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DECEMBER 1960

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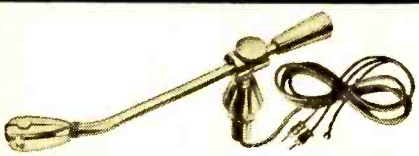

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POPULAR ELECTRONICS

DECEMBER 1960

VOLUME 13 NUMBER 6

Special Feature

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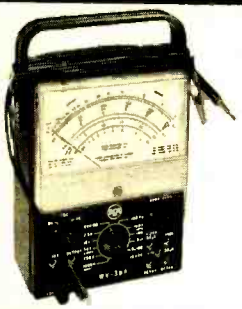

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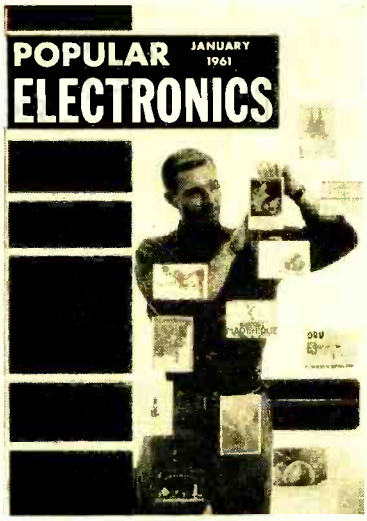

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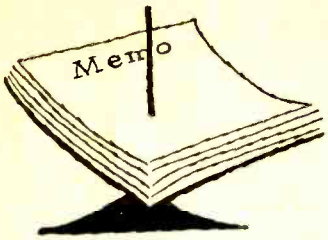

Notes from the Editor

POP 'TRONICS IN 1961. Those who have read POPULAR ELECTRONICS since its beginning back in 1954 are aware that we have progressed from 175,000 to close to 400,000 readers. This is a result of the increasing interest in electronics as well as the growing acceptance of the magazine.

The time has come when POP 'tronics must think about itself as a magazine with over a half-million circulation. This means new problems in obtaining and selecting articles, distributing the magazine, and--last but not least--the actual printing.

Next month, POPULAR ELECTRONICS will be printed by a new printer on giant presses capable of handling a magazine that is growing rapidly. If you are a careful reader, you will detect several slight differences between the appearance of the December issue you are now reading and the January 1961 issue. In particular, the text type will be larger and easier to read. Graphically, our art department will be making use of bigger and better photographs, more color, and more carefully constructed step-by-step illustrations. Most of the changes will be subtle, however, so don't expect a totally ''new''-looking magazine--just a more pleasing one.

BONUS FOR AUTHORS. Have you ever had an article published in P.E.? Do you have any good ideas for articles you think we might buy? If you do, remember that POPULAR ELECTRONICS is an active buying market. We are looking for material on stereo and hi-fi, construction projects to be built in home workshops, and news stories on the rapidly advancing electronics art. Payment rates are high and are based on the completeness of the ''package'' submitted--such matters as the furnishing of clear photographs and drawings, diagrams and parts lists, as well as the story itself.

Now for the good news--if you have an article published in the first half of 1961 (in one of the three categories mentioned above), you automatically become eligible for our ''Double Rate Bonus.'' This means that if, in the consensus of opinion of both the readers and the editors of POP 'tronics, your story was the most noteworthy in the category, you will receive a second check equal to your original payment!

Your article must be published in one of the six issues from January through June 1961, and it must be on hi-fi, construction, or electronic news. Bonus checks will be issued during early August, and the runner-up in each of the three categories will receive a $50.00 check as a consolation award.

Okay, fellows--get busy!

Oliver P. Fenell

POPULAR ELECTRONICS

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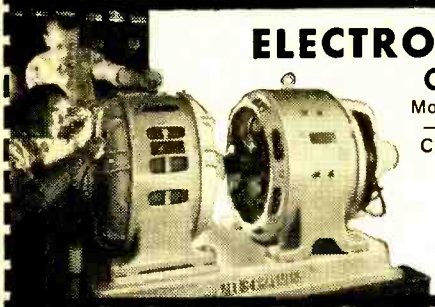

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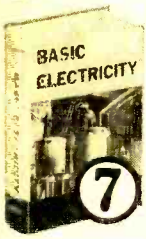

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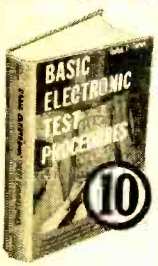

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FCC Report

By ROBERT E. TALL
Washington Correspondent

CB Rule Clarifications

IF you can't get the communications range you want in the Class D Citizens Radio Service, you'll be more successful in switching to some other radio service than in trying to get the Federal Communications Commission to relax its CB antenna height or power limitations.

This fact was made clear when the FCC flatly denied the first two formal requests for waiver of the agency's CB antenna height rule. The unsuccessful applicants, CB'ers from San Diego and Yonkers, were advised that they should look to another service, such as the FCC's business radio service, if they felt that they needed greater range.

The agency stood fast on its earlier holding that antennas for Class B, C, or D stations are not to be higher than 20 feet above either man-made structures or natural formations on which they are mounted. Where CB antennas are mounted on existing antenna structures used by other radio services, the CB antenna cannot exceed the height of the structure.

For marine-minded CB'ers, the FCC has clarified some points involving cases where vessel owners had installed CB equipment on vessels also equipped with radio transmitters licensed in the maritime radio service. Questions were raised as to whether the two types of services had to be operated as two separate communications systems, and the Commission declared that they must indeed be "operated as separate and independent radio systems."

Specifically, the agency said that the maritime mobile service calling and distress frequency of 2182 kc. cannot be used by a ship station for calling a CB station, or by two ship stations for the purpose of establishing contact for CB communications be-

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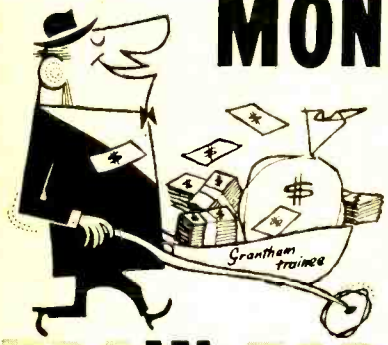

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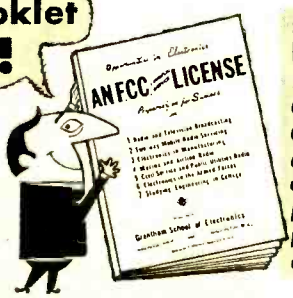

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tween the two vessels involved. Similarly, use of other marine intership working frequencies in the 2-mc. band for citizens radio purposes is *verboten*.

The agency softened this policy pronouncement with the observation that a common calling frequency has been established on a voluntary basis in many areas for use by CB-equipped vessels, and anyone interested can get the information on a particular locality from either his radio equipment dealer or local yacht club.

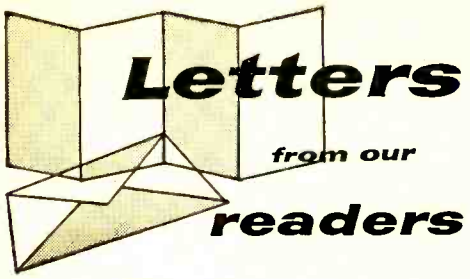
A recent FCC crackdown was made on the use of more than one call sign for the same transmitting equipment to get around the 5-minute cutoff rule. Several CB'ers have been stung for not sending their old licenses back to the FCC when they got their new ones reflecting a modification of the earlier authorization. And the FCC warns that a number of others will be hurt if they do not treat this provision of the rules with a little more respect.

When the Commission officials complain about this practice, they are not talking about CB'ers who, for one reason or another, have two or more different call signs because they want to use the service in more than one FCC field district. The agency has been peeved in a number of instances, however, where two or more people were using different call signs for the same transmitter—in direct violation of the rules. Except for partnerships, only one person is eligible to be licensee of specific transmitting equipment.

Another point recently clarified by the Commission involved requirements for logging Conelrad test alerts in the station records of the licensees. This clarification had been called for in view of what the Commission noted might have been a "misunderstanding" of the subject.

The agency spelled out the fact that logging by land mobile radio licensees "is not required of weekly Conelrad test alert broadcasts transmitted by standard broadcast stations." It explained that "only nation-wide Conelrad drills or tests applicable to the stations involved need be logged," and that the nation-wide Conelrad drill held earlier this year "applied only to broadcast stations."

There had been a mix-up among FCC field offices on this point, and some citations had been issued to mobile radio licensees who had not logged the tests. Those citations have since been withdrawn. —30—



Vibrator Substitute

■ As author of the "Vibrator Substitute" (October, 1960, p. 64), I would like to point out an error in the article. When I designed the vibrator substitute, it was my intention that *R1* and *R3* be 220 ohms (not 10 ohms) and that *R2* and *R4* be 10 ohms (not 220 ohms).

PATRICK A. GAINER
Newport News, Va.

Readers should simply reverse the value shown in the parts list for these two pairs of resistors following author Gainer's advice. Operation with the incorrect values would result in a blown fuse; there would be no damage to the auto radio or vibrator substitute.

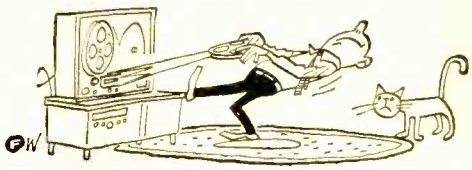
CB Cut-Out

■ Congratulations on your November CB issue—it certainly answered many of the questions that I had about Citizens Radio. Here's an idea which other readers might like to make use of: I went out and bought a second copy of the November issue just so I could cut out the map on the cover and use it in my CB shack—without defacing my regular copy.

ED FREDERICK, 2W4580
New York, N. Y.

Tape Markers

■ I have been reading your *Tips and Techniques* column for many years, and have applied many of your *Tips* to my own equipment. However, I hope



none of your readers used the *Tip* submitted by Jay Willever in the August 1960 issue concerning cellophane tape as an index marker for recording tape. The heat produced while the machine is operating may cause the adhesive to melt and stick to the heads and adjoining layers of tape.

HAROLD A. MILLER, VE3PE1K
Toronto, Ont., Canada

Reader Miller has a point—standard splicing tape would be much safer.

(*Continued on page* 18)

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Letters

(*Continued from page* 14)

Canadian Novices

■ I would like to start a move to have Novice licenses issued in Canada. Any Canadian SWL's who are interested in becoming Novices are invited to send me their signatures so I can forward them, along with our arguments, to the Department of Transport.

DAVID A. GRANGER
73 Sunninghill Ave.
Hamilton, Ontario, Canada

"Min-O-Scope" News

■ Here is a picture of the "Min-O-Scope" I constructed from plans in the August 1960 issue of POPULAR ELECTRONICS. I have had a lot of fun

with it, and it is just right for audio work. The whole effort cost less than $20 despite the fact that I used only new parts.

HANS J. WECKE
Munich, Germany

■ Somebody goofed on the "Min-O-Scope" parts list—tubes *V1* and *V2* were given as 6AM6's *or* 6AU6's. The 6AU6 has a different base connection than the 6AM6, but the schematic gives the details for the 6AM6 only. I didn't find this out until after completing the wiring.

BOB DICKERSON
Newberg, Oregon

Our regrets to reader Dickerson. The pictorial diagrams and schematics were drawn for the 6AM6 base connections. If a pair of 6AU6's are to be used, it is necessary to change the diagrams.

Where There's a Will . . .

■ I enjoy your magazine immensely, especially the entertaining *Carl and Jerry* "electronic episodes." But one thing bothers me: since the boys' activities seem to center around school, fishing, loafing, and riding bicycles, where do they get the necessary cash for their projects—from a rich uncle?

DOUGLAS BENSON
Schenectady, N. Y.

Yes, Jerry does have a rich uncle, but—more important—both boys have a clever aunt named "Necessity." Any boy who finds electronic experimenting an insatiable hobby will find a way to overcome expenses. —30—

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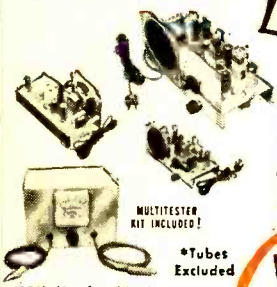

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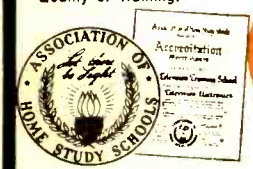

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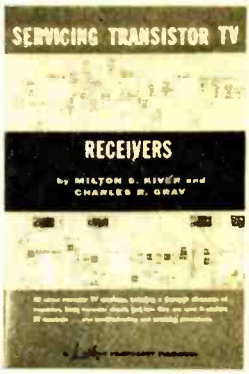
"SERVICING TRANSISTOR TV RECEIVERS" by Milton S. Kiver and Charles R. Gray. Published by Howard W. Sams & Co., Inc., 2201 East 46th St., Indianapolis, Ind. 269 pages. Soft cover. $4.50.



Here is a good basic book written for the television technician. With the coming of transistorized television sets, this text should be welcome on every test bench. Also, the theory discussion and circuit drawings of the basic TV circuit elements should prove valuable to the electronic experimenter who likes to putter with new transistor circuits.

"QUAD ANTENNAS" by William I. Orr, W6SAI. Published by Radio Publications, Inc., Wilton, Conn. 96 pages. Soft cover. $2.85.

There are few hams or SWL's who have not heard of the "cubical quad" antenna. Invented by Clarence Moore while he was working at short-wave station HCJB in Quito, Ecuador, the quad is simply a radiator and reflector folded into a huge cube. But getting the quad to work right calls for some tricky matching. Bill Orr has assembled in this book all of the information needed to erect and match the quad. Recommended to readers who want to put up a highly directional two-element antenna for hamming or SWL'ing.

"MAGNETIC AMPLIFIERS—PRINCIPLES AND APPLICATIONS" by Paul Mali. Published by John F. Rider Publishers, Inc., 116 West 14th St., New York 11, N. Y. 112 pages. Soft cover. $2.45.

The increasing use of magnetic amplifi-

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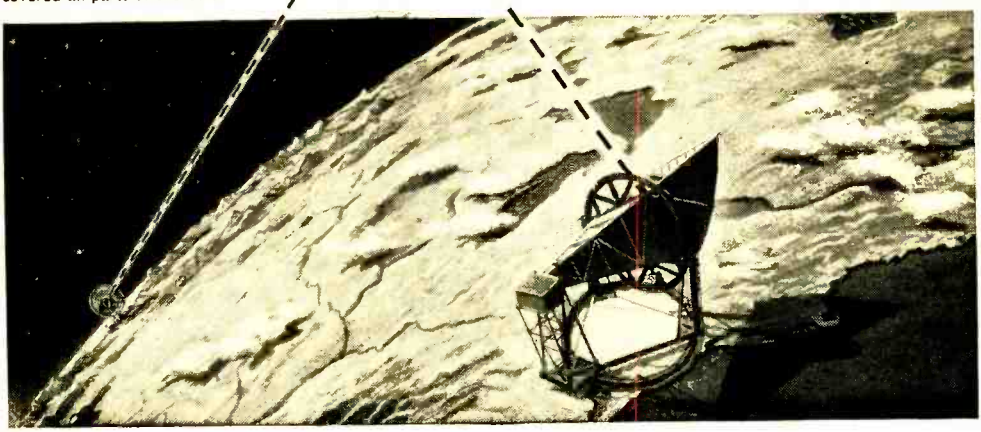

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Bell Telephone Laboratories recently took the step by successfully bouncing a phone call between its Holmdel, N. J., test site and the Jet Propulsion Laboratory of the National Aeronautics and Space Administration (NASA) in Goldstone, California. The reflector was a 100-foot sphere of aluminized plastic orbiting the earth 1000 miles up.

Dramatic application of telephone science

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- The Delta rocket which carried the satellite into space was steered into a precise orbit by the Bell Laboratories Command Guidance System. This is the same system which recently guided the remarkable Tiros I weather satellite into its near-perfect circular orbit.
- To pick up the signals, a special horn-reflector antenna was used. Previously perfected by Bell Laboratories for microwave radio relay, it is virtually immune to common radio "noise" interference. The amplifier—also a Laboratories development—was a traveling wave "maser" with very low noise susceptibility. The signals were still further protected from noise by a special FM receiving technique invented at Bell Laboratories.

"Project Echo" foreshadows the day when numerous man-made satellites might be in orbit all around the earth, acting as 24-hour-a-day relay stations for TV programs and phone calls between all nations.

This experiment shows how Bell Laboratories, as part of the Bell System, is working to advance space communication. Just as we pioneered in world-wide telephone service by radio and cable, so we are pioneering now in using outer space to improve communications on earth. It's part of our job, and we are a long way toward the goal.

BELL TELEPHONE LABORATORIES
World Center of Communications
Research and Development

Bookshelf

(*Continued from page* 20)

ers makes this book both timely and practical. Presuming a fundamental knowledge of electricity, it starts with a basic review of magnetism, electromagnetism, and magnetic circuitry, then goes into saturable reactor theory—the key to this field. Gain and feedback in magnetic amplifiers is covered, as well as construction and general uses, maintenance, and trouble-shooting.

"OFFICIAL REGISTRY OF BUSINESS AND MISCELLANEOUS RADIO SYSTEMS," 1960 Edition. Published by Milton B. Sleeper, Communications Engineering Book Co., Monterey, Mass. 104 pages. $5.00.

This is the fourth in the 1960 series of registries published by Milton Sleeper. Included in this volume are call signs, locations, and frequencies of v.h.f. and u.h.f. commercial stations licensed for one-way signaling, telephone maintenance, business service, manufacturers service, common carriers, and studio-transmitter links for TV broadcasting. Transmitters for these services are in the 27-, 35-, 42-, 151-, and 464-mc. bands. The listings are arranged geographically by licensee, and also by frequency and call sign.

Free Literature

■ EICO (Electronic Instrument Co., Inc.) is offering a compact 28-page catalog covering its complete line of stereo and mono hi-fi equipment, test instruments, ham equipment, Citizens Band transceivers, and radios in both kit and wired form. The catalog contains pictures, detailed descriptions, specs, and prices for every item of EICO equipment, and is available for the asking from EICO, 33-00 Northern Blvd., Long Island City 1, N. Y.

■ Radio Shack's 1961 catalog of electronic, hi-fi, and hobbyist equipment contains descriptions and prices of leading manufacturers' lines, and features the company's own "Realistic" equipment. The catalog comes in a smaller, handier size than previous issues, and is available from the Radio Shack Corporation, 730 Commonwealth Ave., Boston 17, Mass. —30—

BUILD 20 RADIO CIRCUITS AT HOME

with the New PROGRESSIVE RADIO "EDU-KIT"®

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ONLY $26.95

A Practical Home Radio Course

Now Includes

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

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ School Inquiries Invited
- ★ Sold in 79 Countries

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

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

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

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

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

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $26.95. The Signal Tracer alone is worth more than the price of the entire Kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment. Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

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

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are twenty Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 20 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instructions Manuals, hook-up wire, solder, selenium rectifiers, volume controls and switches, etc.

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

FREE EXTRAS

- **SET OF TOOLS**
- **SOLDERING IRON**
- **ELECTRONICS TESTER**
- PLIERS-CUTTERS
- ALIGNMENT TOOL
- WRENCH SET
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

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

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

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. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The 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.

UNCONDITIONAL MONEY-BACK GUARANTEE

ORDER DIRECT FROM AD—RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS WORTH $7

☐ Send "Edu-Kit" postpaid. I enclose full payment of $26.95.
☐ Send "Edu-Kit" C.O.D. I will pay $26.95 plus postage.
☐ Rush me FREE descriptive literature concerning "Edu-Kit."

Name .....

Address .....

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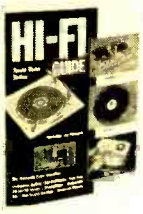
Right now, one or more of these great books—chosen carefully by Ziff-Davis Electronics Book Service as among the best in their field—will be sent to you for 7 days FREE! Simply write your choices on the coupon below and mail it today. When your books arrive, read and enjoy them for seven full days. If you don't agree that they are everything you need and want, return them and owe nothing.



2751. HI-FI GUIDE—STEREOPHONIC SOUND, Heofler
A "how-to" book on hi-fi, written in simple language. Will help you buy the right equipment and see that you get the most out of your stereo or monaural investment. $2.50

2752. HIGH QUALITY SOUND REPRODUCTION, Moir
The perfect manual for both the professional engineer and the serious amateur interested in high fidelity. The "why" and "how" of sound reproduction is covered in complete detail. $15.00

2753. LOW-COST HI-FI, Heofler
Hundreds of hints for budget hi-fi will be found in these fourteen chapters with over 300 detailed photographs, drawings and diagrams. Will save you money in starting or improving your system. $2.50

2755. THE PRACTICAL HI-FI HANDBOOK, King
A guide to high fidelity sound reproduction for the service engineer and amateur. Chapters on amplifiers, loudspeakers, pickups, microphones, record players, disc, tape and stereo. $5.95

2771. HI-FI HANOBOOK, Kendall
How to plan your home music system, choose the best components, install your system easily and maintain it by yourself. All these, and ways to save money, are presented in this basic book. $3.50

42. REVERE TAPE RECORDER GUIDE, Tydings
The first non-technical book to provide useful information on the Revere Tape Recorder. Also a basic guide to the entire field of tape. Will show you new uses and add to your enjoyment. $1.95

49. TAPE RECORDING GUIDE, Marshall
Designed to help you get the most out of your tape recorder, whether for business, pleasure or professional use. A handy guide to have around, no matter what equipment you own. $1.95

2750. ELEMENTS OF MAGNETIC TAPE RECORDING, Haynes
Here's how to get professional results with tape the way the experts do. Complete nomenclature, basic techniques, how to splice and edit, how to repair and maintain your recording equipment. $7.95

2759. TECHNIQUES OF MAGNETIC RECORDING, Tall
Translates the complexities of a science into practical, easy-to-follow techniques. New ideas, new standards, especially for the amateur who wants a good working knowledge of magnetic recording. $8.50

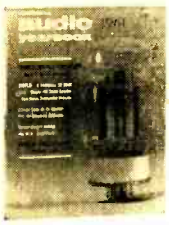
2765. YOUR TAPE RECORDER, Marshall
Based on 2500 experiments with almost every type of recorder, this book helps to eliminate trial and error under all conditions. Includes illustrations of 55 magnetic recorders with specifications. $4.95

2757. RIBBONS OF SOUND, Barleben
A handbook on the fundamentals of magnetic tape recording simply and interestingly presented. Factual information you can use no matter what type or make of recorder you own. Paper. $2.50.
2772. Cloth. $3.50

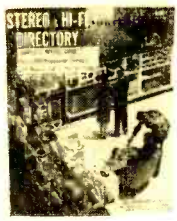
2006. ELECTRONIC EXPERIMENTER'S MANUAL, Findlay
With a few dollars worth of basic tools and this book to guide you, you can explore the wonderworld of electronics experimentation more completely than ever before. 10 big sections. $4.95

Yours For a 7-Day Free Examination from ELECTRONICS Book Service!

Each volume is designed to help you get more use and pleasure from your high fidelity equipment. Whether you're planning to buy or ready to improve your system—whether you now enjoy stereo or plan to convert to stereo—whether you're a music-lover or a hi-fi do-it-yourselfer—you'll find one or more books of interest below! For yourself or for gift-giving—use the coupon below today!



2010. AUDIO YEARBOOK, 1961, Ziff-Davis
Brand new edition. By the editors of Electronics World. Advanced discussions and instructions on every phase of audio. Special features make this an excellent guide for the advanced audiophile. $1.00



2011. STEREO & HI-FI DIRECTORY, 1961, Ziff-Davis
New! Complete buyers' guide of over 1200 component listings, 800 photos; latest models, prices! World's most complete reference. Entire sections on every phase of stereo and monaural high fidelity. $1.00

2000. STEREO HI-FI GUIDE, 1960, Ziff-Davis
1960 edition features 60-page exclusive by Joseph Marshall on components and how they work. Includes "what you should know before buying stereo". Complete, interesting, invaluable! $1.00

2002. ELECTRONIC KITS DIRECTORY, 1960, Ziff-Davis
New 1960 edition lists over 750 kits, latest models, prices and features for hi-fi kits—preamps, amplifiers, tuners, speakers—ham radio, SWL, Citizens Band. Fun and education. $1.00

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Leading hi-fi dealers and salons and radio and electronics parts jobbers are making their stores headquarters for books on every electronics subject. You can take this list to your favorite dealer for immediate purchase.

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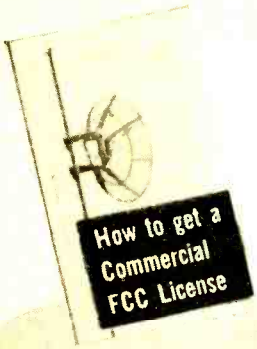
Hi-Fi Showcase

NEW stereo hi-fi products are pouring out of laboratories and production lines in a veritable flood. Space limitations prevent us from describing one and all, but some of the most interesting are discussed below. For further information write directly to the manufacturers whose addresses appear at the end of this department.

A new contender in the battle between the "separate component" and "integrated single-unit" factions is ***Crosby Electronics***' 650 stereo receiver. It has independent AM and FM tuners, two preamplifiers, and two power amplifiers (14 watts per channel). Said to be the smallest tuner/preamp/amp combination on the market, the 650 measures 14½" x 5$\frac{3}{16}$" x 11⅜" and lists at $219.95. . . . As you probably know, "skating" is a by-product of the force that tends to pull a cartridge toward the center of the record, increasing wear, tracking error, and distortion. ***Fairchild Recording Equipment***'s answer to the problem is an "anti-skating" arm which introduces a force in the opposite direction. Supplied with a high-compliance cartridge (the Fairchild SM-2 with 20-db channel separation all the way to 15,000 cps), the 500 arm-and-cartridge combination is priced at $55.00.

Following up on the success of the Citation I and II kits, ***Harman-Kardon*** has released three more—the Citation III FM tuner with preassembled and aligned front end; the Citation IV stereo preamplifier/control center; and the Citation V stereo power amplifier (40 watts per channel). All units are available in both kit and wired form; cases are optional. Prices for the Citation III are $149.95 as a kit, $229.95 factory-wired; the Citation IV is $119.95 for the kit, $189.95 factory-wired; and the Citation V sells for $119.95 do-it-yourself, $179.95 assembled. . . . ***Lafayette Radio*** also gives you your choice of kit or wired versions of its new stereo amplifier. Rated at 50 watts per channel (100 watts monophonic), the 550 has specially designed output transformers and wide-band amplifier circuitry for a frequency response two oc-

(*Continued on page* 38)



tells how

FREE

Completion of the Master Course (both Sections) will prepare you for a First Class Commercial Radio Telephone License with a Radar Endorsement. Should you fail to pass the FCC examination for this license after successfully completing the Master Course, you will receive a full refund of all tuition payments. This guarantee is valid for the entire period of your enrollment agreement.

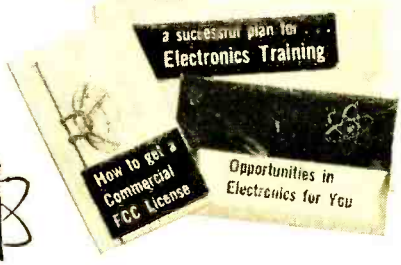
Get your FCC Commercial License —or your money back

"License and $25 raise due to Cleveland Institute training"

"I sat for and passed the FCC exam for my second class license. This meant a promotion to Senior Radio Technician with the Wyoming Highway Department, a $25 a month raise and a District of my own for all maintenance on the State's two-way communication system. I wish to sincerely thank you and the school for the wonderful radio knowledge you have passed on to me. I highly recommend the school to all acquaintances who might possibly be interested in radio. I am truly convinced I could never have passed the FCC exam without your wonderful help and consideration for anyone wishing to help themselves."

