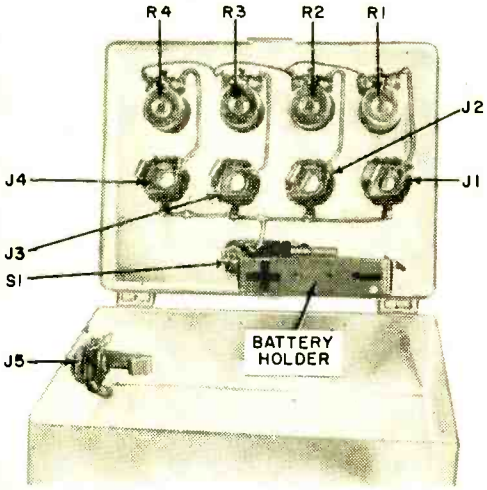
Problems encountered in designing a mike mixer are mostly ones of noise and control interaction. Both of these problems can be easily solved through the use of our old friend, the transistor. By employing a transistor with a low input impedance and having a very high resistance in series with each microphone input, almost perfect isolation between the input lev-



Rear view of completed mixer shown mounted in plastic case.



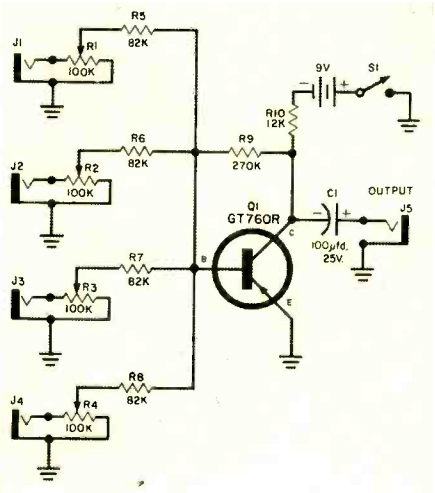
Phenolic board with Q1, C1 and series resistors ready for installation in cabinet.



Jacks and controls are mounted before installation of perforated circuit board.

PARTS LIST

B1—9-volt battery (RCA VS309 or equivalent)
C1—100-μfd., 25-volt tubular electrolytic capacitor
J1, J2, J3, J4, J5—Phone jack
Q1—GT760R transistor (General Transistor)
R1, R2, R3, R4—100,000-ohm miniature potentiometer
R5, R6, R7, R8—82,000-ohm, ½-watt resistor
R9—270,000-ohm, ½-watt resistor
R10—12,000-ohm, ½-watt resistor
Misc. transistor socket, cabinet, knobs, phenolic board



HOW IT WORKS

Each microphone "sees" its potentiometer, the 82,000-ohm series resistor, and the 1000-ohm input impedance of the transistor (*Q1*). Since the major voltage drop takes place across the 82,000-ohm resistor, the level at the input at the base of *Q1* is very small and interaction between the microphones is minimized.

Input signal mixing takes place in the base element of *Q1*. The transistor itself is used in the grounded emitter arrangement which provides the necessary low input impedance. *R9* is the base-biasing resistor.

Since a transistor in the grounded emitter mode provides a 180° phase shift between base and emitter, negative feedback occurs which enables a frequency response from 20 to 15 kc. ± 1 db. The 12,000-ohm collector load resistor is low enough to match to the input of any amplifier, yet large enough to give the over-all 5-db circuit gain.

Q1 is a *p-n-p* r.f. type with alpha cutoff of 3 mc. and very good noise characteristics.

el controls on the mixer can be obtained.

A moderately high input impedance suitable for most mikes is obtained by using an 82,000-ohm isolating resistor in series with each mike. This drops down the voltage appearing at the base element of the transistor (*Q1*), but no circuit problems are introduced. Because of the order of impedances involved and the characteristics of *Q1*, little noise or hum is encountered.

Although a small plastic case was chosen as the container for this mixer, almost any material could be employed. If you do use plastic, the mounting holes can be "drilled" very easily with a pencil-type soldering iron.

The circuit board layout is made with flea clips inserted into the phenolic board holes. Glue holds the transistor socket in place. The author's parts arrangement can be followed, or you can adapt the layout for your particular requirements.

Almost any number of inputs can be added by connecting a potentiometer and isolating resistor in the same manner that the present four inputs are connected. —30—

By
ANDREW MANDALA

CITIZENS BAND RADIO

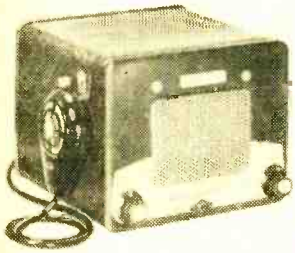
FCC ruling makes it easy to go on the air

POW! There goes your rear tire! And you've left your spare at the filling station to be repaired. What do you do now? Flag down a passing car? Not if you have a radio transceiver in your car. Just give the wife a ring and have her send Junior and his jalopy to the rescue.

But don't you have to be some kind of electronics whiz to operate a transmitter? And don't you have to pass tough FCC exams? Not any more. The FCC has recently set aside a special band of frequencies for use by any adult citizen, even if he doesn't know an ohm from an ampere.

Called the "citizens band,"

Equipment courtesy of
International Crystal Mfg. Co.



Gonset Model G-11

Motorola "Private-Line" Radio

Kaar Model FM/TR500

this band of frequencies can be used for any personal or business purpose. The breadwinner can radio his wife to get dinner ready as he drives home from work. The business man can contact the company's pickup truck and route it to the railroad station. Surveying parties can chit-chat instead of waving signal flags at each other.

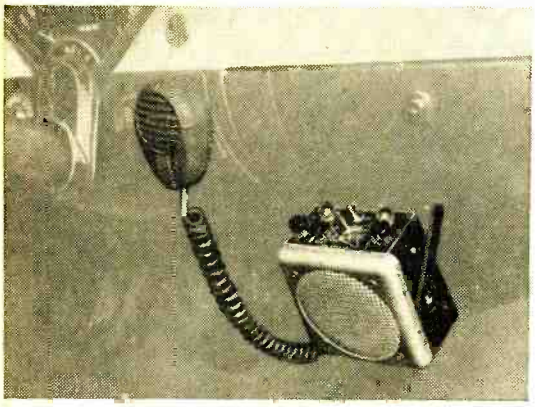
Licensing. All that's necessary to start using the citizens band is to get Part 19 of the Citizens Radio Service Rules, available for 15¢ in coin from Superintendent of Documents, Government Printing Office, Washington 25, D. C. (specify edition effective September 11, 1958). Read it, then apply to the FCC for Form 505, which must be filled out and returned. There's no code test or theory exam. Anyone who is a citizen and over 18 can apply.

There are four classes of service. Each class is assigned a frequency band and is intended for a particular purpose. Classes A and D are intended for personal communications only. Classes B and C are for radio-control fans. The frequencies, maximum power, and types of emission allowed under each class of service are given in the accompanying table. All classes except Class C may be operated as fixed stations.

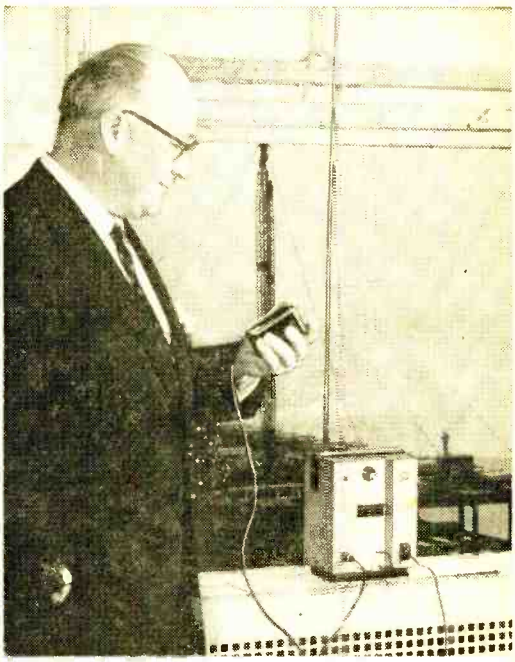
CITIZENS RADIO TRANSMISSION DATA*

Class of Service	Frequency (mc.)	Maximum Power (watts)	Types of Emission
A	462.55 - 463.20, 464.75 - 464.95 and 465.05 - 466.45 at intervals of 50 kc. Also available but subject to change: 460.05 - 460.95 at intervals of 50 kc.	60	FM and AM telephone only. Tone signals may be used to establish contact.
B	462.525 - 467 - 475 at intervals of 10 kc.	5	AM or FM. For remote control.
C	26.995, 27.045, 27.095, 27.145, 27.195 and 27.255. (Last frequency is shared with other services.)	5 (30 on 27.255)	AM tone or on-off carrier for remote control. May not transmit intelligence.
D	26.965 - 27.035, 27.005 - 27.085, 27.105 - 27.135, 27.155 - 27.185 and 27.205 - 27.225 at intervals of 10 kc.	5	AM radiotelephone only. Tone signals may be used to establish contact.

** Abstracted from FCC rules effective September 11, 1958*



A typical automobile installation using Communications Company, Inc., gear.



Designed for the citizens band, the RCA "Radio-Phone" offers low-cost radio communications to small businesses.

MANUFACTURERS OF CITIZENS BAND EQUIPMENT

Communications Company, Inc.
300 Greco Ave.
Coral Gables, Fla.

General Electric Company
Electronics Park
Syracuse, N. Y.

Gonset Division
Young Spring and Wire Corp.
801 South Main St.
Burbank, Calif.

International Crystal Mfg. Co.
Oklahoma City, Okla.

Kaar Engineering Corp.
2995 Middlefield Rd.
Palo Alto, Calif.

Motorola Inc.
4501 West Augusta Blvd.
Chicago 51, Ill.

Radio Corporation of America
Industrial Electronic Products
Camden 2, N. J.

Springfield Enterprises
P.O. Box 54
Springfield Gardens, N. Y.

Vocaline Company of America, Inc.
Old Saybrook, Conn.

Class C is for mobile use only, and licenses are available to twelve-year-olds and older.

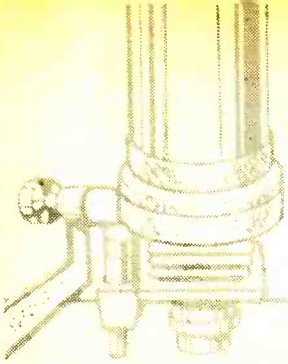
Most citizens service units are transceivers, with the transmitter, the receiver, and power supply all being housed in one unit. The transmitter must be approved by the FCC; therefore, the transmitter or transmitter subassemblies should be obtained from a manufacturer who has received FCC approval. The only exception to this rule is that a home-built transmitter may be operated as a Class D station provided it is crystal controlled and the maximum input power is 5 watts or less; the crystal frequency tolerance should be 0.005% or less.

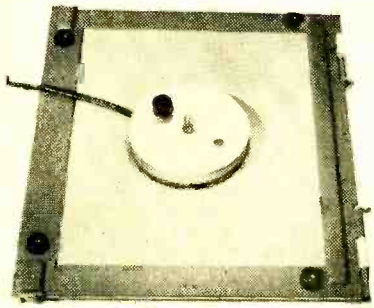
Some of the manufacturers who make citizens band equipment are listed at left. Transmitters are available from under four dollars for Class C radio-control units to several hundred dollars for top-notch Class A installations.

Antenna Requirements. The location and height of citizens service radio antennas must comply with FCC regulations. With the exception of Class A, the maximum permissible height of an antenna may not be more than 20 feet above a man-made structure. In addition, if the antenna is more than 170 feet above ground level, FCC Form 401 must be filled out. For Classes B, C, and D, the antenna's farthest point cannot be more than 25 feet from the transceiver.

Since a 20′ antenna would be impractical for car use, any installation in a car would meet FCC requirements. —30—

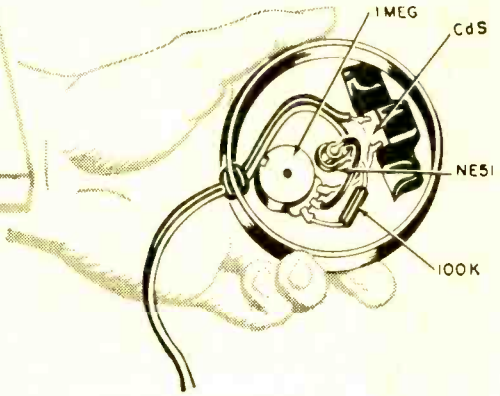
Inexpensive Photoprint Meter





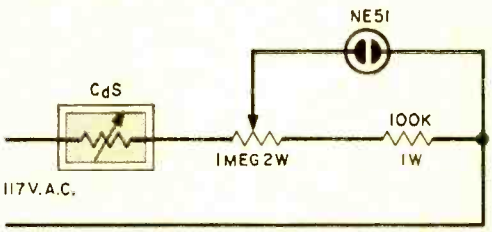
A darkroom time saver

By G. A. WESENFELD



THE DARKROOM TECHNICIAN who turns out hundreds of photo enlargements each day usually has no trouble in estimating exposure times. The "occasional" photo printer, however, loses the feel of the work and ends up by wasting time and test strips. Both can be saved, of course, with one of the commercially available printing exposure meters, but the part-time photographer finds their cost hard to justify.

The neon-bulb unit described in this article is the answer to the photo hobbyist's problem. Simple to construct, inexpensive, and yet quite accurate, it will prove a valuable tool for any "bathtub" photo processer.



Simple Circuit. The circuit consists basically of a cadmium sulphide photocell (Powermaster CdS photocell or Clairex CL-2) in series with a 1-megohm potentiometer and a 100,000-ohm fixed resistor. Connected in parallel with the fixed resistor and the slider contact on the potentiometer is a NE51 neon lamp.

A discarded tape can was used as a housing; a small plastic or wooden box would also be satisfactory. Positioning of the parts is not critical. Holes must be drilled to accommodate the pot, the neon bulb, and the photocell. The neon bulb mounting can be made through a rubber grommet. No socket need be used for it and the wires can be soldered to the contacts on the bulb base. The photocell can be taped into place under the hole. All exposed wires should be taped to prevent shorting to each other and to the metal can.

Calibration. Make a good print from a normal negative and make a note of the exposure time; then, without changing any of the conditions, place the photocell under the area of the projected image where you got a good black on your test print. Now

(*Continued on page* 100)

NOVICES
LET'S GO GENERAL

Here are some tips on training for that General exam

. . . determined effort is rewarded by those extra QSL's

By DWIGHT CROSS, KØCZU

ROCK-BOUND and frustrated, we have battled the QRM of the Novice bands. But there is the wistful dream of the promised land—green pastures of uncrowded kc.'s, the freedom of VFO, and the chance to enrich the ether with one's own voice. Phone and c.w. unlimited—who could wish for more than the General ticket?

Well, OM, like most dreams, much of it is an illusion, but there is enough reality to make that General worth working for.

Licking the Theory. Although more aspirants flunk the code than the theory during the General examination, many fellows have hurdled the c.w. obstacle—and then met with real heartbreak. Ohm's law, a few diagrams, and transmitter fundamentals have thrown three perfect strikes. Don't let it happen to you.

I doubt if anyone can memorize the ARRL License Manual word for word and pass the test. The questions are multiple choice and maybe you can guess a few, but the License Manual's real value is *as a guide*. For example, suppose you memorize the formula for frequency; unless you un-

derstand the theory behind it, the mere formula is not enough. You may meet up with one question which requires you to explain the change in frequency if either inductance or capacitance varies. You will be called on to use logical deduction which only a thorough knowledge of the theory can give you.

It is much easier to memorize the diagrams if you know the theory which they represent. Then, too, the test may ask for just a part of a diagram. If you don't understand the whole critter—how are you going to butcher him?

Practice drawing the diagram while studying transmitter theory and use Ohm's law with problems until it becomes second nature. Use the License Manual as a road map. The Radio Amateur's Handbook is an excellent reference and it is a good idea to have the page which contains the information noted opposite each question in the License Manual. This provides you with a systematic way of review.

A number of questions (enough to fail you) ask about the FCC regulations governing amateur radio. These are covered in the License Manual and are based on common sense—but don't take them for granted. A friend of mine missed the question which asks how long a log book should be preserved. Save your misses for the difficult questions.

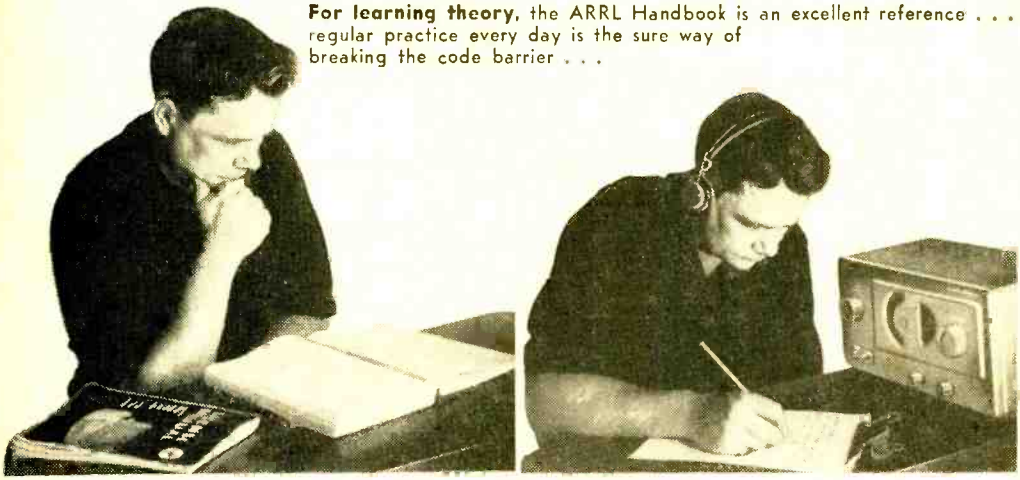
Breaking the Code Barrier. While preparing for the theory examination, work hard on the code. Gazing fondly on a small piece of paper tacked to the wall of the shack, I can forget the discouragement which came with every hump. During an entire month, I was satisfied that I would never copy faster than 8 words per minute. Then, at 11 words per minute, the line suddenly gave way. I ran the ball to 16 words per minute in three weeks. OM, it will happen to you too.

Hindsight is much better than foresight; I am certain that these humps were my own fault. As the conscious mind cannot react fast enough, you copy c.w. with your subconscious mind. The subconscious mind is likely to rebel if it is pushed too hard. I did this with lengthy practice sessions. During long periods, I found that characters interchanged their meaning and became confused. Instead of learning, I actually slipped back. Fifteen to thirty minutes of regular practice *every* day is effective. Three hours practice once a week is practically useless. Approach the code with determination—but don't fight it.

On-the-job training in the Novice bands provides excellent practice. First, you copy code through the most difficult QRM which you will ever hear. When you listen to the clean signal before the FCC examiner a few months later, it will seem clear by comparison. Secondly, the subconscious mind readily accepts a skill which you are *using*. You and the ham a few hundred miles away are exchanging ideas. The code is unconsciously forgotten—you are too busy trying to hear what the guy has to say.

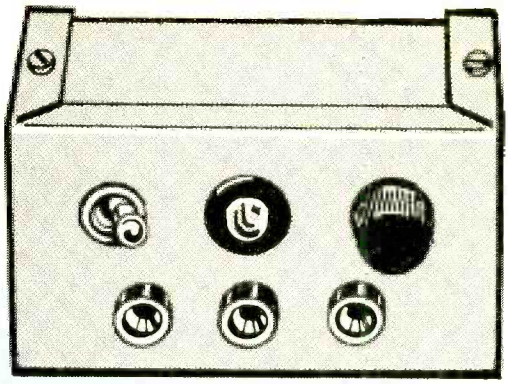
However, don't depend on practice in the

(*Continued on page* 113)



For learning theory, the ARRL Handbook is an excellent reference . . . regular practice every day is the sure way of breaking the code barrier . . .

By PHIL E. SHIPE



Build this Multi-Purpose Checker

THIS CHECKER is handy both on the test bench and in the tool kit. It serves mainly as a capacitor leakage checker and a B-battery eliminator. It can also be used as a continuity checker, a substitution capacitor, and for a.c. or d.c. voltage check. Cost of components should be under $5.00.

Capacitor Checker. Plug in the a.c. line cord, then place the leads in jacks *J1* and *J2*. When the capacitor to be tested is connected between these leads, the neon bulb will indicate if the capacitor is open, shorted, or to what extent it is leaking.

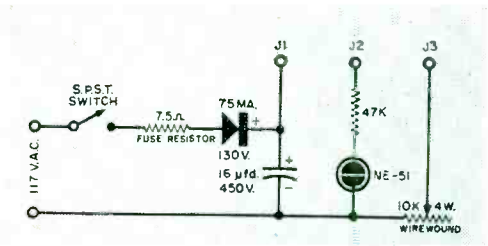
If the capacitor is good, the bulb will blink once every three or four seconds. If the capacitor is bad, the light will blink rapidly; the more leakage, the faster the rate. An open capacitor will cause no reaction and a shorted capacitor will cause the light to come on and stay on. The checker will check 1-μfd. to .001-μfd. units satisfactorily. Through use, you will learn to judge a good capacitor from a bad one.

B-Battery Eliminator. With the leads in *J1* and *J3*, turn the wire-wound potentiometer to the low-voltage end. *J1* is positive and *J3* negative. You should meter the B-plus output when setting the pot. Voltages between 22½ and 90 volts can be obtained by proper adjustment.

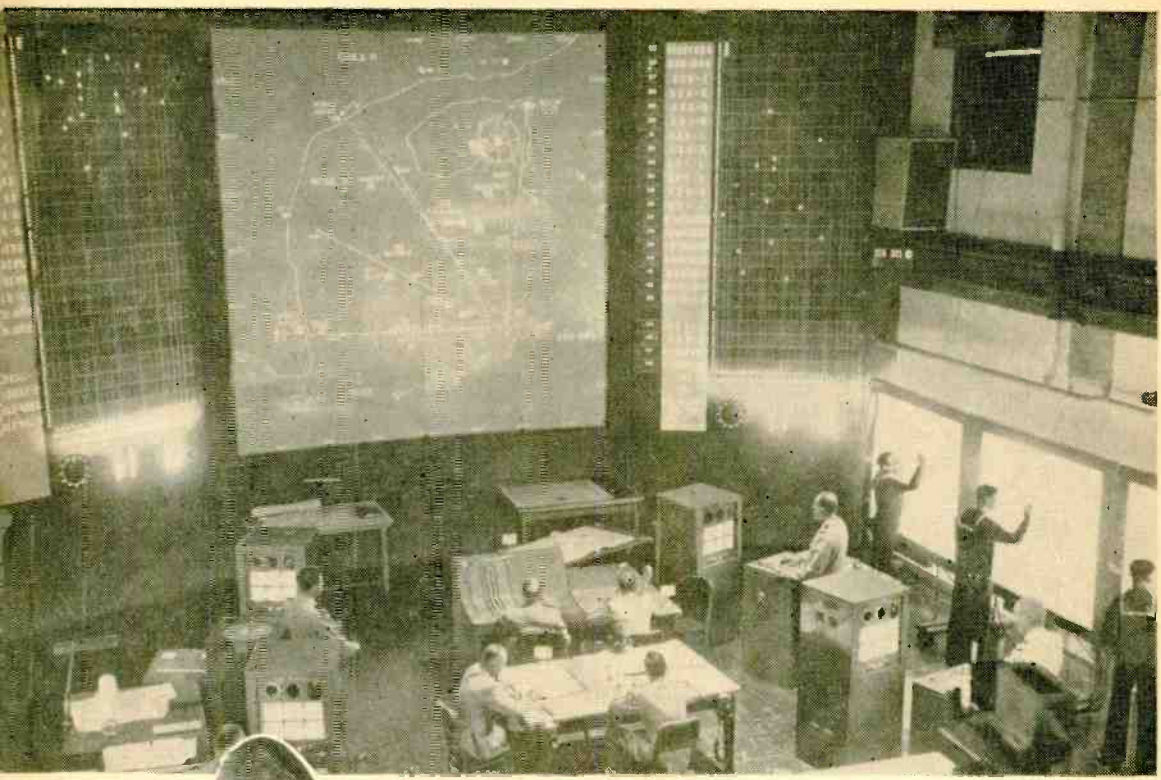
Voltage Checker. Remove a.c. line cord from wall socket. With the test leads in *J2* and *J3*, put the leads on the test points. On a.c., both poles of the neon bulb will light. On d.c. only one pole will light. The checker will not check voltages lower than 90 volts.