CHARLES C. ROBERSON, Cheyenne, Wyoming

CIE HELPS TRAINEES GET BETTER JOBS



Employers Make Job Offers Like These To Our Graduates Every Month

Broadcast Station in Illinois: *"We are in need of an engineer with a first class phone license, preferably a student of Cleveland Institute of Electronics. 40 hour week plus 8 hours overtime."*

West Coast Manufacturer: *"We are currently in need of men with electronics training or experience in radar maintenance. We would appreciate your referral of interested persons to us."*

Cleveland Institute of Electronics

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Accredited by National Home Study Council.

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

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

In what kind of work are you now engaged?.....

.....

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

.....

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

Address.....

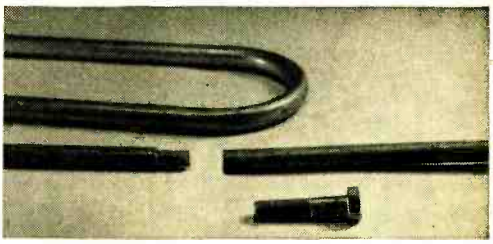
City..... Zone.... State.....

PE-72

Tips and Techniques

REPAIRING TV ANTENNAS

Broken elements on hollow-rod type TV antennas can be temporarily repaired with a threaded bolt. Take a bolt that is about three or four inches long and which will fit snugly into each end of the broken antenna rod. Cut off the threaded portion of the bolt

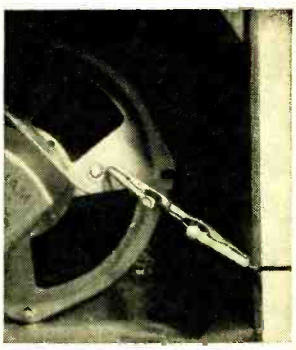


and push it into one end of the broken rod; the other end of the broken rod fits on the protruding portion of the bolt. Crimp the broken ends with a pair of pliers, and, if possible, solder the joint, using a good brand of aluminum solder. Then wrap a few turns of plastic tape over the repaired portion.

—*H. L. Davidson*

QUICK HOOKUP CLIP

To make a temporary connection quickly, without soldering, use a "double-ended" alligator clip. This is merely two alligator clips fastened together back-to-back; for best results, crimp their lugs together and solder them to insure a good connection.—*Kenneth Miller*



OUTPUT METER

You can make an excellent output meter for any receiver or hi-fi set by connecting six inexpensive components to the voice coil terminals of the set's speaker: a diode, a milliammeter, a capacitor, a potentiometer, and a pair of switches. Operating volt-

NEW for 61 FROM INTERNATIONAL

MOBILETTE 61

A New "Advanced Engineered" All Transistor, Crystal Controlled Short Wave Converter

AMATEURS • CITIZEN LICENSEES • CIVIL AIR PATROL

Mobilette 61, International's *new improved* all transistor, crystal controlled converter provides a "quick and easy" way to convert your car radio for short wave reception. Mobilette 61 units cover a specific band of frequencies providing a broad tuning range. Mobilette units are quickly interchangeable.

Check these all new features! New and improved circuit for increased gain . . . New internal jumper for positive and negative grounds . . . New RF amplifier, mixer/oscillator . . . New separate input for broadcast and short wave antennas . . . Installs neatly under dash.

Mobilette 61 is available in a wide choice of frequencies covering the Amateur bands 75 through *6 meters*, Citizens band, *Civil Air Patrol* low band frequencies, WWV time and frequency standards.

Designed for 12 VDC, Mobilette 61 will operate on 6 VDC at reduced output.

See the Mobilette 61 at your dealer today.

Complete, ready to plug in and operate only $22.95

Any frequency in the range 2 MC to 50 MC available on special order $25.95

International Mobilettes cover these short wave bands.

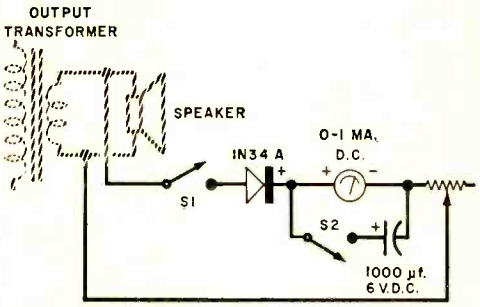
Catalog No.	Frequency
630 - 110	6 meters (Amateur) 50 - 51 MC
630 - 111	10 meters (Amateur) 28.5 - 29.5 MC
630 - 112	11 meters (Citizens) 26.9 - 27.3 MC
630 - 113	15 meters (Amateur) 21 - 21.6 MC
630 - 114	20 meters (Amateur) 14 - 14.4 MC 15 MC (WWV)
630 - 115	40 meters (Amateur) 7 - 7.4 MC
630 - 116	75 meters (Amateur) 3.8-4.0 MC
630 - 117	10 MC (WWV)
630 - 118	CAP (Low Band)
630 - 119	Special Frequencies 2 MC - 50 MC

Write for International's complete catalog of precision radio crystals, and quality electronics equipment . . . yours for the asking.

Tips

(*Continued from page 28*)

age comes from the audio signal appearing across the voice coil. In the circuit shown, switch *S1* turns the unit on and off; closing switch *S2* makes for a smoother meter reading but reduces sensitivity to weak signals. Use the original 0-1 ma. scale on your

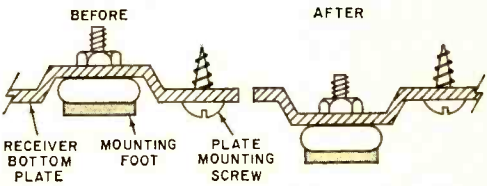


milliammeter or substitute a 0-100 volume unit (VU) scale. The potentiometer should be about 20,000 ohms for audio outputs of 30 watts, and a correspondingly smaller resistance should be used for lower power outputs. Adjust the potentiometer to give maximum meter deflection at full output.

—Wayne L. Stebbins

RECEIVER MOUNTING FEET

Communications receivers often have mounting feet so low that they are almost useless—the screws holding the bottom plate can scratch the table top on which the receiver is resting. To remedy this situation, it is sometimes possible to reverse the bottom plate and mount the feet



in the same holes, as shown. This process will raise the bottom plate screws at least ¼" and prevent further scratching.

—Clifford Marshall

ALLEN WRENCH SCREWDRIVER

If you have an Allen wrench with a burred or "rounded" shank, you can turn it into a different tool by grinding it to fit a screwdriver slot. It will be convenient for use with the small screws frequently encountered in making delicate adjustments.

—Glen F. Stillwell

LISTEN!

Here's Hilversum, Cologne, Copenhagen, and Brussels. January POPULAR ELECTRONICS tells you when to listen to all the European English-language shortwave broadcasts...gives you call letters, locations, frequencies, and times.

And there's more on shortwave too! You'll learn how to record and make displays of your listening adventures by collecting QSL cards...how to pick out a powerful shortwave receiver... and much more! Don't miss these exciting shortwave articles next month!

January POPULAR ELECTRONICS also brings you:

• DENTISTRY WITHOUT PAIN?

Electronics may eliminate pain from dentistry! A new experimental system uses music and "white sound" to anesthetize patients during tooth extractions or cavity fillings. Find out how these systems are installed...how they work, in January POPULAR ELECTRONICS.

• BUILD A 16-SPEAKER SOUND SYSTEM

Here's a system that outperforms any single speaker on the market! It uses 16 tiny 5" speakers —sets up 35" high and wide by only 8" deep. Do it yourself from full construction plans in next month's issue.

Subcription Rates:

One Year $4 Two Years $7 Three Years $10

POPULAR ELECTRONICS, 434 S. Wabash Avenue, Chicago 5, Illinois

Replace improper equipment with the only microphone designed specifically for citizen's band

THE TURNER 350C

This reasonably priced, mobile-type ceramic microphone is the perfect replacement for the many improper, tape recorder-type microphones now being used on CB equipment. Has DPST switch wired for relay operation with easily reversible terminals to allow modifications (if necessary); wiring diagram enclosed with each microphone; hanger button and standard dash bracket for mobile rig mounting; and an 11" retracted (five foot extended), plastic-jacketed, coiled cord. Response: 80-7,000 cps. Output: −54 db. List price: $16.80 complete. See your Turner Distributor, listed below, he has the 350C in stock.

THE TURNER MICROPHONE COMPANY
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Cedar Rapids, Iowa

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Little Rock: Southern Radio Supply
Texarkana: Lavender Radio & T.V. Sup.
CALIFORNIA
Downey: Net Electronics
Hemet: Gil Severns
Hollywood: Pacific Radio Exchange
Los Angeles: Radio Product Sales
The Sound Foyer
Oakland: Elmar Electronics
Sacramento: Selectronics
San Francisco: Market Radio Sound Dept.
San Pedro: Marine Radio Service
DISTRICT OF COLUMBIA
Washington: Electronic Wholesalers
FLORIDA
Miami: East Coast Radio & TV
Tampa: Kinkade Radio Supply
GEORGIA
Atlanta: Specialty Distributing
ILLINOIS
Chicago: Nationwide Radio
Irving Joseph, Inc.
La Salle: Klaus Radio & Electric
La Salle Electronics
Peoria: Klaus Radio & Electric
INDIANA
Anderson: Seybert's Radio Sup.
Bloomington: Stansifer Radio Co.
Evansville: Hutch and Son, Inc.
Ohio Valley Sound
Fort Wayne: Pembleton Laboratories
Indianapolis: Brown Distributing Co.
Graham Electronic Sup.
Van Sickle Radio Supply
Kokomo: George's Electronic Sup.
Michigan City: Tri-State Electrical Sup.
Portland: Buck's Hi-Fi
Richmond: Fox Electronics Company
Terre Haute: Midwest Supply Company
IOWA
Cedar Rapids: Iowa Radio Supply
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KANSAS
Topeka: Acme Radio Supply
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P. I. Burks Company
Peerless Electronic Equipment Co.
LOUISIANA
Baton Rouge: Davis Electronics Sup.
New Iberia: Brooks Electronics
MASSACHUSETTS
Boston: A. W. Mayer Company
O'Donnell Electronic Supply
Radio Shack Corp.
Lawrence: Alco Electronics
MICHIGAN
Ann Arbor: Purchase Radio Supply
Detroit: High Fidelity Workshop
Lansing: Offenhauer Company
MINNESOTA
Minneapolis: Lew Bonn
National Electronics Co.
Harry Starks, Inc.
Schaak Electronics
MISSOURI
St. Louis: Radonics
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Jersey City: Nidisco-Jersey City
Mountainside: Federated Purchaser
NEW YORK
Albany: Greylock Electronics Supply
Buffalo: Radio Equipment Corp.
Farmingdale, L.I.: Gem Electronics
Forest Hills: Beam Electronics
Hicksville: Gem Electronics
Kingston: Greylock Electronics
Long Island City: Spera Electronics
Mt. Vernon: Davis Electronics
New York: Harvey Radio Company
Acme Electronics
Poughkeepsie: Greylock Electronics
Rochester: Rochester Radio Supply
NORTH CAROLINA
Greensboro: Johannesen Electric Company
Raleigh: Southeastern Radio Supply Co.
Winston-Salem: Womack Company
OHIO
Cleveland: Pioneer Electronic Sup.
Columbus: Whitehead Radio Company
Mansfield: Wholesaling, Inc.
Toledo: Lifetime Electronics
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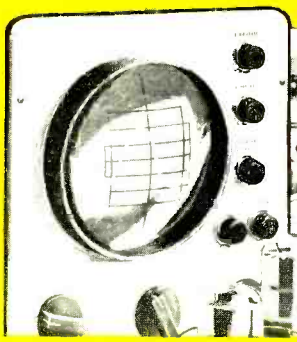

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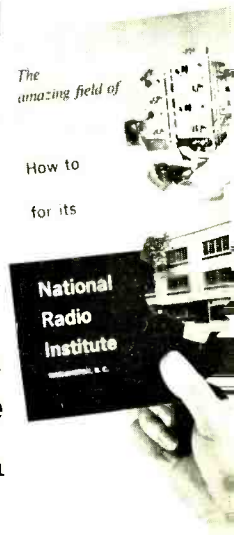

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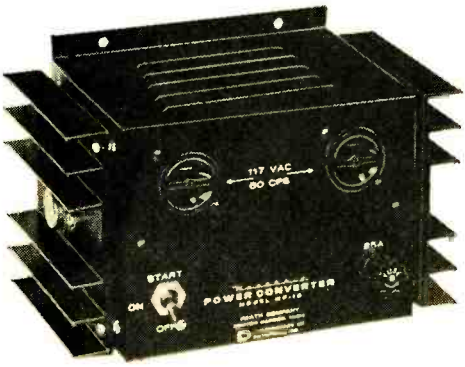
NEW products

SHIPBOARD POWER CONVERTER

The *Heath Company* (Benton Harbor, Mich.) has announced a transistorized power converter kit for use aboard boats. A compact unit, the Model MP-10 converts power from 6- or 12-volt batteries to 117-



volt, 60-cycle a.c., and can feed two appliances simultaneously through its two outlets. Power rating with a 12-volt battery is 175 watts continuous, 240 watts maximum; with a 6-volt battery, 120 watts continuous. The entire unit is fused. Price, $29.95.

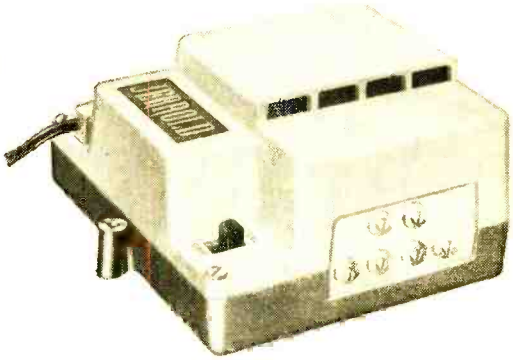
OSCILLOSCOPE PROBE

Fully transistorized, the Model D-200-T oscilloscope probe is intended for localizing i.f.-strip troubles. Marketed by *Doss Elec-*

tronic Research, Inc., 820 Baltimore, Kansas City, Mo., it can be used with general-purpose or wideband scopes and with either 20- or 40-mc. i.f. systems. Placing its pick-up loop over an i.f. tube or transformer is said to impose minimum loading on the circuit being tested; its low-impedance output minimizes high-frequency losses in the output cable and eliminates hum pick-up. Price, with pickup loop, $19.95.

THREE-SET COUPLER

Designed for improving TV/FM reception in the multi-set home, the Model HSA-43 amplified 3-set coupler produced by *Jerrold Electronics Corp.* (15th & Lehigh Ave.,



Philadelphia 32, Pa.) can feed any combination of up to three TV and FM sets from a single antenna. The unit's built-in isolation transformer prevents set interaction and "ghosting;" input and output impedances of 300 ohms permit the use of twin lead. Price, $29.95.

80- TO 6-METER TRANSMITTER

The new HE-25 "Voyager" transmitter, suitable for Novice, Technician, or General Class hams, features single-knob band-

switching on 80 through 6 meters. The unit runs 120 watts c.w. input on 80 through 10 meters; 85 watts c.w. on 6 meters; and 70 watts phone on all bands. Its straight-through class C final assures highest efficiency. Priced at $109.50, the HE-25 is

products

(*Continued from page* 35)

available from *Lafayette Radio Electronics Corp.*, 165-08 Liberty Ave., Jamaica, N. Y.

GRID CIRCUIT TESTER

Hundreds of foreign and industrial types of television tubes, as well as types with grid, plate, or cathode caps, can be checked on the GCT-9 grid-circuit tester. Manufactured by *Seco Electronics, Inc.*, 5015 Penn Ave. South, Minneapolis, Minn., the GCT-9 quickly lets you test for grid emission, leakage, shorts, and gas in one operation. Results appear instantly on a 6AF6 "eye" indicator. The unit also offers two additional testing features: (1) a cathode continuity check, and (2) a complete interelement short test, with shorts identified as to pin numbers. Price: $32.95 (in metal case); $34.95 (in portable carrying case).

ELAPSED TIME INDICATOR

Would you like to be able to gauge how long that tube was in the circuit, or that phono stylus in use? Try the improved "Chronistor" elapsed time indicator sold by *Bergen Laboratories Inc.*, 60 Spruce St., Paterson 1, N. J. Fitted snugly in any 3AG fuse holder, the "Chronistor" draws 1 milliampere from any 6-volt d.c. source. The unit operates on the electroplating principle; a copper marking is gradually dissolved, indicating the elapsed hours. Price, $3.25, in small quantities.

UNIVERSAL CRIMPING TOOL

A four-in-one tool produced by *Waldom Electronics, Inc.*, 4625 W. 53rd St., Chicago, Ill., will (1) crimp all terminals in wire sizes from 10 through 22, (2) cut wire, (3) strip wire, and (4) shear bolts and screws. The bolt-shearing feature provides for cutting bolts and screws in *4-40, 6-32, 8-32, 10-24,* and *10-32* sizes; the tool is said to cut screws clean so that they are ready for use without deburring. Price, $4.25. —30—

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Showcase

(*Continued from page* 26)

taves below and above the range of normal human hearing. Output tubes are 7027A's, allowed to "loaf" along at 50 watts—far below their maximum—for longer tube life. Price for the KT-550 (kit) is $134.50, while the LA-550 (factory-wired) is $184.50. Another stereo product by Lafayette is the Panasonic transcription tone arm. Using an integrated moving-magnet cartridge, the PK-449 has a 20 to 15,000 cps, ±2 db frequency response. The arm has mu-metal shielding throughout its length, is factory-set to track at 3 grams, and sells for $32.50 with a 0.7-mil diamond stylus.

If your present stereo setup is equipped with a ceramic cartridge, ***Shure Bros.*** has come up with a sure-fire way to improve its performance. Simply replace your ceramic cartridge with a magnetic unit and plug Shure's M65 stereo preamplifier between it and your amplifier. The M65 sells for $24.00 and can also be used as a preamp for tape heads and mikes. . . . Latest addition to the Butoba line of self-powered portable tape recorders is the ***Turning Corp. of America***'s MT-5. Weighing but 12 pounds, the MT-5 is powered by 8 standard flashlight cells (or special converter/inverter). There are two speeds—3¾ and 1⅞ ips, push-button controls, and a pause switch. Playing time is up to 4 hours per reel (double track), and frequency response is 50 to 13,000 cps on the unit's built-in 5" x 7" speaker. A transparent plastic cover supplied with the recorder insures that reels will be visible at all times. The MT-5 goes for $249.50.

Speaking of space problems (and who doesn't have space problems these days?), ***Utah Radio & Electronic***'s PT-2 wall-mounted extension speaker should come in handy. It contains a 6" x 9" inverted woofer, a 3" x 5" tweeter, and a bass relief port. Size? Just 12" x 18" by only 3" deep. The PT-2 has a power rating of 8 watts and should be a breeze to hang with the screw slots and "S" hooks provided. Thin as many picture frames, it's priced at $32.50. —30—

Crosby Electronics, Inc., Syosset, L. I., N. Y.
Fairchild Recording Equipment Corp., 10-40 45th Ave., Long Island City 1, N. Y.
Harman-Kardon, Inc., 520 Main St., Westbury, L. I., N. Y.
Lafayette Radio Corp., 165-08 Liberty Ave., Jamaica 33, N. Y.
Shure Bros., Inc., 222 Hartrey Ave., Evanston, Ill.
Turning Corp. of America, 34 Park Row, New York 38, N. Y.
Utah Radio & Electronic Corp., 1124 E. Franklin St., Huntington, Ind.

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	1AX2	.62		4CS6	.61		6AW8	.89		6DG6	.59		12AF3	.73		12CU5	.58		17DQ6	1.06
	1B3GT	.79		4DE6	.62		6AX4	.65		6DQ6	1.10		12AF6	.49		12CU6	1.06		17L6	.58
	1DN5	.55		4DK6	.60		6AX7	.64		6DT5	.66		12AJ6	.46		12CX6	.54		17W6	.70
	1G3	.73		4DT6	.55		6BA6	.49		6DT6	.53		12AL5	.45		12DB5	.69		19AU4	.83
	1J3	.73		5AM8	.79		6BC5	.54		6EU8	.79		12AL8	.95		12DE8	.75		19BG6	1.39
	1K3	.73		5AN8	.86		6BC7	.94		6EA8	.79		12AQ5	.52		12DL8	.85		19T8	.80
	1L6	1.05		5AQ5	.52		6BC8	.97		6H6GT	.58		12AT6	.43		12DM7	.67		21EX6	1.49
	1LN5	.59		5AT8	.80		6BD6	.58		6J5GT	.51		12AT7	.76		12DQ6	1.04		25BQ6	1.11
	1R5	.62		5BK7A	.82		6BE6	.55		6J6	.67		12AU6	.50		12DS7	.79		25C5	.53
	1S5	.51		5BQ7	.97		6BF6	.44		6K6	.63		12AU7	.60		12DZ6	.56		25CA5	.59
	1T4	.58		5BR8	.79		6BG6	1.66		6S4	.48		12AV5	.97		12EL6	.50		25CD6	1.44
	1U4	.57		5CG8	.76		6BH6	.65		6SA7GT	.76		12AV6	.41		12EG6	.54		25CU6	1.11
	1U5	.50		5CL8	.76		6BH8	.87		6SK7	.74		12AV7	.75		12EZ6	.53		25DN6	1.42
	1X2B	.82		5EA8	.80		6BJ6	.62		6SL7	.80		12AX4	.67		12F5	.66		25EH5	.55
	2AF4	.96		5EU8	.80		6BK7	.85		6SN7	.65		12AX7	.63		12F8	.66		25L6	.57
				5J6	.68		6BL7	1.00		6SQ7	.73		12AZ7	.86		12FM6	.45		25W4	.68
	3AL5	.42		5T8	.81		6BN4	.57		6T4	.99		12B4	.63		12K5	.65		25Z6	.66
	3AU6	.51		5U4	.60		6BN6	.74		6U8	.78		12BA6	.50		12SA7M	.86		35C5	.51
	3AV6	.41		5U8	.81		6BQ5	.65		6V6GT	.54		12BD6	.50		12SK7GT	.74		35L6	.57
	3BA6	.51		5V6	.56		6BQ6GT	1.05		6W4	.57		12BE6	.53		12SN7	.67		35W4	.52
	3BC5	.54		5X8	.78		6BQ7	.95		6W6	.69		12BF6	.44		12SQ7M	.73		35Z5GT	.60
	3BE6	.52		5Y3	.46		6BR8	.78		6X4	.39		12BH7	.73		12U7	.62		50B5	.60
	3BN6	.76		6AB4	.46		6BU8	.70		6X5GT	.53		12BL6	.56		12V6GT	.53		50C5	.53
	3BU8	.78		6AC7	.96		6BY6	.54		6X8	.77		12BQ6	1.06		12W6	.69		50DC4	.37
	3BY6	.55		6AF3	.73		6BZ6	.54		7AU7	.61		12BY7	.74		12X4	.38		50EH5	.55
	3BZ6	.55		6AF4	.97		6BZ7	.97		7A8	.68		12BZ7	.75		17AX4	.67		50L6	.61
	3CB6	.54		6AG5	.65		6C4	.43		7B6	.69		12C5	.56		17BQ6	1.09		117Z3	.61
	3CF6	.60		6AH6	.99		6CB6	.54		7Y4	.69		12CA5	.59		17C5	.58			
	3CS6	.52		6AK5	.95		6CD6	1.42		8AU8	.83		12CN5	.56		17CA5	.62			
	3CY5	.71		6AL5	.47		6CF6	.64		8AW8	.93									
	3DK6	.60		6AM8	.78		6CG7	.60		8BQ5	.60									
	3DT6	.50		6AN4	.95		6CG8	.77		8CG7	.62									
	3Q5	.80		6AN8	.85		6CM7	.66		8CM7	.68									
	3S4	.61		6AQ5	.50		6CN7	.65		8CN7	.97									
	3V4	.58		6AR5	.55		6CR6	.51		8CX8	.93									
	4BC5	.56		6AS5	.60		6CS6	.57		8EB8	.94									
	4BC8	.96		6AT6	.43		6CU5	.58		10DA7	.71									
	4BN6	.75		6AT8	.79		6CU6	1.08		11CY7	.75									
	4BQ7	.96		6AU4	.82		6CY5	.70		12A4	.60									
	4BS8	.98		6AU6	.50		6CY7	.71		12AB5	.55									
	4BU8	.71		6AU7	.61		6DA4	.68		12AC6	.49									
	4BZ6	.58		6AU8	.87		6DB5	.69		12AD6	.57									

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Choosing and Using P-15 Transceivers

EVERYMAN'S all-transistor miniature transceiver is here. As this article is written, ten different models are on the market, ranging in price from $32.95 (an unwired kit) to a top figure of $149.50. Each of them is a completely self-contained transceiver suitable for two-way communications over ranges of one-half to two miles.

While still king-size compared to the inimitable Dick Tracy "wrist radio," the new midget radiotelephones are nevertheless much smaller than conventional military-style walkie-talkies. Weighing an

By LEO G. SANDS

Transmissions of 1 to 2 miles are now possible with unlicensed walkie-talkies

Manufacturer	Model Number	Price (ea.)	Weight (incl.)	Whip extended	Receiver Circuit	Transistors plus diodes	Battery or equiv.	Remarks
Cadre Industries	Transitfone-100	$125.00	20 oz.	47"	superhet	7+1	(3) Mercury cells	
EICO	early 1961							
Electra International	Miniphone-400	$89.75	11 oz.	n.a.	superhet	9 + 1	(1) Burgess 2V6	Provision for 117-volt a.c. adapter. Has earphone jack.
Electro-Voice	RME 4303	$99.50	28 oz.	34"	superhet	7+2	(2) Burgess Z-4	Features calibrated tunable receiver. Sold with carrying case.
Globe Electronics	Pocketphone	$125.00	13 oz.	29"	superhet	9+2	Rechargeable nickel-cadmium	Has tip jacks for earphone.
Gonset	early 1961							
Heath Co.	Heathkit GW-30	$32.95 (unwired) $50.95 (wired)	32 oz.	40"	superregen	4+0	(1) Burgess 2N6	Supplied with carrying case.
International Crystal	early 1961							
E. F. Johnson	early 1961							
Kaar Engineering	Han-(D)-Phone TR330	$127.50	30 oz.	35"	superhet	8+3	(6) Burgess Z	Features adjustable squelch circuit. Has elastic hand grip.
Lafayette Radio	HE-27	$62.50	18 oz.	n.a.	superhet	7+1	(1) Burgess P6M	Crystals are accessible for channel change.
Morrow Radio	VP-100	$149.50	21 oz.	7"	superhet	12+1	(1) Burgess 2U6	Features adjustable squelch circuit. Has lapel microphone and earphone jack. Short antenna has base loading coil.
Osborne Electronics	Duo-Com 100	$99.50	20 oz.	38"	superhet	10+0	(8) Burgess "NE"	Has jacks for external antenna and lapel speaker/microphone.
Wightman Electronics	WE-PT-1	$149.50	40 oz.	48"	superhet	10+1	(12) Type "C"	Receiver has built-in noise filter.
Vocaline Co.	early 1961							

average of one and one-half pounds, they are far lighter than the conventional walkie-talkie which may weigh as much as eight pounds or more.

No License Required. The most interesting aspect of the P-15 miniature transceivers is that they can be used by anyone —aged three or ninety, alien or American citizen—without a Federal Communications Commission license. Such unlicensed operation is permitted on Citizens Band channels 2 (26.975 mc.) through 23 (27.255 mc.). (For Class D Citizens Band operation, as you probably know, licenses are limited to the American citizen who is over 18 years of age.) Of course, since there is no need for FCC licenses for the P-15's, no call letters can be used in communications between two or more of these miniature transceivers.

The communications range depends upon where the transceivers are used. While essentially "line-of-sight" devices, the transceivers operate in an area where radio waves have a tendency to bend around obstructing objects.

Under adverse conditions (in major metropolitan areas with tall steel buildings, for example), the operating range may be as low as six or seven city blocks. But the average residential area range between comparable units is ¾ to 1½ miles, and extraordinarily favorable conditions (such as an unobstructed path over water) will permit communications over a range as high as 12 miles. Such "DX" is an exception to the rule, of course, but many users have consistently achieved satisfactory communications at distances of from 2½ to 4 miles.