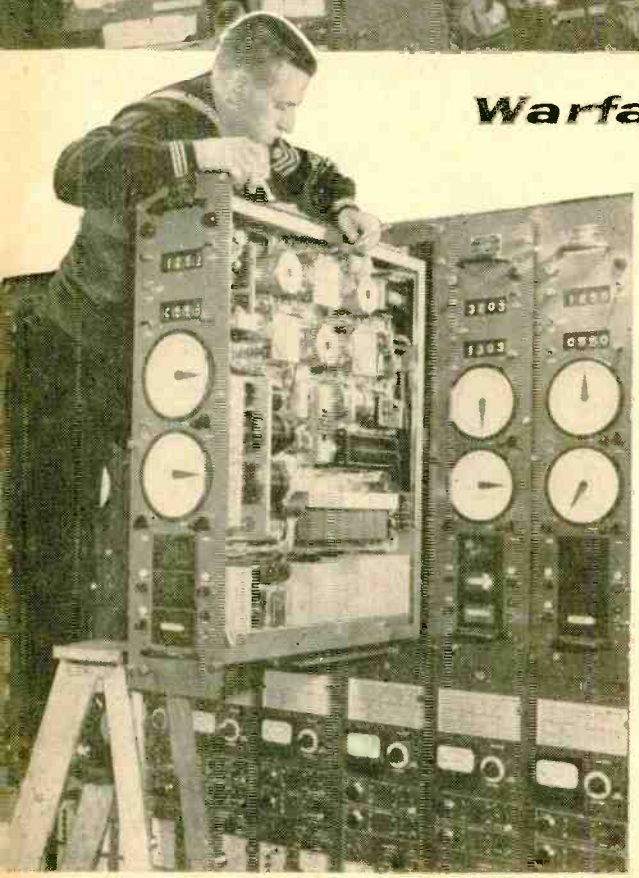
Continuity Checker. Plug in the leads in *J1* and *J2*. When the test leads are shorted together, the neon lamp will light. Now put the circuit under test between these leads. If the light comes on, the circuit is complete; if the light does not come on, the circuit is open. Resistances of several megohms will cause the lamp to glow dimly.

Substitution Capacitor. Remove a.c. line cord from wall socket and place test leads in *J1* and *J3*. The pot should be set to the "no-resistance" position. *J1* is the positive lead and *J3* the minus lead. The 16-μfd., 450-volt capacitor is suitable for test shunting almost any electrolytic. —30—



If a metal cabinet is used in construction, insulate all jacks and do not use a chassis ground.



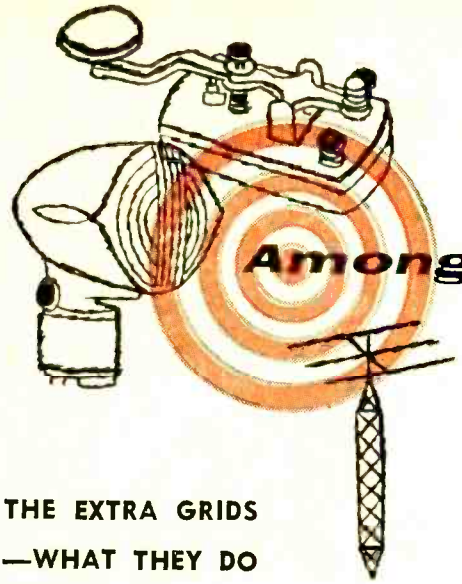


Warfare Simulator Fights Mock Battles

ANOTHER milestone in the electronic age has been reached with the installation of the U.S. Navy Electronic Warfare Simulator (NEWS) at the Naval War College in Newport, R.I. The NEWS consists of an extensive complex of computers, radar units, and other equipment. Ships and aircraft may be moved about like chessmen as naval commanders evaluate different battle plans. Photo at top shows master control room where progress of the "battle" is followed; technician at left is adjusting part of the complicated mechanism. —30—

Official U. S. Navy Photos

By
HERB S. BRIER
W9EGQ



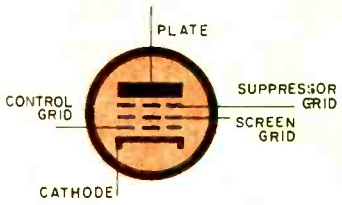
Among the Novice Hams

THE EXTRA GRIDS —WHAT THEY DO

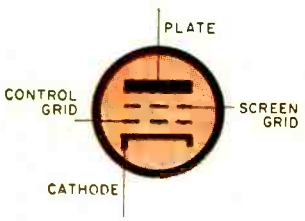
IN the January *Among The Novice Hams,* we learned why it is necessary to neutralize the grid-to-plate capacitance of a triode radio-frequency amplifier to prevent self-oscillation. Otherwise, a transmitter may operate out of its band. In a receiver, lack of neutralization results in low receiver sensitivity and uncontrolled squeals and whistles. Now let's talk about tubes that do not require neutralization in r.f. amplifier circuits.

Screen-Grid Tubes. By placing a second grid, called the *screen grid,* between the plate and the control grid of a triode, a *tetrode* or four-element tube is produced. If the screen grid is grounded, it acts as a "Faraday" or electrostatic shield and reduces the control-grid-to-plate capacitance to such a low value that it does not require neutralization in most cases to prevent oscillation in r.f. amplifiers.

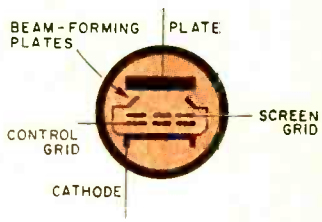
In operation, the screen grid is not actually grounded, but it is connected to ground through a bypass capacitor. The screen grid is effectively connected to a.c. ground. However, the screen grid is connected *directly* to a d.c. voltage source. This d.c. voltage attracts the electrons passing through the control grid to the screen grid. But, when they reach the screen grid, they are going so fast that most of them zip through the screen grid and on to the positive plate. A few electrons do strike the positive screen wires, resulting in a small screen current, usually 10% to 20% of the plate current.



PENTODE



TETRODE

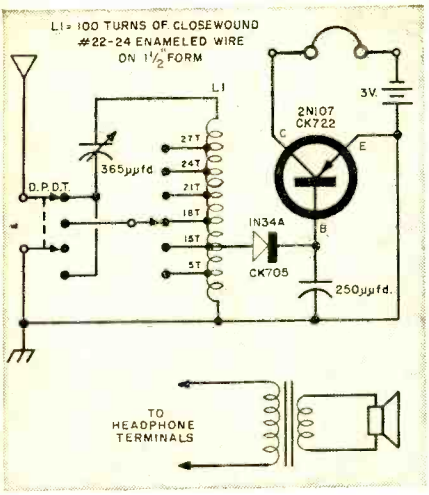


BEAM POWER

Schematic symbols for three common types of multi-grid tubes.

Besides eliminating the external neutral-

(*Continued on page* 114)



Pick Your Tuning Circuit

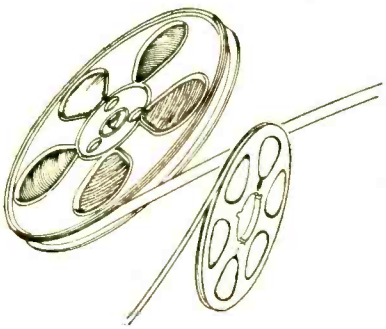
Many hobbyists have built simple transistor crystal diode receivers and then have been annoyed at their lack of selectivity. It often happens that one or two strong local stations blanket the whole band. You can increase selectivity by adding a special type of tuned circuit in the receiver front end.

A tapped antenna coil has been used in the past to improve selectivity—the coil provides a better match to the diode detector, prevents loading the tuned circuit with subsequent lowering of the *Q*, and thereby increases selectivity. Another technique for increasing selectivity is the use of a series circuit similar to those found in World War II receivers.

The diagram shows a circuit which employs both of these methods. A simple d.p.d.t. switch—slide, rotary or toggle—allows flipping to whichever circuit gives the best reception. Adding a small output transformer will permit the use of a speaker if there is a strong station nearby.

—W. G. Eslick

Tips on Tape Timing



Thanks to the new super-strength plastic Mylar, recording tapes can now be made both thinner and stronger. The thin tape pays off to the tape recording hobbyist with more playing time on the same size reel. Using double-time tape, an hour's worth of Bach or Brubeck can be recorded at 7½ ips on one track of a 7" reel with no reel-flipping or other interruptions necessary. Here's a handy tape timing chart which will simplify the job of estimating playing time for the new time-and-a-half and double-time tapes. The times listed are for a single track only. If your machine has dual track heads, the recording time available is doubled.

—Ken Laurence

REEL SIZE	STANDARD TAPE			TIME AND A HALF			DOUBLE TIME		
Inches	*Feet*	*3.75 ips*	*7.5 ips*	*Feet*	*3.75 ips*	*7.5 ips*	*Feet*	*3.75 ips*	*7.5 ips*
3	150	8 min.	4 min.	225	12 min.	6 min.	300	16 min.	8 min.
4	300	16 min.	8 min.	450	24 min.	12 min.	600	32 min.	16 min.
5	600	32 min.	16 min.	900	48 min.	24 min.	1200	1 hour	32 min.
7	1200	1 hour	32 min.	1800	1½ hours	48 min.	2400	2 hours	1 hour

Test Instruments

Part 3

Radio Repair with

THE VOLT-OHM-MILLIAMMETER

IN OUR LAST two installments (Jan. and Feb. 1959), we "dissected" a standard volt-ohm-milliammeter into its basic functions and ranges. Now let's reinstall the components in the black Bakelite cabinet, and have the VOM start earning its keep. Let's fix a radio!

"All-American Five." The basic circuit design of the five-tube a.c./d.c. superheterodyne receiver has remained unchanged for about 20 years. Back in the middle thirties people listened to "Myrt and Marge" and "Easy Aces" on the first of the a.c./d.c. superhets. The tube line-up ran something like this—there was a 6A7 oscillator/mixer, a 6D6 i.f. amplifier, a 75 detector/audio amplifier and a 43 output pentode. The rectifier was usually a 25Z5. The set had a ballast tube or resistance-type line cord which some thought convenient for warming their feet at night.

A few years later the war started in Europe and people were listening to the news and the Andrews sisters on compact plastic-cased sets, some with built-in loop antennas, some still trailing five or six feet of antenna wire. Octal-based tubes appeared with 12-, 35-, and 50-volt filaments. The line-up now was a 12K8 (or 12A8), a 12K7, 12Q7, 50L6 and 35Z5. The grid caps of the tubes disappeared, and the new receivers that told the news of Pearl Harbor each had a 12SA7, 12SK7, 12SQ7, 50L6 and a 35Z5.

Tube line-ups that you're apt to encounter are listed in Table 1. Of course, you'll find some older "hybrid" sets with combinations of octal and 6- or 7-prong tubes, but the general groupings will be as given. The schematic of a typical a.c./d.c. receiver is shown in Fig. 10. (See previous issues for Figs. 1 through 9.) Octal tubes are used throughout, but the circuit itself is practically unchanged from that used during the middle thirties.

Why all the past history? Well, there are a number of these older a.c./d.c. radios around. Lots of them are still in working or semi-working condition. And if you get familiar enough with the basic circuit of the "All-American Five" type receiver, you should be able to handle repairs on any of these sets with ease.

Now let's get back to the a.c./d.c. repair that's been waiting quietly on our test

By LARRY KLEIN
Technical Editor

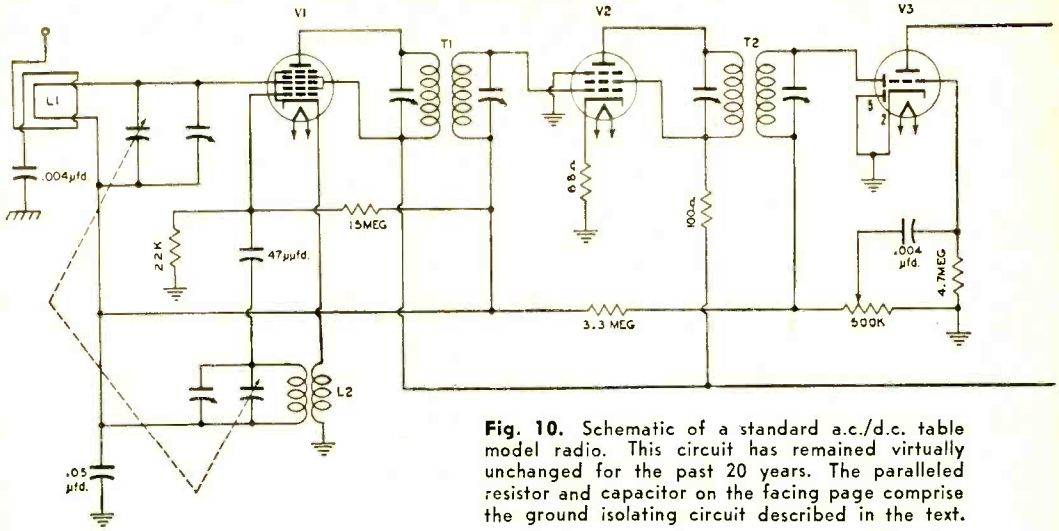


Fig. 10. Schematic of a standard a.c./d.c. table model radio. This circuit has remained virtually unchanged for the past 20 years. The paralleled resistor and capacitor on the facing page comprise the ground isolating circuit described in the text.

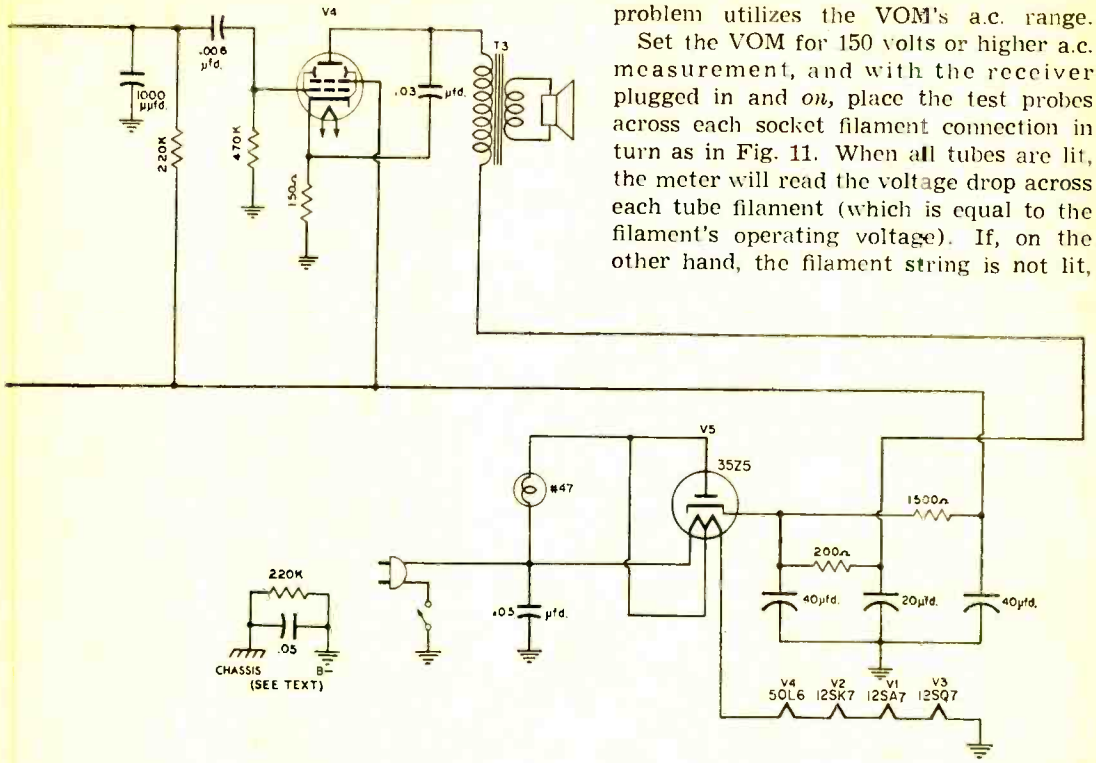
bench. We've taken the radio chassis out of its cabinet and blown away the accumulated dust. What's our next step? Well, that depends on how careful we want to be. It is a good idea when working with an a.c./d.c. chassis to check which way the line cord and hence, the chassis, is polarized when plugged into the 117-volt a.c. line.

Cooling a Hot Chassis. Set your VOM to the 150-volt (or higher) a.c. scale. Now plug in the radio and make sure it's switched *on*. Touch one test probe to the metal chassis of the set and the other to a good external ground such as a cold water pipe. Note the meter reading, if any. Then reverse the radio's line plug in the a.c. outlet, and take another meter reading between external ground and radio chassis. One reading will be substantially lower than the other—and that's the one we want. Leave the receiver plugged in that way. We've just gotten started and the VOM may have saved your life already, that is, if you tend to be careless and have a well-grounded washing machine or waterpipes around your basement test bench.

Now that we've got the set plugged in (the safe way) and turned on, let's see what it does. If the answer is nothing—the tubes don't light—then the odds are

Table 1. Chronological listing of the "All-American Five" tube line-up.

Oscillator/ Mixer (*V1*)	I.F. Amplifier (*V2*)	Diode Detector/1st Audio Amp. (*V3*)	Power Output (*V4*)	Rectifier (*V5*)	Comment
6A7	6D6	75	43	25Z5	All of these tubes are 6- or 7-prong types, with .3-amp. filaments. Receiver includes ballast tube or resistance line cord.
6A8	6K7	6Q7	25L6	25Z5	First of the octal-based tubes. V1, V2 and V3 had grid caps.
12A8 12K8	12K7	12Q7	50L6	35Z5	Filament string now totals 121 volts — no more line cords or ballast tubes.
12SA7 7A8	12SK7 14A7	12SQ7 14B6	50L6 50A5	35Z5 35Y4	The "S" in V1, V2 and V3 means "single-ended" — no more cracked-off grid caps. The A and B designations indicate loctal tubes.
12BE6	12BA7	12AT6 12AV6	50C5 50B5	35W4	Seven-pin miniature tubes used to save space. Almost all present-day models use this line-up.



problem utilizes the VOM's a.c. range.

Set the VOM for 150 volts or higher a.c. measurement, and with the receiver plugged in and *on*, place the test probes across each socket filament connection in turn as in Fig. 11. When all tubes are lit, the meter will read the voltage drop across each tube filament (which is equal to the filament's operating voltage). If, on the other hand, the filament string is not lit, that there's a tube with an open filament in the set. We have a choice of two techniques, using the VOM, for locating the culprit. The first and most common technique is simply to "pull" the tubes one by one and check for filament continuity. Set your VOM to the lowest ohmmeter range and take a measurement across the filament pins of each tube. Your tube manual is a reliable guide to the different tube basing arrangements used.

It's a good idea, if the radio's pilot lamp is burned out, to check the pilot bulb tap of the rectifier tube's filament. For if a replacement bulb is installed and the pilot tap of the rectifier is open, the new bulb may have one blaze of glory when the radio is turned on and then shine no more. Set the ohmmeter to the low range and check between all *three* rectifier filament terminals to be sure.

A.C. Continuity Check. The second approach to the open filament problem is justified only by special circumstances. Occasionally you'll come across a tube which checks *Good* cold, but as it heats up in a set the internal elements of the tube flex and the filament opens. The trouble-shooting technique for this type of open filament the voltage drop across the good tubes will be zero. However, when the test probes are placed across the open tube filament, full line voltage will be read by the meter. A recheck of Fig. 11 will indicate why this occurs.

Checking for other open connections in the filament string is also facilitated by the a.c. continuity check. A defective volume control switch or an intermittent socket connection can be tracked down easily with the same technique used for pinpointing an intermittent filament.

Assuming that the bad tubes and/or pilot

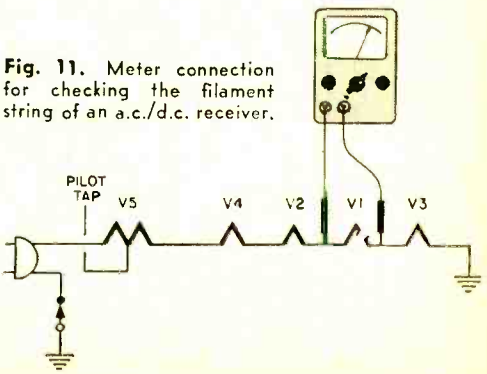
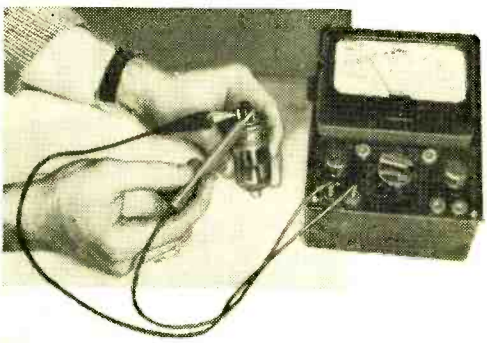


Fig. 11. Meter connection for checking the filament string of an a.c./d.c. receiver.

lamp have been replaced, we are ready to go on with the rest of our trouble-shooting. We have the test radio plugged in, the switch is on, the tubes light . . . but the only sound we hear is a slight hum from the speaker. Where do we go from here? Most technicians at this time would check the B+ voltage; but before we do, let's make sure we know what points we are going to check between.

In transformer-operated or straight a.c. radios, voltage measurements are invariably taken between a circuit point and chassis. The chassis is the "ground," or as it is sometimes known, the "B− return." A.c./d.c. receivers, on the other hand, *may* have a chassis ground, but most later models will usually have an arrangement like that shown in Fig. 10.



In checking out a tube filament with an ohmmeter, you'll find it convenient to have an alligator clip installed on the end of the negative meter lead.

The Floating Ground. As can be seen from the schematic, the radio's ground return is "floating" and is connected to chassis via a parallel resistor and capacitor. (We'll not go into the reason for this arrangement except to say that the object of it—complete elimination of shock hazard—is seldom achieved.) If in doubt as to the proper ground spot for connection of the negative lead of the VOM, the filter capacitor's negative lead is usually a good bet as a ground point to clip your meter lead to.

Set the VOM for a range of about 150 volts d.c. and connect the test leads between ground and the cathode of the rectifier tube (*V5*). The meter reads 70 volts, which is somewhat lower than the normal 95-130 B+ volts. Could the rectifier tube be weak? A quick check is made by substituting a new tube. There is no improvement. The low B+ voltage must be due to excessive current being drawn from the tube. Excessive current drain, in turn, is usually due to a short to ground somewhere in the B+ line.

Now we'll use the VOM as an "electronic bloodhound" to track the B+ voltage through the various paths until we find where it takes a short-cut to ground. Each time B+ goes through an isolating or plate resistor, the voltage falls somewhat. But you can always tell when you're at the exact location of the short because the voltage will have fallen radically between the last check point and the grounded point.

We have already measured 70 volts B+ voltage at the cathode of *V5*. Referring to Fig. 10 again, we find that the B+ path branches out, one path leading through a 1500-ohm resistor, the other through a 200-ohm resistor. A d.c. voltage measurement taken at the junction of the 20-μfd. filter capacitor and the 200-ohm resistor shows a drop to about 40 volts. A VOM reading taken at the junction of the 1500-ohm resistor and the second 40-μfd. filter capacitor shows 55 volts—much less of a voltage drop.

We now have a clue! The greater voltage drop across a mere 200-ohm resistor indicates quite a bit of current flow through it. The B+ path from the 20-μfd. filter capacitor up through the output transformer (*T3*) seems to be the road to investigate. A quick d.c. measurement of the plate voltage of *V4* reveals that there isn't any—the B+ is shorted to ground right in this area. But how do we isolate the guilty component?

The Suspects. There are three likely candidates that could cause the short: transformer *T3*, tube *V4* and the .03-μfd. capacitor. Turning the radio off (an ohmmeter measurement is *never* made with power in the circuit under test), we set the VOM to its lowest ohmmeter range and take a reading between the plate of *V5* and ground. The low resistance confirms what the voltmeter has already indicated—this is the point of the short circuit. Removing *V5* from its socket doesn't change the ohmmeter reading, so we deduce that the tube is not responsible for the short. The suspects we have left are *T3* (whose primary winding may be shorted to ground) and the .03-μfd. paper capacitor. The quickest way

(*Continued on page* 100)

The Vertical Makes a Comeback

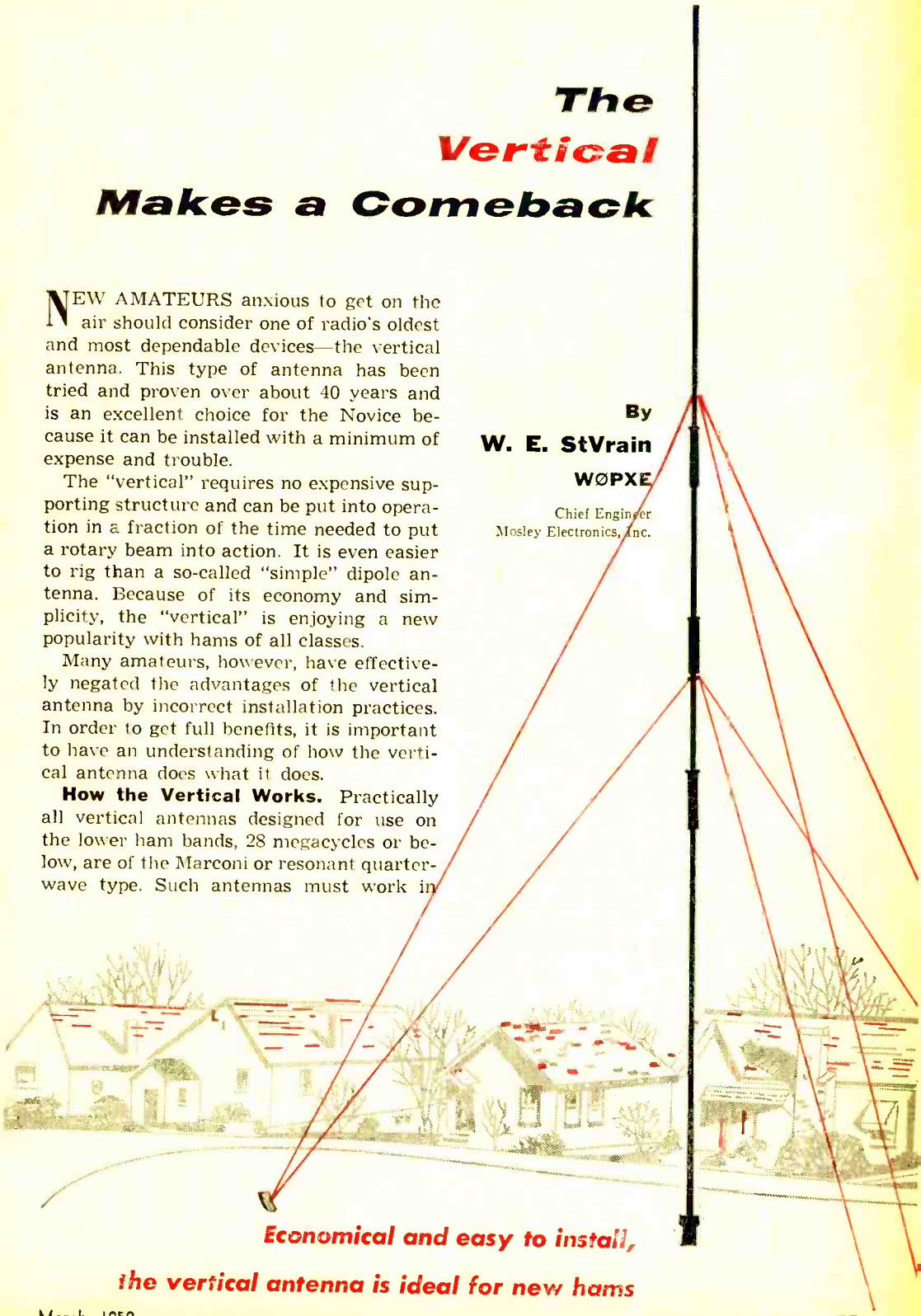
By
W. E. StVrain
WØPXE
Chief Engineer
Mosley Electronics, Inc.

NEW AMATEURS anxious to get on the air should consider one of radio's oldest and most dependable devices—the vertical antenna. This type of antenna has been tried and proven over about 40 years and is an excellent choice for the Novice because it can be installed with a minimum of expense and trouble.

The "vertical" requires no expensive supporting structure and can be put into operation in a fraction of the time needed to put a rotary beam into action. It is even easier to rig than a so-called "simple" dipole antenna. Because of its economy and simplicity, the "vertical" is enjoying a new popularity with hams of all classes.

Many amateurs, however, have effectively negated the advantages of the vertical antenna by incorrect installation practices. In order to get full benefits, it is important to have an understanding of how the vertical antenna does what it does.

How the Vertical Works. Practically all vertical antennas designed for use on the lower ham bands, 28 megacycles or below, are of the Marconi or resonant quarter-wave type. Such antennas must work in



Economical and easy to install, the vertical antenna is ideal for new hams

conjunction with a good ground or counterpoise system that will supply the other quarter-wave, thus completing the dipole antenna.

As shown in Fig. 1, when the antenna is made one-quarter wavelength, point Z will have an impedance of approximately 50 ohms. By connecting a 52-ohm coax line at this point, a good match of line to antenna

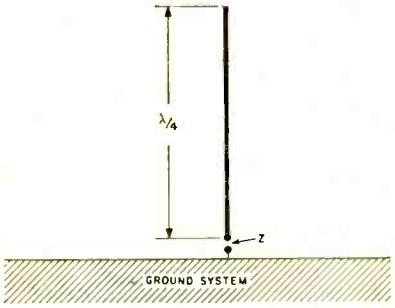


Fig. 1.

is achieved over a considerable portion of a particular band. This is accomplished without the use of tuning coils or other matching devices.

To make an antenna of this type operate on more than one band, the electrical length can be adjusted by installing parallel-resonant traps at the proper points to cut the antenna *electrically* at one-quarter wavelength. Such traps offer a very high impedance at or near resonance, and act as insulators placed at the end of the one-quarter wavelength point for each band.

In Fig. 2, for example, if Trap A is tuned to 28 mc., Section 1 is made one-quarter wavelength at 28 mc. Trap A has "disconnected" the upper sections of the antenna and they do not operate on 10 meters. To make the antenna work on the 15-meter band, the Trap A coil, the section of antenna to Trap B, and Section 1 combine to make a one-quarter wavelength. This entire section of the antenna is designated as Section 2.

These traps and antenna sections can be continued in the same manner to the limit of mechanical practicability and coil design. Section 4 in Fig. 2 includes the inductance of all coils and the top antenna section for an equivalent one-quarter wavelength at the lowest frequency.

Antenna Location. The best location for a vertical antenna is on the ground; the

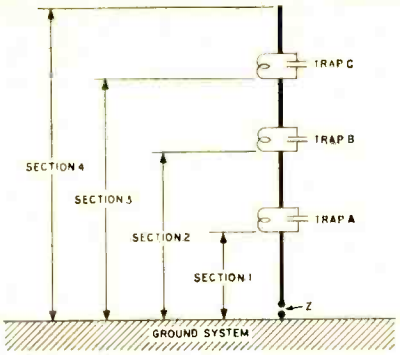


Fig. 2.

closer to the ground, the better! In fact, ground that is *low* in relation to surrounding terrain provides the best results. This is contrary to the usual idea of getting the antenna as high as possible for optimum transmission.

Low ground is desirable because it is usually damp and offers lower resistance than dry ground. Since the ground is part of the antenna system, the performance of the antenna is greatly dependent on this low resistance.

As the angle of radiation of a vertical radiator is not affected so much by its height above ground as by its effective electrical length, maximum sky-wave can be achieved with vertical radiators of one-quarter wavelength. Maximum ground-wave, on the other hand, results when radiators that are five-eighths wavelength are used.

The bottom of the antenna must be within a few inches of the effective ground so a 52-ohm coax line can be connected at that point. If the antenna were mounted higher, an appreciable length of wire would be needed to make the ground connection. Since this length would become part of the antenna, the one-quarter wavelength would not be at the proper resonant frequency and the antenna would not work as intended.

Of course, the ground system can also be suspended in the air—as with a *ground plane*—but this is usually impractical on the lower amateur frequencies. Moreover, the angle of radiation remains the same since the ground plane counterpoise is, in effect, the same as the actual ground.

Installation of a vertical antenna on a flat or gently sloping roof is practical, although the ground system will require more radi-

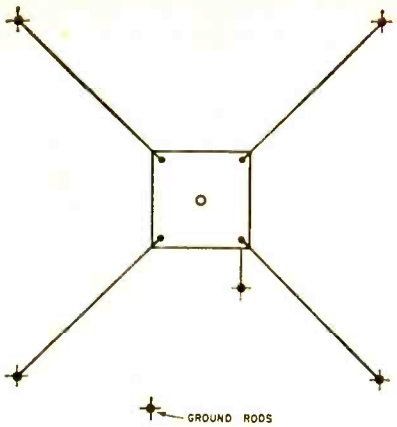


Fig. 3.

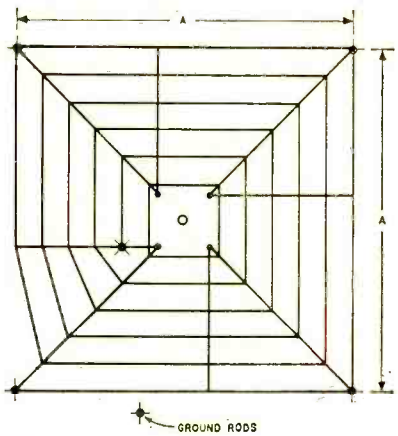


Fig. 4.

als and some experimenting may be necessary in order to achieve optimum performance.

Ground System Installation. Ground systems recommended by the FCC for broadcast stations consist of a minimum of 120 radials, each as long as the height of the antenna, running from the base to the perimeter of a complete circle around the antenna.

Fortunately, a minimum of *four* radials about as long as the equivalent length of the antenna will usually be adequate for amateur use (see Fig. 3). If possible, more radials should be installed to improve performance. All radials should have a ground rod at the outer end, and a ground rod should also be provided at the center. The radials may be buried or left on top of the ground. In the latter case, they will usually work into the ground if not prevented from doing so.

When there is not sufficient space to install radials of the length recommended by the antenna manufacturer, they may be bent back slightly or cut somewhat shorter and more radials added. If space is limited to an area considerably less than that required for a normal system, the arrangement shown in Fig. 4 can be used. Dimension *A* must not be less than one-half the total antenna height.

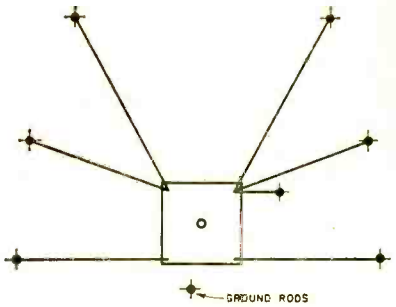


Fig. 5.

If the space available for installing the ground system is rectangular rather than square, the system will be satisfactory as long as it covers about the same area and is installed in the same manner. It is also possible to install the antenna ground system *off-center* as shown in Fig. 5.

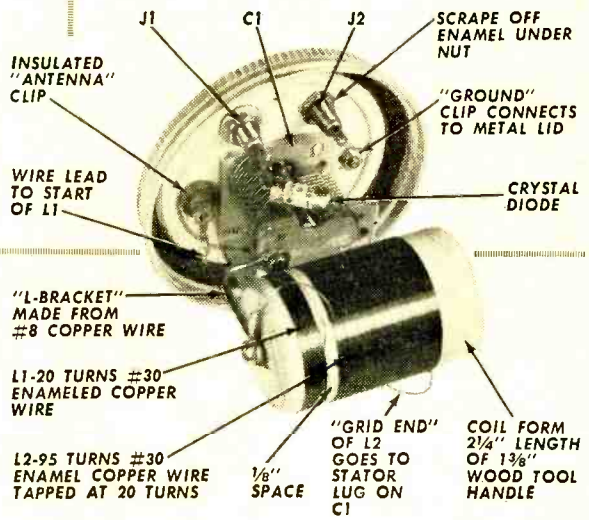
Roof Installation. The methods described for ground installations may also be used for roof-top installations. Multiple ground rods in this case are not practical, but at least one should be installed. Use a heavy conductor connected to a ground rod or water pipe. This ground is in addition to the ground made by the outer conductor of the coax line.

A metal roof makes a good ground system provided that the metal sections make good electrical contact with each other and are not rusted or corroded. A short connection between antenna base and roof is necessary. And, of course, the roof itself should be well grounded.

Properly designed and installed, a *horn* or *ball-gap* at the antenna base will adequately protect the building and equipment from the dangers of lightning and also will meet underwriters' requirements. A gap of ⅛" between wires or balls will not flash

(*Continued on page* 110)

Glass-Jar Crystal Receiver



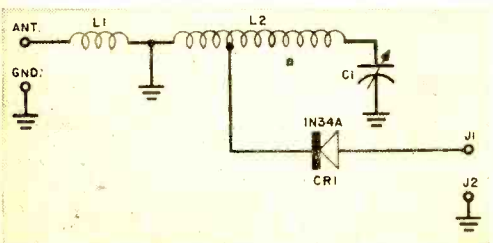
THE NEXT TIME you finish a jar of peanut butter, don't throw away the empty jar. Put a crystal receiver in it! A few inexpensive parts will transform that old dispenser of sandwich filling into a dispenser of local radio broadcasts.

You can use the metal lid of the jar as a ground. The only precaution to be observed is in scraping away the enamel on the lid at the points where you want to wire directly to the "chassis."

The coil is a homemade affair and can be made easily as shown above. Duco cement placed in strategic places is useful in winding the coil. After the coil is completed, a coat of shellac will hold the windings secure.

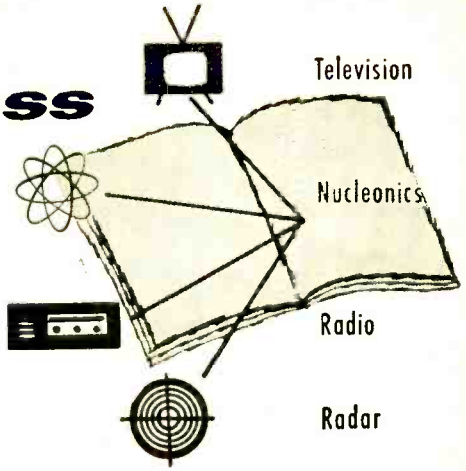
Selectivity is good with the crystal diode (*CR1*) connected to the tap on the secondary coil, but should you want to sacrifice a little selectivity for additional sensitivity, try connecting the crystal diode to the junction of *C1* and *L2*. *CR1* can be a 1N34A or CK705, and *C1* is a 15-400 $\mu\mu$fd. variable capacitor (Allied Radio 61H009 or Lafayette Radio MS-214).

An outdoor antenna at least 75 feet long should be used for best results. Earphones with an impedance of 3000 ohms or more are preferable, but 500-ohm dynamic phones have proven satisfactory with this set. —30—



By ART TRAUFFER

After Class

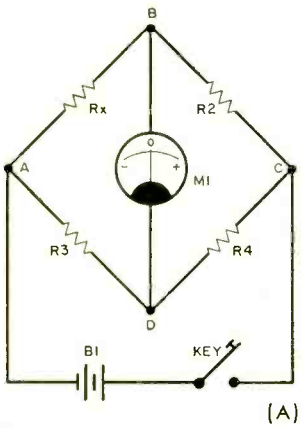


THE SERIES RC BRIDGE

By HARVEY POLLACK

LESS THAN 50 years after the American Revolution, the first account of the Wheatstone bridge was published in the British periodical "Philosophical Transactions." Since those "prehistoric" times, the bridge (as described in last month's *After Class*) has undergone many modifications. And each change has extended the range of the instrument into new domains of measurement.

One "variation on the theme" of the bridge has much appeal for experimenters because it provides a method for precisely determining capacitance with simple equipment. Let's see what changes must be made in the bridge, as shown in Fig. 1 (A), to convert it into a capacitance measuring device.



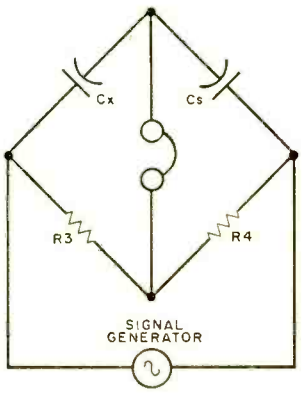


Fig. 1. Basic Wheatstone bridge circuit (A) is converted to RC bridge (B) by modifications and substitutions shown.

If *Rx* is replaced by an unknown capacitor *Cx*, and a standard capacitor *Cs* takes the position formerly occupied by *R2*, we have a simple capacitance bridge. See Fig. 1 (B). You will recall that the unknown resistor (*Rx*) in the Wheatstone bridge is found from the simple relationship:

$$Rx = R2 \times R3/R4$$

for a balanced bridge. Substituting capacitors for resistors means that the power source must put out an a.c. signal and the balance indicator must be the type that will respond to alternating current.

In most bridges, the a.c. is supplied by a "hummer" or high audio-frequency buzzer and headphones. A scope or an a.c. VTVM

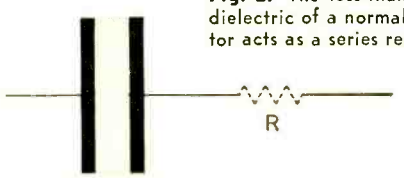


Fig. 2. The less-than-perfect dielectric of a normal capacitor acts as a series resistance.

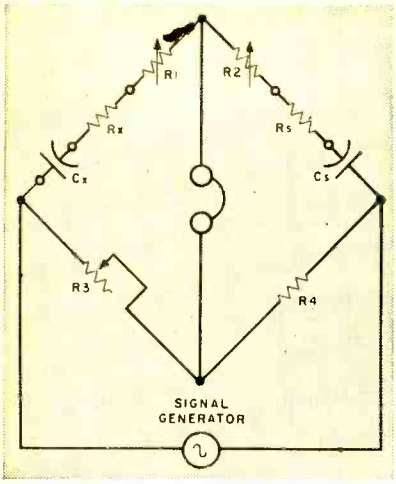
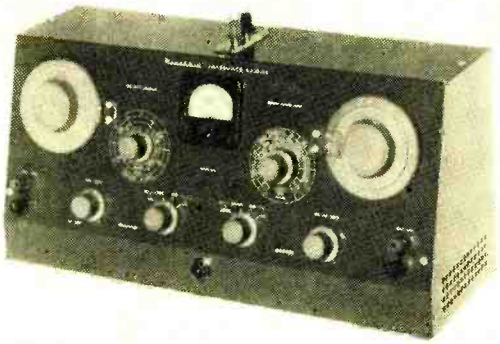


Fig. 3. Theoretical circuit of RC bridge showing the various compensating controls.

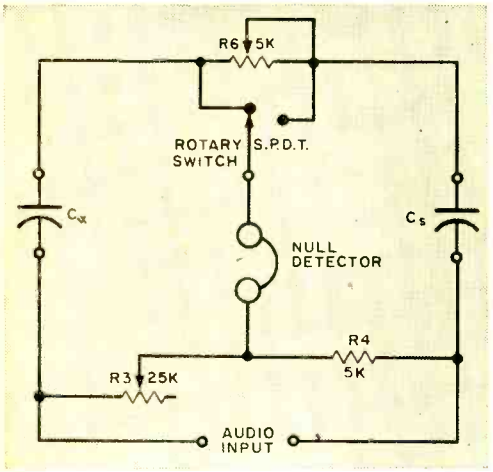
bridge in a balanced condition. The standard capacitor *Cs* is selected so that its value approximates estimated capacitance of the unknown *Cx*, and either *R3* or *R4* is varied until there is a null (no signal) in the headphones.

Phase Adjustments. This seems like a fine way to measure capacitance until we remember that capacitors, like people, are not perfect. Leakage through even the best dielectric causes the capacitor to behave as though there were a resistor hidden inside its case. Although we normally represent



Impedance bridge, above, available in kit form from Heath, incorporates Wheatstone and several other precision bridges.

Fig. 4. A practical build-it-yourself bridge which is capable of great precision.



a capacitor without it, in actual circuits, capacitors act as if they had a resistor wired in series with them, as in Fig. 2.

An ideal or "perfect" capacitor in an a.c. circuit carries a current that is exactly 90° ahead of the voltage across it; an imperfect (or real) capacitor will always reveal a current flow leading the voltage by something less than 90° due to its internal resistance. The added resistor in Fig. 2 represents a hidden "phase shifter" in the capacitor.

What effect does this phase shift have upon the operation of the simple capacitance bridge of Fig. 1(B)? Unless both *Cs* and *Cx* are perfect or, more realistically, have equal imperfections, null balance will be broad and inaccurate.

The method used to correct for phase errors is simple: why not add an adjustable resistance in series to the better of the two capacitors? We can now adjust to make one capacitor as "imperfect" as the other. Since we do not know at the start which of

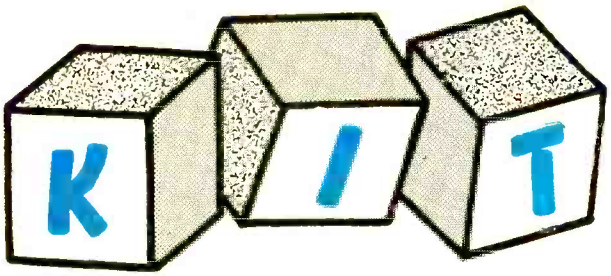
(*Continued on page* 107)

serves as the detector. The level of the a.c. signal voltage, (like the d.c. of the Wheatstone bridge) is not critical.

Since the capacitors are reactances, not resistances, the equation must be rewritten. After a number of substitutions, inversions, etc., we have left:

$$Cx = Cs \times R4/R3$$

This equation, like its counterpart in the Wheatstone bridge, is true only for a

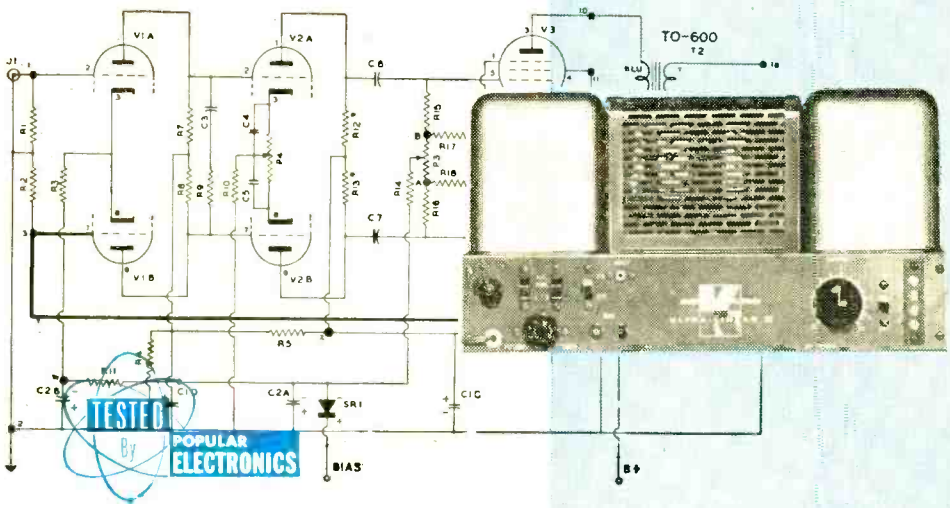


BUILDER'S CORNER

ACROSOUND Ultra-Linear II Power Amplifier

THE GROWING POPULARITY of low-efficiency speaker systems and multiple speaker installations has focused attention on the desirability of higher power amplifiers. One entry in the high power field is the Acrosound Ultra-Linear II, a basic 60-watt amplifier kit (Acro Products, 369 Shurs Lane, Philadelphia 28, Pa.).