Scores of Applications. These miniature radiotelephones have literally scores of uses. Because of their low weight and extreme portability, they will undoubtedly find frequent service in the hands of hunters and fishermen who have long sought some means of radiotelephone communications over distances of one or two miles. Car hops can use them to call food orders to the chef, theater ushers in drive-in movies can report seat availability to cashiers, and sports officials will be able to keep in touch with one another during road and track events.

Additional commercial applications for these transceivers are being found in large-scale construction projects, warehousing, factory and plant protection, stock yards, forestry service and rescue agencies, plus civil defense.

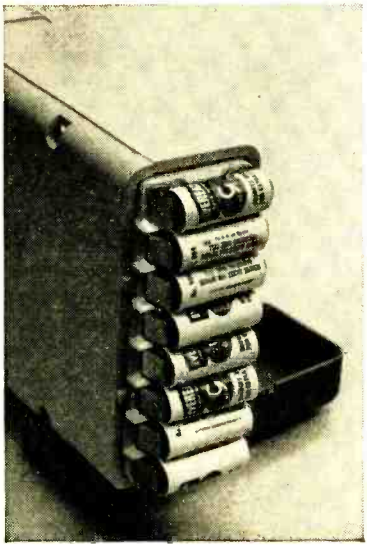
One transceiver currently available—the Electro-Voice Model RME 4303—boasts a tunable receiver.

Minimum Regulations. Under Part 15 of the FCC regulations, only certain low-power communications devices are allowed to operate without a license. In the case of these 27-mc. transceivers, the qualification of low power means an input of 100 milliwatts or less. The units must be crystal-

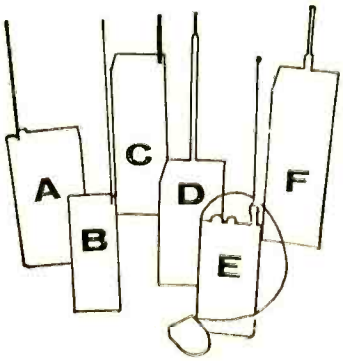
Several models, including Globe Pocketphone shown below, have connections for earphone listening.

The microphone of the Morrow VP-100 can be clipped to a shirt pocket, the main unit attached to operator's belt.

Eight miniature batteries held in the base of the Osborne Duo-Com 100 transceiver operate it for 50 hours.



Transceivers shown on page 41 are: (A) Osborne Duo-Com 100; (B) Globe Pocketphone; (C) Electro-Voice RME 4303; (D) Heathkit GW-30; (E) Morrow VP-100; (F) Wightman WE-PT-1.



controlled on all of the Citizens Band channels involved, and can only be used with single-element antennas whose length does not exceed 60 inches.

The only other noteworthy regulation applied to these unlicensed transcievers is that they must not cause or create interference with interstate or foreign radio transmission and reception. However, the chance of such interference being created by a 100-milliwatt transceiver seems rare indeed.

Part 15. Exactly what is Part 15 of the FCC Rules and Regulations? It is the portion of the Rules pertaining to the operation and use of radio frequencies by "Incidental and Restricted Radiation Devices."

Incidental radiation is emitted by a device that produces energy as a part of its operation—in other words, not for communications purposes.

Restricted radiation—as the name implies—means low-power transmitters that are used for signaling (garage door openers, model airplane control, etc.) and certain equipment used for voice communications. Such voice equipment can be operated at 100-milliwatts input in either the standard AM broadcast band or on one of the channels assigned to Citizens Radio in the 26.97 to 27.27 mc. spectrum.

Class D Operation. Many Citizens Band operators are finding that the new transistorized transceivers have greater value and communications range when used with their regular 5-watt Class D stations. In this case, the transceiver must be designed to meet FCC requirements under Part 19 of the Rules and Regulations—it must satisfy the basic requirement of

0.005% frequency stability. To date, all of the units available do so. Of course, when a transceiver is used as a Class D station, it must be licensed and operated by non-aliens over 18 years of age.

The combination of a transceiver and Class D station is roughly equivalent to boosting power by 17 db. Add to this the fact that most base stations will be using resonant and efficient antennas mounted high above ground level, and you can see that the walkie-talkie range on a quiet CB channel can easily be as much as four or five miles.

"Sophisticated" Units. In spite of their low prices, these transceivers should not be considered toys. Each unit is carefully engineered, employing sophisticated transistor techniques.

One of the transceivers has 12 transistors and one diode, with a superheterodyne receiver section that offers a rated sensitivity better than many full-fledged communications receivers costing $200 or so. Although its overall weight is held to less than 20 ounces, it also has a built-in noise-limiting and squelch circuit.

In fact, most of these units have squelch and noise-limiting circuits to eliminate ignition and other forms of radio signal interference. And many models include provisions for using lapel microphone and speaker, or even a single-piece earphone.

Several of the P-15 transceivers have a jack or other connection to permit the use of an external antenna to increase transmitting range. Unfortunately, though, means are not provided for efficiently loading or tuning up the transmitter for maximum output to the antenna. Use of an external antenna, of course, automatically means that the transceiver must satisfy Part 19 of the FCC Rules.

The development of low-cost radiotelephones is a significant step for the radio industry. For the user, it is the near-ultimate in sophisticated two-way communications—I won't be without mine. —30—

Heathkit GW-30 Easily Assembled in 4 Hours

AT this writing, the Heath Company is the only supplier of a Part 15 transistorized transceiver in kit form. The average experimenter can assemble a GW-30 in just about four hours with little or no fear of encountering discouraging bottlenecks. All wiring is on a printed-circuit board with the sole exception of the transmit/receive switch.

The GW-30 utilizes four transistors. Two are in the audio stages, one is in the crystal-controlled transmitter, and the fourth is used as a superregenerative 27-mc. detector. The miniature speaker serves a double purpose: it is switched into the audio circuit to act as a microphone during transmitting sessions. Although the GW-30 employs a miniature crystal, the unit meets the FCC 0.005% Class D requirements.

Superregen hiss from the GW-30 is not overly objectionable, and sensitivity is fair to good. The POP'tronics staff consistently used a GW-30 over a path of one and one-half miles. —30—

the RECEIVER

a universal test instrument

By LOU GARNER

With modifications, an a.c. superhet can serve as a signal generator, signal tracer, amplifier, VTVM, code practice oscillator, or even as a capacitor checker

MOST electronics hobbyists are long on ambition but short on cash. If you're typical, you'd probably like to fill your bench with a flock of meters, generators, and other equipment, but you are likely to invest any extra cash in your next project. While you may not be able to buy the equipment you want, there may be a potential benchful of test gear hidden in your home—in an a.c.-operated superhet.

For maximum value, the receiver you modify must meet certain basic requirements—it should be a.c.-(transformer-) operated, not an a.c.-d.c. set; it should be a superhet; it should be of recent enough manufacture to use readily available tubes; and it should have a 455- or 456-kc. i.f.

MODIFYING THE RECEIVER

Since you will be modifying the receiver for use as a piece of test equipment, don't worry about the condition of the cabinet (if it has one). However, the set itself should be in operating condition or easily repairable—don't pick a set that has been cannibalized for parts.

When you have found a suitable receiver, determine the make and model number and obtain a schematic for it. Your local parts distributor should be able to help you; if

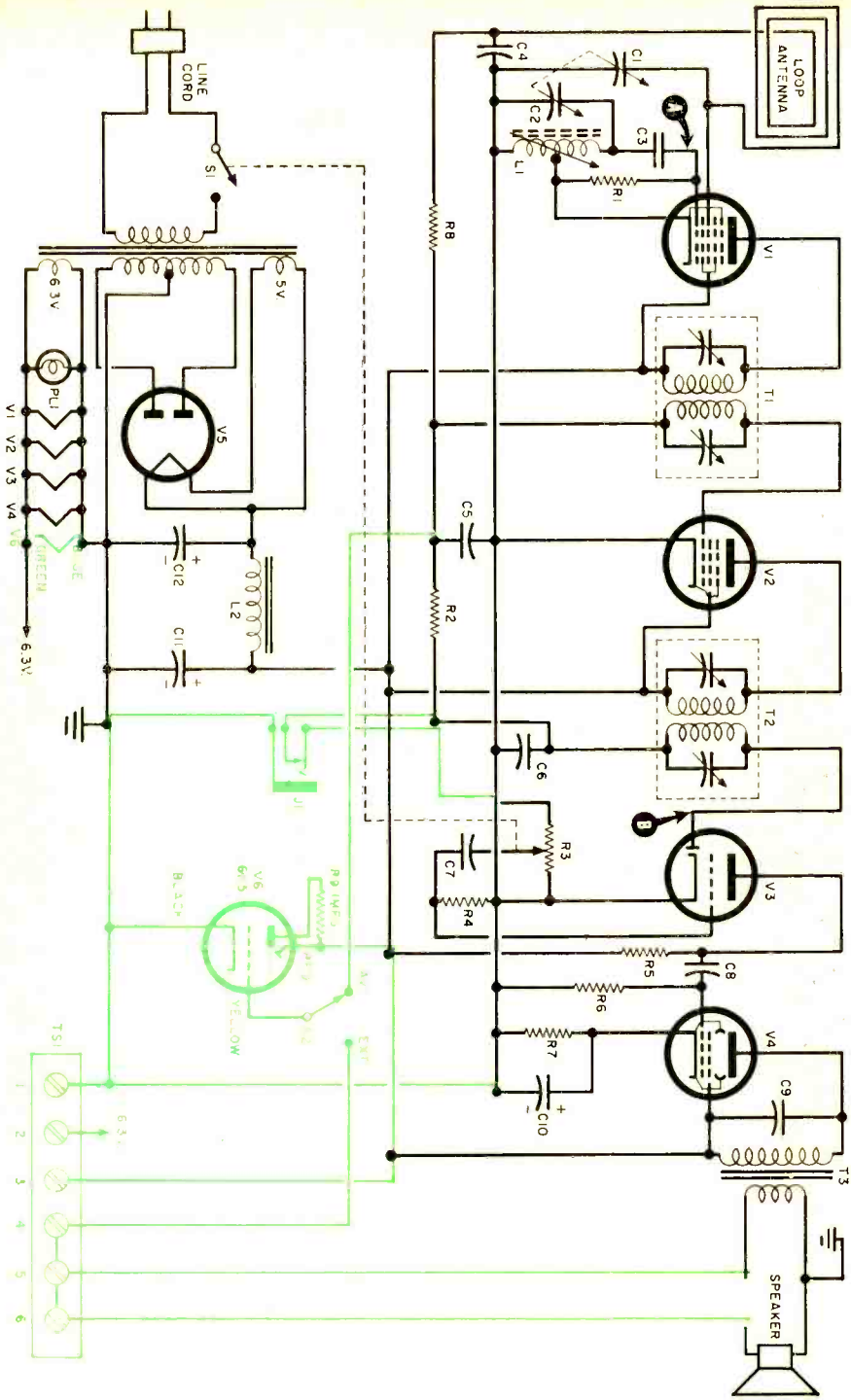


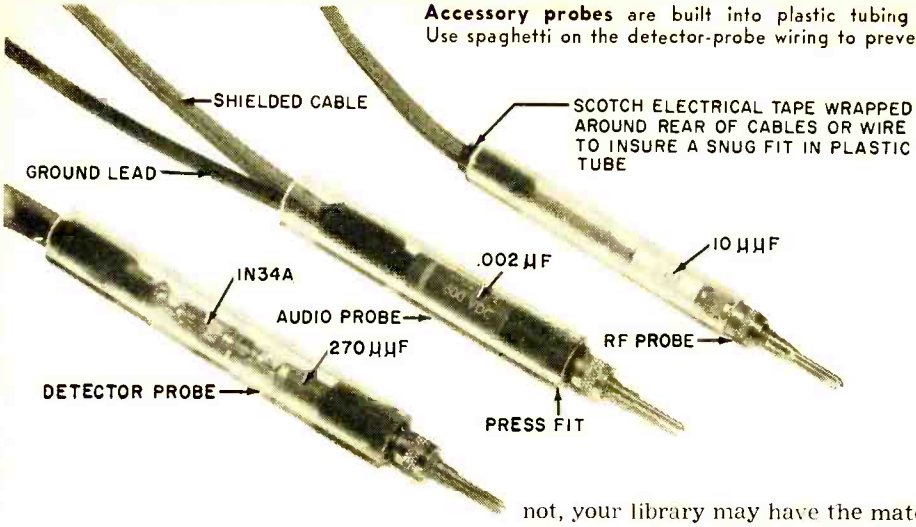
Fig. 1. Schematic diagram of modified receiver. Added parts and changes are shown in green.

ADDITIONAL PARTS

J1—Closed-circuit jack
S2—S.p.d.t. switch
TS1—6-lug terminal strip
V6—6E5 tube

1—Tuning-eye kit (Amphenol 58-MEA6 or equivalent)
3—Probes (see text)
Misc.—Wooden dowel, wire, solder, brackets, knob (for S2), phone plugs, alligator clips, etc.

Accessory probes are built into plastic tubing sections. Use spaghetti on the detector-probe wiring to prevent shorts.



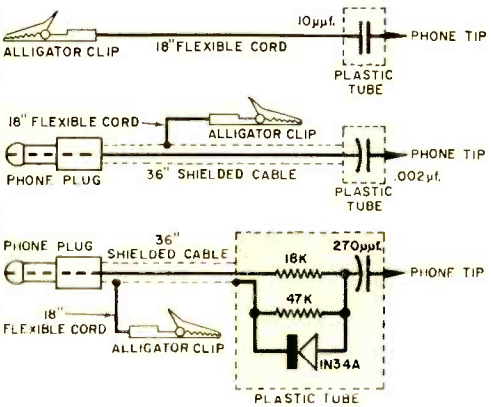
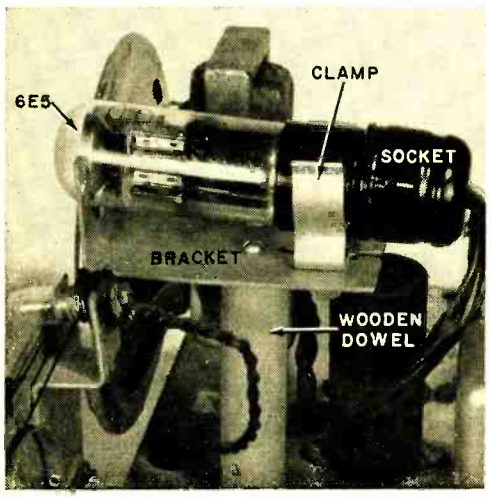


Fig. 2. Schematic diagrams for r.f., audio, and detector probes (top to bottom). See text.

"Magic eye" indicating tube (below) is held in place by a bracket on top of a wooden dowel.



not, your library may have the material. A schematic of a typical receiver is shown in Fig. 1.

Salvaging and Repair. Your first step is to restore the set to its original operating condition. If the set has been sitting around for a while, use a vacuum cleaner or portable hair dryer (heat off!) to blow away excess dust and dirt. Check for missing or broken tubes, broken connections (to the antenna coil, for example), charred resistors or other damage.

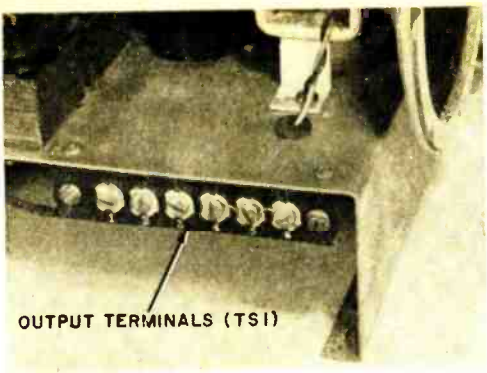
If all seems in order, have the tubes tested and replace any that are weak, leaky, or burned out. Check the tuning capacitor for bent plates and dirt. If necessary, clean between the plates with a piece of stiff cardboard or a pipe cleaner.

If the set hums, filter capacitors *C11* and *C12* (in Fig. 1) may have dried out and need to be replaced. If the sound is distorted, look for a defective speaker, a gassy output tube, or a leaky capacitor (*C8*).

Once the set is operating, it should be aligned. If you have access to an r.f. signal generator, you can do the job yourself or you can have your local service shop do it for you.

New Components. The basic modifications are also shown in Fig. 1; the additional components you will need are given in the accompanying parts list.

Drill a hole in the front or rear chassis apron and install a closed-circuit jack (*J1*). The "hot" (ungrounded end) lead to the volume control (*R3*) is opened and connected to the jack. If the leads must be longer than two or three inches, use shielded single-conductor cable, grounding one end of the shield to the chassis.



Terminal strip TS1 is mounted on small angle brackets at the end of the chassis.

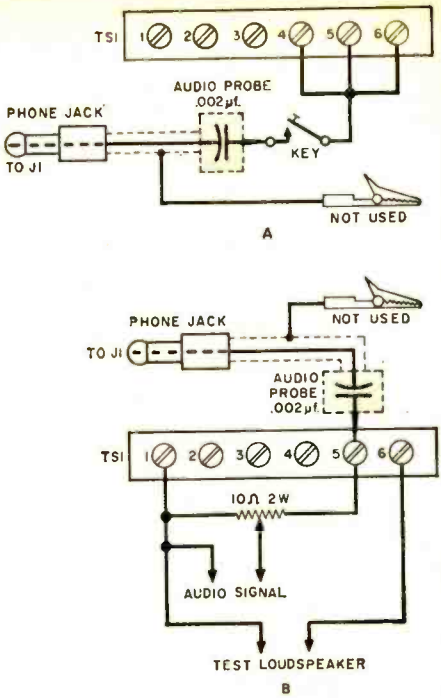


Fig. 3. Setup for using the receiver as a code oscillator (A); and as an audio signal source and test loudspeaker (B).

Install the electron-ray tube (*V6*), using the kit specified in the parts list, and an s.p.d.t. selector switch (*S2*). The 1-meg. resistor is premounted as part of the kit. The switch can be a toggle, slide, or rotary type and should be mounted on the front chassis apron. The 6E5's support bracket can be mounted on metal spacers or on a heavy wooden dowel.

Now mount terminal strip *TS1* on the chassis. Connect terminal *1* to the chassis (ground), terminal *2* to the heater winding, and terminal *3* to the B+. One pole of the selector switch goes to terminal *4*, one side of the voice coil winding goes to *5*, and the other side is grounded. The free end of the speaker's voice coil goes to terminal *6*. A jumper between terminals *5* and *6* restores the connection between the transformer and speaker.

Every piece of test equipment needs a set of accessory cables and probes. Make up a set of probes as shown in Fig. 2. In addition, make up a set of general-purpose clip leads. Use flexible wire in varying lengths from 8 to 24 inches. Terminate some in alligator clips at both ends, others with an alligator clip at one end and a spade terminal at the other. Make up at least one medium-length (24" to 36") shielded cable with a phono plug at one end and a phone plug at the other.

Preliminary Tests. Set *S2* to its *a.v.c.* position and turn on the set. Tune in several different stations. The "eye" should glow (green) and should close somewhat as stronger stations are tuned in. A very strong station may close the eye completely.

Now move *S2* to its *Ext.* position. Connect terminals *4* and *5* of *TS1*. The glow on the indicating tube should vary in accordance with the strength of the program material.

To check the eye as a d.c. vacuum-tube voltmeter, remove the jumper between terminals *4* and *5*, and connect several penlight or flashlight cells in series to supply between 1.5 and 9 volts; attach the positive terminal to terminal *1*, and the negative lead to terminal *4*. As terminal *4* is made increasingly negative, the eye should close further and further. The eye can be roughly calibrated by noting the voltage required to close it halfway, all the way, etc.

USING THE RECEIVER

The basic technique is to use a portion of the receiver's circuitry as a substitute signal-handling device or signal source. The eye serves as a voltage- (or signal-) indicating device in place of a more expensive meter. Let's take a look at some practical test setups.

Audio Output Meter. Basically, the output meter is simply a device for visually indicating relative audio signal levels.

(*Continued on page* 106)

Build a Time Delay Lamp

Inexpensive "genie" gives delayed-off characteristics to most lamps and appliances

By **RONALD L. IVES**

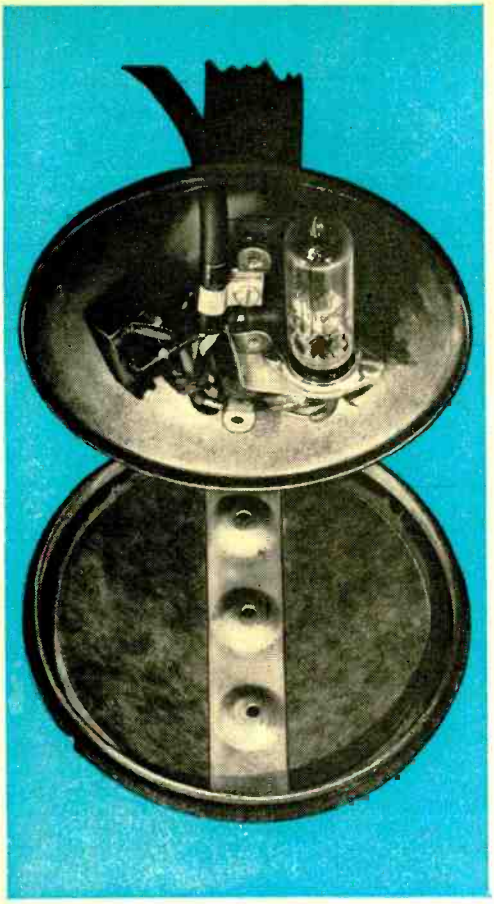
HERE'S a way to put magic into almost any lamp. You modify the lamp so that after you've turned it off its light will stay on for about 30 seconds, then go out of its own accord. This "delayed turn-off" factor can be a great convenience when applied to a bedroom or hallway lamp, and it can also be applied to your porch or garage driveway light.

The heart of the lamp is an inexpensive thermostatic delay relay that mounts in the lamp's base or body; almost any lamp in your house can be modified to operate with this relay. Low-drain appliances can also be wired for delayed turn-off. And if you add a magnetic relay to the circuit, you can operate high-drain lamps and appliances in the same way.

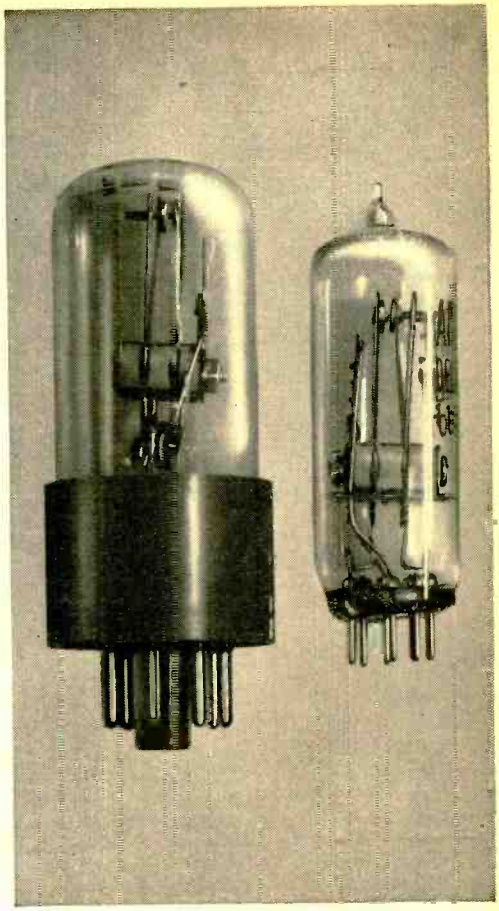
Thermostatic delay relays are stocked by most of the larger radio supply houses and sell for around $2.35 each. Besides the relay, an inexpensive switch and tube socket are all that's needed to modify most lamps.

Construction. The author built his lamp into an upright desk telephone stand which was obtained on the surplus market. Any lamp with a bulb rated up to 200 watts can be used, as long as there is enough room in the base or body to house the thermostatic time delay relay (*K1*), a nine-pin miniature socket, and a d.p.d.t. switch (*S1*). The delay relay given in the parts list has a 30-second delay characteristic and a 200-watt rating.

If you have a particularly attractive lamp or stand with a small base or body,



Wiring for the time delay relay is hidden in the base of a desk-type telephone stand. Thermostatic delay relay K1 (glass bulb) mounts in nine-pin miniature tube socket to right of on-off switch S1.



Thermostatic delay relays are available in several models. Amperite relay with octal base (at left) has 3-amp. contacts; nine-pin miniature model (right) used here has 2-amp. contacts. See text.

you can mount the three parts in a 2¾" x 2⅛" x 1⅝" aluminum box (Bud CU-2100A or equivalent), and place it alongside the lamp. If you want to use a lamp that drains more than 200 watts, or if you have a d.c. line, see the discussion on converting other appliances which appears on the next page.

To convert an old desk telephone to a table lamp, first unscrew the microphone and its fork-like support from the top of the phone. Remove the microphone from the fork, attach a small ⅛" threaded ferrule to the fork in its place, and mount a standard lamp socket on the ferrule. About 1½ feet of heavy lamp cord should be connected to the socket before mounting it to the fork. Do not mount the fork and

HOW IT WORKS

The time delay lamp operates through action of thermostatic delay relay *K1*. This relay consists of a pair of normally open contacts sealed in a bulb with a 117-volt a.c.-d.c. heater element. When power is applied to the heater for at least 20 seconds, the contacts close due to their thermal characteristics. When power to the heater is switched off, the contacts will remain closed for 30 seconds, which is the designed delay characteristic of the relay.

With switch *S1* in the "on" position, power is applied to the lamp and to the heater of *K1*. In the "off" position of *S1*, power to the lamp and the heater is interrupted. When switch *S1* is placed in the "delayed off" position after being "on" for at least 20 seconds, power is applied to the lamp through the contacts of *K1* and *S1*. After 30 seconds in the "delayed off" position, the contacts of *K1* cool and return to their normally open position, extinguishing the lamp.

For operation of high-current-drain appliances, electromagnetic relay *K2* can be connected in place of the lamp. The appliances are then connected to the power line in series with *K2*'s energized contacts.

lamp socket on the phone until final assembly of the lamp.

Now remove the telephone receiver hook and its connecting parts from the main body of the phone; you can fill the hole left by the hook with a small brass shim soldered in place. Drill a hole in the base of the phone to mount switch *S1;* make sure that the hole is so located that *S1* will clear the bottom cover when the phone is reassembled.

To mount the nine-pin miniature socket that holds delay relay *K1,* make a small bracket from a piece of scrap aluminum—be sure it fits inside the base of the lamp. First drill all necessary holes in the bracket, then mount the miniature socket on it. You'll find it easier to solder all connections to the base of this socket and switch *S1* before mounting the bracket inside the phone's base. Now screw the base back on and mount the light bulb and the shade you have chosen.

Placing switch *S1* in the "on" position turns the lamp on; placing *S1* in the center position turns it off. If "delayed-off" is desired, switch *S1* to "on" and leave it there for at least 20 seconds; then switch it to "delayed off." The lamp will remain on for approximately 30 seconds, and then go off by itself.

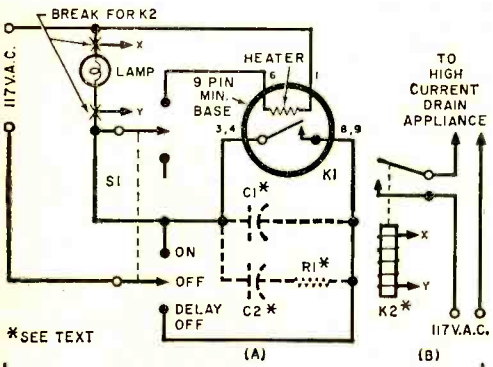
Converting Other Appliances. Any a.c.- or d.c.-operated lamp or appliance can be wired for delayed turn-off using an arrangement similar to that shown for the telephone lamp. To hook up your light or appliance, simply determine its current drain and choose the proper thermostatic delay relay.