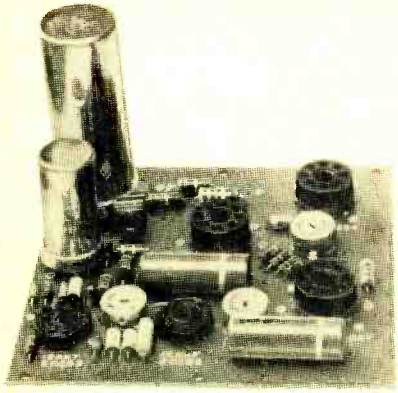
Printed Circuit. Assembly of the kit is exceptionally simple as most of the components are pre-mounted and pre-wired on a printed-circuit board.



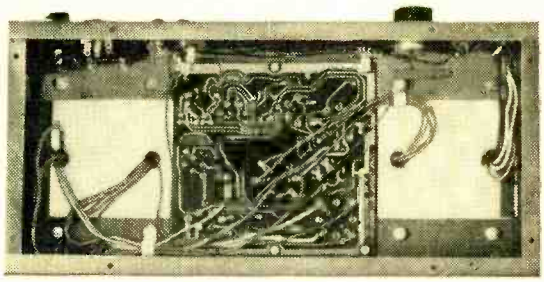
The first step includes mounting and wiring the two a.c. outlets, on-off switches and variable damping control on the front panel. The second consists of assembling the four-section chassis, mounting the transformers and printed-circuit board. Connecting the leads to the printed-circuit board and the mounting and soldering of a few remaining resistors finishes the job.

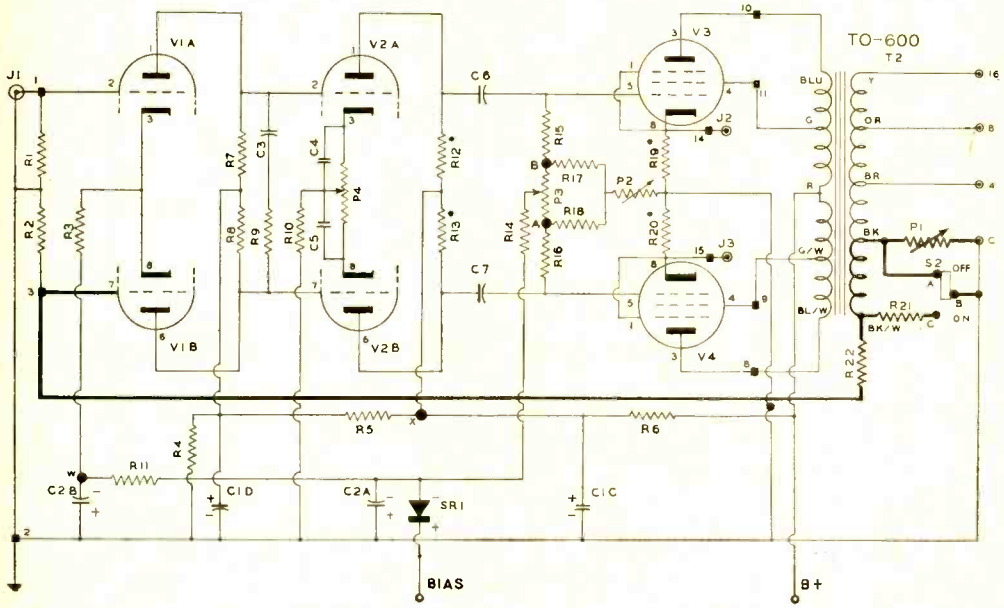
Sound simple? Well, it is. The steps are few and the booklet and accompanying pictorial are clear and easy to follow. Wiring time, including the parts check and the bias and two balance settings, was 3½ hours.

Long-Tailed Pair. The input is fed directly to a 12AX7 tube hooked up as a long-tailed pair phase inverter. A grid of one of the tubes of this type of phase inverter which is normally grounded (a.c.-wise) is used as the feedback point for the "hybrid" winding on the output transformer. This achieves isolation between the load



Printed-circuit board simplifies construction of the Acro Ultra-Linear II. Dark lines in the schematic below indicate unique feedback-damping circuit.





impedance and the feedback circuit, making possible the inclusion of a variable damping control which does *not* affect the over-all feedback.

Output of the phase inverter is direct-coupled to a 12AU7 push-pull voltage amplifier with special balancing provisions in the cathode. The 12AU7 is *RC*-coupled to the push-pull output stages. The output circuit comprises two EL-34's with fixed bias and (of course) an Ultra-Linear output transformer.

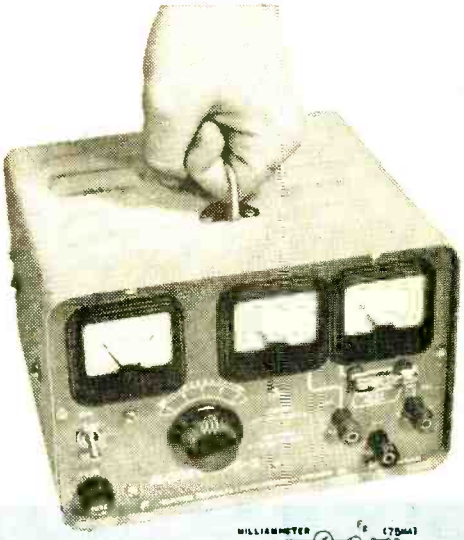
The Acro has a preamp power socket, 4-, 8-, and 16-ohm speaker taps and a damping control variable from 0.5 to 10. The control may also be switched out for a fixed damping factor of 15.

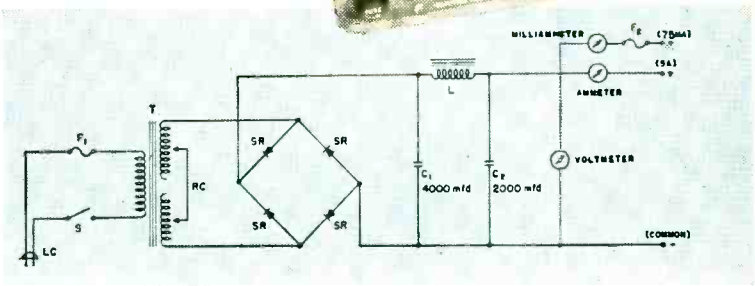
Test Results. Input sensitivity for rated output is 1.6 volts. This amplifier tested out flat from 20 to 20,000 cps within 0.5 db at 60 watts. Hum and noise was 90 db below rated output.

Square wave response was excellent at all audio frequencies and at all power levels. Variable damping did not seem to affect response in any way except for a very slight drop in power. In the last and most important test, the amplifier sounded clean and performed beautifully at all volume levels.

OFTEN the home experimenter finds he can easily fix just about any radio he can get onto his test bench—except the one from his own car. The problem is how to get the 6 or 12 volts needed for operation of the receiver once it is removed from the car. Using the car's battery on the bench is a solution, but a messy one.

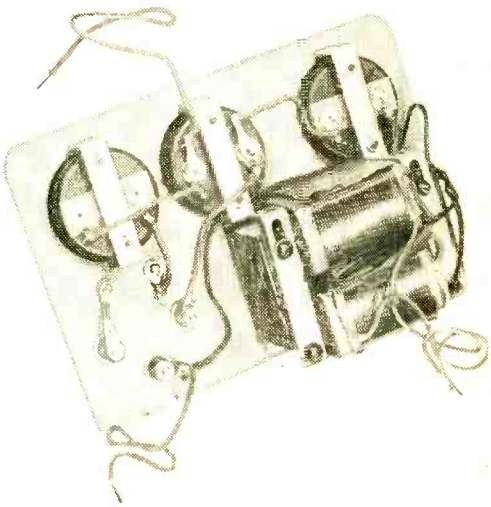
The KPS-2 d.c. power supply kit was designed by Electro Products Laboratories (4501 N. Ravenswood Ave., Chicago, Ill.) to solve such problems. Any 6 or 12-volt car radio can be powered by this rugged kit. As an extra bonus, 0-20 volt, 75-ma. metered output is provided for those who need well-filtered low-voltage d.c. for transistor





TESTED BY POPULAR ELECTRONICS

ELECTRO PRODUCTS KPS-2 Power Supply



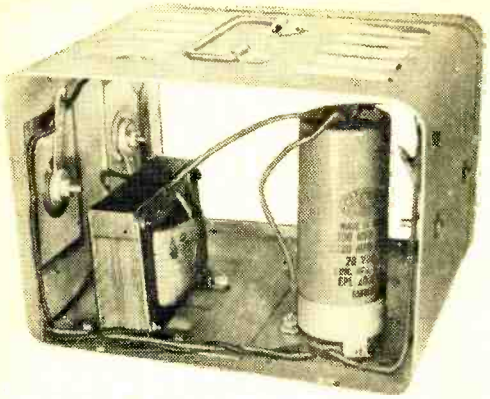
circuit experimentation. Wiring time runs about three hours.

Features. The KPS-2's two controls are an on-off switch and a voltage control knob. As the knob is turned clockwise, a d.c. voltmeter indicates the d.c. voltage being supplied to the load.

Two current meters are included. A 0-10 amp meter reads the up-to-10-amp main output current, and a second meter reads the up-to-75-ma. transistor test current through a separately fused circuit.

It is necessary to rotate the voltage control knob several times throughout its

Front panel assembly mounts the three d.c. meters and autotransformer.



Power supply cabinet mounts four dry rectifiers on its sides. The sides are used as a heat sink to dissipate heat. Mounted on the base of the cabinet are the d.c. choke and the two-section electrolytic capacitor.

entire range before plugging in the KPS-2 power supply. This will insure good contact between the voltage control wiper and the enameled copper wire on the step-down transformer.

The output of the variable step-down transformer is rectified by a full-wave bridge selenium rectifier and filtered by a pi-filter network comprising a choke and a 4000-2000 μfd. dual electrolytic capacitor.

Operation. The KPS-2 power supply can be operated continuously supplying up to 16 volts with a 5-amp current load. Overload currents up to 10 amperes may be drawn for short periods.

Under actual test conditions the KPS-2 was used to charge a 12-volt battery at 5 amperes for 24 hours. During this time, it supplied a charge of 120 amp-hours to the rundown battery without any sign of strain.

A factory-wired model of this d.c. power supply, having the same features as the kit, is also available. —30—

FREQUENCY QUIZ

By ED BUKSTEIN

If you really know your frequencies, you should have no trouble matching each frequency listed below with the letter of the statement describing it. A score of less than ten correct indicates that you should spend more time with your textbooks. Ten to 15 correct puts you in the "well informed" category, and 16 to 19 is superior. If you get all 20 right, it's time to ask your boss for a raise. The correct answers are given on page 112.

1	15,750 cps	**A**	Frequency of 10-centimeter radar
2	3.579545 mc.	**B**	Radio control of model airplanes
3	88 to 108 mc.	**C**	Separation of TV sound and picture carriers
4	27.255 mc.	**D**	TV equalizing pulses
5	6 mc.	**E**	FM broadcast band
6	4.5 mc.	**F**	TV Channel 6
7	30 to 300 mc.	**G**	V.h.f. spectrum
8	456 kc.	**H**	Frequency of four-pole alternator at 1500 rpm
9	50 mc.	**I**	Color-TV subcarrier
10	3000 to 30,000 mc.	**J**	U.h.f. spectrum
11	256 cps	**K**	Six meters
12	120 cps	**L**	Ripple of full-wave rectifier on 60-cycle line
13	50 cps	**M**	TV horizontal scanning frequency
14	3000 mc.	**N**	S.h.f. (microwave) spectrum
15	995,000 cps	**O**	Lower sideband produced when 1000-kc. carrier is amplitude-modulated by 5-kc. signal
16	300 to 3000 mc.	**P**	Frequency at which one henry has reactance of 6280 ohms
17	1000 cps	**Q**	Resonant frequency of 100 μh. and 100 μμfd.
18	1.59 mc.	**R**	Width of TV channel
19	82 to 88 mc.	**S**	Commonly used intermediate frequency in AM broadcast receivers
20	31,500 cps	**T**	Output frequency of a five-stage ring counter with input of 1280 cps

Transistor Topics

By LOU GARNER

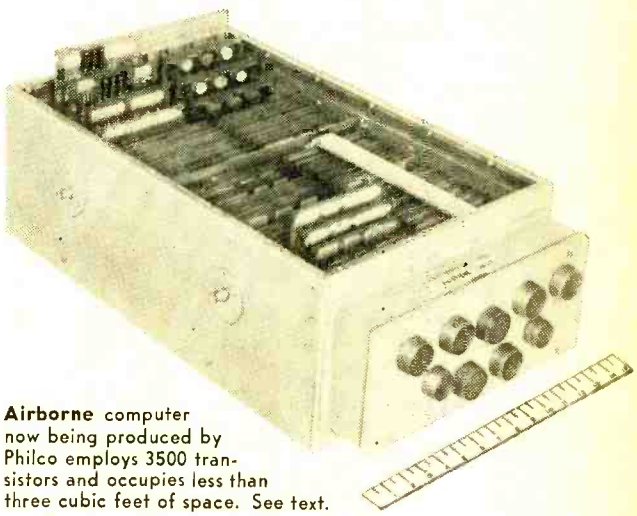
ASIDE from actual electrical specifications, perhaps the most important difference in the application of vacuum tubes and transistors arises from the latter's sensitivity to ambient temperature conditions. The vacuum tube is a "temperature-saturated" device, i.e., it operates at a uniformly "hot" temperature regardless of its environment. Except where relatively large amounts of power are handled, the transistor generally operates at the temperature of its environment.

Since most semiconductor materials are sensitive to temperature variations, the electrical characteristics of transistors and related devices (diodes, thyristors, etc.) tend to vary with changes in the thermometer's reading. Special circuits must be used to compensate for temperature variations if a transistorized device is to be used over a wide range of environmental conditions.

Your columnist can recall a number of experiences with "non-compensated" circuits . . . and perhaps you can, too, if you've spent much time on experimental projects. A pet receiver operated well during the summer (when it was assembled) and even into fall, but had an annoying tendency to break into oscillation outdoors during the winter. A d.c. amplifier used in an instrument worked fine in a cool basement—but tended to run its meter off-scale when taken outside on a summer day. In other cases, amplifiers which worked fine at "normal" temperatures tended to distort or to lose gain if the thermometer went up or down.

Silicon, in general, can "stand" higher temperatures than germanium alloys. As a result, although silicon transistors are quite expensive, they are used frequently in military and industrial equipment which may be subject to unusual temperatures.

Most manufacturers specify *both* upper



Airborne computer now being produced by Philco employs 3500 transistors and occupies less than three cubic feet of space. See text.

Silicon solar modules available from International Rectifier can supply up to 100 watts of power per 14 sq. ft. of cell area.

and lower operating limits for their transistors, and these limits—compared to those applied to vacuum tubes—are relatively narrow. But good news is "in the works." A number of laboratories are devoting special efforts to developing semiconductor materials which can withstand temperature extremes.

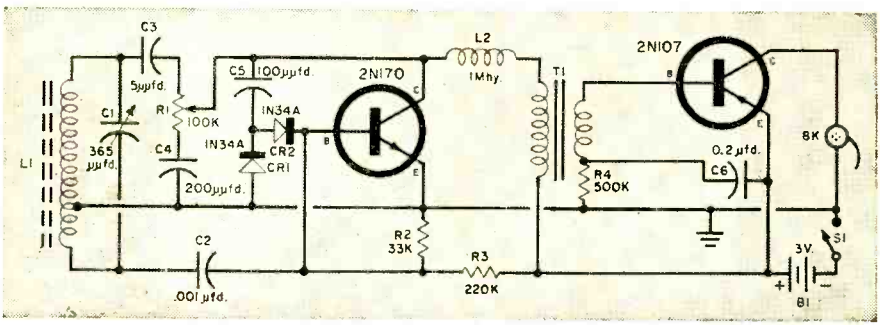
From Sylvania's research laboratory in Bayside, N. Y., comes news of a transistor capable of operating at 2° K. Called a *grain boundary* transistor, it makes use of the properties of the boundary formed between two crystal lattice structures having different grain orientation; this permits the construction of a device with characteristics similar to *n-p-n* or *p-n-p* junctions. Low-temperature transistors should find wide application in earth satellites, moon rockets, and interplanetary rocket "probes."

At the other end of the thermometer, Carborundum's Research and Development Division has developed a new process for the separation of high-purity polycrystalline silicon carbide. This material might well be used for the growth of the large single crystals needed in the manufacture of transistors. If present research results in a further scientific "breakthrough," we may one day be able to purchase transistors capable of operating at temperatures of 1500° C., or higher! Such high-temperature transistors could be used in measuring devices and controls for nuclear reactors, furnaces, volcanic research work, etc.

Reader's Circuit. Some time ago (July, 1958), we featured an audio amplifier circuit submitted by reader Lee Baker (40 Schley Ave., New Rochelle, N. Y.), who likes to experiment with transistor circuits. Lee's "favorite" simple *receiver* circuit is shown above.

Using both *n-p-n* and *p-n-p* transistors, this AM broadcast-band receiver features a regenerative r.f. amplifier, a dual-diode detector, and a transformer-coupled audio amplifier. In operation, individual stations are selected by tuned circuit *L1-C1,* while feedback potentiometer *R1* serves both as a regeneration and volume control.

L1 is a standard "hi-Q" transistor-tapped ferrite antenna (Lee says the unit's "Q" should be at least 200 for best results). *T1* is an interstage transformer with a 50,000-ohm primary and a 1000-ohm secondary (Argonne Type AR-129). Ceramic or mica capacitors can be used for *C2, C3* and *C5; C6* can be a low-voltage ceramic or a paper capacitor—working voltages are not critical. All the resistors are half-watt carbon units.



Two-transistor high-performance receiver circuit submitted by Lee Baker.

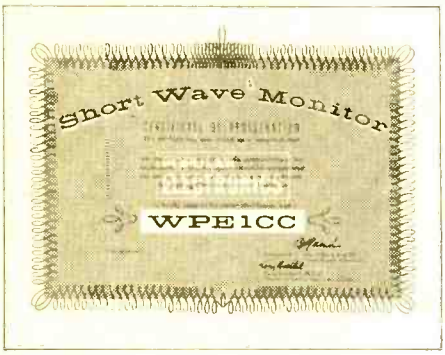
If you would like to duplicate Lee's circuit, follow good wiring practice. Keep all leads short and direct and double-check your wiring as you assemble the project. The set can be put together on a small chassis, or on one of the perforated phenolic boards so popular with experimenters.

Lee has a few tips to pass on. First, if you have several transistors available, pick high-gain (high-*beta*) units. Second, use the values shown for *R2* and *R4* as starting points, determining final values experimentally for best results with your individual transistors. Finally use magnetic earphones of about 8000-ohms impedance with the receiver.

While your columnist hasn't had a chance to check out Lee's circuit, the receiver's performance should be somewhat better than that of the average two-or-three-transistor receiver, but not quite as good as that

(*Continued on page* 104)

ATTENTION
SHORT-WAVE LISTENERS!



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To obtain your certificate, fill out the registration form below and mail to The Editor, POPULAR ELECTRONICS, One Park Avenue, New York 16, N. Y. Please include ten cents to help cover costs of mailing and processing your certificate.

SHORT-WAVE MONITOR REGISTRATION

(Please Print)

Name .....

Address ..... City ..... State .....

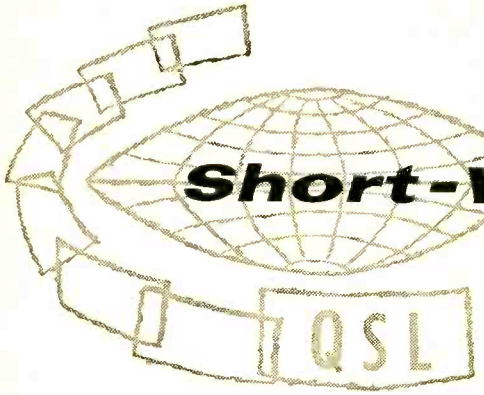
Receiver — Make ..... Model .....

Make ..... Model .....

Principal SW Bands Monitored ..... Number of QSL Cards Received .....

Type of Antenna Used .....

Signature ..... Date .....



Short-Wave Report

By HANK BENNETT

CHIEF OPERATOR of Station KN3GST is Rene Reixach, 5618 Lamar Road, Washington, D. C. Better known to his cohorts as "Hank," he also acts as POP'tronics Monitor #303 and is a member of the American Radio Relay League.

In Hank's listening post is a Hallicrafters S53-A receiver backed up by a Crosley Globemaster, an S-meter for determining signal strength, and a transmitter. His antenna, a Gothan V80, is a vertical and does a most presentable job of pulling in DX. (See page 73 of this issue for installation tips if you are interested in putting up a vertical antenna.)

Hank took up the short-wave hobby two years ago. He listened for a full year before he began sending reports to stations heard. Since he has been operating, he has amassed a total of 37 verifications; they cover 30 countries out of 70 countries heard. His most prized verie is from the station he feels represents his best DX, the 500-watt, 49-meter outlet of *Radio Omdurman,* Khartoum, Sudan.

Listening mostly on 25 meters, his favorite short-wave band, Hank is especially partial to the Swiss Broadcasting Service for programs, ease of reception and the fact that they sent him his first verification. He also appreciates *Radio Australia* for good programing and reception.

Hank would like to see a yearly resume in the *Short-Wave Report* giving station changes as to frequency, schedules, and addresses. While this is indeed a worthwhile suggestion, it is not possible at present due to space limitations. A good source of such information, however, is the *World Radio Handbook,* which is available for $2.50 from Gilfer Associates, P. O. Box 239, Grand Central Station, New York, 17, N. Y.

Current Reports. This month, by popular request, we have compiled another batch of new stations and frequency changes in addition to the regular station reports. Have you been able to identify any of the unknown stations listed last month?

As usual, all times shown are Eastern Standard and the 24-hour system is used. At time of compilation, all reports were correct; stations may change frequency and/or schedule with little or no advance notice.

(*Continued on page* 119)

Nibi-Nibi Islands

A few months ago there appeared in the bulletins of various clubs and organizations an item about a new station located in the Nibi-Nibi Islands. Additional reports on this station have been received from time to time, with the latest report containing information on new programming.

The National Geographic Society claims that there is no such island. And investigation into the situation by several veteran DX'ers has failed to locate the original source of the information. It is believed now that the entire episode was a hoax. While it may have begun as a harmless prank, it has, nevertheless, consumed the time and efforts of the editors of many clubs, organizations, and DX programs.

This sort of thing has no place in short-wave listening. It is sincerely hoped that all DX'ers will be on the lookout for such obviously phony reporting and will do all they can to discourage any repetition of this kind.

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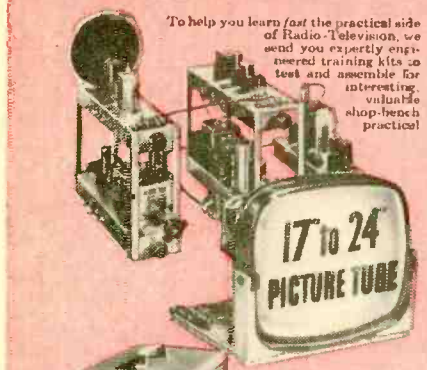
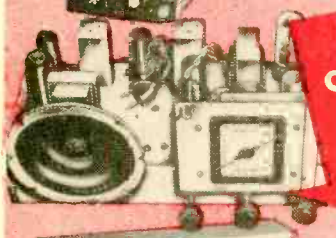


- The new Sprayberry Training Television Receiver, built and tested in 5 sections.
- Now offered . . . this fine modern oscilloscope.
- You build this powerful two-band superheterodyne radio receiver.



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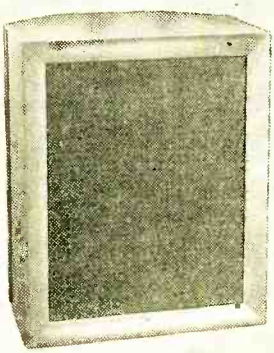
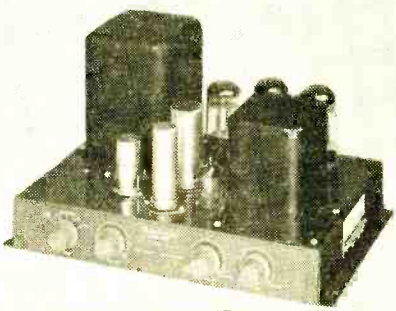
"BASIC" SPEAKER SYSTEM



RANGE EXTENDER



A-9C 20-WATT AMPLIFIER

HEATHKIT "BASIC RANGE" HIGH FIDELITY SPEAKER SYSTEM KIT

This amazing speaker system can fulfill your present needs and still provide for future expansion. Fine hi-fi performance the result of using high quality speakers in an enclosure especially designed for them. Features two Jensen speakers to cover 50 to 12,000 CPS within ± 5 db. Power rating is 25 watts, and impedance is 16 ohms. Enclosure constructed of veneer-surfaced plywood, ½" thick, and measures 11½" H x 23" W x 11¾" D. Precut and predrilled for quick assembly.

Model SS-2
$39.95

Shpg. Wt. 26 lbs.

HEATHKIT RANGE EXTENDING HIGH FIDELITY SPEAKER SYSTEM KIT

Designed especially for use with SS-2 "Basic" system. Contains 15" woofer and compression-type super tweeter. Extends basic unit to 35—16,000 CPS, ± 5 db. Impedance 16 ohms. Measures 29" H x 23" W x 17½" D, and is constructed of ¾" veneer-surfaced plywood.

Model SS-1B
$99.95

Shpg. Wt. 80 lbs.

HEATHKIT A-9C HIGH FIDELITY AMPLIFIER KIT

This model incorporates its own power supply and preamplifier. Plenty of power with full 20 watt rating. Four separate inputs, selected by panel-mounted switch, and separate bass and treble controls. Ideal for home or PA applications. Output transformer tapped at 4, 8, 16 or 500 ohms. Response within ± 1 db from 20 to 20,000 CPS.

Model A-9C
$35.50

Shpg. Wt. 23 lbs.

HEATHKIT HIGH FIDELITY FM TUNER KIT

Now you can have full-fidelity FM performance from 88 to 108 mc at reasonable cost. Features temperature-compensated oscillator—built in power supply, and beautiful cabinet. Components prealigned at factory!

Model FM-3A
$26.95
(with cabinet)

Shpg. Wt. 8 lbs.

HEATHKIT BROADBAND AM TUNER KIT

Tunes standard AM band from 550 to 1600 kc with fine sensitivity and broadband characteristics. Features include built-in power supply and low-distortion detector. All RF circuits prealigned for simplified construction.

Model BC-1A
$26.95
(with cabinet)

Shpg. Wt. 9 lbs.

HEATHKIT "MASTER CONTROL" HI-FI PREAMPLIFIER KIT

Provides extra amplification, selection of inputs, volume and tone controls, and turnover and rolloff controls, for Williamson-type amplifiers. Beautiful satin-gold enamel cabinet. Derives operating power from amplifier.

Model WA-P2
$19.75
(with cabinet)

Shpg. Wt. 7 lbs.

HEATHKIT 25-WATT HIGH FIDELITY AMPLIFIER KIT

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Model W-5M
$59.75

Shpg. Wt. 31 lbs.

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Model XR-1P
$29.95

Note: Prices are with cabinet less batteries.

HEATHKIT MODEL XR-1P TRANSISTOR PORTABLE RADIO KIT

This easy to build transistor radio is designed for lifetime operation. Features 6 name-brand (Texas Instrument) transistors for extra good sensitivity and selectivity. A 4" x 6" speaker for "big set" tone, built-in rod-type antenna, and uses 6 standard size "D" flashlight cells for extremely long battery life (between 500 and 1,000 hours). Cabinet is two-tone blue molded plastic with pull-out carrying handle. Measures 9" L. x 7" H. x 3¾" D. Transformers are prealigned eliminating special alignment equipment. Shpg. Wt. 6 lbs.

MODEL XR-1L: Identical to XR-1P except in leather case. Carrying strap included. Shpg. Wt. 7 lbs.

HEATHKIT BROADCAST BAND RADIO KIT

Covers 550 to 1600 kc with good sensitivity and selectivity. Has 5½" PM speaker for good tone quality. Features transformer power supply and built-in antenna. Signal generator recommended for alignment. Cabinet, as shown, available separately. Shpg. Wt. 10 lbs.

Model BR-2
$18.95
(less cabinet)

HEATHKIT CRYSTAL RADIO KIT

Features a sealed germanium diode to eliminate critical "cats whisker" adjustment. Employs two tuning condensers for good selectivity, and covers the broadcast band from 540 to 1600 kc. Requires no external power. Kit price includes headphones. Shpg. Wt. 3 lbs.

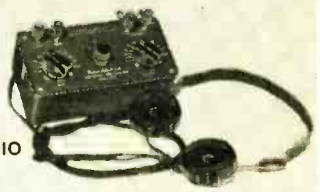
Model CR-1
$7.95

HEATHKIT ENLARGER TIMER KIT

The dial of this handy timer covers 0 to one minute calibrated in five-second gradations, so that the timing cycle of a photographic enlarger can be electronically controlled. Built-in relay handles up to 350 watts, and enlarger merely plugs into receptacle of front panel. Also provision for plugging in safe-light. An easy-to-build device that makes a fine addition to any dark room. Shpg. Wt 3 lbs.

Model ET-1
$11.50

TABLE-MODEL RADIO



CRYSTAL RADIO

ENLARGER TIMER

HEATHKIT FUEL VAPOR DETECTOR KIT

The FD-1 is a safety device to detect fuel vapor in the engine compartment or other sections of your boat. The detector unit mounts in the area to be checked, and the indicating meter and controls mount on the control panel. Will operate intermittently or continuously, and indicates dangers of fire or explosion to protect your boat and its passengers. Models FD-1-6 (6 volts DC) and FD-1-12 (12 volts DC) operate from boat batteries. Kit even includes spare detector unit. Shpg. Wt. 4 lbs.

6-volt FD-1-6, 12-vt. FD-1-12

$35.95 each

HEATHKIT RF POWER METER KIT

This handy device measures the RF field in the vicinity of a transmitter, whether it be marine, mobile, fixed, etc. Requires no electricity, nor direct connection to the transmitter. Provides a continuing indication of transmitter operation. Merely place it in proximity to the transmitter antenna and it will produce a reading on its 200 ua panel meter when the transmitter is in use. Operates with any transmitter between 100 kc and 250 mc. Includes a sensitivity control for meter. Shpg. Wt. 2 lbs.

Model PM-1

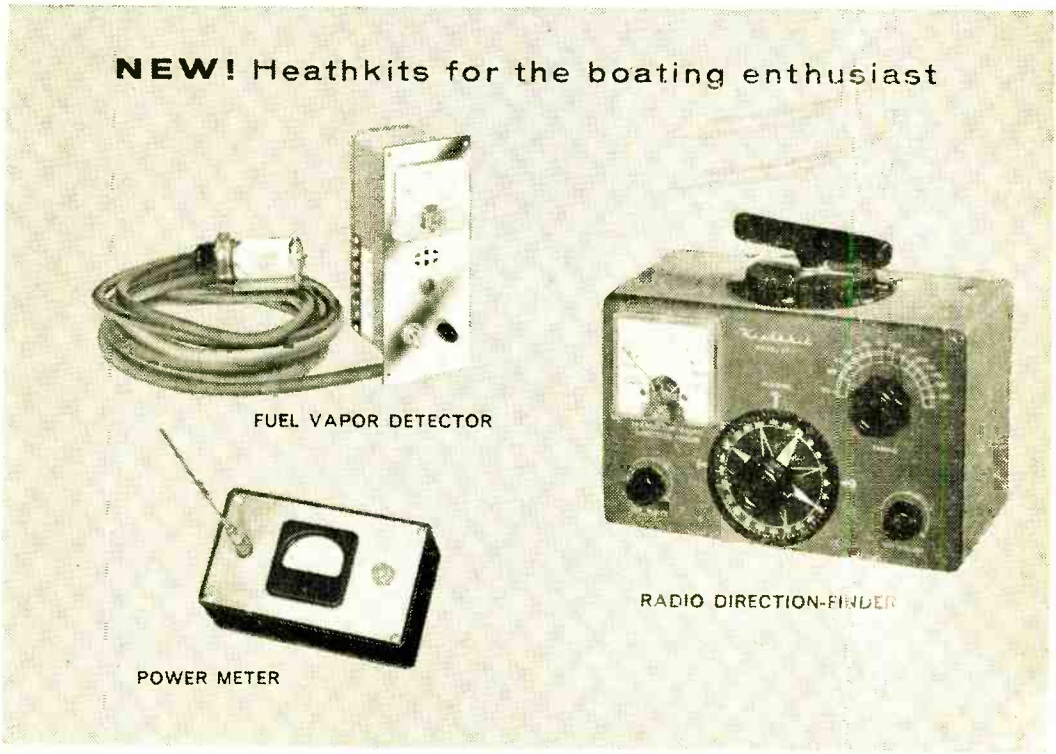
$14.95

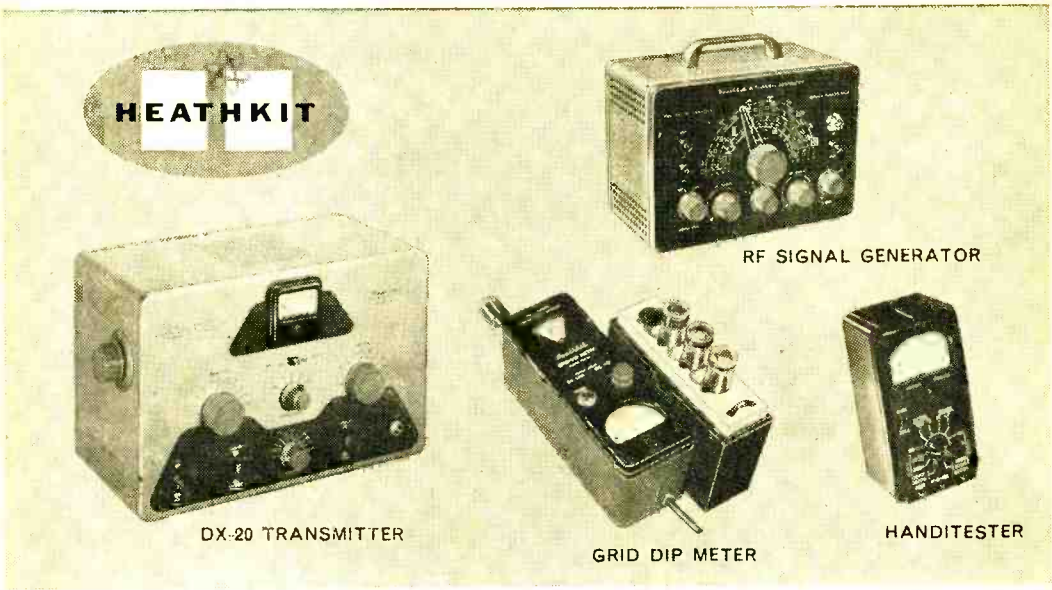
HEATHKIT TRANSISTOR RADIO DIRECTION-FINDER KIT

The Heathkit Transistor Radio Direction-Finder model DF-1 is a self-contained, self-powered, 6-transistor super heterodyne broadcast radio receiver incorporating a directional loop antenna, indicating meter, and integral speaker. It is designed to serve primarily as an aid to navigation when out of sight of familiar landmarks. It can be used not only aboard yachts, fishing craft, tugs, and other vessels which navigate either out of sight of land or at night, but also for the hunter, hiker, camper, fisherman, aviator, etc. It is powered by a 9-volt battery. (A spare battery is also included with the kit.) The frequency range covers the broadcast band from 540 to 1600 kc and will double as a portable radio. A directional high-Q ferrite antenna is incorporated which is rotated from the front panel to obtain a fix on a station and a 1 ma meter serves as the null and tuning indicator. The controls consist of: tuning, volume and power (on-off), sensitivity, heading indicator (compass rose) and bearing indicator (antenna index). Overall dimensions are 7½" W x 5⅞" H x 5⅜" D. Supplied with slip-in-place mounting brackets, which allow easy removal from ship bulkheads or other similar places. Shpg. Wt. 4 lbs.

Model DF-1

$54.95





HEATHKIT DX-20 CW TRANSMITTER KIT

This Heathkit straight-CW transmitter is one of the most efficient rigs available today. It is ideal for the novice, and even for the advanced-class CW operator. It employs a 6DQ6A tube in the 50-watt final amplifier circuit, a 6CL6 oscillator and a 5U4GB rectifier. Single-knob band switching covers 80, 40, 20, 15, 11, and 10 meters. The DX-20 is designed for crystal excitation, but may be excited by an external VFO. Pi network output circuit is employed to match antenna impedances between 50 and 1000 ohms.

Model DX-20
Shpg. Wt. 19 lbs. **$35.95**

HEATHKIT GRID DIP METER KIT

An instrument of many uses for the ham, experimenter, or service technician. Useful in locating parasitics, neutralizing, determining resonant frequencies, etc. Covers 2 mc to 250 mc with prewound coils. Use to beat against unknown frequencies, or as absorption-type wave meter.

Model GD-1B
Shpg. Wt. 4 lbs. **$21.95**

HEATHKIT RF SIGNAL GENERATOR KIT

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

Model SG-8
Shpg. Wt. 8 lbs. **$19.50**

HEATHKIT HANDITESTER KIT

Measures AC or DC voltage at 0—10, 30, 300, 1000 and 5000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 and 0-300,000 ohms. Sensitivity is 1000 ohms/volt. Features small size and rugged construction in sleek black bakelite case.

Model M-1
Shpg. Wt. 3 lbs. **$17.95**

HEATHKIT ETCHED-CIRCUIT VTVM KIT

Sensitivity and reliability are combined in the V-7A. It features 1% precision resistors, large 4½" panel meter, and etched circuit board. AC (RMS) and DC voltage ranges are 0—1.5, 5, 15, 50, 150, 500, and 1500. Peak-to-peak AC ranges are 0—4, 14, 40, 140, 400, 1400 and 4000 volts. X1, X10, X100, X10k, X100k, and X1 megohm.

Model V-7A
Shpg. Wt. 7 lbs. **$25.95**

HEATHKIT ALL-BAND RADIO KIT

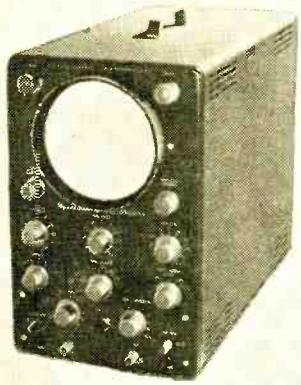
This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image projection. Amateur bands clearly marked on the illuminated dial scale. Employs transformer-type power supply—electrical band spread—antenna trimmer—separate rf and af gain controls—noise limiter and headphone jack. Built-in BFO for CW reception. Cabinet, as shown, available separately.

Model AR-3
Shpg. Wt. 12 lbs. **$29.95**
(less cabinet)

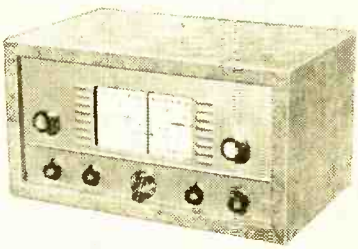
HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

This oscilloscope sells for less than the previous model, yet incorporates features for improved performance. The OM-2 provides wider vertical frequency response, extended sweep generator coverage, and increased stability. Vertical channel is essentially flat to over 1 mc. Sweep generator functions from 20 CPS to over 150 kc. Amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode ray tube is used. The scope features external or internal sweep and sync, 1-volt peak-to-peak reference voltage, three-position step attenuated input, and many other "extras."

Model OM-2
Shpg. Wt. 22 lbs. **$39.95**



"GENERAL-PURPOSE" SCOPE



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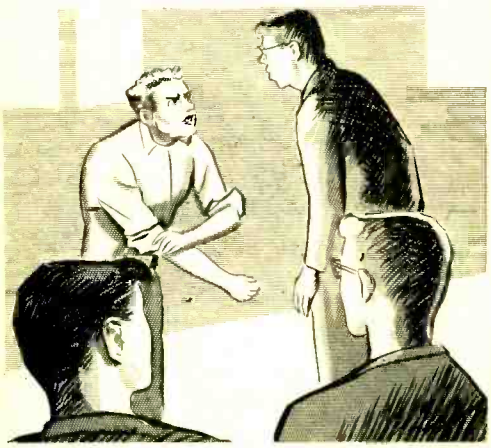
Carl & Jerry

(*Continued from page* 38)

talked over their installation to make sure nothing could possibly go wrong. As they talked, Carl's father came out the front door wearing his hat and coat.

"I'd certainly like to stay here and see what happens with the polecat detector," he said ruefully; "but I just got a telephone call that disturbs me. As you know, I'm running for city councilman in the primary. Pat Gallagher down the street is running



. . . "Put up your dukes," he shouted . . .

against me. Just now I got word that some low-lifer has told Pat a string of lies about what I am supposed to have said against him; and he, quite understandably, has his dander up. I'm going over there right now and straighten things out before they get worse—which they can very quickly. Pat's got a temper that matches his red hair, and I don't want him mad at me. I'll be back as soon as I can—hey!" he broke off; "There goes Pat across the street now."

At this precise instant there was a muffled bump at the side of the house, and a few seconds later a voice bellowed forth: "There goes the skunk! There goes the skunk!"

The two boys and Mr. Anderson raced around the house. The gate had dropped, closing off the hole, but the skunk was not in sight. Jerry walked over and threw the switch that stopped the tape recorder. It was not until then that the three of them noticed a little red-headed man come bounding around the house, peeling off his coat as he ran toward them.

"Stop, you big hulking coward!" he shouted at Mr. Anderson. "I'll teach you to call me names and then run. Put up your dukes, man; don't shame yourself in front of your own flesh and blood."

"Now hold on, Pat," Mr. Anderson said as he moved away from the little man who was dancing back and forth with his clenched fists held stiffly in front of him in the style of the immortal John L. Sullivan. "That wasn't me you heard. Jerry, turn that thing back on and show him."

"Don't add lying to your other black-hearted crimes! I know that Bull of Bashan voice of yours when I hear it. Are you going to fight or am I going to have to—"

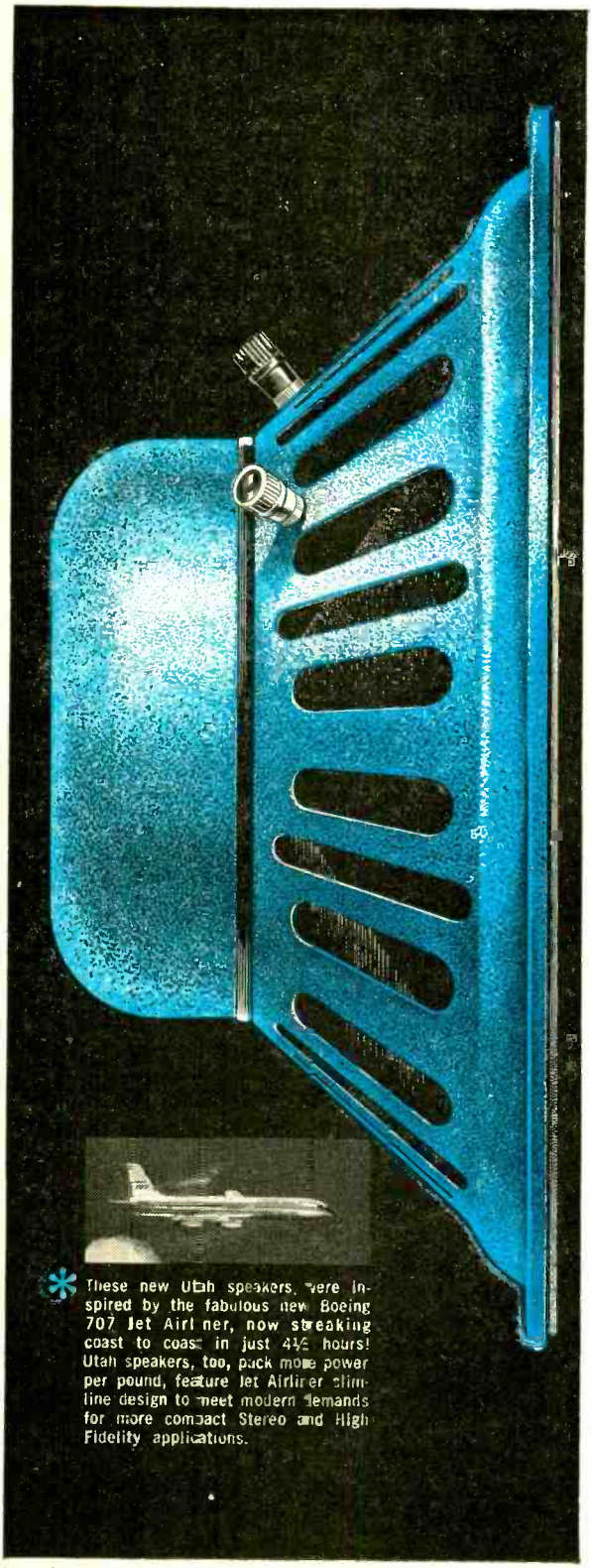
AT THIS MOMENT bedlam broke loose. The tape recorder began shouting its message. A small black animal with a white stripe down its back and along its tail tore around the back corner of the house and raced toward them with Bosco, Carl's dog,

. . . Poor Bosco got the worst of it . . .

in hot pursuit. In the distance they heard the wail of an approaching siren.

The skunk dashed for the hole in the foundation, only to find it closed off. He was trapped. He had to use his secret weapon. Before the horrified gaze of the four people, that plumed, white-striped tail came up and a horrible, choking stench enveloped the whole area.

Poor Bosco got the worst of it because



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Utah Radio & Electronic Corp., Huntington, Ind.

he was closest, but there was plenty to go around. The dog howled in agony as he rolled on the grass and pawed at his stinging eyes. The men and boys fled blindly toward the front of the house. The skunk then sedately and daintily picked his way past the writhing dog and disappeared around the back of the house.

Two patrolmen piled out of a squad car at the curb and came racing toward the group on the front lawn, but suddenly they got a whiff of the rich odor and came to a stiff-legged halt. "What's going on here?" they asked. "We got a report two men were fighting."

"Someone must be mistaken," Mr. Anderson said blandly as he tried vainly to breathe by exhaling only. "I've seen no fighting here; have you, Mr. Gallagher?"

"Certainly not," Pat answered promptly. "Things have come to a pretty pass when a man can't get rid of a skunk without being badgered by the police."

"Who's that blatting away about 'There goes the skunk,'" an officer insisted.

"That's just a tape recording; and it's too long a story to tell now," Mr. Anderson said. "We've got to see what can be done about decontaminating ourselves. Pat, we've got a shower in the basement, and I've got some old clothes down there you can wear home. I'm afraid we are all going to have to bury what we're wearing."

"That's mighty friendly of you, Steve; and I'll take you up on it. Sheila would never let me in the house in this condition."

"Okay, gentlemen," one of the officers said as he got back into the squad car; "but if you don't mind, I'd like to make just one remark—quite respectfully, you understand. I don't know what kind of a campaign you two intend to put on, but it certainly is off to a smelly start!"

AS THE SQUAD CAR drove off, Mr. Anderson and Pat Gallagher looked at each other for a long second; then an irrepressible smile crinkled Pat's Irish face. Mr. Anderson pounded the little man on the back, and all four whooped with laughter as they trooped toward the basement entrance of the Anderson house. Jerry flipped off the switch on the recorder control, and the voice coasted to a stop.