Two 117-volt a.c.-d.c. models of the Amperite delay relay are available with normally open contacts and fixed delays of 2 seconds to 3 minutes. One model has an octal base with a contact current capacity of 3 amperes; the other has a nine-pin miniature base with a contact current capacity of 2 amperes. Both current ratings are non-inductive, which means that the relays can be run at their full rating with appliances having resistive elements—light bulbs, for instance.

With a.c. appliances having inductive loads, such as transformer-operated radios or electric motors, maximum ratings should be reduced about 1 ampere for either relay. In addition, the contacts of the relays should be shunted with a .01- to .1-μf., 600-volt capacitor (*C1*).

If either relay is used on 117-volt *d.c.* lines, shunt the contacts of the relay with a series-connected, 33-ohm, 1-watt resistor (*R1*) and a .1- to 1-μf., 600-volt capacitor (*C2*), as shown in the schematic. No contact shunts are needed when the relays are operated with electric lamps or other *resistive* loads from a 117-volt *a.c.* line.

For high-current-drain lights or appliances, substitute magnetic relay *K2,* as shown in the (B) section of the schematic, for the lamp at points *X* and *Y* in the (A) section of the schematic. Operation is identical to that described for the telephone lamp. —30—

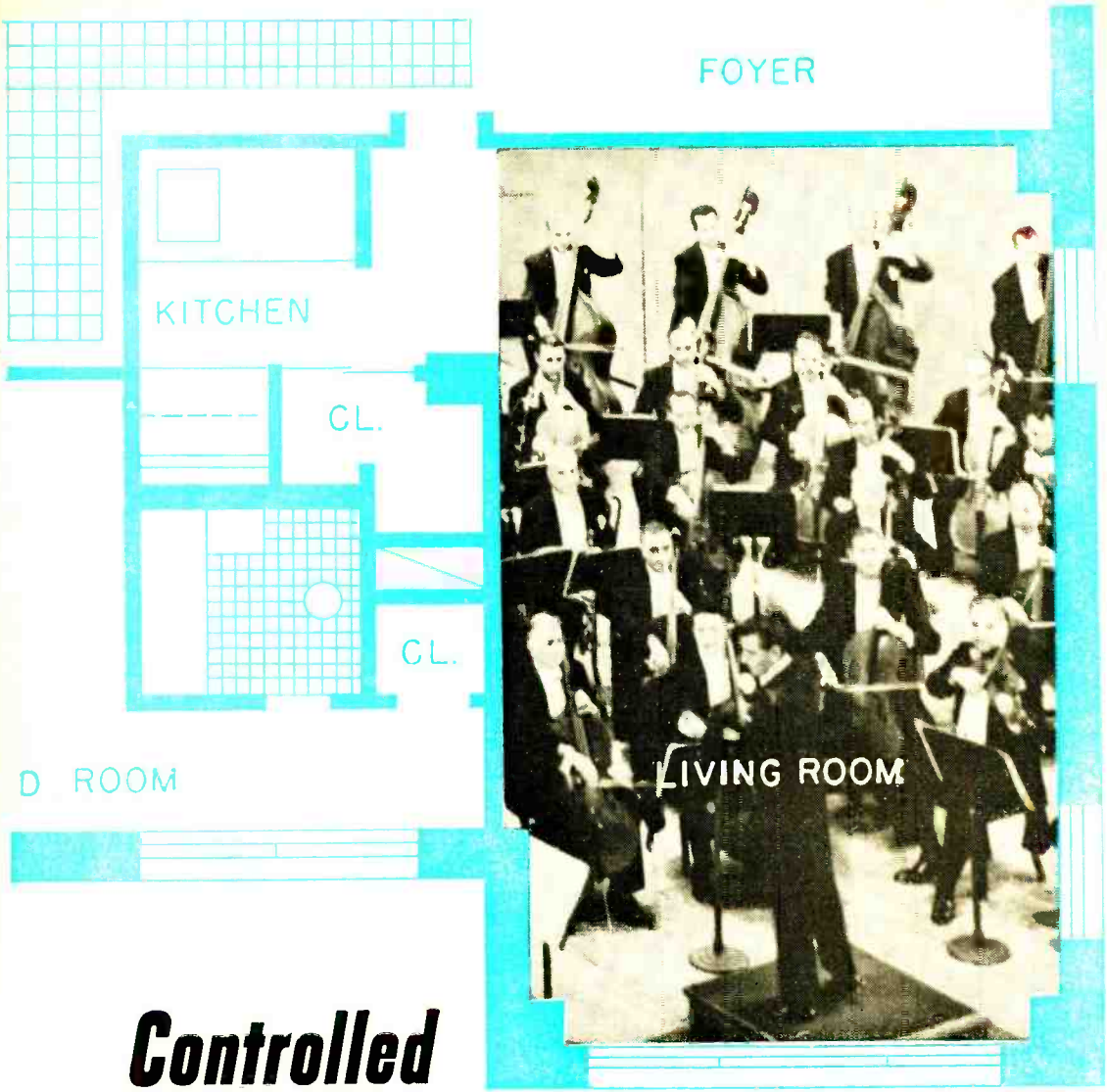


Simple time delay lamp circuit (A) is suitable for lamps draining 200 watts or less. Capacitors C1 and C2 and resistor R1 are needed only for inductive loads or d.c. operation. Devices draining high current use contacts of relay K2 (B) which is wired into lamp's circuit.

PARTS LIST

**C1—.01 to .1-μf., 600-volt capacitor*
**C2—.1- to 1-μf., 600-volt capacitor*
K1—117-volt, a.c.-d.c., 30-second thermostatic delay relay (Amperite 115N030T)
**K2—117-volt a.c. relay, 13-amp., normally open contacts (Potter & Brumfield PR3AY or equivalent)*
**R1—33-ohm, 1-watt resistor*
S1—D.p.d.t. "center-off" toggle switch (Lafayette SW-19 or equivalent)
1—Nine-pin miniature tube socket
**1—Octal tube socket*
Misc.—Lamp cord, ⅛" threaded ferrule, lamp socket, etc.

**Parts for inductive loads, high power, and d.c. operation*

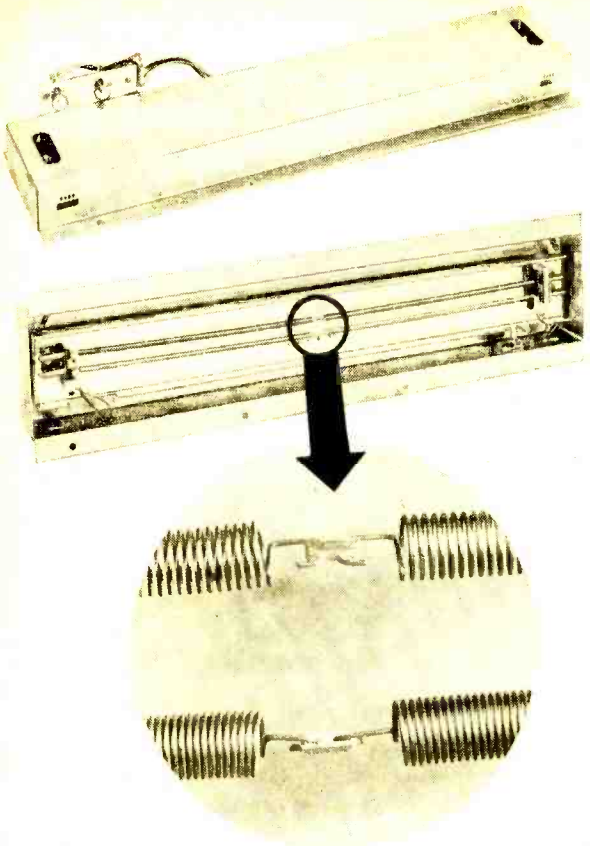


Controlled REVERBERATION

New hi-fi accessory imparts concert-hall "acoustics" to your living room

By **JOHN MILDER**

WHILE there's no denying that today's hi fi is fantastically hi, the sound that fills the average audiophile's living room is still a step or two shy of concert-hall realism. Modern components boast a frequency response which covers everything within the range of human hearing with the greatest of ease, and vanishingly low distortion which allows the audiophile to listen to hours of slam-bang orchestral fireworks without strain or fatigue. The arrival of stereo has made it possible for the first



Mechanical delay device produced by the Hammond Organ Co. is basic component in artificial reverberation units. Signal is fed to ferrite transducers at one end of box, through special springs, then on to another pair of ferrite transducers. To minimize uncontrolled reverberation —footsteps jarring springs into extra action, for example— each spring consists of two sections wound in opposite directions and coupled at the center.

time to hear recorded sound in true depth and perspective. But there's still something missing; there's still an invisible barrier that keeps the Kingston Trio from stepping out of your speakers and into your living room.

Over the past few months, several component and console manufacturers have come up with what they think is the missing ingredient in the recipe for realistic sound. What's been missing, they feel, is a way of matching the acoustics of a studio or concert hall where a recording is made to the acoustic properties of the living room where the recording is played back.

While realizing that it's impossible to turn an audiophile's living room into an exact duplicate of a concert hall, the manufacturers reasoned that there ought to be some way for the listener to simulate at home the acoustic conditions—the engineer's term is "ambience"—under which he hears live music. Until now, the listener's only control over the "feel" of recorded sound in his living room has been the use of tone control to crank down, or step up high and low frequencies.

What has now been added is the reverberation control. Several reverberation units are now on the market carrying names like "Space Expander," "Reverbatron," etc. They are all "cousins," in effect, and so that we may be able to understand what they do, let's first take a look at reverberation and its role in live and recorded sound.

What Reverberation Is. Whether you're sitting in a jam-packed football stadium or walking along a quiet country road, any sound that reaches your ears is made up of a blend of two kinds of sound —direct and reverberated. Part of any sound makes a beeline for your ears from its source; the rest is bounced at you from anything that lies between or beyond you and the source, and it arrives at your ears at least a split-second later than the direct sound.

For designers of auditoriums and concert halls, the big challenge is to come up with

the right mixture of direct and reverberant sound for good acoustics. The right amount of reverb yields a full-bodied but clear sound; too much leads to echoes which bounce back and get in the way of later direct sound. To avoid a soggy or harsh sound, a designer has to calculate the potential of everything in a hall that will reflect or absorb sound—down to the last person in a sell-out crowd.

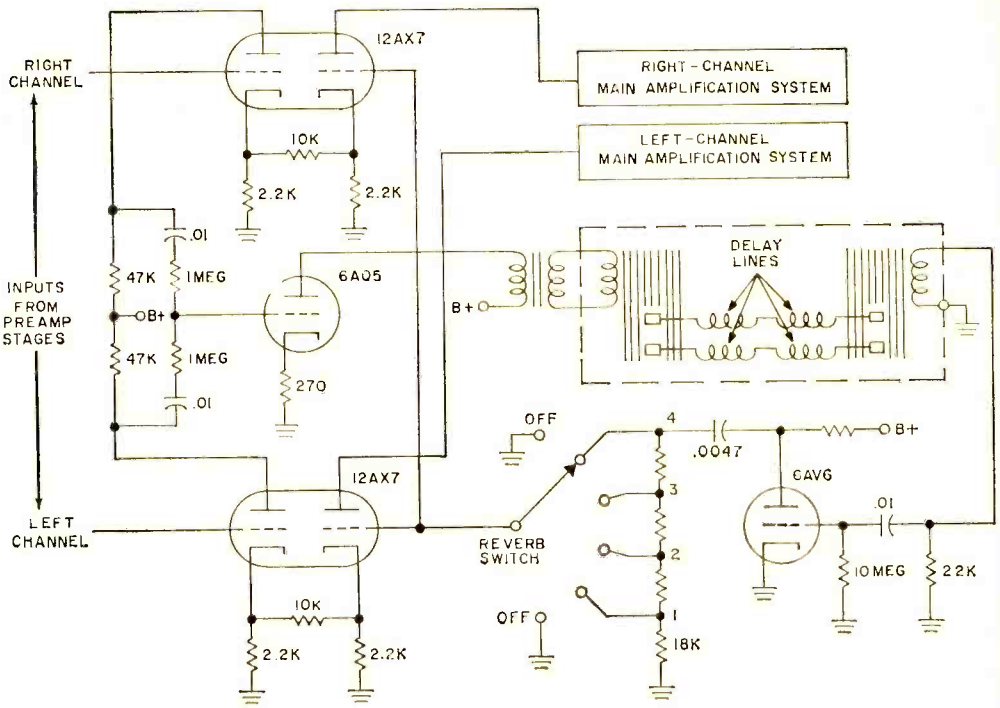
Echo Gimmicks. The recording engineer has the upper hand over the auditorium designer, since he can make some electronic changes in the sound from a recording studio. While he can't do too much about the sound from an overly reverberant hall, he can add a practically unlimited amount of reverberation to beef up a thin-sounding recording.

But except for an extreme case like the whispering singer, it's impossible for any recording engineer to calculate the impact of his efforts on you in your living room—unless he can get you to put on a pair of earphones. Once recorded sound finds its way out of your loudspeakers, it's on its own, and the acoustics of your living room take over. Even stereo, which goes a long way toward giving your living room the acoustic dimensions of a concert hall, varies tremendously in its impact in different living rooms.

It goes without saying that most living rooms weren't built with acoustics in mind. Until now, the only course of action for the average audiophile was to rearrange living room furnishings within limits set by a tight budget or a strong-minded wife. A room with too many reflecting surfaces and a harsh echoic sound called for some sound absorbing drapes or rugs. A soggy sound dictated giving away some overstuffed furniture to a worthy charity.

Enter Reverb Units. All of which brings us to the appearance of reverberation units on the audio scene. The logical theory behind these new gadgets is the idea that the audiophile at home can benefit from an electronic upper hand similar to the recording engineer's echo gimmicks. All of the new reverberation devices are designed to let *you* adjust a recording's reverberation to come up with the maximum realism for your living room. Let's move in for a closer look.

So far, there are at least a half-dozen



Circuit diagram of Philco's "reverbaphonic sound system" is typical of electronic control devices employed with the Hammond mechanical delay unit. Switch controls degree of reverberation in 6-db steps.

reverberation units on the market. Of biggest interest to the audiophile are Fisher's "Space Expander," Allied's Knight reverberation unit, and Sargent-Rayment's "Reverbatron," since all are designed to be added to your present hi-fi rig. Also on the bandwagon are Checker, Ecco-Fonic, Utah, and others, as well as Motorola, Philco, and Zenith, who have added reverb units to their consoles.

Typical reverberation unit makes use of Hammond Organ Company's mechanical reverb device (above, rear) and has an associated electronic control center. This unit is made by Sargent-Rayment.

All of the new units operate on the same general principles, and all of them use a basic mechanical reverb device made by the Hammond Organ Company. This basic unit contains two springs just over 14" long and two special ferrite transducers located at opposite ends of the springs (see photos on page 54).

From the electronic control center used with the mechanical unit, a blend of part of the sound from both stereo channels is fed to the input transducer at one end of the spring assembly. The transducer uses two magnets which rotate in proportion to the polarity and amplitude of the applied signal, and their rotating motion is transmitted to the two springs. When the action set in motion by the magnets reaches the other end of the springs, another transducer converts the motions back into an electrical signal which makes its way back through the electronic control unit and rejoins the original stereo signals on their way to your loudspeakers. The echo effect is a function of the length of time it takes for the signal to dance its way across the two springs.

It's not hard to see, though, that the echo introduced by the time-delay in the springs is also fortified by the tendency of the signal to bounce its way back and forth over the springs several times—each time in slightly weakened form. To get full benefit from this extra bouncing action and prevent phase-opposition from cancelling out part of the signal and producing uneven frequency response, the two springs used in the basic unit have different delay-times—37 milliseconds for one and 29 for the other.

The electronic control unit that works with the mechanical unit has a triple job. Its control knob decides the amount of signal which goes from a preamp to the mechanical unit, and thereby sets the desired amount of reverberation. Beforehand, though, the control unit blends the two stereo signals from a preamp into one; and afterward it takes the reverberated signal from the mechanical unit and imposes it on the original signals heading for both stereo power amplifiers.

Installing the Units. Connecting either the Fisher or the Sargent-Rayment reverb units into your stereo rig is an easy job. You simply plug the two output jacks from a stereo preamp into the inputs marked on the special electronic unit, and re-plug the output leads from the unit into the regular inputs of your stereo power amplifier. The electronic and mechanical sections of the reverb unit also connect via two ordinary shielded phone cables and their respective inputs and outputs are clearly marked. The long (18") but thin mechanical unit can be kept completely out of sight and screwed onto the back of any convenient cabinet.

(*Continued on page* 104)

Build the COMBO Test Set

Three-in-one unit is combination modulation monitor, field strength meter, and c.w. monitor

IF YOU don't want to clutter up the house with a lot of electronic gear just to check out your CB or ham transmitter, the "Combo" is for you. This small test instrument is a modulation monitor, field strength meter, and c.w. monitor all rolled into one. What's more, it requires no batteries or power supply of any kind—it's completely powered by r.f. pickup from your transmitter.

The Combo covers all of the bands from 80 to 10 meters, including the increasingly popular 11-meter

By **PADDY J. LABATO,** W8DLU

C'tizens Band. If you plug in a pair of phones, you will be able to check the quality of your transmitter's modulation—trouble in your modulator will show up at once. Or you can listen to your transmitter's c.w. signal on the Combo's built-in speaker; the instrument will let you know if there are any key-clicks, chirps, or hum on your code transmissions. In addition, the Combo will help you send better code, since you'll be able to monitor your transmissions as you key your transmitter.

You can build the Combo for about $20 using all new components; it will cost much less if you call on your junk box and the surplus market. The completed instrument is both small and attractive, and you should find it a worthwhile addition to your gear.

CONSTRUCTION

Build the Combo in the back half of a 7" x 5" x 3" aluminum box. Drill all the necessary holes in the box before mounting any components, and follow the pictorial diagram for layout. In most cases it will be best to solder leads to the components before mounting them if you want to avoid working in tight corners.

Mounting the Parts. After you mount the four rubber feet on the bottom of the box, locate meter *M1* on the upper right-hand portion of the 7" x 5" side. The meter should have a full-scale d.c. range of 1 to 2 milliamps—as the exact range is not important, any new or surplus meter will do. Mount tuning capacitor *C1* to the left of the meter on the same side of the box, using a pair of metal spacers, so that *C1*'s vernier dial will be symmetrically located with respect to the meter.

Frequency range switch *S1* and function switch *S2* mount directly below capacitor *C1;* phone jacks *J1* and *J2* mount below the meter. Place tone control *R1* in the center of the same side of the box after you have soldered two 4" leads and capacitor *C3* to *R1*'s terminals.

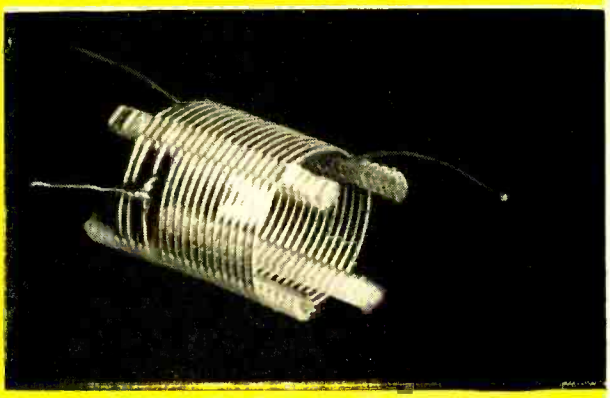
Note that the speaker mounts on top of the box between the meter and tuning capacitor; about 30 small grille-holes should be drilled in a circular pattern for the speaker. The carrying handle—a standard kitchen-drawer handle available at most hardware stores—straddles the speaker grille holes.

Now mount transformer *T1* and the barrier terminal strip on the bottom of the box below the speaker. The five-way binding post (*BP1*) should be located on top of the box, to the left and rear of the carrying handle.

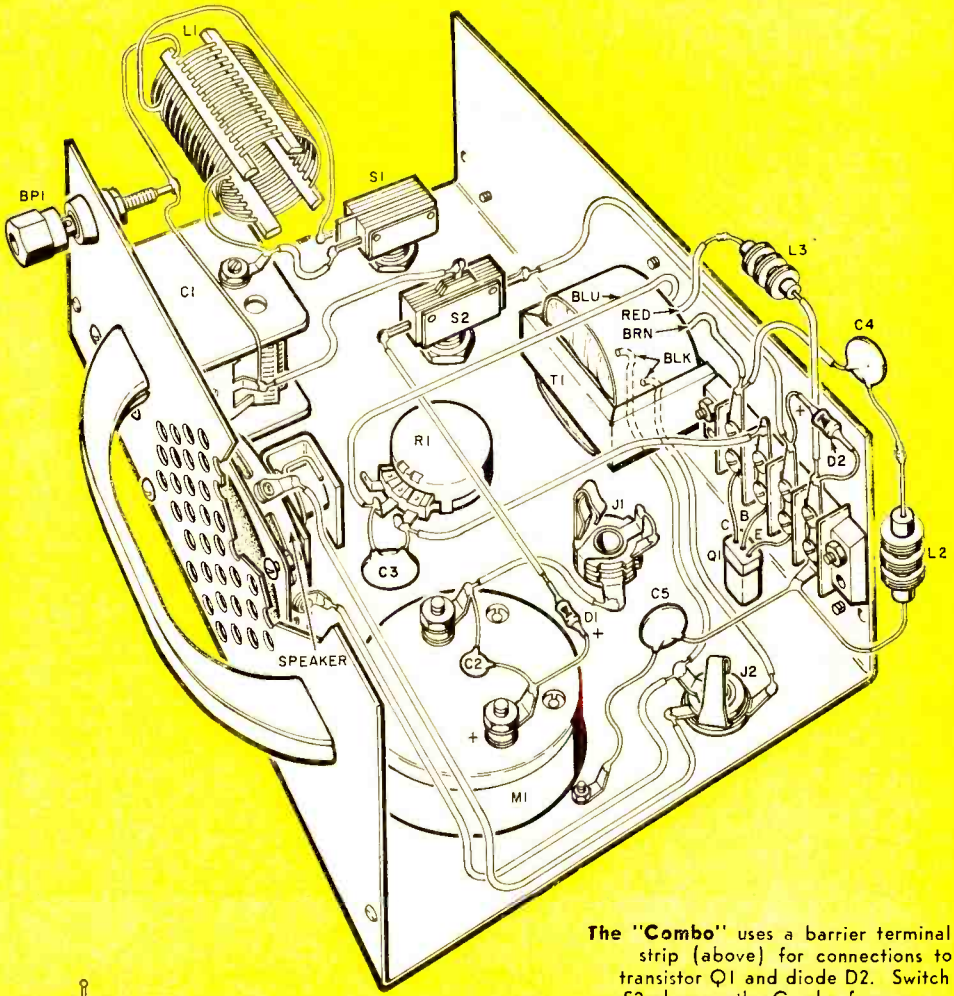
Wiring Details. One component, tuning coil *L1*, must be fabricated from a section of B&W 3015 Miniductor. Cut off 22 turns

PARTS LIST

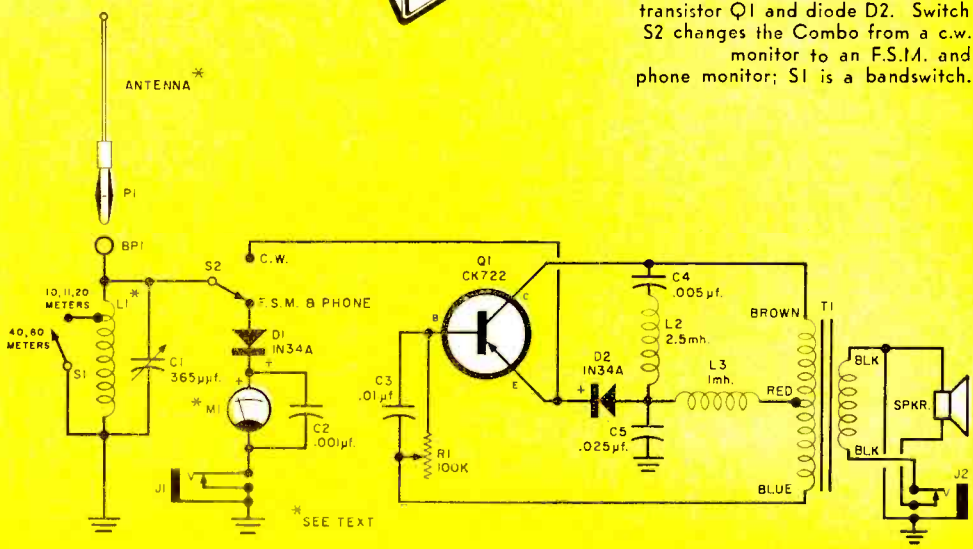
BP1—Five-way binding post
C1—365-μμf. midget variable capacitor (Lafayette MS-214 or equivalent)
C2—0.001-μf. ceramic disc capacitor
C3—0.01-μf. ceramic disc capacitor
C4—0.005-μf. ceramic disc capacitor
C5—0.025-μf. ceramic disc capacitor
D1, D2—1N34A diode
J1, J2—Phone jack, closed-circuit type (Allied 41 H 624 or equivalent)
L1—Tuning coil (see text)
L2—2.5 mh. r.f. choke (National R-100 or equivalent)
L3—1-mh. r.f. choke (National R-50 or equivalent)
M1—D.c. milliammeter (see text)
P1—Banana plug
Q1—CK722 transistor (or equivalent p-n-p unit)
R1—100,000-ohm potentiometer, linear taper (IRC Q11-128 or equivalent)
S1—S.p.s.t. toggle switch
S2—S.p.d.t. toggle switch
T1—Output transformer, 14,000 ohms center-tapped, push-pull plates, to 4-ohm voice coil (Stancor A-3496 or equivalent)
SPKR.—2½" speaker, 4-ohm voice coil (Quam 25A07 or equivalent)
1—7" x 5" x 3" aluminum box (Bud CU-2108A or equivalent)
1—4-lug barrier terminal strip (Cinch-Jones 4-140 or equivalent)
1—1½" vernier dial (Lafayette F-348 or equivalent)
Misc.—Hardware, handle, rubber mounting feet, wire, etc.



Tuning coil L1 is made from a section of B&W 3015 Miniductor. Note that an equal number of turns are unwound on each end of the coil for use as leads. See text for details.



The "Combo" uses a barrier terminal strip (above) for connections to transistor Q1 and diode D2. Switch S2 changes the Combo from a c.w. monitor to an F.S.M. and phone monitor; S1 is a bandswitch.



from the coil stock as purchased and unwind two turns on each end of the cutoff section (leaving 18 turns). The lengths of wire on either end of the coil will make wiring easier. Now solder a 2" length of bare hookup wire to the third turn from one end of the coil. To make the tap easily, push in the second and fourth turns on either side of the tapped point, then solder the bare wire to the desired turn.

One end of coil *L1* is connected to a lug grounded to the rotor (frame) of tuning capacitor *C1* and to one terminal of switch *S1*. The other end of *L1* connects to either of *C1*'s stator lugs and to binding post *BP1;* these connections are clearly visible in the pictorial. Finally, *L1*'s tap is connected to the remaining unused terminal of *S1*.

The remainder of the wiring is simplified through use of the barrier terminal strip which serves as a four-terminal tie point. You need not solder to transistor *Q1;* just twist *Q1*'s leads around the terminal screws and tighten them in place. All other leads connected to the terminal strip should first be soldered to lugs which are then put under the proper terminal screws. The rest of the components are wired point-to-point; be sure to use a heat sink when soldering diodes *D1* and *D2*.

OPERATION

To use the Combo, you must provide the instrument with r.f. from your transmitter. If you have r.f. "floating" around your shack when you transmit, simply connect a few feet of wire to binding post *BP1*. If your transmitter is well shielded, as it should be, thrust the insulated end of the wire through one of the transmitter's vent holes; be sure that the wire doesn't come in contact with any part of the transmitter's circuitry since too much r.f. will burn out the meter and diodes.

Modulation Monitor. If you have a CB rig or operate on one of the ham phone bands, you can use the Combo as a modulation monitor. With the pickup wire set up, place function switch *S2* in the "F.S.M. & Phone" position. Then place switch *S1* in the "10, 11, 20 meters" position (for CB operation) or the "40, 80 meters" position (for 40-or 80-meter phone operation). Plug a pair of moderate-to-high-impedance magnetic phones (1000 ohms or more) into jack *J1,* and ask someone to listen in for you.

Tune up your transmitter and go on the air. When your friend listening in on the Combo tunes capacitor *C1* to your frequency, he will hear your phone transmissions as they sound to your radio contacts. Any overmodulation, hum, or distortion will immediately be detected.

Field Strength Meter. Leave switches *S1* and *S2* in the positions used for the phone monitor. Disconnect the length of wire used for r.f. pickup from *BP1,* unplug the headphones from *J1,* and connect a stiff wire "rod" antenna to *BP1*. You can make such an antenna by soldering about a yard of bus bar to a banana plug (*P1*); the plug will fit into the binding post.

Now, with *C1* tuned to your frequency, ask your friend to take the Combo outside your shack several wavelengths away from your transmitting antenna. As he approaches your antenna with the Combo while you are transmitting, meter *M1* will give a reading that will increase as he gets closer to your antenna. As he walks around the antenna in a wide circle, the different readings on *M1* will indicate sensitivity nodes. (See "Build a Field Strength Meter" in the September 1960 issue of POPULAR ELECTRONICS for complete theory and operation of this instrument.)

C. W. Monitor. Place switch *S2* in the "c.w." position. Connect a short length of insulated wire to *BP1* for r.f. pickup as previously described. Switch *S1* to the appropriate band, tune up your transmitter, and tune *C1* on the Combo to your transmitter's frequency. You should hear a tone from the Combo's speaker; adjust potentiometer *R1* until the tone is a pleasant note. Any roughness or hum in the tone indicates that your transmitter's carrier is accidentally being modulated.

When you key the transmitter, the monitor should come up with an exact replica of your c.w. signal. Chirps or key clicks will be audible in the Combo's speaker. If you wish, you can plug a low-impedance headset (about 8 ohms) into jack *J2* on the Combo; this will cut out the speaker and give you earphone operation. —30—

On the Citizens Band

By TOM KNEITEL, 2W1965

SANTA dropped a nice present down the chimney this year. It was the long-awaited okay for the expansion of *On The Citizens Band*. From now on we'll have a little more elbow room, having gained one whole extra page for the column. This is in line with POP'tronics' greater CB coverage, both through this column and through feature and construction articles. I have only one complaint—I think Santa knocked down my ground plane with all that scuffling around on the roof.

The Civil Air Patrol might be interested in the following idea. At the present time there is a CAP channel on 26.62 mc. available only to stations in Hawaii on a "non-QRM to Government stations" basis. If this channel could be allocated for use in the Continental United States, the CAP radio network (already comprising more than 12,000 stations on the 2-, 4-, and 148-mc. CAP channels) could be vastly enlarged. Many thousands of CB'ers who could easily operate on 26.62 mc. would probably rush to join this worthwhile organization (it's the USAF auxiliary) if they thought that they could be of use.

"On-the-ball" CB clubs and individuals who would like to support this idea might drop a card or letter about it to The Commander, Headquarters Civil Air Patrol, U.S. Air Force, Bolling A.F.B., Washington 25, D. C.

Membership in CAP is open to all U. S. citizens (male and female) 14 years of age and older—and you can join without the fear that you will be "activated" into the full-time Air Force. The CAP activities include air/sea search and rescue operations, disaster communications, practice missions, encampments at Air Force bases, and so on. Members are authorized to wear the CAP uniform, which is almost identical to that of the Air Force.

We'd like to start a "Club of The Month" feature in this column, so we're inviting clubs to send us information on their public service activities and achievements. Please write on your official club letterhead, and tell us something about the club's members and history. Send clear, glossy photos (the larger the better) of club activities and members-in-action. The more information you send, the easier it will be for us to decide if your club rates as "Club of The Month."

Incidentally, two nifty club papers were received here this week: "The Carrier" of The Trans-Ceivers of Southern California and the "C-B News" of The Citizens Band Association of Greater St. Louis. If you have a club newspaper, please send it along —we'd like very much to see it.

The latest addition to Lafayette's now-famed "HE" line of CB rigs (HE-15, HE-15A) is the HE-20 transceiver. This one is a de luxe job with push-to-talk, combination "S" meter and final input wattmeter, 4 transmit channels, 4 crystal-controlled receive channels, plus tunable receive for reception of all 23 channels. It's also got a noise limiter and adjustable squelch—pretty fancy stuff for only $99.50!

There has been some question about the low-powered walkie-talkie sets which operate on 11 meters under the FCC's Part 15 regulations for "Incidental Radiation" devices. The only way you can use one of these walkie-talkies to communicate with a CB station is when the walkie-talkie is actually licensed under Part 19. If the walkie-

talkie is being used to contact only other Part 15 stations, no licenses are required. (Don't miss the Part 15 transceiver article beginning on page 41 of this issue.)

If you buy a walkie-talkie and intend to use it to work a regular CB station, better make certain it meets the Part 19 requirements so you can get the thing licensed. Check especially the required 0.005% crystal-controlled frequency tolerance.

Red, white and blue call sign cards (see illustration below) are being offered to CB'ers by Call Signs, P. O. Box 933, Aurora, Ill. Made of stiff cardboard, these

flashy cards measure 11" x 7". They are sent postpaid, three for a buck. If you order some, don't forget to mention your call letters and give your complete name and address.

A disturbing report was received from a 15W CB'er in Rapid City, S. D., who asked if we knew anything about several CB clubs (among them, one in Detroit) whose members are "turning in" other CB'ers who answer en-route mobile units not from their own call area.

We must admit that this was the first time we'd heard about anything like this. If it's true, the parties involved should be aware that the FCC has *no* objections to en-route motorists asking for road directions and accommodation information via CB. Certainly the fact that the motorist happens to be from another call area should have nothing to do with the situation—CB stations are all licensed to operate anywhere in the United States.

While clubs can be very good for CB, there are some whose members seem to live in glass houses and throw a lot of stones. The club will take a "holier than thou" attitude to an outsider when 75% of its own members are getting away with the same carryings on. The idea of CB'ers doing their own "policing" is fine, only let's start "at home" first.

Volunteer CB'ers were pressed into real police service recently according to Jack Kennedy, 3W2883, of the Delaware County Citizens Radio League. At 8 p.m. one evening, a call went out over the air from local and state police in Tredyfyn, Pa., for everyone with a CB rig to assist in the search for a "psycho" who had been terrorizing the area. By midnight, 18 units had been mustered, representing CB'ers from various clubs.

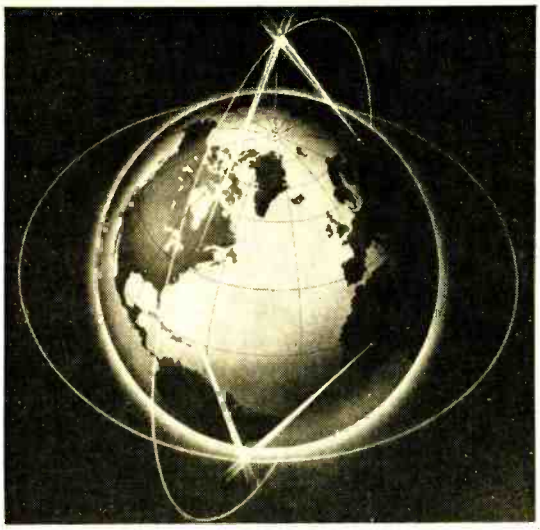
After being sworn in by the authorities, they were given a description of the suspect, and staked out. Channel 11 was cleared of all non-participating local stations so that it could be used as a control channel between the mobile units and police headquarters. The suspect was actually spotted by one of the CB'ers, but he took off into the woods (the suspect, not the CB'er) before he could be caught. Our boys stayed on patrol until daybreak, then returned every night to continue their patrol until it was certain that the area was no longer in danger.

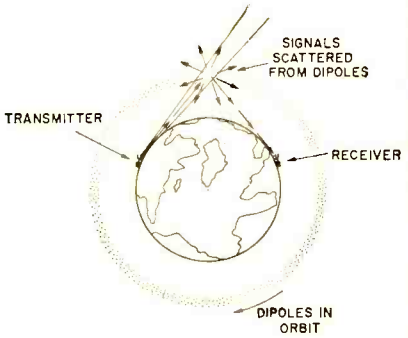
The CB "11 Code" in the September issue drew a huge mountain of mail from both clubs and individuals. Some writers voiced complaints about various aspects of the code, but the majority of the comments were of the "it's about time we had our own code" variety.

A number of correspondents brought to our attention a very important omission in the code—that of references to CONELRAD. Citizens Band stations are required to hush up during CONELRAD alerts, as are all FCC licensed stations. The following listings should take care of this point:

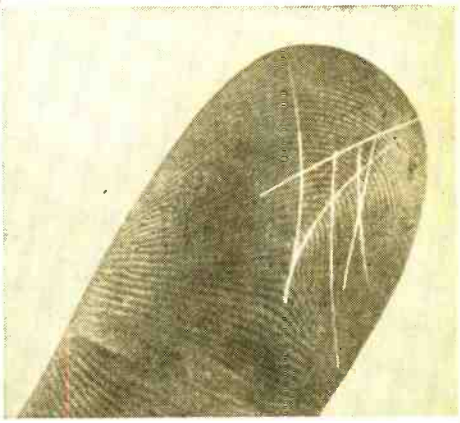
11–97 Leave the air: CONELRAD ALERT
11–98 CONELRAD ALERT ENDED. Resume transmissions.

Surprisingly, many CB'ers wrote to ask for clarification of the signal "11-35, Confidential information." This signal would not be used to preface a message, of course, but as an explanation of why a particular message could not be sent. In other words, you wouldn't say "11-35," and then blurt out a confidential message. Rather, you would tell the other station that you have an "11-35" and that the message must therefore wait for transmission via land-line or until you see the operator in person. —30—





DIPOLES in ORBIT



Minute metallic fibers orbiting far out in space will scatter u.h.f. signals back to earth and provide a reliable means of global communications.

A NEW and unique method of reliable global communications has been proposed by the Lincoln Laboratory of the Massachusetts Institute of Technology. In principle, the system is similar to the ionospheric and trophospheric scatter already used by the U. S. Armed Services.

Called "orbital scatter," the new technique will utilize the reflective properties of metallic fibers—electrical dipoles—about ½" long and one-third the diameter of a human hair. They will be placed in orbit several thousand miles above the earth. U.h.f. radio waves aimed at the orbiting belt will be scattered back to earth and received by suitable equipment at distances up to 4000 miles.

Housed in a special container, the dipoles will be placed in the proper orbit by a rocket, then gradually dispensed from the container. Within one to two months, the dipoles will be spread out in a continuous belt some 40,000 miles in length.

Orbital scatter offers many advantages for long-range u.h.f. communications. With two belts in orbit, a very large number of circuits can be handled. Since a belt will be relatively stationary in space, transmitting and receiving antennas on the ground can be trained continuously on the same spot in the belt, eliminating the need for high-speed tracking equipment.

Computations have convinced Lincoln scientists that the dipoles will have no adverse effects on astronomical observations. —30—

TRANSISTORIZED WATCH

"Tickless timepiece" controlled by electromagnetic tuning fork boasts minute-a-month accuracy

A NEW sound of time—a "microsonic" tone to replace the centuries-old ticking sound—is given off by a new Bulova Watch Company timepiece called the "Accutron." Guaranteed accurate to plus or minus one minute per month, this transistorized device is about ten times as accurate as a conventional fine-quality wristwatch.

From the outside, the Accutron looks like a conventional watch, except that there is no winding or setting stem. Instead, on the back of the case, there is a recessed handle for setting the hands and a removable cap for mercury cell replacement. On the inside, there is the power cell, a set of drive coils, a transistor switching circuit, and an electromagnetic tuning fork—it's the latter that gives off the barely-audible 360-cycle tone.

Drive Coils. A pair of drive coils mounted near the tuning-fork tips keeps the fork vibrating. A sensing coil picks up

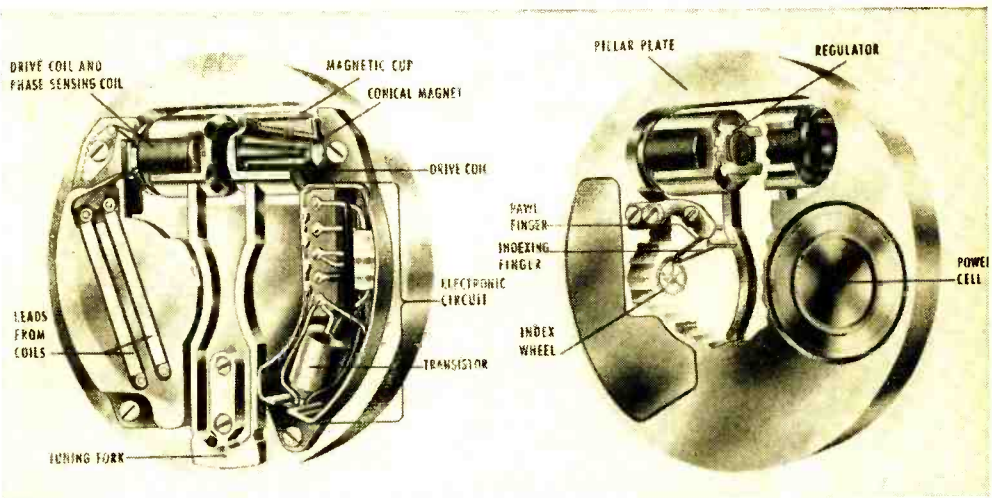
pulses from the fork and triggers the transistor to deliver current to the drive coils. One of the drive coils has 8000 turns of very fine wire, the other has 6000 turns, with the remaining 2000 turns making up the sensing coil.

Attached to one of the tuning fork tines is a tiny index spring. A jewel on the tip of the spring engages ratchet teeth on an index wheel which is moved forward one tooth for each cycle of the tuning fork. To prevent the index wheel from moving backwards and returning to its original position, a pawl finger rests on the wheel's teeth. The wheel, which turns the gear train connected to the Accutron's hands, is 0.095" in diameter (about the size of a pin head); its 300 precisely-machined teeth are separated by one-thousandth of an inch—about one-third the diameter of a human hair!

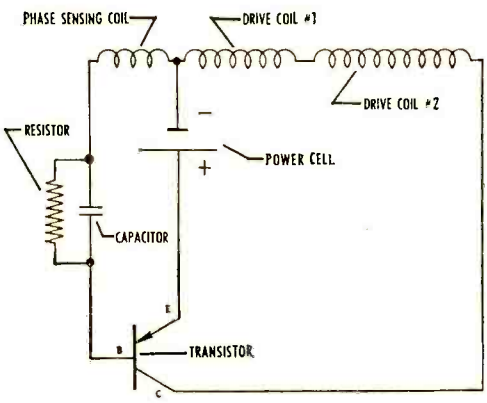
In operation, the voltage induced in the phase sensing coil is added to the power-cell voltage to charge a capacitor (see schematic). A resistor slowly discharges the capacitor. The recharging pulses from the phase sensing coil cause the base circuit to conduct, allowing a driving pulse to flow in the drive coils.

Amplitude Control. An important feature of the circuit is that it will return the tuning fork's amplitude to normal after any disturbance. The proper amplitude is maintained by controlling the size of the drive pulses.

The collector circuit conducts at the instant the induced voltage in the drive coils



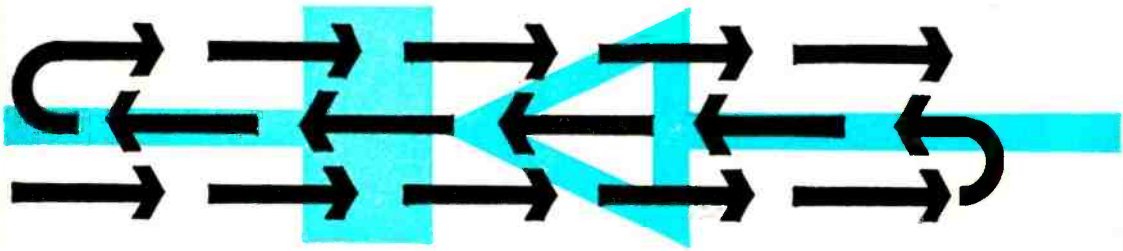
Tuning fork, drive coils, and electronic components (see circuit below) are located at rear of Accutron (above, left); regulator on dial side (above, right) enables jeweler to adjust the fork's frequency. Max Hetzel, Bulova's chief physicist, is the Accutron's inventor.



is at a maximum and opposite in polarity to the power-cell voltage. If the tuning fork's amplitude is high and the induced voltage equals the power-cell voltage, no current will flow and the amplitude will drop. If the fork's amplitude is low, the induced voltage will be low—more current will flow in the drive coils and bring the amplitude up to normal.

The specially designed mercury cell will power the timepiece for at least one year before replacement is necessary—the Accutron requires only about eight-millionths of a watt for operation.

—Mike Richards



Add a touch of realism to your toy motors and lamps with this

Current REVERSING Rectifier

By MARTIN H. PATRICK

THIS little experimenter's gadget is an easy-to-build a.c.-to-d.c. converter with a single control for changing its output voltage and polarity. It is, in effect, a current reversing rectifier that puts out a few volts of pulsating d.c. You can use it to power and reverse the direction of miniature 1.5-volt d.c. motors in a variety of toys, music boxes, and the like. It will also dim and brighten flashlight lamps, such as are installed along model railways.

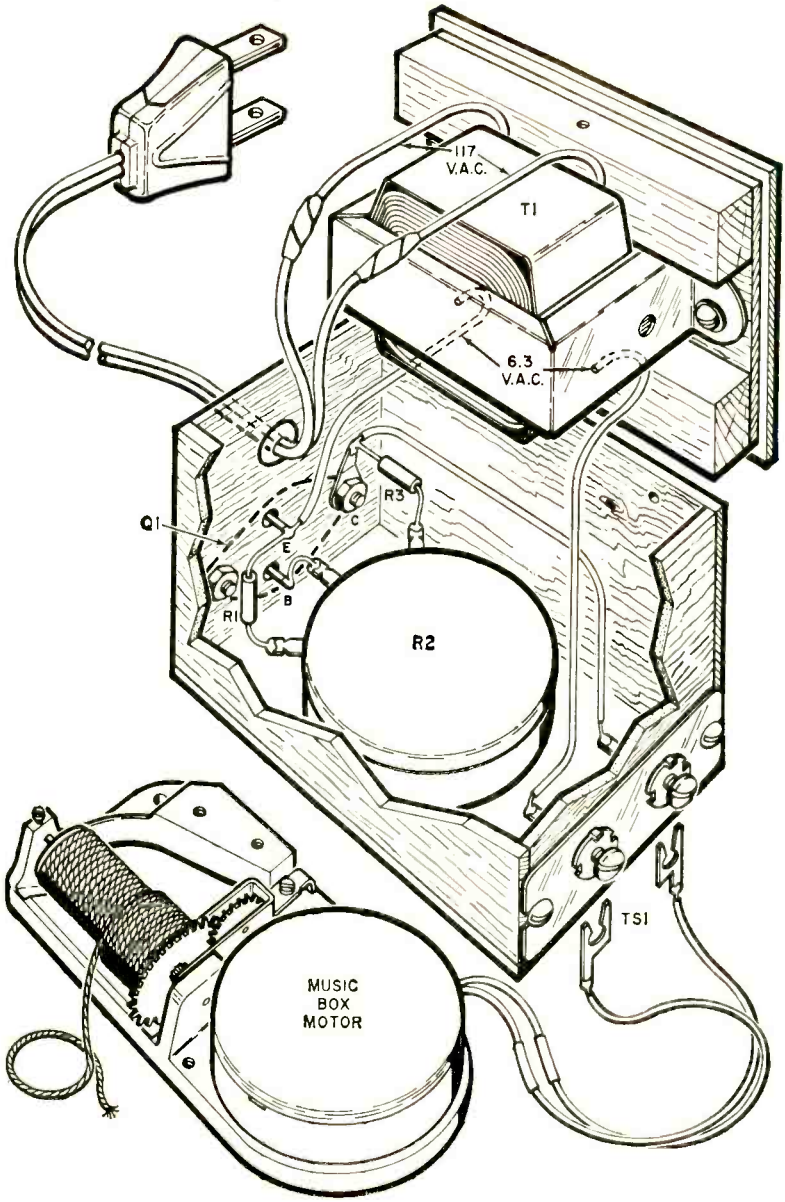
The rectifier is completely safe to use, since an isolation transformer protects you against accidental shock. It's also inexpensive—less than $5 is needed for all the parts.

Construction. The whole unit can be housed in a 3" x 2" x 2½" wooden box as shown. You'll find that the box is just large enough to mount filament transformer *T1*, resistors *R1* and *R3*, and potentiometer *R2*. Although a 2N255 *p-n-p* power transistor was used for *Q1* in the model, any bargain equivalent will work.

If you take apart a music box that uses a 1.5-volt d.c. motor, you can use the drum of the music box as a winch (see pictorial diagram). With a dozen turns of cord on the winch's drum, you can control the speed and direction of toy cranes and similar models with striking realism.

How It Operates. Polarity at the output terminal strip (*TS1*) depends on current flow through transistor *Q*1; the current flows from emitter to collector or from base to collector depending on the setting of potentiometer *R2*.

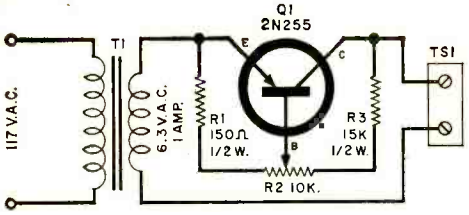
When *R2*'s arm is at the collector end of its rotation, it gives the collector of *Q1* a positive polarity of about 3 volts with respect to the emitter. With *R2* set this way, current flows from the 6.3-volt a.c. second-



Housed in a small wooden box, the current reversing rectifier makes an ideal power source for a 1.5-volt d.c. music box motor. Metal reed assembly on music box movement can be removed so that drum may be used as winch for model toys.

ary of transformer *T1* through *Q1* (from emitter to collector) on *T1*'s positive half cycles. The output voltage appears across the output terminals on terminal strip *TS1* and causes current to flow through the motor connected to *TS1*.

As the arm of *R2* is moved toward the emitter of *Q1*, the output voltage across *TS1* decreases until it reaches zero, near the center of *R2*'s rotation. In the last half of the arm's rotation toward the emitter of *Q1*, base-to-collector current flow begins on negative cycles of *T1*'s output. This flow gives the collector a negative polarity with



Setting of potentiometer R2 governs rectifier's output voltage and polarity. Voltage can be increased by moving R2 toward either end of range.

PARTS LIST

Q1—2N255 transistor
R1—150-ohm, ½-watt resistor
R2—10,000-ohm, ½-watt potentiometer
R3—15,000-ohm, ½-watt resistor
T1—Filament transformer; 117-volt primary; 6.3-volt, 1-amp. secondary (Stancor P6134 or equivalent)
TS1—2-lug screw-type terminal strip
1—3" x 2" x 2½" wooden box
1—Music box movement (Lafayette MS-760 or equivalent)

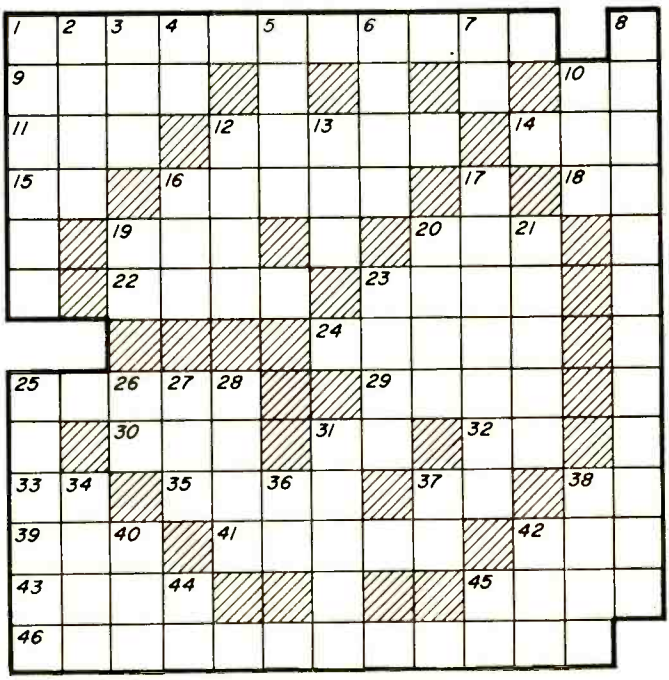
respect to the emitter and reaches a value of about 4 volts at the end of potentiometer *R2*'s rotation.

Since the base of *Q1* is biased both with the d.c. appearing across the transistor and with the a.c. output of transformer *T1*, the output voltage at *TS1* has an a.c. component; this makes the unit unsuitable for powering transistorized radios, amplifiers, and similar circuits.

Using the Rectifier. Connect a 1.5-volt d.c. toy motor to the output terminals on *TS1*. Adjusting potentiometer *R2*, you'll find that the *speed* of the motor is fastest at either end of *R2*'s range, but that the *direction* of rotation is different; at one end of *R2*'s range you'll get clockwise rotation, at the other end counterclockwise rotation. Somewhere near the middle of *R2*'s range, the motor will stop; the output voltage is then zero. —30—

CROSSWORD PUZZLE

By Margaret LeFevre



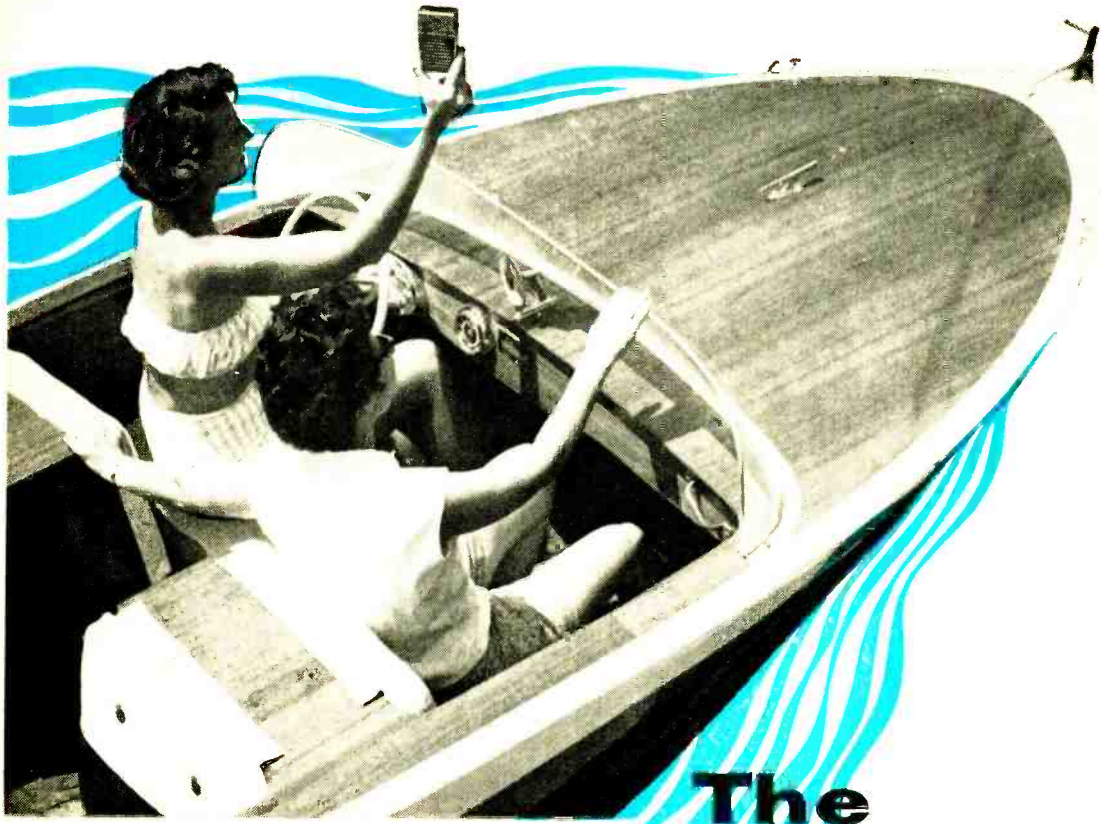
ACROSS

1 Harvey-Wells T90 is a _____
9 Inclined passageway.
10 Toward.
11 Novices are limited to 75 watts _____: abbrev.
12 I^2R.
14 Code for "Do you have anything for me?"
15 All right: abbrev.
16 In transistors, N is the _____ of electrons.
18 Diameter symbol seen on mechanical blueprints.
19 State in third amateur district: abbrev.
20 Helpful for mobile operation.
22 Better halves: code.
23 Novice who can't make General Class.
24 One of the "R's" in ARRL.
25 Type of lug.
29 Directional antenna.
30 Policeman.
31 Swan Island station prefix.
32 _____ Cobb.
33 Components of a tuned circuit: symbols.
35 Modulation used in R/C devices.
37 Type of engineering degree.
38 Initials of your favorite magazine.
39 Control grid is to electron stream as _____ is to river.
41 More cunning.
42 Leyden _____.
43 Evenings before.
45 Friends.
46 Receiver type.