"There goes the-e sku-u-u-u-nk!" it said lugubriously. —30—

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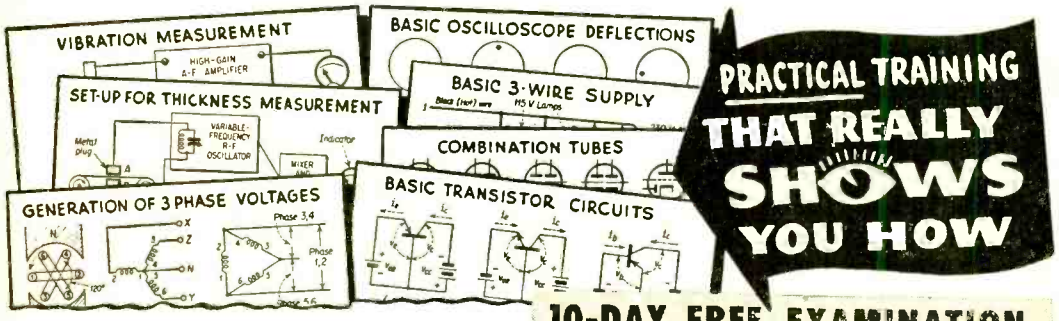

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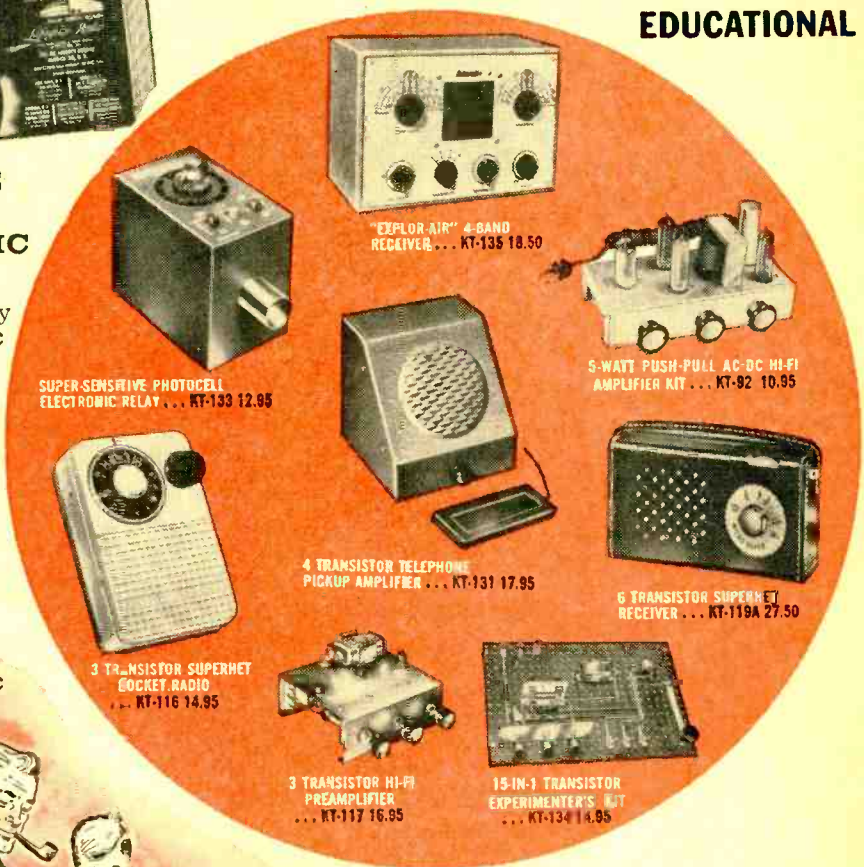

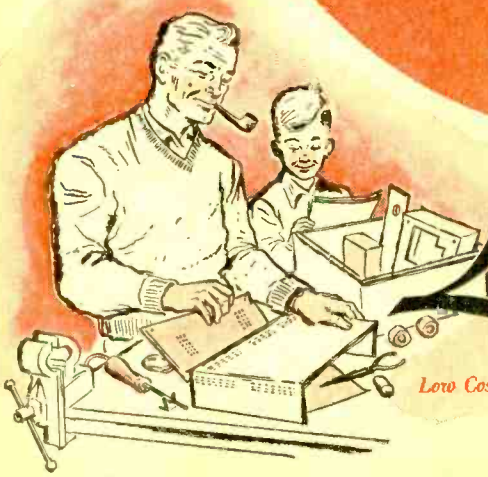

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LAFAYETTE Kits Are FUN To Build!

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KITS FOR BEGINNERS • 10-In-1 Lab Kit • Transistor Code Practice Oscillator • AC-DC Broadcast Receiver • 3-Way Broadcast Receiver • 5-Watt Push-Pull AC-DC Amplifier • 7-In-1 Radio Lab Kit • 2-In-1 Kit • Germanium Diode Radio • 1-Transistor Pocket Radio • 2-Transistor Pocket Radio

HI-FI KITS • Stereo Master Audio Control Center & Preamplifier • Stereo Remote Control Center – Electronic Stereo Adapter • 36-Watt Basic Stereo Amplifier • AM-FM Stereo Tuner • Preamp Audio Control Center • 70-Watt Power Amplifier • 4-Watt Stereo Amplifier • Speaker Enclosure Kits

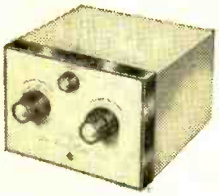
ADVANCED KITS • Broadcast-Shortwave Receiver • Electric Brain Kit • 10 Watt Push-Pull Hi-Fi Amplifier • 15-In-1 Transistor Experimenter's Kit • 4-Band Broadcast-Shortwave Receiver • Photocell Electronic Relay • 6-Transistor Superhet Receiver • 3-Transistor Pocket Radio • 3-Transistor Hi-Fi Preamplifier • 2-Transistor Reflex Radio with Sun Battery • Transistor Code Practice Oscillator • Radio Control Transmitter • Transistor-Diode Checker • Multitester Semi-Kit • 4-Transistor Telephone Pickup Amplifier

PRACTICAL

36-WATT STEREO BASIC POWER AMPLIFIER KT-310 47.50

STEREO MASTER AUDIO CONTROL CENTER-PREAMP KT-600 79.50

STEREO AM-FM HIGH FIDELITY TUNER KT-500 74.50



STEREO REMOTE CONTROL CENTER ELECTRONIC STEREO ADAPTER KT-315 27.50

70-WATT DELUXE BASIC AMPLIFIER KT-400 69.50

4-WATT STEREO PHONO AMPLIFIER KT-126 8.95

DELUXE MASTER AUDIO CONTROL CENTER-PREAMPLIFIER KT-300 39.50

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LAFAYETTE KITS SAVE YOU REAL MONEY. You save up to 50% or more when you build a low-cost Lafayette kit as against factory-wired units of equal or even lesser quality. You save also because Lafayette manufactures these kits and sells them *direct to you*, eliminating the usual dealer's markup.

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NEWARK 2, N. J. 24 Central Ave. MArket 2-1661 Open WEDNESDAY 'till 8:45 P.M.	**PLAINFIELD, N. J.** 139 W. 2nd St. Plainfield 6-4718 Open THURSDAY 'till 8:45 P.M.	**BOSTON 10, Mass.** 110 Federal St. HUbbard 2-7850 Open MON.-WED. 'till 8:45 P.M.

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SEND FOR THE WORLD'S LEADING ELECTRONICS, RADIO, T.V., INDUSTRIAL, AND HI-FI GUIDE

☐ Send FREE LAFAYETTE Catalog 590

Name .....

Address .....

City....., *Zone*.... *State*.....

Inexpensive Photoprint Meter

(*Continued from page 62*)

adjust the potentiometer until the neon bulb just goes out.

For all future enlargements, using the same type and contrast paper, proceed as follows: Make sure the 1-meg. pot is at the same setting and, with the lens wide open, place the photocell of the unit in the area where you want a good black. Then close the diaphragm slowly until the neon bulb just goes out. Now you make your print with the same exposure time that you used in making the test print.

The calibrating procedure should be repeated with papers of various contrasts. Don't forget to record the printing time required for each type of paper for future reference.

An alternate method of compensating for different papers is to mark the dial settings on the exposure meter case and use the same printing time for all papers. —30—

Test Instruments

(*Continued from page 72*)

to determine the guilty party is to clip one lead of the capacitor. If we cut the lead as close as possible to *V5*'s plate lug, then we will be able to solder it back in place, if the capacitor doesn't prove to be defective.

As soon as the capacitor lead is cut, the ohmmeter indicates an open circuit. However, moving the range switch to a higher ohms scale shows that there is a normal 35,000 ohms to ground at the plate lug of *V5*. As a double-check, we take an ohmmeter reading across the .03-μfd. capacitor, and sure enough—0 ohms—a dead short!

We replace the capacitor, turn the set on . . . and it plays. However, it seems a little weak and distorted. What else could be wrong? Perhaps the capacitor damaged some other component when it shorted out. Let's take some more d.c. voltage measurements around *V5*. The plate and screen voltage seem okay (105-120 volts), even a little higher than normal. How about the cathode voltage? Incorrect cathode bias on the tube might cause the low volume and distortion. The meter shows about 15 volts at the cathode of *V5*. The tube manual indicates that 7.5 volts is correct.

Closer inspection shows that the 150-ohm resistor seems a little burned up about

ANNIVERSARY SALE! UNTIL MARCH 31 ONLY!

Lektron's Biggest-Ever

DOUBLE-BONUS OFFER!

BUY ANY TEN POLY-PAKS© AND GET *BOTH* OF THESE BONUSES . . . FREE! **FREE!**

1 YOUR CHOICE OF ANY POLY-PAK IN THIS AD FREE WHEN YOU BUY 10!

PLUS

2 SPECIAL ASSORTMENT $15 WORTH OF RADIO PARTS . . . FREE!

BOTH BONUSES FREE WITH EVERY 10 POLY-PAKS!

FREE!

★ Anniversary Gift Free With EVERY Order!

★ 24-page "Family Shopper" WHOLESALE OR BELOW PRICES ON HI-FI, ELECTRONICS, GIFTS FOR EVERYONE!

10 RCA PLUG-N-JACK SETS, matched. Most pop. amps, tuners, phonos. 88¢

WIRE STRIPPER Strips & cuts hook-up wire, #16 thru #22. Wt. 1 lb. 88¢

70 TUBULAR CONDENSERS Paper, molded, oil, pore., to .5mf to 1000V. 2 lbs. Reg. $14. 88¢

0-15 VAC MINI-METER Hundreds of uses! Only 1¾" dia. Wt. 1 lb. Reg. $3.50. 88¢

0-60 MIN. TIMER For darkroom, lab, shop, kitchen. Loud alarm. 2 lbs. Reg. $6. 88¢

SUN BATTERY Similar to famed B2M. 1" long. Reg. $2.50. 88¢

2 VARI-LOOPSTICKS Adj. 540-1500 KCS. Transistor radios, etc. 1 lb. 88¢

2 P-N-P TRANSISTORS Popular make. Dozens of uses! $5 value. 88¢

2 N-P-N TRANSISTORS Used in many pop. make radios. Worth $5. 88¢

2 TRANSISTOR IF'S Double-tuned. Only ½" square. 456 kcs. 88¢

TEN 3-SECOND TIMER mechanisms. Precision geared. 2 lbs. Reg. $30. 88¢

5" HOBBY SPEAKER For radios, code osc., intercoms. Wt. 2 lbs. Reg. $5. 88¢

60 SUB-MINI RESISTORS ¼" long, 20 values, 1/5W to 10 megs. Reg. $6. 88¢

10 PANEL SWITCHES Asstd. 115VAC, power, multi-circuit & SPST, DPST, DPDT. 2 lbs. Reg. $5. 88¢

15 INSTR. KNOBS Knurled black bakelite, w/pointer; brass inserts, set-screws. Reg. $5. 88¢

5-IN-1 DRILL BIT Reams, saws, shapes, drills, copes. Hand or electric drill. 88¢

20 PILOT LITES 6V. Mini bayonet for panels, radios, etc. 88¢

15 ROTARY SWITCHES Asstd. gangs. 3 lbs. Reg. $12. 88¢

30 MOLDED CONDENSERS Asstd. Finest made! Wt. 2 lbs. 88¢

100 HALF-WATTERS Asstd. value carbon resistors. Incl. 5%. Reg. $12. 88¢

300-FT. HOOKUP WIRE Tinned, asstd. sizes, colors. 2 lbs. Reg. $5. 88¢

65 COILS, CHOKES IF, RF, Ant.; slug-tuned, too. 3 lbs. Reg. $15. 88¢

70 TERMINAL STRIPS Solder lug & binding; to 20 terms. 2 lbs. 88¢

6-PC. HACKSAW SET Includes 6 assorted blades. 1 lb. 88¢

1500 PCS. HARDWARE Nuts, screws, washers, etc. 1½ lbs. Reg. $6. 88¢

7 ROLLS WIRE 25-ft. each. #18 thru #22. Asstd. insulation, stranding, colors. 2 lbs. Reg. $5. 88¢

60 CONDENSER SPECIAL! Molded, paper, ceramic, oil, mica, discs, variable. 2 lbs. 88¢

75 RESISTOR SPECIAL! WW, precision, carbon, variable, mini types. 3 lbs. Worth $15. 88¢

15-PC. TWIST DRILL SET 1/16" thru ¼" by 64ths; w/calibrated case. Reg. $3. 88¢

75 MICA CONDENSERS .00025 to .01 to 1200V; silver, too. 25 values. Reg. $28. 88¢

20 ARTISTS BRUSHES 100% pure bristle, sizes 1-6. Reg. $2.50. 88¢

10 TUB'L'R ELECTROLYTICS Asstd. paper types; AC, DC. Hobby. 3 lbs. Reg. $15. 88¢

4 POWER WOOD BITS Hi-Q steel. ⅜, ½, ¾ & 1" 5" long. Reg. $3. 88¢

60 RADIO-TV KNOBS Asstd. colors, insulation. Some worth $1 ea. 2 lbs. Reg. $17. 88¢

10 ELECTROLYTICS Radio, TV. 10-500 mf to 450VDC. 3 lbs. Reg. $12. 88¢

75-FT. TV TWINLEAD 300-ohm. Flanked, tinned. 3 lbs. Reg. $3.50. 88¢

9-PC. WRENCH SET 3/16 thru 7/16" steel wrenches for shop and auto use. Reg. $3.50. 88¢

POSTAGE STAMP MIKE Crystal. 100 to 8,000 cps. 1 lb. Reg. $7. 88¢

4 OUTPUT XFMRS. 501.6, etc. 3 lbs. Reg. $8. 88¢

HEARING-AID PHONE Crystal, w/cord set and plug. Reg. $5. 88¢

70 HI-Q RESISTORS Carbon, IRC, Ohmite, 1%, too! ½, 1 & 2 W! 10 ohms to 10 megs. 2 lbs. Reg. $13. 88¢

HOBBY BENCH VISE Clamp type. Fits tables, too. Steel. 1 lb. 88¢

SYLVANIA TV MIRROR 10 x 12" stainless steel. 2 lbs. Reg. $4. 88¢

100 RADIO PARTS Wide variety resistors, condensers, pots, forms. 3 lbs. 88¢

2 MIKE XFMRS. Carbon, 100 to 100K ohms impedance. Leads, encased. 2 lbs. Reg. $10. 88¢

5 ROLLS MICRO WIRE #24 thru 32; for transistor sub-mini circuits. 1 lb. 88¢

40 HI-Q CONDENSERS Finest porcelain; NPO's too! 1 lb. Reg. $6. 88¢

35 POWER RESISTORS WW, 5 to 50W to 10,000 ohms. Vitreous, too. 3 lbs. Reg. $15. 88¢

70 ONE-WATTERS Asstd. value carbon resistors. 5%, too! 88¢

15 VOLUME CONTROLS Incl. duals; some w/switch. To 1 meg. 2 lbs. Reg. $12. 88¢

TV PIC BOOSTER Parallel, 6-wire. Extends picture tube life. 1 lb. 88¢

8-PC NUTDRIVER SET $3 value! Plastic handle; 3/16"-7/16" socket wrenches. 1 lb. 88¢

4 SUB-MINI VARIABLES Condensers. ½" sq., 1" shaft. All transistor, sub-mini work. 1 lb. Reg. $8. 88¢

0-6 AMP MINI-METER AC. 1¾" dia. 1 lb. Reg. $3. 88¢

6 SILICON DIODES Sylvania 1N22, 1N23. Reg. $36. 88¢

$25 SURPRISE PACK Large, varied assortment radio, TV parts. 3 lbs. 88¢

60 PLUGS n RECEPTACLES Audio, power, line, battery, spkr. 3 lbs. Reg. $7. 88¢

8 SCREWDRIVER SET With wall rack. Asstd. drivers, plastic handles. 1 lb. List $3.50. 88¢

40 SUB-MINI CONDENSERS For transistor, printed circuit work. 1 lb. Reg. $7. 88¢

8 SUB-MINI SOCKETS Mica-filled; for transistors, too. 88¢

4 OSCILLATOR COILS For printed circuit, transistor portables, etc. Reg. $5. 88¢

MINI-RADIO KIT World's smallest! 2 x 1 x 1". Loopstick, jacks, diode, etc. w/instructions. 1 lb. Reg. $3. 88¢

3 AC-DC CHOKES For power supplies. 50 to 200 ma. Open frame. 3 lbs. Reg. $9. 88¢

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Anniversary Special!

Lowest Price Ever—Anywhere!

TRANSISTOR RADIO

Reg. $14.95

ONLY $9.95

Ready to Play

INCLUDING BATTERIES AND SENSITIVE PHONE

By special arrangement with the manufacturer, Lektron offers this superb transistor radio at the lowest price it's ever been sold for, or is likely to be sold for again! VEST POCKET SIZE, only 3⅞ x 2⅜ x 1", this strikingly designed set has wonderful tone, amazing volume! Precision reflex circuit operates from single battery (no penlite cell) interchangeable with Eveready 216, etc. And it comes all ready to play, complete with battery and sensitive hearing-aid type phone. ALL ORDERS RECEIVED DURING MARCH WILL BE FILLED AT THIS LOW ANNIVERSARY PRICE, even tho we may be forced to re-order at a higher price than under our special arrangement! Order TODAY!

HOW TO ORDER: ORDER BY "BLACK TYPE" HEADLINES, i.e. ONE TRANSISTOR RADIO, $9.95

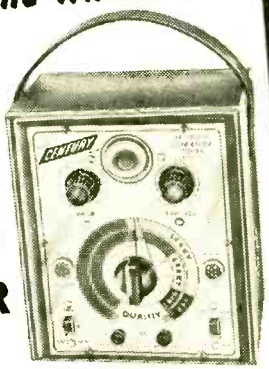
State price with each item. Send check or M.O. including sufficient postage; excess returned. C.O.D. orders, 25% down; rated, net 30 days. INCLUDE POSTAL ZONE in address. (Canada postage, 48¢, 1st lb.; 28¢ ea. add'l. lb.)

LEKTRON 131-133 EVERETT AVE. CHELSEA 50, MASS.

SHIPPED ON APPROVAL

an IN-CIRCUIT CONDENSER TESTER THAT DOES THE WHOLE JOB!

The CT-1 actually steps in and takes over where all other in-circuit condenser testers fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation . . . and makes it an absolute 'must' for every serviceman.



IN-CIRCUIT CONDENSER TESTER Model CT-1

Model CT-1 — housed in sturdy hammertone finish steel case complete with test leads only **$34.50** Net

in-circuit checks:

- Quality of over 80% of all condensers even with circuit shunt resistance present . . .(leakage, shorts, opens, intermittents)
- Value of all condensers from 200 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- Transformer, socket and wiring leakage capacity

out-of-circuit checks:

- Quality of 100% of all condensers . . .(leakage, shorts, opens and intermittents)
- Value of all condensers from 50 mmfd. to .5 mfd.
- Quality of all electrolytic condensers (the ability to hold a charge)
- High resistance leakage up to 300 megohms
- New or unknown condensers . . . transformer, socket, component and wiring leakage capacity

OUTSTANDING FEATURES

- Ultra-sensitive 2 tube drift-free circuitry
- Multi-color direct scale precision readings for both quality and value . . .(in-circuit or out of circuit)
- Simultaneous readings of circuit capacity and circuit resistance
- Built-in hi-leakage indicator sensitive to over 300 megohms
- Cannot damage circuit components
- Electronic eye balance indicator for even greater accuracy
- Isolated power line

Check all power rectifiers in-circuit whether SELENIUM, GERMANIUM, SILICON, etc. with the IN-CIRCUIT RECTIFIER TESTER Model SRT-1

With the growing trend towards compactness, portability and low price, TV manufacturers are resorting more and more to producing series-string TV sets employing selenium, germanium or silicon power rectifiers. Now the need for an in-circuit rectifier tester is greater than ever.

Model SRT-1—housed in sturdy hammertone finish steel case complete with test leads.....only **$29.50** Net

THE SRT-1 CHECKS ALL POWER RECTIFIERS IN-CIRCUIT AND OUT-OF-CIRCUIT WITH 100% EFFECTIVENESS FOR:

✓ Quality ✓ Fading ✓ Shorts ✓ Opens ✓ Arcing ✓ Life Expectancy

OUTSTANDING FEATURES

- Checks all types of power rectifiers rated from 10 ma. to 500 ma. (selenium, germanium, silicon, etc.) both in-circuit or out-of-circuit.
- Will not blow fuses even when connected to a dead short.
- Large 3" highly accurate multi-color meter . . . sensitive yet rugged.
- Separate meter scales for in-circuit and out-of-circuit tests.
- Cannot damage or over heat rectifier being tested.

SIMPLE TO OPERATE

Just clip SRT-1 test leads across rectifier under test right in the circuit without disconnecting rectifier from circuit. Press test switch and get an instant indication on the easy-to-read three-color meter scales . . .

ALL CENTURY INSTRUMENTS ARE GUARANTEED FOR ONE FULL YEAR

The extremely low prices are made possible because you are buying direct from the manufacturer.

TRANSISTOR TESTER Model TT-2

Every day more and more manufacturers are using transistors in home portable and car radios . . . in hearing aids, intercoms, amplifiers, industrial devices, etc. Since transistors go bad the need for TRANSISTOR TESTER is great. They can develop excessive leakage, poor gain, shorts or opens. The TT-2 is an inexpensive quality instrument designed for accurate and dependable tests of all transistors and diodes — quickly and accurately.

OUTSTANDING FEATURES

- Checks all transistors, including car radio, power output, triode, tetrode and unijunction types for current gain, leakage, opens, shorts, cut-off current
- Checks all diodes for forward to reverse current gain
- All tests can be made even if manufacturers' rated gain is not available
- Less than half a minute required for tests of either transistors or diodes
- Large 3" meter is extremely sensitive yet rugged . . . with multi-color scales designed for quick easy readings
- Power is supplied by an easy to replace 6-volt battery — current drain so small, service life almost equal to shelf life. Battery cannot be drained due to accidental shorting of test leads
- Cannot burn-out its own meter or damage transistor or diode under test
- Long test leads and insulated test clips enable tests without entirely removing transistor from circuit
- Test leads are identified by E.I.A. color code so that connection to the correct terminal is assured
- Comes complete with replaceable transistor set-up chart that fits into a special rear compartment.

Model TT-2 — housed in sturdy hammertone finish steel case complete with test leads . . . only **$24.50** Net

IMPORTANT FEATURE: The TT-2 cannot become obsolete as the circuitry is engineered to enable you to check all new type transistors as they are introduced. New listings will be furnished at no cost.

EASY TO BUY IF SATISFIED
see order form on facing page

FOR 10 DAY *FREE* TRIAL

try them for 10 days before you buy . . . only then, when satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

Convince yourself at no risk that CENTURY instruments are indispensable in your every day work. Send for instruments of your choice without obligation . . .

STILL THE BEST SELLING TUBE TESTER IN THE FIELD

FAST-CHECK TUBE TESTER

Model FC-2

The greatest testimonial ever paid an instrument . . . over 20,000 sold in a little more than a year—and still selling as fast as we can produce them. See for yourself at no risk why so many servicemen choose the FAST-CHECK above all other tube testers — regardless of price.