DOWN

1 Amplifier tube.
2 Standing.
3 Unit of current measurement: abbrev.
4 One of the magnetic poles: abbrev.
5 Radar signals were bounced off this object.
6 Layer.
7 Plate voltage: symbol.
8 Sound transducers.
10 Prefix for three.
12 Broad end of a hammer.
13 Succeeded.
16 Pasha of Tunis.
17 An antenna is used to _____ electrical energy.
19 Long distance: abbrev.
20 C.W. signals.
21 What most ham shacks are not.
23 Small amounts of speaker cement.
25 Metal alloy used by experimenters.
26 Alternating current: abbrev.
27 C.W. for "e."
28 Epic poetry.
31 One who operates code-sending device.
34 Natural opening.
36 North latitude: abbrev.
37 "Call Me _____": abbrev.
38 Pallid.
40 1,000,000: abbrev.
42 Islander with PKI ham prefix: abbrev.
44 Element used in some solid-state rectifiers.
45 Type of antenna impedance network.

(Answers on page 123)



The 2182-er

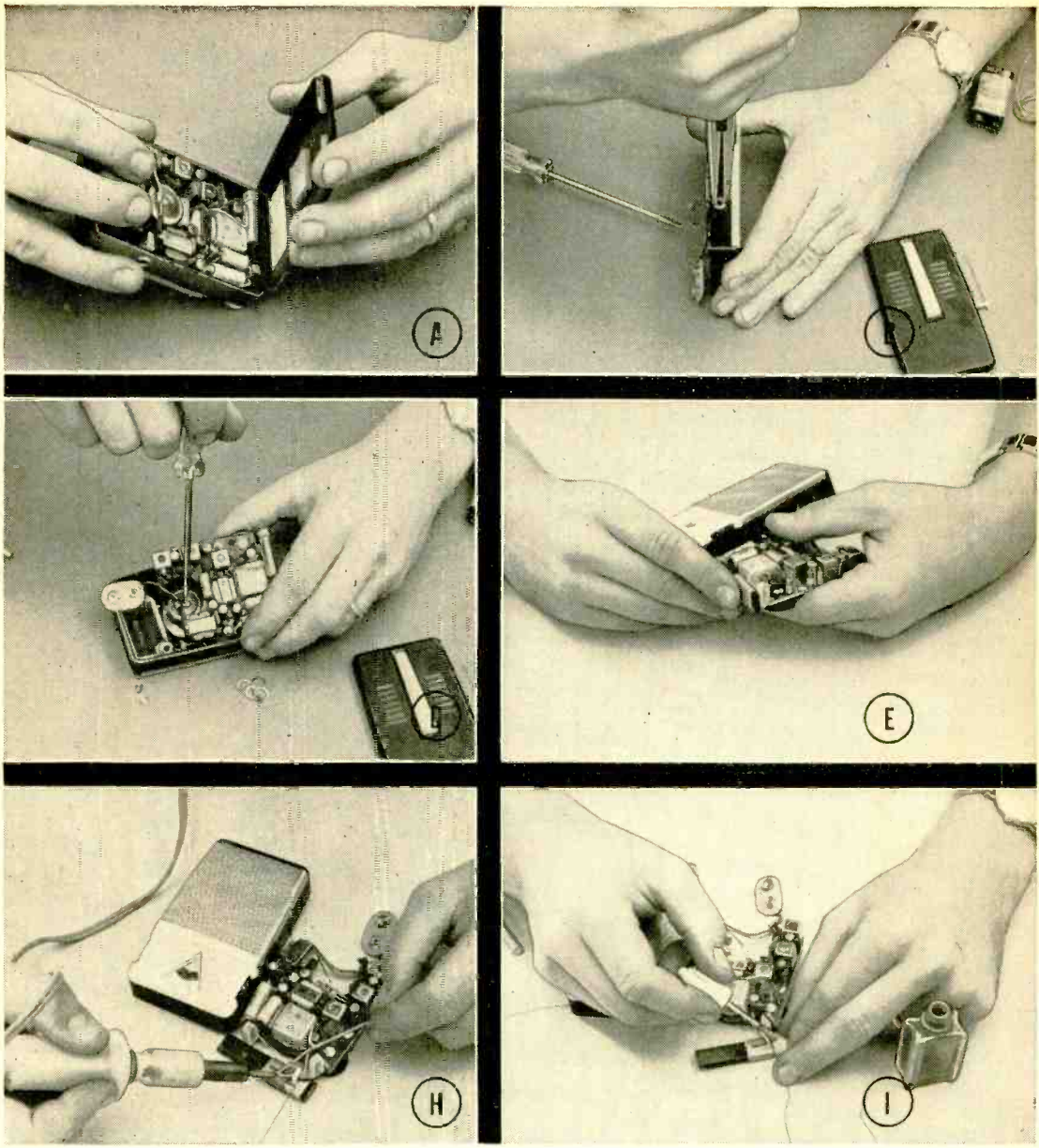
Simple modifications will place the 2182-kc. marine emergency frequency on the dial of most transistor portables

By **DONALD L. STONER,** W6TNS

LAST SUMMER, far too many mariners endangered their own safety or failed to come to the aid of other boats in distress because they couldn't monitor the 2182-kc. marine emergency frequency. Monitored high sea reports and bad weather warnings will send any wise small-craft skipper scurrying to a safe harbor.

As a boat owner, you can tune in the distress frequency on your shipboard radio. However, the majority of marine radiotelephone units consume a tremendous amount of battery power, and you might be reluctant to keep your receiver going while powering other marine accessories. There's no need to fuss with high-drain equipment, though—you can easily convert an inexpensive transistor portable to do the job.

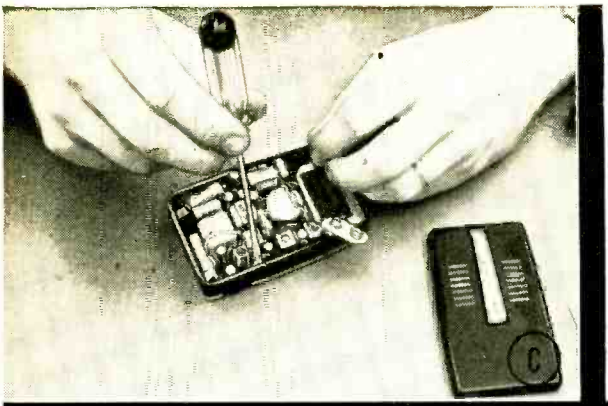
A transistorized pocket radio can be purchased for less than $20—if you don't already have one. Whatever make or model you choose, modifying it to pick up the 2182-kc. distress frequency is a simple matter. Essentially, all you do is take a

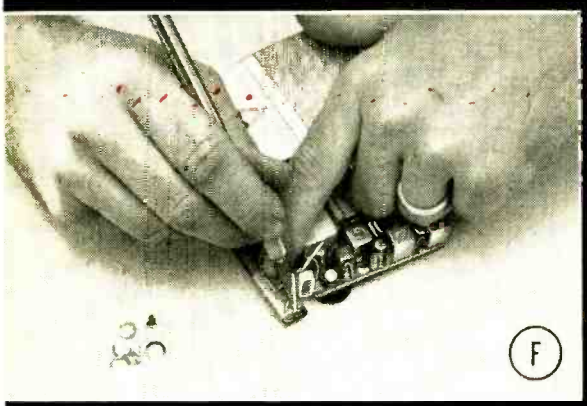


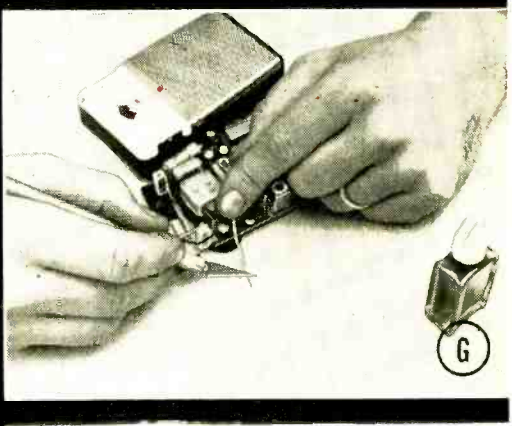
few turns off the antenna coil, hook up a 25-cent capacitor to the set, and you're in business. The author used a Lafayette FS-91 ($26.95), which he happened to have on hand.

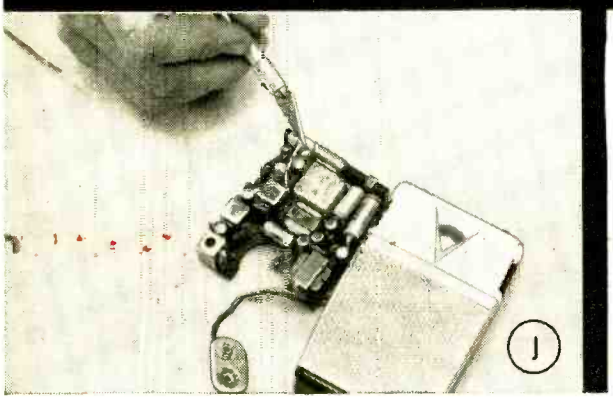
Modifications. First remove the back of the transistor portable (A) you have selected. Then detach the phone jack from the case (B); long-nose pliers can be used as a spanner wrench if necessary.

Looking into the set, you'll see that there are two to four screws which hold the printed-circuit board in the case. Remove these screws (C) and carefully lift out the board. In many models, the speaker, volume control, phone jack, cable clamps, and battery remain in the case and are connected to the board by short leads; you can temporarily remove any of these parts from the case if you wish so that the loop antenna will be free and clear for a minor operation (D).









Before modifying the loop antenna, note its construction. It consists of many turns of wire wound around a ferrite bar; there are two wires at one end of the coil and only one wire at the opposite end. In the FS-91, the leads at the two-wire end are blue and black, respectively, while at the single-wire end a yellow lead is used. It is with the single wire (yellow lead) that the modification begins.

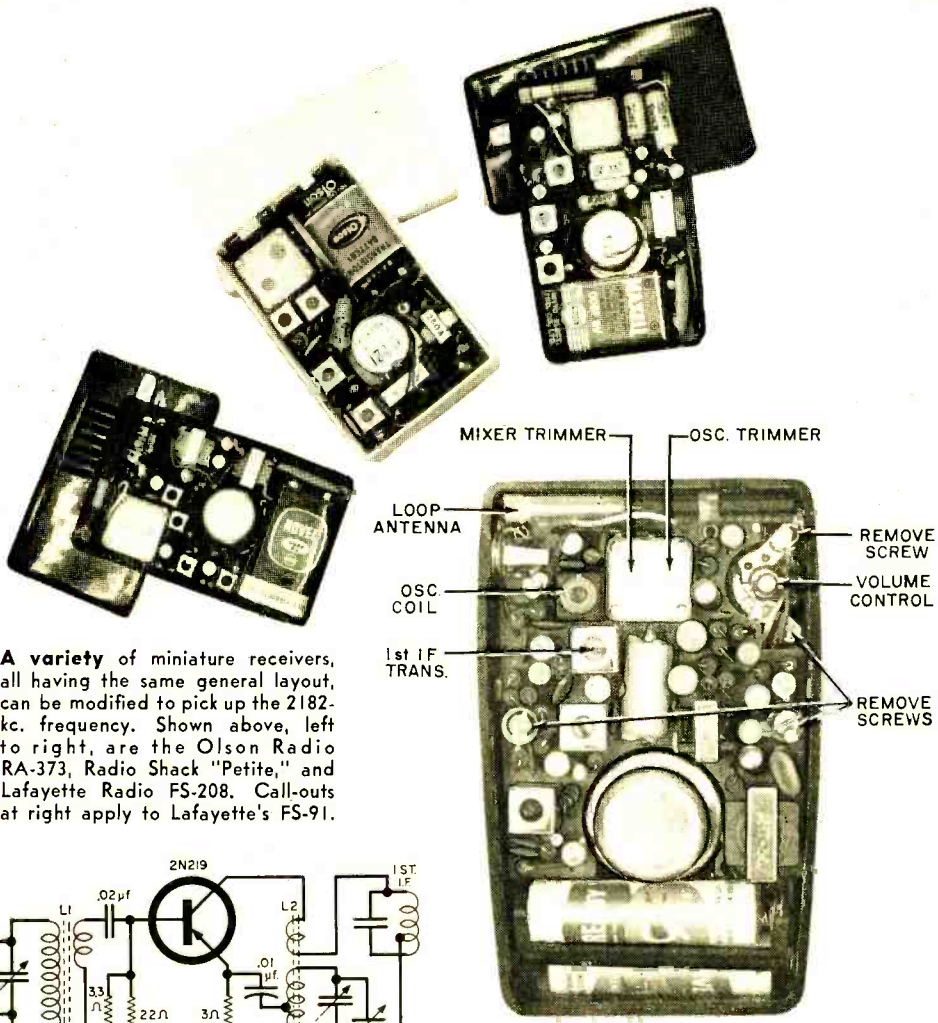
Carefully remove the loop antenna from the board by sliding it out of its plastic retaining clips (E). Cut the lead connecting the single-wire end near the coil (F), and remove 44 turns from this end of the loop. Then scrape carefully (G) and tin both the cut-end of the antenna wire and the original yellow lead.

Solder one terminal of a small 47-$\mu\mu$f. ceramic capacitor to the yellow lead (H); the other capacitor terminal is soldered to the cut-end of the wire, effectively placing the capacitor in series with the loop antenna. Coat the soldered connections with fingernail polish so that they don't short to any other components (I). Finally, replace the loop in its plastic clips and reassemble the radio (J).

Alignment. The tuning capacitor is in a small plastic box to which the shaft of the tuning dial is connected. In the Lafayette FS-91, it is a white plastic box with two small adjustment screws on the back. One screw controls the oscillator frequency and thus changes dial calibration; the other controls the mixer which peaks up the station being received. Determine which is which and mark them.

Now locate the oscillator coil; in most radios this is in the can nearest the tuning capacitor and has a small screwdriver adjustment slug on top. In the Lafayette FS-91, the oscillator coil is in a small black can next to the tuning capacitor; don't confuse it with the larger i.f. cans nearby.

Actual alignment can be done without a signal generator. If you have one, however, you will be able to locate the 2182-kc. point



A variety of miniature receivers, all having the same general layout, can be modified to pick up the 2182-kc. frequency. Shown above, left to right, are the Olson Radio RA-373, Radio Shack "Petite," and Lafayette Radio FS-208. Call-outs at right apply to Lafayette's FS-91.

Converter stage of typical portable makes use of a ganged tuning capacitor, with separate trimmer capacitors paralleled across the oscillator (coil L2) and the mixer (coil L1) sections.

on the dial of the converted set accurately.

The best time to align the set is in the evening when stations around 2 mc. come in well. Start by setting the tuning dial near 16, the high end of the dial. Then, tune the mixer adjustment until a station or background noise and static are heard; the frequency now tuned in should be near 2.5 mc.

Then set the tuning dial to 5.3, the low end of the dial, and adjust the oscillator *coil* for maximum noise or signal strength; adjust the tuning dial slightly, at the same time, to maintain reception. Since the high end and low end adjustments affect each other, you may have to repeat these steps until the receiver tracks all stations in between.

You should now be able to locate several marine stations (as well as amateur and police calls) between 10 and 16 on the dial. By turning the radio when receiving a station, you will discover that the loop antenna is directional. With the sensitive end of the loop pointed toward any station sending out a distress signal, you'll be able to get a good idea of the general direction of the craft in trouble. —30—

Revolution in Relays

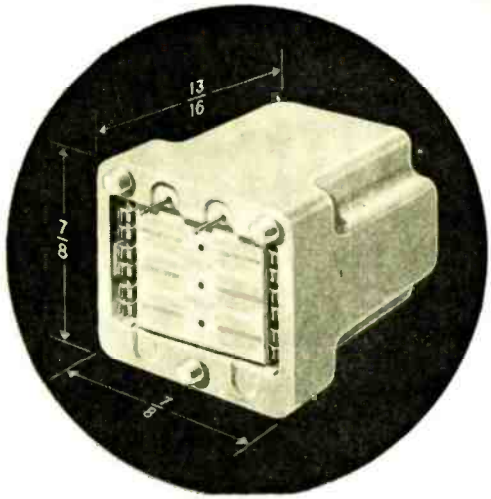
AN ENTIRELY NEW relay design, using no springs or mechanical linkage, has been developed by Executone, Inc., of New York, for use on printed-circuit boards. Dubbed the "Printact" relay, it mounts directly on a board and is held in place with a snap-on clip. The only soldering necessary is to the coil terminals.

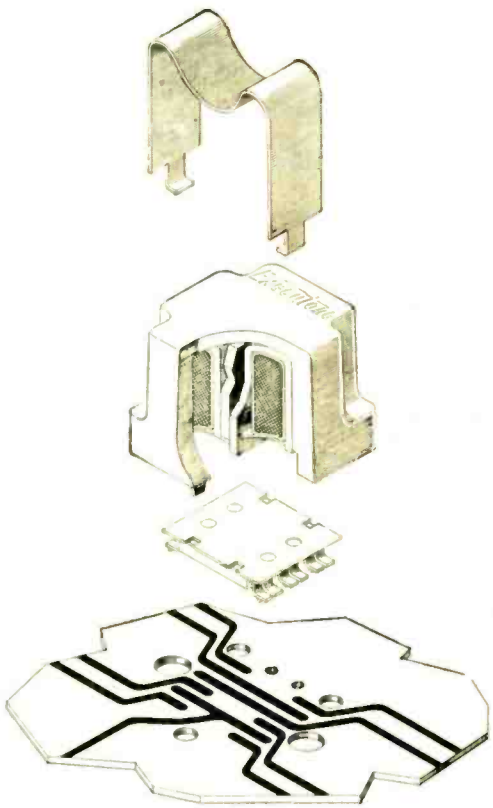
There are no stationary contacts in the relay. Instead, it makes use of the copper conductors on the printed-circuit board. By changing the layout pattern of the conductors under the relay, virtually any contact arrangement can be selected—from a standard single-pole, single-throw (either normally closed or normally open) to a three-pole, double-throw setup.

The only moving part in the relay is the armature, which is held in position against one leg of a U-shaped permanent magnet. When a voltage is applied to the relay coil, the coil attracts the other side of the armature and at the same time bucks the flux of the permanent magnet. This reduces the pull of the permanent magnet and the armature snaps to its other position.

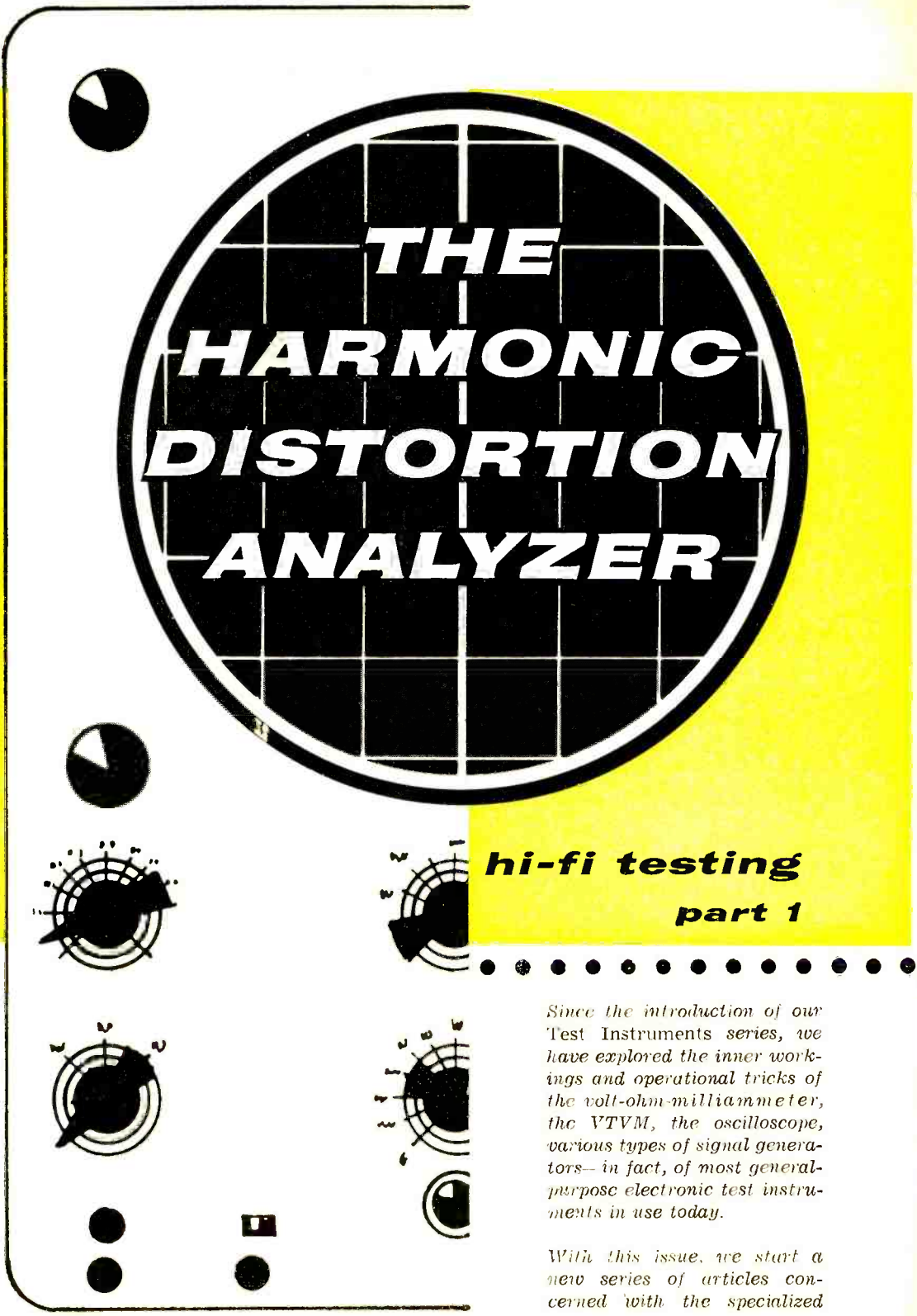
When the current through the coil is reduced, the permanent magnet pulls the armature back to its original position, eliminating the need for a return spring which can be a trouble source in the conventional relay. Contacts on the armature make and break with the printed-board conductors when the armature is "seesawed."

Advantages of the new design are many. Because the restoring force of the permanent magnet decreases as the armature rotates, the unit has high sensitivity and a pronounced "snap" action. The balanced-armature construction gives a high degree of freedom from shock and vibration which, with the simple design and absence of hand adjustments, make for high reliability. And since the relay has no exposed parts or wiring—nothing which might need adjustment—and requires low operating power, its life expectancy is very high—from 100,000 to 5,000,000 operations. —30—





"Printact" relay snaps onto printed-circuit board (as shown in exploded view). Printed conductors form stationary contacts.



THE HARMONIC DISTORTION ANALYZER

hi-fi testing part 1

Since the introduction of our Test Instruments *series, we have explored the inner workings and operational tricks of the volt-ohm-milliammeter, the VTVM, the oscilloscope, various types of signal generators— in fact, of most general-purpose electronic test instruments in use today.*

With this issue, we start a new series of articles concerned with the specialized

By G. H. HARRISON

PICK UP the "spec sheet" for any audio amplifier. The first figure given is probably power output, and the next figure is likely the unit's distortion rating. If a hi-fi amplifier—or any other amplifier, for that matter—did exactly what it's designed to do, there wouldn't be any need for this distortion figure. To be more exact, there wouldn't be any distortion.

An amplifier, after all, is simply a device which takes a small voltage and builds it up into a powerful signal. In the process, the amplifier isn't supposed to change the signal's waveform—which means it's expected to amplify all of the complex waveshapes delivered to it, leave the waveform precisely as it found it, and not add any spurious signals of its own. Good hi-fi amplifiers come very close to this ideal, but the perfect amplifier has yet to be built. Even the best amplifier changes or distorts the signal to some extent.

Let's look at two examples. One amplifier, with a sine-wave input, produces the output signal in waveform *A* (page 77). No amplifier is perfect, so we know there must be some distortion even though it is too slight for us to see. But another amplifier, an inferior instrument, gives the output signal shown in waveform *B* with the same sine-wave input. This waveform has obviously been beaten and battered on its trip through the amplifier.

The amount by which an amplifier distorts the signal it amplifies is expressed as a percentage: 2%, 5%, 10%, and so on. But before we find out just what this means and how the distortion is measured, it might be useful to find out something about the basic nature of distortion and what causes it.

What Is Harmonic Distortion? The distortion we have been discussing is called *harmonic* distortion (there are other kinds which we will take up in later articles). That word *harmonic* is our clue. Suppose we are using a test frequency of 1000 cycles per second. As this signal goes through the amplifier, certain circuits add secondary signals of their own—harmonics of the original 1000 cps. Some of these are second harmonics (2000 cps), some third harmonics (3000 cps), and so on. If we had a way of viewing them separately on an oscilloscope, they might look like waveforms *C, D,* and *E*. Actually, the amplifier's output signal is a mixture—or to be more accurate, the sum—of all harmonics, plus the original fundamental frequency. Thus, the irregular shape of waveform *B* is now seen to be a sine wave with superimposed harmonics.

If we want to find out how much distortion has been added by the amplifier, we can do so by merely subtracting the original sine-wave signal from the output. Anything left over was generated in the amplifier and is harmonic distortion (waveform *F*). Let's apply this idea to a typical

test instruments used primarily in the rapidly growing hi-fi field. These instruments, such as the harmonic distortion meter, the intermodulation distortion analyzer, and the square-wave generator, will not be found on nearly so many workbenches as the VOM. But their use is becoming more widespread every day, due at least partially to the fact that all of them are now available in kit form at moderate prices.

If you're interested in hi-fi—even if you don't own and don't plan to buy equipment of this sort—we think this series will be useful to you. In discussing the instruments designed to measure various amplifier characteristics, we plan to go into considerable detail about the characteristics themselves. For this reason, we hope the series will be helpful not only as a discussion of audio test instruments but of what the test procedures themselves really mean.

harmonic distortion meter and see how the theory works.

Analyzer Theory. In the simplified schematic of the Heath HD-1 harmonic distortion meter shown here, tube *V1* is a straight voltage amplifier. Tube *V2* is a phase splitter: it takes the signal from *V1* and slices it neatly into two signals 180° out of phase. These two identical but out-of-phase signals—one from the plate circuit and one from the cathode of *V2*—are applied to the grid of *V3* through an *RC* network.