Model FC-2 — housed in hand-rubbed oak carrying case complete with CRT adapter . . . only **$69.50** Net

SIZE: W: 14⅝" H: 11¼" D: 4⅜"

Just 2 settings on the FAST-CHECK TUBE TESTER tests over 700 tube types completely, accurately — AND IN SECONDS!

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes.

No other tube tester made at any price can match the value of the FAST-CHECK.

RANGE OF OPERATION

- Checks quality of over 700 tube types, employing the time proven dynamic cathode emission test. This covers more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes. OZ4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- Checks for inter-element shorts and leakage.
- Checks for gas content.
- Checks for life-expectancy.

IMPORTANT FEATURES

● No time consuming multiple switching . . . only two settings are required instead of banks of switches on conventional testers ● No annoying roll chart checking . . . tube chart listing over 700 tube types is located inside cover. New listings are added without costly roll chart replacement ● Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale ● 41 phosphor bronze beryllium tube sockets never need replacement ● 7-pin and 9-pin straighteners mounted on panel ● Large 4½" D'Arsonval type meter is the most sensitive available, yet rugged — fully protected against accidental burn-out ● Special scale on meter for low current tubes ● Compensation for line voltage variation ● 12 filament positions ● Separate gas and short jewel indicators ● Line isolated — no shock hazards ● Long lasting etched aluminum panel.

NOTE: The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.

NEW

For those looking for a real ECONOMY MULTIPLE SOCKET TUBE TESTER without sacrificing *ACCURACY, SPEED and VERSATILITY*

MINI-CHECK TUBE TESTER

Model MC-1

Here is a multiple socket tube tester designed to meet limited budgets. Although low in price it boasts a unique circuitry that enables you to check over 600 tube types — and has a range of operation that far exceeds others in its price class.

Model MC-1 — housed in sturdy wrinkle finish steel case ..... only **$39.50** Net

SIZE: W: 9" H: 8½" D: 2¾"

OUTSTANDING FEATURES

● Checks emission, inter-element shorts and leakage of over 600 tube types. This covers OZ4s, series-string TV tubes, gas regulators, auto 12 plate volt, hi-fi and foreign tubes ● 3 settings enable a test of any tube in less than 10 seconds ● Employs dynamic cathode emission test principle ● 3½" D'Arsonval type meter — most accurate type available . . . its greater sensitivity means more accuracy . . . its jewel bearing means longer life ● 17 long lasting phosphor bronze tube sockets ● Combination gas and short jewel indicator ● 9 filament positions ● Handy tube chart contained in special back compartment ● New tube listings furnished periodically at no cost ● Detachable line cord

plus these BONUS FEATURES . . . found in no other low price tube tester

✓ Checks for cathode to heater shorts ✓ Checks for gas content ✓ Checks all sections of multiple purpose tubes . . . will pickup tubes with one "Bad" section ✓ Line isolated — no shock hazard ✓ Variable load control enables you to get accurate results on all tubes ✓ Positively cannot become obsolete as new tube types are introduced.

CONVENIENT TIME PAYMENT PLAN — NO INTEREST OR FINANCING CHARGES

CENTURY ELECTRONICS CO., INC.

111 Roosevelt Avenue, Dept. 303, Mineola, New York

CHECK INSTRUMENTS DESIRED

- ☐ Model CT-1 In-Circuit Condenser Tester.....$34.50 — $9.50 within 10 days. Balance $5 monthly for 5 months.
- ☐ Model SRT-1 In-Circuit Rectifier Tester.....$29.50 — $4.50 within 10 days. Balance $5 monthly for 5 months.
- ☐ Model TT-2 Transistor Tester.....$24.50 — $4.50 within 10 days. Balance $5 monthly for 4 months.
- ☐ Model FC-2 Fast-Check Tube Tester.....$69.50 — $14.50 within 10 days. Balance $11 monthly for 5 months.
- ☐ Model MC-1 Mini-Check Tube Tester.....$39.50 — $9.50 within 10 days. Balance $6 monthly for 5 months.

Prices Net F.O.B. Mineola, N. Y.

Please rush the instruments checked for a 10 day free trial. If satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. If not completely satisfied I will return the instruments within 10 days and there is no further obligation. It is understood there will be NO INTEREST or FINANCING charges added.

Name .....

Please print clearly

Address .....

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

something . . . probably all the current that the shorted .03-μfd. capacitor was pulling through it. Switching the VOM back to the ohms range again, a measurement of *V5*'s cathode resistor shows that it's nowhere near its color-coded value of 150 ohms. We replace the cathode resistor, turn the radio on—and lo and behold—music fills the room.

Of course, we haven't covered *all* the possible faults found in a.c./d.c. receivers. What we've tried to do is give a few examples and show how proper use of the various ranges and functions of the VOM will enable you to track down the cause of almost any circuit problem you're apt to encounter.

Next month, we'll check out a *Vacuum-Tube Voltmeter,* see what the inside story is, and why a VTVM with its tube-driven meter movement has certain practical advantages over the VOM. –30–

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Transistor Topics

(*Continued from page* 84)

of a small superhet. Performance-wise, you should be able to pick up stronger local broadcast stations without an external antenna.

Help Wanted! Every now and again, a *Transistor Topics* reader will ask about a special circuit for a pet application, or one which will "fit" parts he happens to have available. And, very often we receive a number of requests for circuits of a given type. Starting this month, we'll mention the more popular "requests" from time to time. Perhaps you . . . or you . . . or you . . . will have just the circuit information needed.

We've had quite a number of requests for transistorized equipment suitable for use by the Civil Air Patrol (CAP). The most recent came from Cadet Basic/Joe Carr, Arlington CAPC, 6137 N. 12th Street, Arlington 5, Va. Joe is looking for circuit data on mobile crystal-controlled transmitters and receivers operating at 4467.5 kc. He indicates that he—and his squadron—are "not scared of schematics and solder guns." Can anyone help him?

Incidentally, if you've an experimental turn of mind, and would like to try your hand at developing CAP gear, but lack info on operating frequencies, type of emission, power limits, frequency tolerances, and so

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PROGRESSIVE RADIO "EDU-KIT"®

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You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for Television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $22.95. The Signal Tracer alone is worth more than the price of the entire Kit.

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You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

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

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In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

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You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

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

FROM OUR MAIL BAG

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

Robert L. Snuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Troubleshooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

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

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

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on, a friend of ours has volunteered to answer any questions on these subjects. Write to: Major Walter Starling, Commander, Northeastern Squadron, National Capital Wing, CAP, 3326 Buchanan St., Mt. Rainier, Md. Please include a stamped, self-addressed return envelope for your answer.

Transistorized Computer. One of the first firms to manufacture a fully transistorized electronic computer, the Philco Corporation is now producing the world's fastest and first all-transistor airborne computer. A modified version of its famous "Transac" computer, Type C-1100 operates 10 times faster than any commercially available airborne unit, and can perform 64,000 additions or take 16,000 square roots per second. Mighty fast figuring!

The C-1100 is designed to handle all the computational requirements necessary to control a jet aircraft from take-off to landing. In military craft, the C-1100 can also compute weapon delivery and interception. As an added bonus, it constantly cross-checks its own operation.

But although Philco's new computer was designed originally for aircraft use, it can be easily adapted to other mobile or industrial control applications.

A typical C-1100 computer occupies less than three cubic feet of space, weighs only about 150 pounds, and requires only 60 watts for operation. It employs 3500 transistors, 2300 resistors, 280 capacitors and 20 core memory planes. Its drum storage (memory) can retain from 1500 to 5000 instructions and numbers.

High-Frequency Transistors. In an earlier column, we mentioned that Texas Instruments (Dallas, Texas) was producing a high-frequency power transistor. A number of readers have written for further info on this new unit. Here's the dope: Type Number 2N1046; *p-n-p* germanium transistor made using the diffusion process; cut-off frequency, 10 mc.; maximum collector-to-emitter voltage, 80 volts; maximum collector current, 3 amperes; total dissipation, 15 watts. A typical unit has a forward current transfer ratio of 70 (at 25°C), with a collector current of 0.5 amp, collector voltage of 2 volts.

From the same firm comes news that they are now producing ultra-high-frequency "mesa" transistors. The first of these is Type 2N559. With an alpha cutoff frequency of 250 *megacycles*, this unit has a collector dissipation rating in excess of 150

milliwatts and can be used at temperatures up to 100°C.

Product News. Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) has introduced a four-transistor two-station intercom. Intended for office and home use, this unit should make an excellent "electronic baby sitter" because shock hazard has been eliminated, and there are no hot tubes to burn curious fingers.

A portable all-transistor tape recorder-player is now being merchandized by Steelman Phonograph & Radio Co. (2-30 Anderson Ave., Mount Vernon, N. Y.). Measuring only 2⅞" x 6½" x 9¾" over-all, it operates on standard mercury penlight batteries and can provide a full hour of voice recording on its standard 3" reel.

The International Rectifier Corporation (1521 East Grand Ave., El Segundo, Calif.) is producing high-efficiency solar converter modules for commercial and military applications. Each module contains five series-connected 1 cm. x 2 cm. silicon cells embedded in an epoxy mold which provides a shockproof, weatherproof housing. Carrying a list price of $24 each, a "battery" of these new modules can supply as much as 100 watts of power per 14 square feet of cell area.

If you live in a TV "fringe" area, you may be interested in a *transistorized* TV preamplifier just introduced by Westbury Electronics, Inc. (Westbury, N. Y.). Featuring a bandwidth of 6 mc. and 40-db gain, these low-noise single-channel amplifiers are designed for pole mounting at the antenna.

That's it for now, fellows.

Lou

After Class

(*Continued from page* 78)

the two capacitors has a better dielectric resistance, a variable resistance is included in series with each. Then we can try adding resistance first to one capacitor and then to the other by varying *R3* or *R4* until the null is sharp and definite.

In the theoretical *RC* bridge in Fig. 3, *Rx* and *Rs* are the "built-in" resistances while *R1* and *R2* are the variable resistors used to adjust for dielectric differences.

After a sharp null is obtained with the

assistance of either of these two resistors, the value of the unknown capacitor is determined by substituting the known values of *Cs*, *R3*, and *R4* in the last equation given. *R1* and *R2* are merely little "helpers" that aid the operator in establishing a clear and definite balance, and their final setting is of no importance.

Homemade Series RC Bridge. If you would like to build a very precise *RC* bridge for capacitance measurement, you'll need a 1-kc. audio oscillator (output voltage not critical) and the circuit shown in Fig. 4. An accurate capacitor decade box is best for *Cs*, but any known values can be used in the *Cx* terminals in the absence of a decade arrangement.

The 25,000-ohm potentiometer (*R3*) should be equipped with a dial that will permit you to read its resistance setting with good precision, and for best results *R4* should be of 1% accuracy. *R6* is a 5000-ohm potentiometer that can be switched to add the required series resistance to either *Cs* or *Cx*. The headphones should be of the low-impedance type (about 600 ohms).

For capacitors between 2 μfd. and .0005 μfd., no audio amplification will be required if the headphones are in good shape. If you are interested in checking out capacitors smaller than .0005 μfd., it will be probably necessary to amplify the signal.

Using the Bridge. The precision to be expected of any measurement made with the *RC* bridge is limited only by the accuracy to which *Cs*, *R3*, and *R4* are known, and by the care taken by the operator to establish a sharp null.

Suppose you have a paper capacitor about 1½" long and ½" diameter rated at 400 volts. Its capacitance would probably be between .005 and 0.1 μfd. For a start, you might then choose .01 $\mu fd.$ as *Cs*, and adjust for null. If no balance is obtained, try larger or smaller capacitors.

Now adjust *R3* for as close a null as possible. With the rotary switch in either position, *R6* is then varied slowly while touching up *R3* to determine if the balance is improved. If it is not, rotate switch to other position, and readjust *R6* and *R3*.

Once you have discovered which capacitor needs the phasing resistor *R6*, *R3* and *R6* are adjusted alternately for the sharpest balance. The values of *Cs*, *R3*, and *R4* are then substituted in the evaluation to obtain the precise value of *Cx*.

For example, assuming that *Cs* is

.01 μfd., $R4$ is 5000 ohms, and $R3$ achieves good balance at a setting of 10,300 ohms, then the substitutions would look like this:

$$Cx = Cs \times R4/R3$$
$$Cx = .01 \times 5000/10{,}300$$
$$Cx = .01 \times 0.485$$
$$Cx = .0049\ \mu fd.$$

Vertical Makes Comeback

(*Continued from page* 75)

over at the maximum power allowed. Figure 6 shows a horn gap that is easy to make. A small wooden fence at the antenna base is recommended for ground installations.

Manufacturers' instructions for guying should be carefully followed. Where nonmetallic guy lines are used, such as plastic rope, and not enough rope is supplied for an unusual installation, the guys can be extended with regular guy wires which have been electrically broken by means of insulators. Use of a building for support is not recommended, due to absorption from

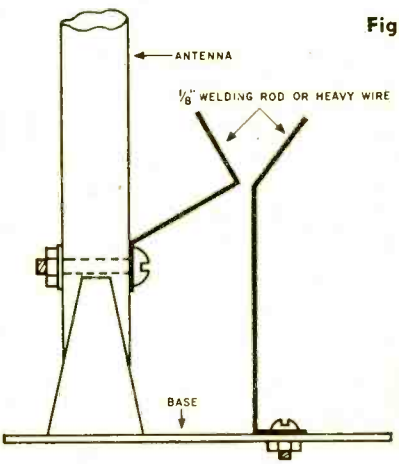


Fig. 6.

wiring, gutters, etc., although such an installation can be made to do if no other location is available.

Because a vertical antenna can be located close to the transmitter, the tendency is to make the transmission line as short as possible. With coax lines, this may lead to trouble on the lower frequencies due to line resonances. Resonant problems can be avoided by making the line at least one-half electrical wavelength at the lowest frequency. With RG coax, use 23' lengths for 20 meters, 45' lengths for 40 meters and 90' lengths for 75/80 meters. —30—

Inside the Preamplifier

(*Continued from page 47*)

values depend upon a number of factors in the specific circuit.

Equalization Methods. There are two general ways of employing a network in the preamplifier to obtain RIAA playback equalization. One is the "bypass" method shown in Fig. 3(A). Here the network is placed between two amplifying stages and the signal is given two alternate paths. One path is through the amplifier, the other is the "bypass" to ground. The network detours the frequencies we want to attenuate

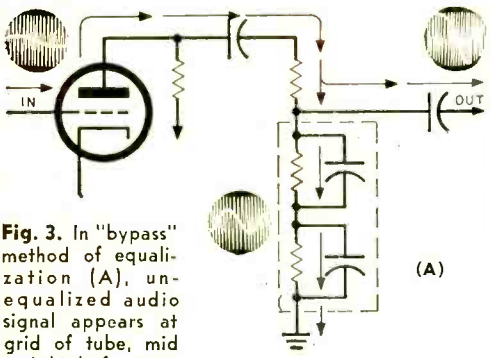
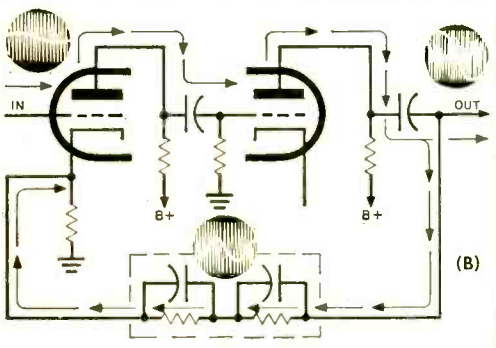


Fig. 3. In "bypass" method of equalization (A), unequalized audio signal appears at grid of tube, mid and high frequencies are bypassed to ground, and correctly balanced output signal goes to next stage. Feedback equalization (B) is accomplished by feeding back out-of-phase mid and high frequencies, thus restoring output signal to proper frequency balance. Waveform amplitudes are for illustrative purposes only and are not exact.



to ground while passing the frequencies we want to boost into the amplifier.

A 20-cycle signal passes through without any bypass loss. On the other hand, 90% of a 100-cycle signal will be bypassed to ground and only 10% permitted to go through the amplifier. At 20,000 cycles, 99% is bypassed to ground and only 1%

permitted to pass into the amplifier. The result is a response approximating the RIAA playback curve. When an RIAA recording is fed through such an equalizer, the response at the output of the preamplifier will be flat from 20 to 20,000 cycles.

The other way of achieving equalization is to vary the gain of the preamplifier at a rate that is proportional to the desired playback curve. By using a negative feedback loop with an RIAA network in it we can do just that, and derive other benefits besides. The most commonly used feedback equalizer employs a loop around two stages as in Fig. 3(B). This loop goes from the output of the second stage to the cathode of the first stage. The use of feedback equalizers is particularly advantageous because in addition to providing equalization feedback it also results in less distortion and noise.

How Many Equalizers? The RIAA equalizer will equalize all microgroove recordings made in the past few years. However, modern 78-rpm records have a somewhat different equalization curve. Furthermore, we have noted that prior to 1955 a number of curves were used by various disc manufacturers, including the LP, NARTB, NAB, AES, European, and FFRR. Most preamps provide a choice of several other equalizations in addition to the RIAA; and a few of the most elaborate provide a variety (generally by using separate controls for bass and treble equalization) sufficient to equalize any standard recording.

This variety of equalizers can be quite puzzling to the purchaser of a preamplifier. The person who has a large library of older recordings, or expects to collect older recordings, will prefer a preamplifier that offers relatively elaborate equalization facilities. On the other hand, if one has few or no recordings made prior to 1955, the single RIAA equalizer will usually suffice. It will equalize all modern recordings and do an acceptable job on the older ones with a little touching up of the tone controls.

Next month we will see how *tone controls* supplement equalizers, and we will go into the design and operation of various types of tone control circuits. —30—

ANSWERS TO FREQUENCY QUIZ ON PAGE 82

1 M	6 C	11 T	16 J
2 I	7 G	12 L	17 P
3 E	8 S	13 H	18 Q
4 B	9 K	14 A	19 F
5 R	10 N	15 O	20 D

Novices—Let's Go General

(*Continued from page* 64)

Novice bands alone to bring you up to the 15 or 16 words per minute which you actually need. Thirteen words per minute on the nose is not enough. The extra two or three words per minute above the minimum are welcome insurance. This higher speed won't be found on the Novice bands for it is rare that a Novice fist is heard above 12 words per minute.

Listening to Perfect Code. If you depend entirely on Novice band code practice, you'll face another problem. The tape which you hear before the FCC examiner will not sound like the fists you hear on the air. The tape is perfect code. The perfect fist is a rarity. Some boys have enough swing to send your toe tapping the woodwork, but it is not good practice. You must accustom yourself to the code which you are going to hear when you're sweating out the 13 per.

Probably the best practice to supplement your Novice activities is the code practice sent out by W1AW nightly at 9:30 EST. Speeds vary from 5 to 13 words per minute on Sunday, Tuesday, Thursday, and Saturday. Transmissions on the other nights range from 15 to 35 words per minute. The exact frequencies are listed in QST and cover practically all the amateur bands.

These transmissions are perfect code and give valuable practice in plain language, punctuation, and numerals. When you can copy 13 words per minute with fair accuracy, concentrate on the higher speeds. Those added words per minute above the minimum are going to pull you through.

Code records are helpful. If a code machine is available through rental or purchase, make use of it. But whatever method of practice you employ—make it the same time every day. Above all, don't be discouraged. Spend considerable time on the characters, such as the fraction-bar, which you don't hear often on the air. Surprisingly, that one character has tripped a lot of fellows and caused enough confusion to make them fail the test.

Taking the Test. The code test consists of plain language and you must copy solid one minute out of five—or 13 consecutive words. Actually it is a little less because numerals and punctuation count as two characters.

Now for the day of the test. It is a good

idea to arrive before the crowds come and avoid chewing the fat with anyone—you are virtually certain to meet one or two fellows who have failed the test. If you have brought your receiving speed up to 15 or 16 words per minute, *13 per will seem slow.* Place the phones over your temples rather than directly over the ears; the signal will probably be louder than you expect.

Time spent on the Novice bands and keying simultaneously with W1AW or a tape machine has put your fist in good shape. The sending test should not be difficult. Now you have until the office closes to finish the theory examination.

Check, and double check, your answers. The questions aren't tricky, but let the brighter boys rush through the examination. You want that General ticket! —30—

Among the Novice Hams

(*Continued from page* 67)

izing circuit in r.f. amplifiers, a tetrode normally has a much higher amplification factor than a triode; therefore, it requires less signal at its control grid to produce a given output signal than is required by a triode. In popular terminology, a screen-grid tube is easier to drive than a triode.

But a simple tetrode has a serious disadvantage. In general, when the electrons from the cathode of a vacuum tube strike the positive plate, they are traveling so fast that some of them bounce right off again. In the process, they dislodge electrons already on the plate.

This process is called *secondary emission.* In a triode, secondary emission is not too much of a problem, as its plate is the only positively charged element in it; therefore, any foot-loose electrons cannot escape the positive of the plate for long. In a tetrode, however, if they get too close to the screen grid, which also has a positive potential, it gobbles them up, and they are permanently lost to the plate. This effectively reduces the plate's signal current.

During the part of the operating cycle when the instantaneous plate voltage of a tetrode approaches the value of the screen voltage, its plate may lose more electrons by secondary emission than it receives from the cathode. As a result, its plate current is not entirely controlled by the signal applied to the control grid; and, consequent-

ly, the output signal is a distorted version of the input signal.

One way to minimize such distortion is to operate the screen grid at a low positive voltage and limit the input signal to a low value. Unfortunately, this method reduces the over-all efficiency of the tube.

The Pentode. A better way of minimizing distortion is to insert a third grid, called the *suppressor grid,* between the screen grid and the plate, thereby producing a *pentode* or five-element tube.

In operation, the suppressor grid is connected to the cathode of the tube, making it negative with respect to both the screen grid and the plate. But, by the time the electrons emitted by the cathode pass the screen grid, they are going so fast that they crash through the negative field around the suppressor grid like bullets through a paper target and continue on to the plate.

However, the electrons bounced off the plate do not have time to pick up speed before they reach the suppressor, which gently shooes them back to the plate again, instead of allowing them to reach the screen grid. Thus the distortion from secondary emission is eliminated.

Beam Power Tetrodes. Another method of minimizing distortion is utilized by a *beam power tetrode.* In it, the screen grid is positioned so as to place its wires in line with the wires of the control grid. Then, the spacing between the screen grid and the plate is made comparatively wide. Finally, a pair of *beam-forming plates* is inserted in this space, one at each end of the plate, and connected to the cathode.

As a result of the aligned grid wires, the electrons from the cathode shoot through them in concentrated "beams" and start to slow down as they travel away from the screen grid, only to pick up speed again as they approach the plate. In this way, a wall of electrons is formed in the space enclosed between the plate, the screen grid, and the beam-forming plates. This wall of electrons keeps any secondary electrons from the plate from reaching the screen grid. Thus, a beam tetrode performs much like a pentode, even though it does not contain an actual suppressor grid.

Beam tetrodes usually work best when the plate current is fairly high; pentodes are generally used as small-signal amplifiers, and beam tetrodes in higher power applications.

While screen-grid tubes were originally

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photo courtesy Electro-Voice, Inc.

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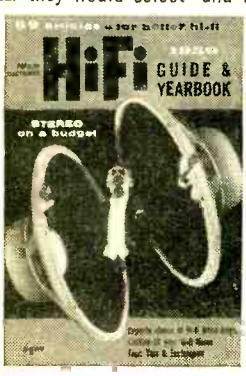

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developed as r.f. amplifiers that did not require external neutralization, their power sensitivity is so high that the grid-to-plate capacitance of the larger transmitting types may still be high enough to sustain self-oscillation in an r.f. amplifier. Therefore, most high-power, transmitter r.f. amplifiers using screen-grid tubes do incorporate a neutralizing circuit for maximum stability.

Nevertheless, as far as the General/Conditional Class license examination is concerned, the correct answer to the question "What is the principal advantage of a screen grid type r.f. amplifier over a triode of equal power rating?" is still "the principal advantage of a screen-grid tube as an r.f. amplifier is that it does not require an external neutralizing circuit, because the screen grid reduces its grid-to-plate capacitance to a very low value."