If this network looks familiar, it's because it's our old friend, the Wien bridge. We've seen this circuit in the *Test Instruments* series twice before: once in our discussion of audio generators (January, 1960), and once in the article on bridges (in the October and November issues of POPULAR ELECTRONICS).

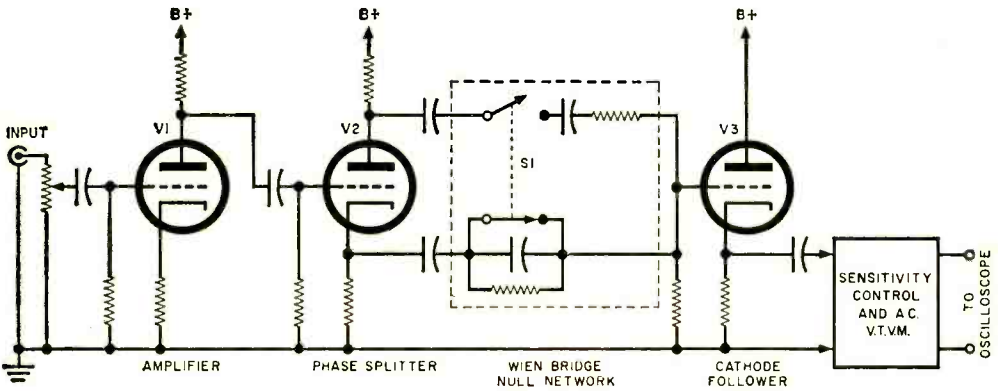
It works like this. Let's say we're checking the harmonic distortion of an amplifier at 1000 cps. The bridge, of course, is tuned to 1000 cps. With the proper setting of *S1*, the reactance of the series network will equal the reactance of the parallel network at this frequency, and the 1000-cps fundamental will be cancelled out. But the harmonics are at other frequencies for which the bridge is not in balance. Therefore, depending on its frequency, each harmonic signal finds that either the parallel or the series path is of lower reactance than the other.

To put it another way, one network will offer a low reactance path from *V2* to the *V3* grid; the other, high. The harmonic signals which reach the grid through the two paths will still, of course, be 180° out of phase—the phase splitter splits all incoming signals—but one will be much larger than the other. The final result is that while the fundamental is cancelled, all harmonics are fed through cathode follower *V3* to the self-contained sensitivity and VTVM circuit.

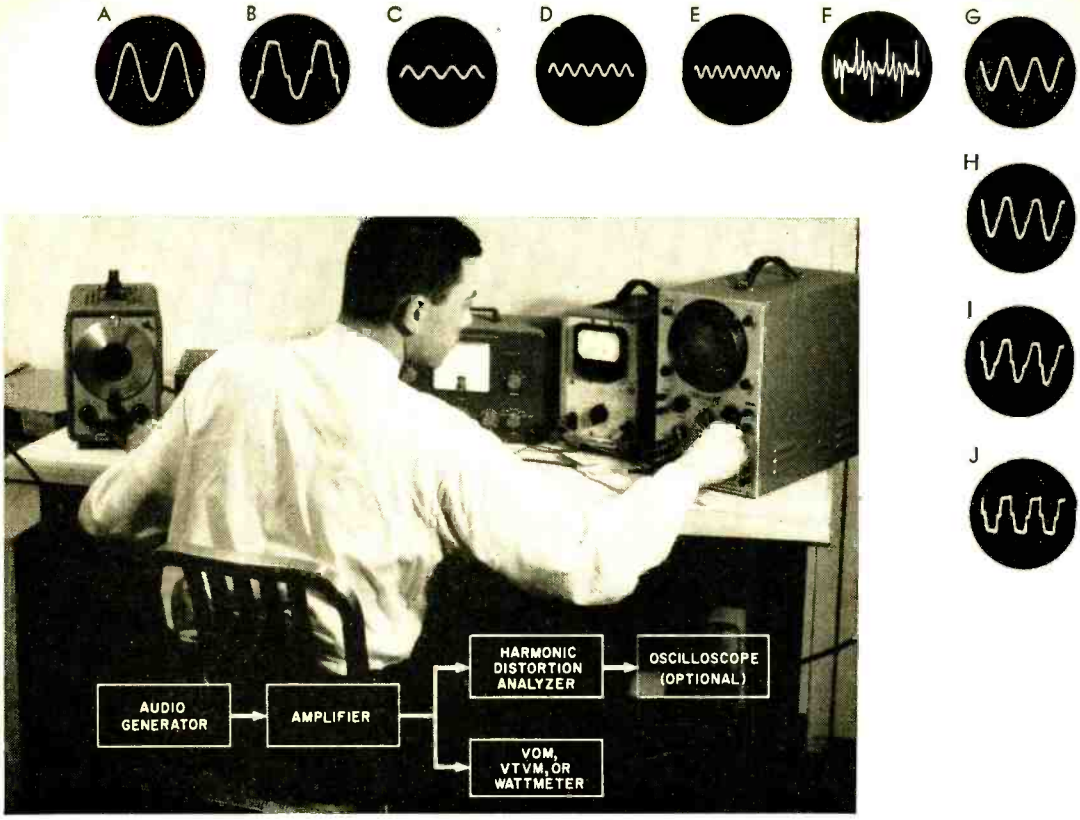
Since we know we have distortion in the signal being tested, the question is, how much? The meter can tell us this, too. First, the bridge is switched out of the circuit. This is done by putting *S1* in the position shown in the diagram. Set in this position, *S1* opens the signal path from the plate of *V2* to the grid of *V3*, but the output of the cathode of *V2* is hooked directly to the grid. The bridge, in other words, is completely out of the circuit, and *V2* operates as a simple cathode follower.

To measure distortion, we first set the *Sensitivity* control to 100% and set the input level until the meter reads full scale on the 1-10 scale. Now we throw *S1* to its second position, inserting the bridge network into the circuit. Next, we set the range switch to the test frequency we are using, and balance the bridge for resonance.

At resonance, the output signals from the plate and cathode of *V2* (which are 180° out of phase) are applied in exactly equal proportions to the grid of *V3*. The fundamental —1000 cps—is cancelled out, leaving only the distortion components to be measured by the meter. Since we set the meter to read full scale before the fundamental was cancelled out, any remaining signal can



Simplified schematic of Heath HD-1 distortion analyzer. Heart of unit is the Wien bridge null network between tubes V2 and V3; it cancels equal but out-of-phase signals, leaving only distortion component.



Bench test setup for measuring harmonic distortion. The oscilloscope is optional but shows actual waveforms, thus giving visual indication of distortion.

now be read as a percentage of full scale. If the remaining distortion now reads "1," for example, on the 1-10 scale, there is obviously one-tenth as much distortion as there was signal. We call this 10% harmonic distortion. An actual amplifier with this much distortion, of course, would sound pretty bad.

Practical Testing. Now that we've got the theory down pat, let's put an actual amplifier on the test bench and see how it checks out. The test setup is shown in the block diagram and the photograph above. The output of the signal generator is connected to the input of the amplifier, and a dummy load resistor is placed across the amplifier's output. If you're using the 8-ohm output, then use an 8-ohm resistor, and so on. Be sure that the wattage rating is high enough.

Across this load resistor, connect both the distortion meter and a VOM or—preferably—a vacuum-tube voltmeter; then connect an oscilloscope to the output of the distortion meter. This is not essential, but it will give you a good idea of what the waveforms actually look like.

With the volume control of the amplifier all the way down, set the audio generator output frequency to 1000 cps, and its output level to zero. Turn the volume control of the amplifier to its wide-open position. The *Range* switch of the distortion meter should be adjusted to the "set level" position, and *Sensitivity* to 100%. Since the amplifier we are testing has a rated output of 14 watts, set the VOM or VTVM to an a.c. volts scale that will read at least 15 volts (10.5 volts across the 8-ohm load equals about 14 watts).

Now slowly turn the output of the audio generator up until the output waveform as seen on the scope begins to distort, and adjust the scope for a usable trace. Adjust the level control of the distortion meter for full-scale deflection on the 0-10 scale. The image appearing on the oscilloscope looks

(*Continued on page* 110)

Novel CB Kit

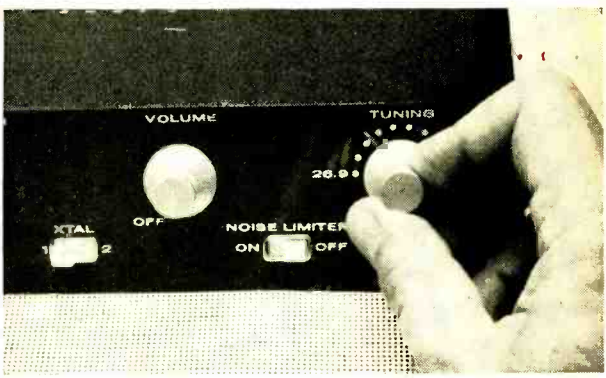
Knight C-27 features double-conversion superhet with two crystal receive channels plus full tunability

THE long-awaited Knight-Kit C-27 Citizens Band transceiver is now available from Allied Radio Corp. (100 N. Western Ave., Chicago 80, Ill.). It offers the convenience of two crystal-controlled transmit/receive channels plus a tunable receiver section for cross-channel operation.

One of the C-27's has undergone extensive testing by the POP'-tronics staff, and the results were most impressive—particularly in the areas of receiver sensitivity and selectivity, not to mention the unit's well-modulated carrier. Purchasers need have no fear of any difficulty in assembling the unit; construction time should average only about 12-14 hours, since the wide-open chassis design coupled with two printed-circuit boards makes wiring a routine matter.

Although somewhat oversize, the C-27 is an impressive CB transceiver. For one thing, the edge-lit front panel is tastefully styled—a thought many other transceiver manufacturers would do well to consider. Our "box score" (below) tells the rest of the story. Noise limiting was just a little too severe for our taste, incidentally, but would be fine in a mobile installation.

The receiver in the C-27 incorporates a 6CB6 slug-tuned r.f. stage, and a 6U8 first mixer/crystal-controlled oscillator with a 4.5-mc. i.f. output. This is followed by a second 6U8 mixer/oscillator and two 455-kc. i.f. stages. Part of a 6AW8A operating as a tunable oscillator can be switched into the circuit to replace the second crystal-controlled oscillator, thus permitting you to bandspread the CB channels. Audio, noise limiting, and squelch circuits involve three additional tubes.

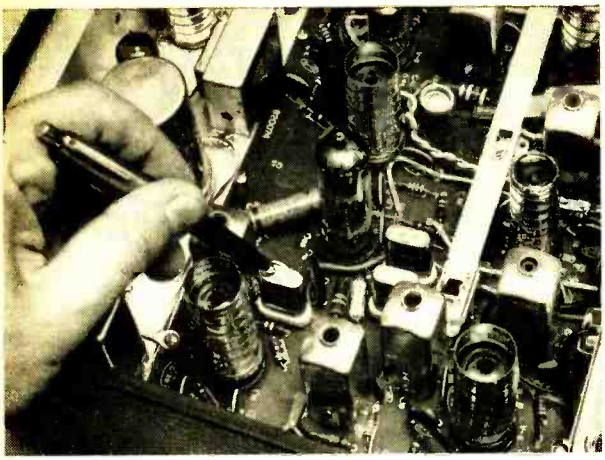


Manually tuned receiver sweeps from 26.9 to 27.3 mc. Crystal switch selects any two adjacent transmit/receive channels.

BOX SCORE

	Excellent	Good	Fair	Poor
Talk Power	✔			
Selectivity	✔			
Sensitivity	✔			
Squelch	✔			
Noise Limiting		✔		
Stability	✔			
Operating Ease			✔	

Built around the new 6AW8A tube, the transmitter section of the C-27 has a TVI trap for 54 mc. incorporated in the antenna output circuit. Straight plate loading (not a pi network) works fairly well if the

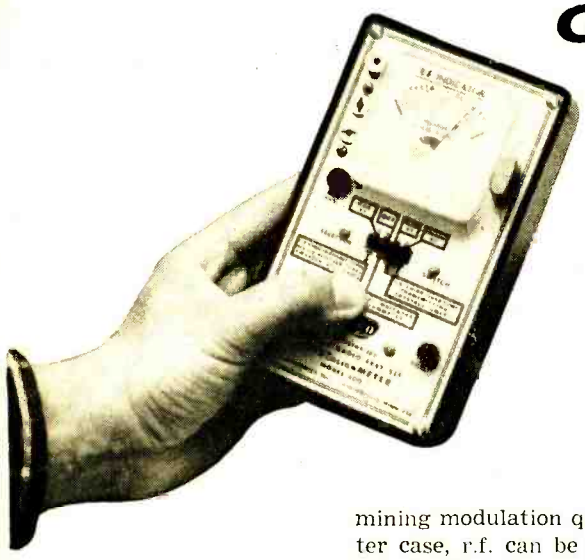


Printed-circuit wiring (left) in C-27 simplifies assembly; pen points to 22.61-mc. crystal in first oscillator of double-conversion receiver. Press-to-talk bar (below) coupled to relay switches speaker for use as microphone.

two transmitting channels are kept close together (not more than 5 channels apart).

The C-27 is priced at $79.95. Optional extras include a mobile power supply kit ($12.95), mobile mounting bracket ($5.35), and a special telephone-style handset ($19.95). Although the kit is not supplied with a ceramic microphone ($9.50 extra), switching facilities are provided for using the speaker as a mike when desired. —30—

Crystal Checker Great for CB



PUT to daily use by the POP'tronics staff, the Seco Model 500 CRYSTalign-METER is a combination oscillator and field strength meter that has proved its value time and again. It's ideal for checking crystal "activity" or "goodness" on the CB channels and for checking ham and short-wave receiver calibration. As a crystal-controlled signal generator (with switching to tone modulation), we use it to set tunable receivers, set squelch and noise-limiting levels, and to peak slug-tuned r.f. stages on CB receivers.

Other uses for the 500 include sampling plate current to check power input, determining modulation quality, and measuring power output. In the latter case, r.f. can be coupled to the meter through the plastic case, or brought to the meter through the extension cable supplied. The 500, complete with a 15-foot cable, sells for $29.95. (*Seco Electronics, Inc.*, 5015 Penn Ave. South, Minneapolis 19, Minn.) —30—

Short-Wave Report

By HANK BENNETT
W2PNA/WPE2FT

TWO YEARS AGO, while glancing through a radio parts catalog, Richard Roll suddenly decided to try DX'ing. Now he has veries from 34 countries, holds the call WPE2ALE, and is a member of the Newark News Radio Club, the Universal Radio DX Club, and The DX'er. One of our younger monitors, Dick is 17, a student, and operates at 265 Stilwell Rd., Hamburg, N. Y.

Dick's first major DX'ing investment was a Hallicrafters S-107 receiver. Using only the ten feet of antenna wire that came with the receiver, he found that he was able to pull in Brussels as his first DX station. About a year later Dick traded the S-107 in on another, larger Hallicrafters receiver, the SX-110. He also obtained his present 10-meter beam antenna and a vertical fan. His future plans call for a receiver in the $400.00 price range and for a long-wire antenna.

Additional equipment at Dick's shack includes a tape recorder, an antenna tuner, and a Q-multiplier—he sends taped reception reports to several stations every month. Out of Dick's total of 42 veries, the most prized are from *Radio Peking* and the Windward Islands Broadcasting Service.

Besides his regular coverage of the short-wave broadcast bands, with emphasis around 12 and 17 megacycles, Richard does considerable monitoring of the shipping channels. In this connection, he makes good use of the book "Merchant Vessels of the United States," which lists all U. S. ships, down to and including yachts and their owners. Interested DX'ers can obtain a copy of this 1074-page book from the U. S. Government Printing Office, Washington, D. C., for $5.25.

Richard would like to see listings of more short-wave non-broadcast stations in this column, including aero, point-to-point, ship-to-shore, and telephone stations. Such listings would probably interest quite a number of our readers, but unfortunately space limitations do not permit us to include them at present.

Club Publicity. We would like to say again that it is our policy to withhold publicity on new clubs until such time as they have had a chance to become fully organized. In past years, several new clubs which have been mentioned here have fallen by the wayside due to improper leadership or inability to handle a large volume of mail. However, after clubs "grow up" a bit, we are only too glad to help them in their efforts to obtain new members.

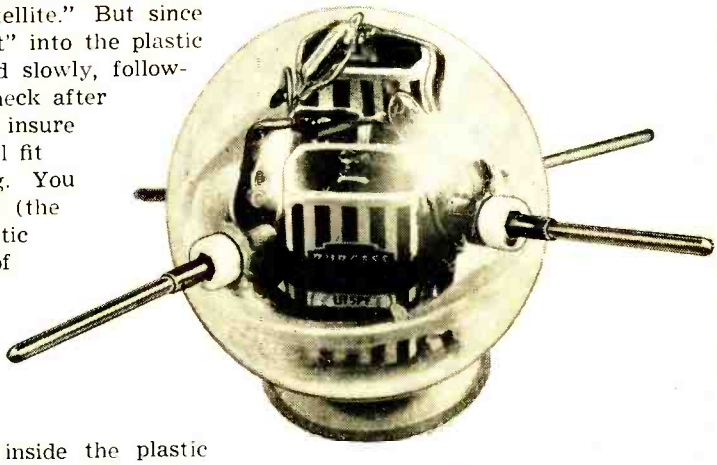
Richard Roll, WPE2ALE, Hamburg, N. Y., uses a Hallicrafters SX-110 receiver, a tape recorder, and an antenna tuner.

(*Continued on page* 117)

SATELLITE FLASHER

Easy-to-build desk ornament makes inexpensive gift

By
ALAN O'NEAL, Jr.



WITH everyone space-conscious these days, this easy-to-build desk ornament is just the thing for an amusing homemade Christmas gift. Tagged the "Satellite Flasher," its flashing lights bring to mind the familiar "beep-beep" radio signals of satellites. It will flash continuously, night and day, for nine months to a year, and can serve as an entertaining night-time "guardian" in the childrens' bedroom.

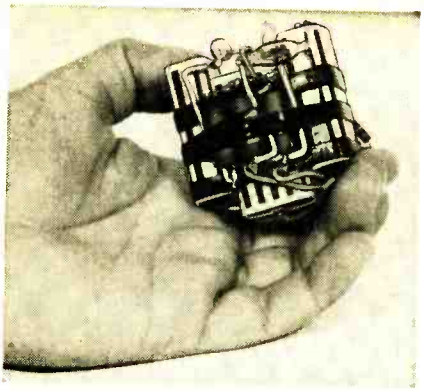
There is nothing critical in the wiring or assembly of the "satellite." But since the components "just fit" into the plastic ball, you should proceed slowly, following the pictorial, and check after mounting each part to insure that all of the parts will fit into the plastic housing. You can buy the plastic ball (the satellite's "body"), plastic base, and a small bottle of cement to glue them together for only 50 cents plus postage—see parts list for details.

The flashing circuit is assembled and put inside the plastic ball, after which the ball is sealed permanently with the cement. Ordinary phone tip jacks serve as sockets for the "antennas," which are actually crochet needles or similar metal rods; no connections are made to the "antennas" since they serve only as decorative appendages.

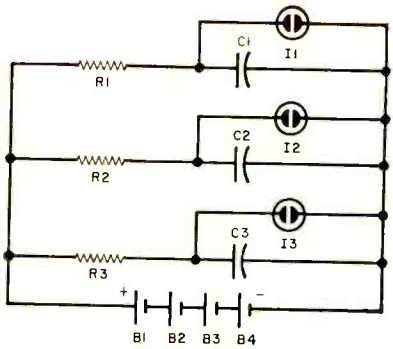
Construction Count-Down. To prevent cracking the plastic, drill small pilot holes for the phone tip jacks in both halves of the plastic ball before drilling them to final size. Cut off the jacks' soldering lugs to provide room for the flashing circuit. Now mount the jacks.

Group the four 22½-volt batteries used in the flashing circuit so that they will fit into the ball with both "hemispheres" in place, then tape them together to form a single pack. There should still be ample room inside the ball for the capacitors, resistors, and neon lamps. When you connect the batteries in series, leave about a 2" lead from each terminal of the resulting 90-volt battery.

Now hook up the capacitors, resistors and neon bulbs, following the schematic and pictorial diagrams, and taking care to arrange the neon bulbs so they will be near the top of the upper hemisphere when the satellite is assembled. Connecting the bulb



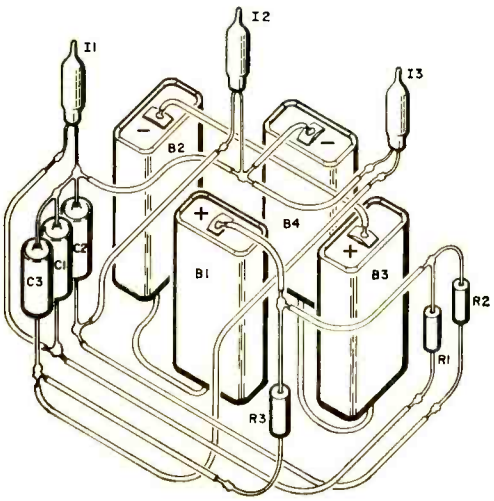
Complete flasher circuit fits in palm of hand. Batteries are taped together; other components are supported by their leads.



PARTS LIST

B1, B2, B3, B4—22½-volt battery (Burgess U-15 or equivalent)
C1, C2, C3—0.05-μf., 200-volt subminiature capacitor
I1, I2, I3—NE-2 neon bulb
R1—3.9-megohm, ½-watt resistor
R2—3.3-megohm, ½-watt resistor
R3—2.7-megohm, ½-watt resistor
**1—3" split polystyrene ball*
**1—2" beveled plexiglas disc with ¼" hole*
**1—Small bottle of EDC MC-26 cement*
4—1⅝" metal rods (see text)
4—Phone tip plugs
4—Phone tip jacks

**Available from Industrial Plastics Supply Co., 324 Canal St., New York 13, N. Y.*



circuit to the battery should cause all of the bulbs to start flashing, with a different flashing rate for each bulb.

To make the antennas, cut four 1⅝" sections from crochet needles or any metal rods you may have available. Insert one end of each antenna into a phone tip plug and solder it in place. Excess solder should be buffed or filed away.

"Launching" the Satellite. The two halves of the ball should now be sealed permanently together with the flasher circuit in place. Coat the mating edges of the hemispheres with cement. When the cement is tacky, put the halves together and hold them in place with slight pressure until the cement has set. Then cement the satellite's base plate to the small "pip" on the lower half of the ball.

Plastic hemispheres are cemented together to form satellite's body. Pip on lower hemisphere fits into matching hole in base.

Insert the antennas in the phone jacks, and your satellite is ready to be launched. Fortunately, you won't need a rocket—just place the satellite where people can see it and you will have automatically put it in "orbit." —30—

Across the Ham Bands

By
HERB. S. BRIER
W9EGQ

ELIMINATING MAN-MADE NOISES

DO MAN-MADE noises jam the signals you expect to hear when you turn on your ham receiver? It happens to all of us at times. We can tolerate noises that come and go rapidly, but those that last and last decrease the pleasure of ham radio in direct proportion to their strength.

Fortunately, with a little effort, we can eliminate many of these noises. Here are a few suggestions on how to get rid of them that may be helpful to you.

Check Your Antenna. Disconnect the antenna from the receiver at its antenna terminals. If the noise from the loudspeaker drops to the normal background level, the noise is getting into the receiver via the antenna. With modern ham receivers, this is the usual path. However, if you have an inexpensive receiver in a wood or plastic cabinet, strong nearby noises may be picked up by its unshielded components. Such pick-up can be greatly reduced by shielding the inside of the cabinet.

If you have more than one antenna, test them all. Sometimes a background noise is very strong from one antenna but weak from another only a few feet away.

In general, a high, horizontal antenna center-fed with coaxial feedline discriminates against man-made noises better than many other receiving antennas. In fact, such an antenna and your receiver's noise

Ham of the Month

Some 8500 airline miles from New York, and a stone's throw from Hong Kong, is the island of Macau (or Macao). To tourists, Macau is famous for its gambling casinos and other facets of the romantic Far East. To ham DX chasers, its big attraction is John Alvares, CR9AH, the only active ham on Macau.

John was CR9AG before World War II and has also operated in Hong Kong. At present, as CR9AH, he limits operation to c.w. and single-sideband on 20 meters. He participates in most of the world's DX contests, usually on c.w. Except for his Collins 75A4 receiver, CR9AH's equipment is home constructed. The transmitter uses a pair of 813's, and the antenna is a three-element, wide-spaced rotary beam. A new transmitter is in the works.

A member of the A1 Operator's Club and of the Quarter-Century Wireless Club, John holds WAC, WAS, WAZ, DXCC, and similar DX certificates. His comparatively modest 160-country total results from the fact that he does not actively seek new countries. Instead, he answers as many of the stations that call him as possible in order to give them each a new country.

By profession, John is a radio engineer—he keeps Macau's one short-wave and two broadcast-band stations on the air. If you work CR9AH, and want his QSL card, send him your card along with a stamped, self-addressed return envelope in care of Station W2CTN.

limiter are about your only defenses against automobile ignition interference, except to move farther away from the road.

Pinpoint the Source. If you have a rotary beam, rotate it while watching your receiver's S-meter. If the noise is coming from a localized source, the beam will point right to it. Then a battery-operated portable receiver can be used to pinpoint the source. A mobile installation in your car is also helpful in tracking down noise.

The receiver used for tracking down the noise should preferably cover both the broadcast and ham bands—a simple broadcast receiver may not respond to certain noises that are strong on the ham bands until it is very close to the noise source. A one-milliampere meter in series with a 1N34 diode across the receiver speaker terminals gives a more accurate check on the strength of the noise than your ears.

Bert Shephard, KN8RMU, of Mansfield, Ohio, a machinist by trade, runs 75 watts to his Globe Chief 90A transmitter and receives on a Knight R-100.

XYL Marcia Guest, WV6MAZ, is waiting for her General license. She will be glad to help other Novices get their General tickets—see News and Views.

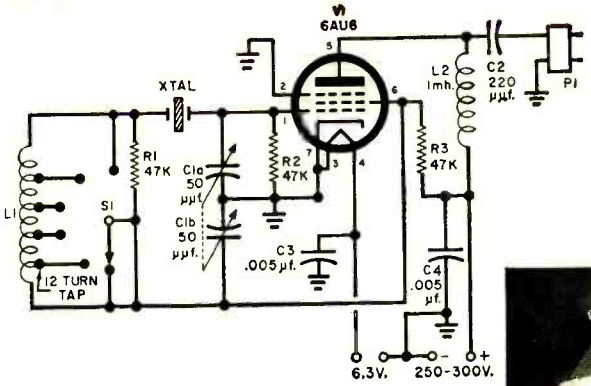
Noise produced by utility power lines can be very annoying and difficult to locate. Use your mobile or portable receiver to pinpoint the source. Then examine all nearby utility poles and power lines through binoculars for cracked insulators, poorly separated wires, interfering tree limbs, etc. Note anything suspicious, and report your findings to the power company.

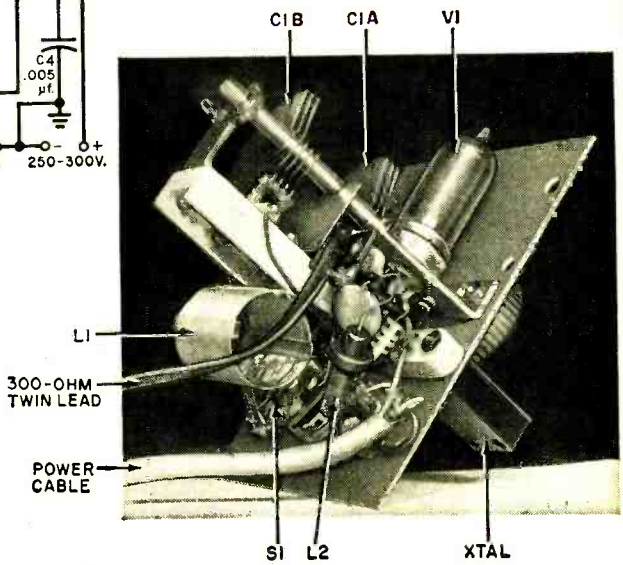
Electrical Appliances. Before blaming your neighbors or the power company for the noise, make certain your own home is "clean." The quickest way to locate the noise is to start removing fuses to isolate the circuit. If the noise disappears, you can then unplug individual appliances until the guilty one is found. Suspect everything, including the family TV set, but don't condemn any one unit as the noise producer until an actual test proves it guilty.