News and Views

Dave Becker, KN2SBN, 140 Van Cortlandt Ave. W., Bronx 63, N. Y., has worked Australia, Panama Canal Zone, Canada, Italy, Puerto Rico, and England in six months on the air to go with 32 states, 28 confirmed. Dave transmits with a Heathkit DX-40 at 75 watts and receives with a Hallicrafters S-85 equipped with a Heathkit Q-Multiplier . . . . . **Eric Johnson, KNØRHE,** 374 Elmwood Ave., Fargo, N. D., should have his Conditional license by the time this is printed. In three months as a Novice using a Knight "Ocean Hopper" receiver and a WRL Globe Chief-90 transmitter running 75 watts, he has worked 42 states, Canada, Hawaii, Brazil, Panama Canal Zone, and Germany on 40 and 15 meters. This is a good record for any Novice, but it is phenomenal with such a simple receiver. Write to Dave for a sked, if you need a North Dakota contact.

Bob Vincent, KN3DTQ, 217 State St., Grove City, Pa., spent most of his nine months as a Novice on 40 meters, where he worked 33 of his total of 37 states. His only DX is Puerto Rico, but Bob is not complaining. His equipment includes a Heathkit DX-20 transmitter, an RME-69 receiver, and a 40-meter folded dipole . . . . . **Larry Rossow, KN8MPD,** 1200 Ross, Plymouth, Mich., has really kept the 15-meter band hot. In his first 27 days on the air, he worked 27 states, Canada, and Puerto Rico, using a Heathkit DX-35 and a Hallicrafters S-20R in conjunction with a "Demi-Quad" antenna (POPULAR ELECTRONICS, January, 1958), which obviously works well . . . . . **Dick Abbott, WV2AFQ** (13), 952 Downing Road, Valley Stream, N. Y., sticks to 80 meters, where he has worked ten states. He uses a DX-40 to excite a center-fed antenna, and he receives on a National NC-54 receiver. Dick offers help to prospective Novices.

Steve Case, 1018 St. George's Road, Baltimore 10, Md., has been a short-wave listener for four years, using a Hallicrafters S-38C re-

ceiver, and has 241 QSL cards to show for it from all states, all Canadian call areas, and 84 countries. He reports a 70% return on cards sent—an excellent record. Steve is now studying for his Novice license . . . . . Gladys Sparks, K4PZB, thinks that the Novice record of **"Duke," Huston Beall, K4TRV,** Route 1, Winchester, Ky., is worth writing about. It took him only six months to work the 48 states and 20 countries in five continents. Even with a Collins 75A-4 receiver and a Johnson Ranger transmitter, such a record takes real operating in the Novice bands—and in the General bands, too . . . . . **Gene Owens, W6ORZ,** (15) 1327 Park Ave., Long Beach 4, Calif., blames it all on me! He read one of my columns, and decided to become a ham. Lyle, K6IPJ, and a local code and theory class kept him going. He started with a Novice license but traded it in on a General after about 275 contacts and now has over 1000 contacts. His present transmitter is a DX-35, and his receiver is a Hallicrafters SX-99. Gene is president of the St. Anthony's High School Amateur Radio Club.

Mike Elliott, KN1IYV, 9 Baltimore St., Lynn, Mass., does most of his "DX'ing" from about 1:00 to 4:30 a.m., Saturday and Sunday mornings. So far, his National SW-54 receiver and Heathkit DX-20 transmitter are tied to a 40-meter doublet antenna. Mike's pet peeve is hams who claim 100% copy by answering a transmission with a series of "R's," and then ask for a bunch of repeats . . . . . **Kip Edwards, KN7GGC** (11), 12228 N. E. 5th St., Bellevue, Wash., offers to sked anyone wanting to get into the RCC (Rag-Chewer's Club)—which is done by rag-chewing with a member for a minimum of a half hour and then both parties dropping a card with details to ARRL, 38 LaSalle Road, West Hartford, Conn. Upon receipt of both cards, ARRL will send a membership certificate to the applicant. Kip has worked Alaska, a couple of Canadians, and 13 states using a 35-watt, home-brew transmitter, a Heathkit AR-3 receiver with Q-Multiplier added, and a dipole antenna.

Joe Zwirn, KØPML, 757 Armstrong Ave., St. Paul 2, Minn., reports receiving lots of fine letters after his note appeared in the November column, in spite of his call being misprinted. Joe has had his General for three months and does some phone work, but he still prefers c.w. He is using a base-loaded vertical antenna, which works well on all bands . . . . . **Larry Camp, K4JNM,** 381 Walnut St., Hopeville, Ga., worked 46 states—all but two confirmed—Puerto Rico, Canada, and Hawaii in five months as a Novice on the 80- and 40-meter bands. Larry transmitted with a Heathkit AT-1 transmitter running 35 watts and received on a three-tube Allied Knight Space Spanner, for which he wound an 80-meter coil.

Due to lack of available space this month, we have been forced to leave out the section entitled "Help Us Obtain Our Ham Licenses." How about a report on your activities for next month? 73,

Herb, W9EGQ

Short-Wave Report

(*Continued from page* 86)

Aden—*R. Aden,* 6148 kc., was heard with weak but readable signals from 1215 to 1225, Arabic chanting and Oriental-type music. A brief Eng. ID was given at 1225, and the station left the air at 1227. This was logged with a vertical antenna. *(61)*

Angola—*R. Clube de Congo Portuguesa,* 4720 kc., Carmona, has been noted from 1630 with dance and classical music. The final ID in Portuguese at 1658 was followed by the anthem "A Portuguesa." Signal varies greatly from day to day. *(166)*

CR6RZ, Luanda, 17,795 kc., has music to 1715 followed by two gongs and news to 1728. S/off at 1730 is with a guitar theme and anthem. *(418)*

Belgium—Brussels has moved from 15.335 to 15,340 kc. and is noted at 1300-1600. *(100, 378)*

The 11,850-kc. outlet is still coming in well at 1930-2000, dual to the Leopoldville relay outlet on 9655 kc., and at 1815-2000 on Saturdays. Reports go to P. O. Box 26, Brussels 1, Belgium. *(DW, 172)*

Brazil—A new station is *Radio Rural,* 15,105 kc., Rio de Janeiro. This one was heard testing in Portuguese at 1500-1800 and may be on regular schedule. *(100, 420)*

Burma—Rangoon has been heard on 4795 kc. at 0700 in native language. A nearby unmodulated carrier mars reception. The 9540-kc. outlet is scheduled at 0000-0500; 6035 kc. at 1900-0500. *(104, 166)*

Chile—The new *R. Diego Portales,* Talca, 6020 kc., 10 kw., was noted at 2100. The schedule reads 0700-0000. *(465)*

China—Chinese regional stations heard recently include: Shanghai, 5283 kc., at 0725 in Oriental language; Fukien, 4981 kc., at 0730 in a native language; and Urumchi, 7385 kc., scheduled at 0700-0830 in Kazakh. The latter is dual to 4770 kc. *(166, 488)*

Comores Island—*R. Comores* operates Sundays only at 0700-0830 on 7340 kc. *(378)* Has anyone heard this one as yet?

Czechoslovakia—Prague schedule to N.A. reads: 1930-2000 on 9550, 11,725, 11,745, 11,845, and 15,285 kc.; 2200-2300 and 0000-0030 on 7255, 9550, 9605, 11,725, and 11,745 kc.; and 0330-0430 on 11,725, 15,185, and 21,450 kc. A special program for radio amateurs is presented on the first and third Thursday at 1930 and 0000. *(EB, WC, HF, JT, 348, 425, 475)*

Dahomey—*R. Cotonou,* on 4900 kc. for a while, has returned to 4870 kc. and is being tuned from 1540 to 1645/close with African-type music. No ID until 1630. French news at 1630. *(166, 488)*

Dominican Republic—A new station is HIL, Ciudad Trujillo, 3310 kc., heard at 1900-2300. HI5C, *La Vos del Progresso,* San Francisco de Macoris, has moved from 4875 to 4860 kc. and is noted at 1800-2200. HI9B, Santiago de los Caballeros, 4910 kc., is heard with Spanish music and talks at 1725-1745; ID at 1730. *(100, 531)*

Ecuador—A new station is HC1FA, *R. Metropolitina,* Quito, 5782 kc. This 1-kw. station is reportedly dual to an outlet on 19,600 kc.

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although the latter channel bears checking. Reports go to Apartado 2850. The schedule is not known. *(465)*

R. Nacional Espejo, Otavalo, 3325 kc., has been heard at 2330 with music and announcements. *(378)*

Egypt—A report on the Foreign Service shows the following: 17,915 kc. at 0600-1000 in Arabic, Indonesian, Malay, Persian, Pushtu, and English to South, S.E., and Central Asia. Eng. news is given at 0830. Further scheduling: 1015-1200 in Arabic, Sudanese, Swahili, Amharic, and Eng. to Africa on 17,915 kc., with Eng. news at 1025-1030; 1400-1520 in French and Eng. to Europe with Eng. at 1500-1520 on 17,915 kc.; 1830-2000 in Spanish, Portuguese, and Arabic to South America on 15,465 kc., no Eng. at present; 1830-2000 in Spanish, Portuguese, and Arabic to N.A. on 9795 kc. *(378)*

Falkland Islands—A verification was received from Port Stanley for the outlet on 3958 kc. Try for them at 1815 with sports, 1830 with world news. The ID is given frequently. Noted until 1935, the schedule reads to 2030 s/off. *(61)* (Ed. Note: This is difficult to hear due to ham radio QRM. At time of compilation, Monitor *61* is the only one known to have logged this station.)

France—Paris can be tuned on 7220 kc. from 0245 to 0300/close with "The French Have A Word For It"; on 11,920 kc. in French from 1915 to 2000/close; and on 6045 kc. in Arabic to 1800 s/off. *(442, 501)*

Another Paris xmsn is noted on 7117 and 3913 kc. from 1425 to 1800 s/off. In Arabic, this may be a relay from Algeria. *(488)*

French Equatorial Africa—Recent changes include; *Radio AEF* from 15,420 to 15,460 kc., heard at 1300-1545; *R. Brazzaville,* from 17,880 to 17,720 kc., scheduled at 0830-1015; and the latter also from 11,970 to 11,725 kc., noted to N.A. with Eng. at 2015-2100 and 2145-2200. Reports for *R. Brazzaville* go to P. O. Box 108, Brazzaville. *(AR, 100)*

French Togo—*R. Lome,* 3220 kc., is noted in French at 0225-0300 with talks and Parisian show music. Listen for the ID *Ici Lome* around 0250. *(61)*

French West Africa—*R. Niamey,* 5021 kc., is scheduled at 1258-1500 in vernacular languages and from 1500 to 1600/close in French. The location is 510 miles north of Cotonou, Dahomey, and 1280 miles east of Dakar. *(166, 378, 488)*

Germany—*Deutsche Welle,* Cologne, has added 15,405 kc. to its 2030-2330 xmsn to N.A., dual to 9640 and 11,795 kc. *(4, 100, 378)*

Greece—Try for Athens at 1115-1145 to France and England or at 1300-1400 to Northwest Europe on 15,345 and 21,485 kc. Other channels available include 9607, 17,778, and 11,718 kc. *(TM)*

Haiti—Recent changes: 4VB, *R. Commerce,* Port-au-Prince, has dropped 9543 kc. and is broadcasting only on 5981 kc. at 0600-0900 (Sundays at 0700-1900); do not confuse the Sunday "Paris Star Time" program at 1830-1900 with *R. Paris. La Voix de la Vie Marie,* Cap Haitien, has moved from 6195 kc. to 6100 kc. and is noted Monday through Saturday at 0630 and at 1715-1830, and Sundays at 1900-

1935. *La Voix Evangelique*, Cap Haitien, has moved from 6100 to 6138 kc. and has "Listener's Post" at 0500 Saturdays. A new station is 4VU, *R. Lumiere*, Cayes, 250 watts, on 3322 kc. (alternate channel is 3455 kc.); they have scheduled programs in French and Creole only; reports go to Box 71, Cayes. (*4, 100*)

India—A new outlet for Delhi is 21,620 kc., replacing 21,570 kc., and has been noted at 0630-0730. (*100*)

Iran—The Dep't. of Press and Propaganda discloses that *R. Tabriz* operates on 6152 kc. at 2130-0030, 0230-0630, and 0730-1230. Power is 7500 watts. (*488*)

Japan—JOB24, 21,620 kc., Tokyo, has replaced 15,325 kc. for its 1800-1900 xmsn to Eastern N.A. (*GF, JG, RM, RP, AR, 59, 61, 225, 226, 348, 533*)

Kenya—ZHW2, Nairobi, has been heard on 4934 kc. at 1300-1330 in English. A verification lists the power as 6000 watts and is signed by A. M. Dean. (*465*)

Luxembourg—*R. Luxembourg* has been tuned on 6090 kc. with s/on in language at 0030. Does anyone have the Eng. schedule? (*501*)

Mexico—XELZZ, Mexico City, has moved to 11,852 kc. and has Eng. at 2000. (*420*)

Morocco—Rabat has moved to 15,340 kc. and is noted at 0700-1000 in Arabic. (*100*)

Mozambique—CR7BU, Lourenco Marques, is now on 4858 kc. at 1530 with an Eng. religious program. Off at 1601 after final Eng. ID. (*166*)

English is scheduled as follows: 2230-0000 on 11,760, 7250, and 4925 kc.; 0000-0400 on 11,760, 9616, and 7250 kc.; 0400-0800 on 15,097, 11,760, 7250, and 9616 kc.; 0800-1000 on 11,760, 9616, and 7250 kc.; 1000-1030 on 4925 kc.; 1030-1200 on 11,760, 7250, and 4925 kc.; 1200-1400 on 11,760, 4925, and 3211 kc.; and 1400-1600 on 4925 and 3221 kc. (*VV*)

Nepal—Kathmandu, 7100 kc., still transmits Wednesday only and is audible in the Mid-East at 0645-0722 with song recital; news in Nepalese at 0722-0728. Music continues to 0750 when the station closes abruptly without an ID. English is no longer featured or else has been retimed. (*488*)

SHORT-WAVE ABBREVIATIONS

Eng.—English	QRM—Station interference
ID—Identification	R.—Radio
kc.—Kilocycles	s/on—Sign-on
kw.—Kilowatts	s/off—Sign-off
N.A.—North America	xmsn—Transmission

New Zealand—The latest schedule from Wellington reads: to Pacific Islands at 1200-1345 on 11,830 kc., at 1400-0045 on 15,280 kc., at 0100-0345 on 6080 and 9540 kc.; and to Australia at 1500-1730 on 11,780 kc., at 1745-0045 on 15,220 kc., and at 0400-0645 on 9540 and 11,780 kc. (*ME*)

Norway—*R. Norway*, LLM, Oslo, 15,175 kc., operates to N. A. at 2000-2045 in Norwegian with frequent Eng. ID. (*JS*)

South Africa—The South African Broadcasting Corp., Paradys, has moved from 15,230 to 15,205 kc., dual to 25,800 kc. at 1100-1300. The 11,900-kc. channel has world and local news, and weather, at 0000. (*348, 400, 442*)

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Southern Rhodesia—Salisbury, 4911 kc., is heard from 1520 with classical music; jazz and dance music from 1530 to 1630/closing (Saturdays). Signal is best around 1615. (*166*)

Switzerland—HE18, Berne, has moved from 17,785 to 17,795 kc. at 0015-0200 and 0945-1740 to Africa. (*100*)

Other Swiss xmsns noted: to N. A. at 2030-2215 and 2315-0000 on 9535, 6165, and 11,865 kc., with a DX program on the first Friday of each month; to India and Pakistan at 0945-1130 on 15,305 and 11,865 kc.; to the British Isles at 1345-1530 on 9665 and 7210 kc. (*100, 277, 286, 475, 502, 529*)

SHORT-WAVE CONTRIBUTORS

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John Beaver *(61)*, Canon City, Colo.
Roger Legge *(100)*, McLean, Va.
Ed Kowalski *(104)*, Philadelphia, Pa.
George Cox *(166)*, New Castle, Del.
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Maurice Ashby *(286)*, Wichita, Kans.
Paul Edelson *(291)*, Brooklyn, N. Y.
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Algie Adams *(502)*, Roanoke, Va.
David Baughman *(522)*, Camden, N. J.
Vince McGarry *(529)*, Clayton, N. J.
Robert Prinsky *(531)*, Westmount, Quebec
Jon Grouf *(533)*, Woodmere, N. Y.

Thailand—HSK9, Bangkok, 11,670 kc., has a program at 0800-0900 in Thai. The only Eng. is at the 0858 ID. (*286*)

The announced 7140-kc. outlet was found to be actually 7299 kc. from 0920 to 1035 s/off. This is dual to 4830 kc. (*488*)

Uruguay—*R. Sarandi*, CXA60, Montevideo, 15,385 kc., is apparently no longer carrying the Eng. program at 2000 on Mondays. (*AR*)

United States—The Army-Mars station at Fort Monmouth, N. J., is broadcasting a radio course in fundamentals on 4030 kc. at 2100 Wednesdays and at 1400-1600 Sundays on 3295, 7540, and 15,715 kc. (*291, 366*)

Yemen—*R. Sanaah*, 5985 kc., is scheduled at 2300-0000 and 1200-1300, all Arabic. (*378*)

Clandestine—The Cuban Clandestine station was checked on 15,055 kc. at 2310. ID is *Radio Libre de Cuba*. (*420-522*) —30—

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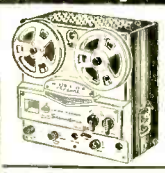

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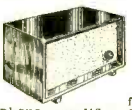

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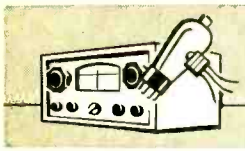

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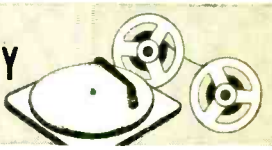

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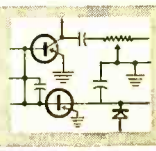

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RADIOACTIVE SPECIMEN

- Employs the extra sensitive 6306 Bismuth Type Geiger Counter tube. Sensitivity is .015 Roentgens per hour (1 MR/HR = 6600 counts per minute).
- Three counting ranges: 0-200/2,000/20,000 counts per minute.
- Handy reset button.
- Ideal for survey work because the complete unit weighs only 5½ lbs.
- Sight and sound indications by neon flashes and headphone. Then when an indication is obtained you switch to meter reading for exact measurements.

- Decontamination easy with damp cloth applied to the weather-proofed aluminum case.
- A radioactive specimen is included for instrument checking and experiments.
- Included at no extra charge — U.S. Atomic Energy Commission booklet titled "Prospecting with a Counter."

Endless experiments and discoveries in the new exciting field of nuclear energy are made possible when you acquire this finely built and engineered device. In the past, a rugged counter which was suitable for the prospecting of radio-active ores such as uranium, thorium and radium, was unsuitable for laboratory work due to the inability of combining accuracy with ruggedness. Conversely, a laboratory counter, while being extremely sensitive, could not withstand use in the field where it would be subjected to abuse and abnormally hard knocks.

The Model WF-11AWB combines the laboratory and field counter in one rugged instrument. The use of phones and a visible lamp permits the operator greater freedom of operation as he no longer has to keep his eyes on a relatively small indicator.

In the laboratory where determinations of intensity (counts) of a reading are necessary, the WF-11AWB provides sensitivity far surpassing many laboratory counters.

SPECIFICATIONS

Three counting ranges are available:

0-200 counts per minute—used in cosmic ray and extremely low activity determinations.

0-2,000 counts per minute—used for average activity and normal work.

0-20,000 counts per minute — used for tracer and high activity determinations.

High accuracy is assured by the handy *reset button*, located on the front panel, which permits compensation for variations of battery voltages and background count.

A rugged weather-proof aluminum case houses this light economical unit. The batteries will provide over 200 hours of intermittent operation from the two 67½ volt batteries and 50 hours from the three flash light batteries.

Comes with complete set of batteries, carrying strap, headphone, radioactive specimen and A.E.C. booklet. Only ..... **$47.50 NET**

SHIPPED ON APPROVAL
NO MONEY WITH ORDER — NO C.O.D.

SEE FOLLOWING PAGE FOR COMPLETE DETAILS

MOSS ELECTRONIC, INC. DEPT. D-575 3849 TENTH AVENUE, NEW YORK 34, N.Y.

TRY FOR 10 DAYS

before you buy! ***then*** if satisfactory pay in easy, interest free, monthly payments. See coupon below.

Superior's New Model 82A

A truly do-it-yourself type

TUBE TESTER

TEST ANY TUBE IN 10 SECONDS FLAT!

1. Turn the filament selector switch to position specified.
2. Insert it into a numbered socket as designated on our chart (over 600 types included).
3. Press down the quality button—

THAT'S ALL! *Read emission quality direct on bad-good meter scale.*

FEATURES:

• Tests over 600 tube types. • Tests OZ4 and other gas-filled tubes. • Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings. • Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence. • Dual Scale meter permits testing of low current tubes. • 7 and 9 pin straighteners mounted on panel. • All sections of multi-element tubes tested simultaneously. • Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82A will outperform similar looking units which sell for much more—and as proof, we offer to ship it on our examine before you buy policy.

Model 82A comes housed in handsome, portable, Saddle-Stitched Texon case. Only.... $36.50 Net

Model 82A—Tube Tester
Total Price $36.50
Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

Superior's New Model TW-11

STANDARD PROFESSIONAL

TUBE TESTER

• Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Subminars, Proximity Fuse Types, etc.

• Uses the new self-cleaning Lever Action Switches for individual element testing. **All elements are numbered according to pin-number in the RMA base numbering system.** Model TW-11 does not use combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.

• Free-moving built-in roll chart provides complete data for all tubes. Printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE

SEPARATE SCALE FOR LOW-CURRENT TUBES Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types.

Housed in hand-rubbed oak cabinet $47.50 Net

Model TW-11—Tube Tester
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

We invite you to try before you buy any of the models described on this page, the preceding page and the following pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

MOSS ELECTRONIC, INC.
Dept. D-575 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

☐ **RCA RADIATION COUNTER** Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ **Model 82A** ..... Total Price $36.50 $6.50 within 10 days. Balance $6.00 monthly for 5 months.

☐ **Model TW-11** ..... Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ **Model 77** ..... Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.

☐ **Model TV-50A** ... Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

Name .....

Address .....

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

All prices net, F.O.B., N. Y. C.

SHIPPED ON APPROVAL

NO MONEY WITH ORDER — NO C.O.D.

Model 77—Vacuum Tube Voltmeter
Total Price $42.50
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

Superior's New Model 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price

• Extra large meter scale enables us to print all calibrations in large easy-to-read type.

• Employs a 12AU7 as D. C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability. • Meter is virtually burn-out proof The sensitive 400 micro-ampere meter is isolated from the measuring circuit by a balanced push-pull amplifier. • Uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, Intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

SPECIFICATIONS

• **DC VOLTS**—0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS** (Peak to Peak)—0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER**—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS:** −10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Comes complete with operating instructions, probe leads, and streamlined carrying case. Operates on 110-120 volt 60 cycle. Only..... $42.50 Net

Model TV50-A—Genometer
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

Superior's New Model TV-50A

GENOMETER

7 Signal Generators in One!

- R.F. Signal Generator for A.M.
- R.F. Signal Generator for F.M.
- Audio Frequency Generator
- Marker Generator
- Bar Generator
- Color Dot Pattern Generator
- Cross Hatch Generator

This Versatile All-Inclusive **GENERATOR** Provides **ALL** the Outputs for Servicing:

• A.M. RADIO • F.M. RADIO • AMPLIFIERS • BLACK AND WHITE TV • COLOR TV

R. F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

MARKER GENERATOR: The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency)

BAR GENERATOR: Pattern consists of 4 to 16 horizontal bars or 7 to 20 vertical bars.

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

CROSS HATCH GENERATOR: The pattern consists of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

Complete with shielded leads **$47.50 Net**

TRY FOR 10 DAYS *BEFORE* you bu *THEN* if satisfac

pay in easy, interest free, monthly payments. See coupon inside.

We invite you to try before you buy any of the models described on this and the preceding pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time payment schedule details.)

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

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