To determine whether the noise is emanating from someone else's house, you can pull his main power switch; if the noise stops, check his individual appliances as above. The amount of cooperation you get from your neighbors in eliminating an electrical noise is likely to be in direct proportion to how well you have cooperated in trying to eliminate possible interference with their radio and TV reception caused by your transmitter.

Noise Filters. Once you discover the source of the noise, its cure is dictated by its nature. Noisy motors often need cleaning, oiling, and new brushes. Noisy thermostats may require replacement of worn and pitted contact points. If a noisy appliance is in good condition, a noise filter in its power cord will usually reduce the interference considerably.

Consult your electronics parts catalog for information on suitable noise filters. Full installation instructions are packed with each one. In general, a filter must be installed close to the appliance—not on the





Unusual oscillator is crystal-controlled, yet offers features of VFO. Entire circuit can be assembled on front panel of a small metal box.

end of a long power cord—to be effective. A .005- or .01-μf. capacitor in series with a 470-ohm, ½-watt resistor connected directly across sparking contacts or brushes will often take the snap out of the spark.

If the noise is being caused by machinery, you may be able to persuade the owner to install a line filter and spark suppressors. If you can't, try and find out when the machinery is scheduled to be used; then avoid using your receiver during those hours.

If you cannot locate your noise source the first time you go after it, keep your eyes and ears open—you may find it unexpectedly. For example, Dale, W9DDK, cured a persistent noise when he went to the store one day for his wife. In the store, he saw a display light flickering in the same pattern that the noise followed in his receiver. Telling the manager what he suspected, Dale climbed a ladder and unscrewed the bulb. His noise was gone!

CRYSTAL VFO

Hams who use crystal control often wish for a way to shift frequencies just enough to avoid an interfering station while retaining the advantages of crystal control. The variable-frequency crystal oscillator described here allows Generals and Technicians to do just that.

If you plug the output of this oscillator into the external VFO socket of a 50-mc. transmitter, for example, and plug the 8- or 24-mc. transmitter crystal into the oscillator, varying capacitor *C1* (see diagram) will change the transmitter output fre-

(*Continued on page* 112)

PARTS LIST

C1a/C1b—50-50 μμf. dual variable capacitor (Hammarlund MCD-50-M or equivalent)
C2—220-μμf. ceramic capacitor
C3, C4—.005-μf. ceramic capacitor
L1—44 turns of #22 wire, 1" dia., 1⅜" long, tapped at 12, 20, 28 and 36 turns (portion of B&W 3016 "Miniductor" or equivalent)
L2—1-mh. r.f. choke
P1—Crystal socket plug (Mosley 301 or equivalent)
R1, R2, R3—47,000-ohm, ½-watt resistor
S1—S.p., 6-pos. rotary switch (Centralab PA-1002 or equivalent)
V1—6AU6 tube
Xtal.—Quartz crystal for desired frequency
1—6" x 5" x 4" aluminum box (Bud AU-1029 or equivalent)
1—Crystal socket (Millen 33102 or equivalent)
Misc.—Tie points, wire, etc.

Transistorized Heart Monitor

The puppy is listening to beeping sounds from the small instrument in the foreground—an electronic heart monitor developed by the Chemetron Corporation. Invented by Dr. William F. Veling, a Detroit surgeon, the device contains a high-gain transistorized amplifier powered by a mercury-cell power supply. In operation, it is usually strapped to the patient's forearm, with a small wire leading to an electrode strapped to the other forearm. Electric "heartbeat" impulses are amplified and reproduced as "beeping" sounds, providing a more convenient indication of the heart's condition than heartbeats, blood pressure, or pulse. Useful to doctors, dentists, and veterinarians alike, the device instantly alerts personnel to the possible need for immediate lifesaving measures, such as the administration of stimulants or oxygen and heart massage.

Talking Books for the Blind

Tape will soon replace discs in England's Institute for the Blind's continuing efforts to help the blind "see" the world around them. The Institute's machine, with its amplifier, speaker, and drive mechanism housed in a single compact case, looks like most conventional tape players. But the unique feature of the system lies in the tape itself. One-half inch in width, the tape accepts up to 18 tracks of recorded material —enough to reproduce up to 20 full hours of recorded speech.

Transistor Topics

By LOU GARNER

Electronic toys in easy-to-build kit form are now available from the Heath Company. Requiring no soldering, the kits feature pre-cut and pre-stripped wire for connection to screw terminals.

ATTENDED BY newsmen, manufacturers, distributors, retailers, and —who knows?—perhaps by many of Saint Nick's invisible "helpers," the *Toy Fair* is the annual trade show of the nation's toy industry. Every year, in New York City, toy makers display their latest dolls, model trains, hobby horses, pistols, space helmets, bicycles, coloring sets, etc.

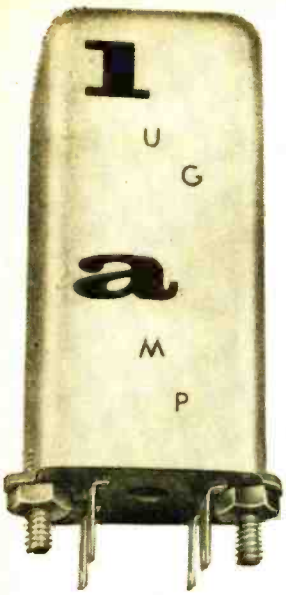
Although held early in the year, the Toy Fair is really a "Christmas" show, for many of the toys displayed are hand-assembled prototypes which are actually manufactured later in the year for fall distribution and sale to the holiday market. A few toys —those in which little or no interest is shown by prospective buyers—never pass beyond the prototype stage. They are born in a manufacturer's "idea" room or in an inventor's basement, make their debut at the Fair, and die shortly afterwards.

This year a new "toy" manufacturer was on the scene with a whole line of exciting new science kits—the Heath Company of Benton Harbor, Mich. Long familiar to hobbyists, hams, servicemen, and audiophiles as a manufacturer of top-quality electronic equipment kits, Heath is the first major kit producer to enter the toy field.

Designed for the newcomer to electronics and dubbed "Heathkit Jr.," the new line of kits includes many transistorized items. Featured are crystal and transistor radio receivers, a two-station transistorized intercom, a wireless "broadcast station," and several laboratory kits. The latter permit the owner to assemble a variety of electronic items, including such units as receivers, code-practice oscillators, amplifiers, and simple transmitters.

Transistors, of course, are ideally suited for toy items, for their ability to operate on low voltages permits the use of battery-type power supplies, thus eliminating the danger of accidental electrical shock and preventing blown line fuses by overenthusiastic experimenters.

Keeping the beginner's needs in mind,



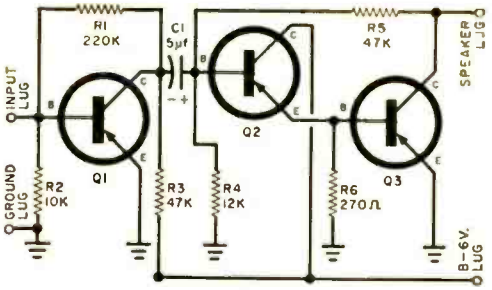
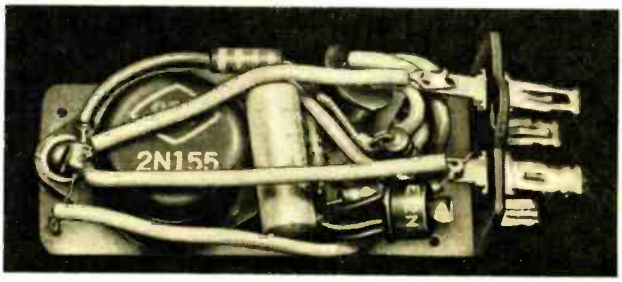


Fig. 1. The "Lug Amp," submitted by Homer L. Davidson, is tiny enough to be assembled in a standard i.f. can. Ground lug serves as common tie-point for input as well as the positive terminal of the 6-volt battery; one side of speaker connects to B— lug.



Heath has supplied detailed manuals which are quite educational, including much basic electronic theory along with the usual step-by-step assembly instructions. The theory is made quite painless, however, by a liberal sprinkling of cartoon-type illustrations and simple analogies.

Perhaps the most interesting feature of the new kits is that they are designed for easy assembly *without soldering*. The hook-up wire is supplied in pre-cut and pre-stripped lengths, with all component and lead connections made by means of spring or screw-type connectors. Standard electronic components are used throughout, permitting the kit owner to salvage the parts for more advanced projects as his knowledge and skill grow.

Reader's Circuit. This month a general-purpose audio amplifier circuit was contributed by reader/author Homer L. Davidson of Fort Dodge, Iowa. It can be used as the audio section of a small receiver, as the foundation for a portable phonograph, or as part of various portable test instruments, such as a signal tracer. The unit's wiring diagram is given in Fig. 1, while construction details are shown in the photographs.

The amplifier employs three low-cost *p-n-p* transistors. Transistor *Q1* is connected as a common-emitter amplifier, with base bias supplied by voltage-divider *R1-R2*, and with *R3* serving as the collector load. The amplified signal appearing across *R3* is coupled through d.c. blocking capacitor *C1* to *Q2*'s base circuit. The second stage's primary function is to match *Q1*'s relatively high output impedance to the power output stage's low input impedance; to this end, the common-collector arrangement ("emitter follower") is used.

Transistor *Q2*'s base bias is supplied by voltage-divider *R4-R5*, with *R6* serving as the stage's emitter load. The signal developed across *R6* is direct-coupled to the output stage, *Q3*, a power transistor used as a common-emitter amplifier. Transistor *Q3*, in turn, is connected to the output load, a suitable impedance-matching transformer or loudspeaker voice coil. Operating power is supplied by a six-volt battery.

All the components needed for assembly are standard and readily available through both local and mail-order outlets. Transis-

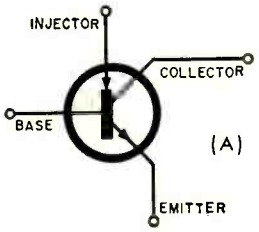
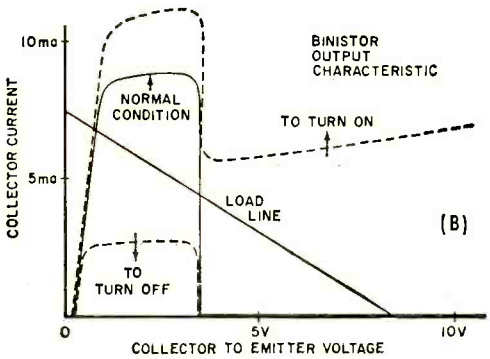


Fig. 2. The "Binistor," a negative-resistance device, is ideal for use in "flip-flop" circuits. Schematic (A) shows fourth element; typical operating characteristics are charted in graph (B).



tors *Q1* and *Q2* are G.E. Type 2N107's, and *Q3* is a CBS-Hytron Type 2N155. All the resistors are ½-watt units, while *C1* is a 5-μf., 10-volt electrolytic capacitor.

Since neither parts layout nor lead dress is especially critical, any of several construction methods may be followed. Homer assembled his model on a small phenolic board, sized to fit within a standard i.f. transformer shield can. He brought his input, output and battery connections out to lugs on the base plate. This prompted him to dub his completed unit, quite logically, the "Lug-Amp."

If you use this type of construction, follow the usual care when soldering to avoid overheating the transistor and electrolytic capacitor leads. Be careful of shorts, using spaghetti tubing to insulate any bare leads. Finally, when you are ready to mount the assembled unit in its can, make sure that no bare connections project to make contact with the can itself; if necessary, insulate the inside of the can with Scotch electrical tape or a piece of varnished cambric.

Double-check your wiring *before* connecting the battery. An "intercom"-type PM loudspeaker having a 45-ohm voice coil can be connected directly to the output stage. If you prefer to use a standard 4- to 8-ohm speaker, however, you'll need to provide an impedance-matching transformer—a Stancor Type TA-11 is a suitable unit and may be mounted on the loudspeaker's frame. The 6-volt battery can be assembled by connecting four standard flashlight cells in series.

The "Binistor." A New England manufacturer, the Transitron Electronic Corporation (168-182 Albion St., Wakefield, Mass.), has developed and is now producing a new type of electronic device having a negative resistance characteristic. Called the "Binistor" (pronounced by-nis-tor), it has bistable properties and hence is particularly useful in "flip-flops" and similar switching and storage applications. A typical flip-flop circuit using conventional transistors requires 13 components, for example, while an equivalent Binistor circuit needs only four components to do the same job.

Currently available units are manufactured of silicon, using an *n-p-n* tetrode construction. As you can see by referring to the Binistor's schematic symbol, given in Fig. 2(A), the device resembles a transistor to which a third "injector" junction has been added. In operation, the upper junction serves as a "latch" to hold the unit on when it's in a conducting state. Typical operating characteristics are shown graphically in Fig. 2(B).

Semiconductor Materials. As a general rule, transistors, diodes, and related devices are made from elements found in the IV column of the Periodic Table of Chemical Elements. Most transistors are made of silicon or germanium, for example.

Unfortunately, neither silicon nor germanium are "ideal" semiconductor materials. Germanium transistors have high gain (*beta*), are relatively easy to make, and will give good performance at both low and high frequencies, but they are notoriously sensitive to temperature; the maximum temperature for most germanium devices is about 85°C. Silicon units, on the other hand, have pretty fair high-temperature characteristics, but do not provide as much gain as germanium types and are somewhat more difficult to produce, with resulting high prices.

In an effort to combine the best charac-

(*Continued on page* 126)

By
JOHN T. FRYE
W9EGV

Carl and Jerry

The Snow Machine

CARL AND JERRY were sitting in Mr. Gruber's study listening with deep interest to what their elderly neighbor and friend was saying.

"People today don't know what snow is," he snorted, his bright blue eyes flashing in his wrinkled face. "When I was a boy, the first snow usually fell around Thanksgiving; and many times we never saw bare ground again all winter. The snow was deep, too; and they needn't try and tell me it only seemed so because I was measuring it against my shorter boyish legs."

The boys waited expectantly to see what would follow Mr. Gruber's reference to his boyhood. They knew that with Mr. Gruber the past was simply a storehouse where he went to get an experience or a memory that could be of current use. He did not live there, as many old people do. He lived in the present and in the future. He knew far more about missiles and satellites than either Carl or Jerry, and he had a keen, daring mind.

"I've read that this part of the world has been experiencing a warming trend for the last several years," Jerry offered.

"It's high time they admitted it," Mr. Gruber said, getting to his feet. He put on his battered derby hat and tapped it into place with a firm slap on the crown. "You boys come on out to the shop. I've got something to show you."

THE BOYS put on their coats and followed the old gentleman out the back door into the rapidly fading winter day. There was a damp chill in the air and a low bank of clouds in the southwest.

"A couple of nights ago my nephew—that's my wife's sister's boy—dropped in to see us," Mr. Gruber explained. "He's a salesman for a West Coast electronics outfit, and he had a demonstration unit with him that I know will interest you two. He tows it behind his car in that trailer sitting beside the garage; but we rolled the gadget out and into the shop."

As they stepped into the small, neat workshop, Carl and Jerry saw a bulky piece of electronic gear standing on heavy rollers in the middle of the floor. Several panels were arranged in a special shielded rack, and they carried a dazzling array of meters, knobs, vari-colored pilot lamps, and push-buttons. One heavy cable ran from the cabinet to the 220-volt outlet box on the wall. Another ran to what looked like an extremely heavy-duty speaker mounted in a

gimbal-like arrangement that permitted it to be pointed in any direction by proper adjustment of a pair of hand-wheels. This apparatus rested on its own set of rollers. When the boys examined it closely, they saw that the cone of the "speaker" was made of heavy steel that looked like boiler plate.

"What on earth is it?" Carl asked in awe.

"It's a super-duper, high-power ultrasonic amplifier," Mr. Gruber explained, patting

(*Continued on page* 96)

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"DELUXE" AM/FM STEREO TUNER

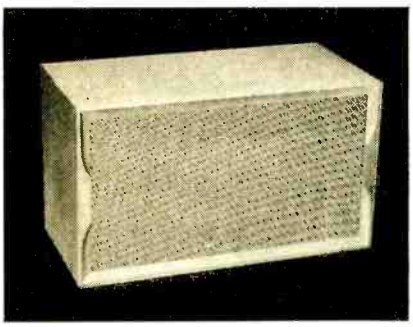
Exciting new styling and advance-design features rocket this Heathkit to the top of the Christmas value list. Featured in this outstanding tuner are: complete AM, FM, Stereo reception, plus multiplex adapter output; individual flywheel tuning; individual tuning meters on each band; FM automatic frequency control (AFC) and AM bandwidth switch. 24 lbs.

Model AJ-30 (kit).....$9.75 dn. **$97.50**
Model AJW-30 (wired)...$15.30 dn. **$152.95**

HI-FI RATED 50-WATT STEREO AMPLIFIER

In the inimitable style of the Heathkit AJ-30 Tuner above, this complete stereo amplifier offers you the ultimate in stereo conveniences. Jam-packed with extra features, including: mixed-channel center speaker output; "function selector" for any mode of mono or stereo operation; "stereo reverse"; "balance" and "separation" controls; ganged volume controls; and separate concentric bass and treble tone controls. 30 lbs.

Model AA-100 (kit).....$8.50 dn. **$84.95**
Model AAW-100 (wired)...$14.50 dn. **$144.95**



ACOUSTIC SUSPENSION SPEAKER SYSTEM KIT

Its "bookshelf" size belying its gigantic capabilities, this amazing unit outperforms speakers 4-times its size. A 10" acoustic suspension woofer and two "dispersed-array" cone tweeters deliver high-fidelity tone with fantastic brilliance over the entire range of 30-15,000 cps, ± 5 db. Preassembled cabinet in choice of finishes or unfinished woods. Measures 24" L x 11½" D x 13½" H. 28 lbs.

Model AS-10M or W (mag. or wal.)...$8.50 dn. **$64.95**
Model AS-10U (unfinished)...$6.00 dn. **$59.95**

STEREO EQUIPMENT ENCLOSURE ENSEMBLE

Now, just in time for Christmas, Heathkit introduces new factory-assembled, ready-to-use equipment and speaker cabinets designed to house complete monophonic or stereophonic systems. The cabinets, resplendently styled in a timeless and universally compatible motif, are available in rich hand-rubbed walnut or mahogany finishes . . . or unfinished if desired. ¾" stock is used for all exterior panels and supports; solids for edgings, furniture grade veneers for front and side panels and shelves. Versatile in accommodations, the center cabinet has room for all components of a complete stereo or mono hi-fi system except speakers. The changer compartment will accept any Heathkit record changer or most tape recorders. The storage compartment holds records and tapes or using an accessory slide-out drawer may be used for a tape recorder. Two shelf compartments accept tuners and amplifiers. The power amplifier compartment will hold any Heathkit stereo power amplifier, a pair of UA-2 mono amplifiers or any single mono amplifier. The handsome speaker-wing cabinets in two models for 12" and 15" speakers are designed to blend into the flowing lines of the center cabinet and are perfectly acceptable as single console speaker enclosures. Adapter rings are provided for using other size speakers, while a special port is provided for installation of a horn-type tweeter.

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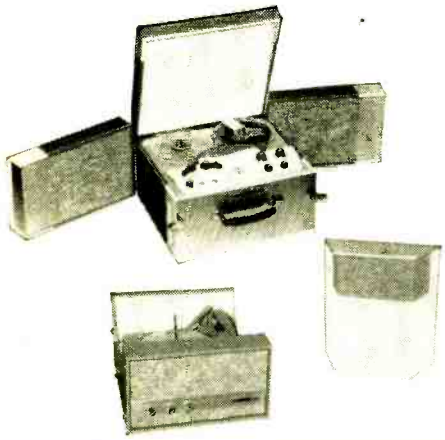


PORTABLE 4-TRACK STEREO TAPE RECORDER KIT

What better gift than this? . . . a compact portable tape recorder just waiting to record the caroling, frolicking family joys of the holiday season! You'll thrill to the natural stereophonic sound of this new unit that also serves as a hi-fi, power center for your tuner and record player. Tape deck and cabinet are preassembled.

Model AD-40. . . $18.00 dn., $16.00 mo. **$179.95**

STEREO/MONO PORTABLE STEREO PHONO KIT

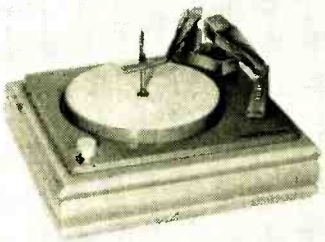
Thrill to your favorite Christmas recordings in life-like stereo! This GD-10 offers you complete stereo and mono operation *plus* portable convenience. Handsome aqua and white two-tone vinyl clad cabinet and four-speed automatic changer come preassembled—you build only the amplifier in just a few enjoyable hours. Changer has turnover diamond and sapphire stereo cartridge. Complete tone controls. Measures 15½" W x 18" D x 8⅝" H. 28 lbs.

Model GD-10. . . $7.00 dn., $7.00 mo. **$69.95**

HIGH FIDELITY AM TUNER KIT

Here is the AM counterpart of the best selling Heathkit FM-4 tuner bringing you high fidelity AM reception plus many extras. Switch selection of broad or narrow band width, flywheel tuning, edge-lighted slide-rule dial, built-in antenna, self-powered. Styled to match Heathkit FM-4.

Model AJ-20. . . . . **$29.95**

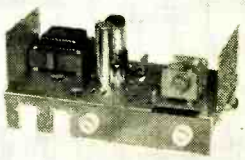


AUTOMATIC RECORD CHANGER KIT

Jam-proof mechanism . . . quick-change cartridge holder . . . "muting" switch . . . and "size-selector" for intermixing 7", 10" and 12" records of the same speed! Holds up to 10 records, for hours of delightful stereo or mono listening enjoyment.

Model AD-50. . . **$49.95** to **$54.95** depending on cartridge.

Other models from **$22.95**. Send for FREE Heathkit catalog today!



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Perfect gift for all ages . . . a basic course in radio that teaches radio theory in a way you can understand. Actual experiments are performed with radio parts supplied leading in successive steps from the construction of a simple crystal radio to a genuine regenerative radio receiver. Designed as a continuation of the popular EK-1 Educational Kit—but equally valuable as a starting point in radio electronics.

Model EK-2A. . . 8 lbs. **$19.95**

HAND-HELD CITIZENS BAND TRANSCEIVER

The perfect HEATHGIFT for everyone on your shopping list! No license required . . . anyone can use this 2-way radio! Operates up to a mile between units . . . more with regular Citizens Band stations. It's ideal for hunting, fishing, boating . . . most anywhere you need 2-way communications. Features 4-transistor circuit; fixed-tuned, super-regenerative receiver and crystal-controlled transmitter. 3 lbs.

Model GW-30 (kit). . . . . **$32.95** (64.95 a pair)

Model GWW-30 (wired). . . . . **$50.95** (99.95 a pair)

DELUXE 2-WAY CITIZENS BAND TRANSCEIVER

This Christmas, give the best that money can buy in a Citizens Band Transceiver. The efficient superheterodyne receiver has an automatic "noise limiter" and adjustable "squelch" control, single channel "crystal" or continuous tuning. The transmitter has press-to-talk microphone and can be switched to any of the three crystal-controlled channels. Choose the "under-dash" DC mobile model or "fixed" station AC unit. 11 lbs.

Model GW-10 (kit). . . . . $6.30 dn., $6.00 mo. **$62.95**

Model GWW-10 (wired). . . $10.00 dn., $9.00 mo. **$99.95**

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Model IO-10...14 lbs....$8.00 dn., $8.00 mo.....**$79.95**

LABORATORY 5" OSCILLOSCOPE KIT

A real time-saver in audio and TV service work, where the same sweep frequencies are used over and over; the IO-30 offers two extra, switch-selected, pre-set sweep frequencies. Kit is supplied with capacitors appropriate for TV service giving preset frequencies of 30 cycles and 7875 cycles; by changing capacitor values, any two desired preset frequencies within the sweep frequency range can be made available.

Model IO-30...22 lbs....$7.70 dn., $7.00 mo.....**$76.95**

Model IO-10

Model IO-30

PHONE AND CW TRANSMITTER KIT

Brand-new in every respect, the DX-60 combines smart styling, top-flight performance and low Heathkit cost to offer the "Amateur rig" value of the season. Ideal for General class Amateurs, the Transmitter may also be run at reduced power for novice operation. Covers 80 through 10 meters. Power input: 90 watts peak, carrier controlled phone or CW. 27 lbs.

Model DX-60...$8.30 dn.....**$82.95**

2, 6 & 10 METER TRANSCEIVER KITS

Make a hit with the "Hams" on your gift list by giving one of these outstanding transceivers. All are identically styled to the popular Heathkit CB-1 Citizens Band Transceiver: feature variable-tuned superregen receivers; 5-watt input crystal-controlled transmitters. All are supplied with mike, power cables and AC power supply.

Model HW-30...(2 meter).....**$49.95**
Model HW-29...(6 meter) or
HW-19 (10 meter).....**$39.95** ea.

DELUXE VACUUM TUBE VOLTMETER KIT

Hobbyist and professional alike will prize this useful gift. This brand-new Heathkit features big, easy-to-read 6" meter with multi-color scales; high-visibility switches; greater accuracy; longer meter scales; special low voltage AC scales; broader frequency response; thumb-wheel controls and easy-access adjustments.

Model IM-10...7 lbs.....**$32.95**

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Carl and Jerry

(*Continued from page* 90)

the rack-and-panel fondly. "If I've got my figures straight, it costs around $80,000; it uses tubes with 7000 volts on the plates drawing 3 amperes of current; and it puts 350 volts at 30 amperes on the voice coil of the transducer there."

"Whe-e-e-ew!" Jerry whistled softly, "ten and a half kilowatts of audio power! What's it do besides split eardrums?"

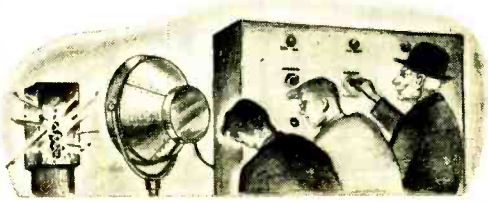
"For one thing, manufacturers use it to check the effect of ultrasonic vibrations, such as those produced by air-buffeting at extreme speeds, on products designed to be mounted in missiles. You boys weren't around when my nephew had it going. He was called home to California suddenly because his father suffered a heart attack, but he taught me how to run it and said I could show it to you."

As he finished speaking, Mr. Gruber upended an empty cardboard carton on top of a block of wood with the open side of the box facing the transducer. A large Coca Cola bottle was placed well back in the carton, and the block of wood was slid to within about three feet of the cone. Then the transducer was aimed directly at the center of the bottle.

"Put these in your ears," Mr. Gruber directed as he handed the boys some rubber ear plugs. "The frequency is too high to be heard as sound, but we don't want to take any chance on injuring our ear drums."

A few moments later Mr. Gruber said, "I guess we're ready, then," a little nervously. He reached over and gingerly pushed a button on the panel of the instrument. A green pilot lamp came on, and a low hum issued from deep inside the rack. After about a minute an orange lamp began to glow.

"Stand back!" Mr. Gruber shouted to the boys as he crouched down beside the rack and pushed another button. A red pilot lamp flashed on, and the hum increased. Very slowly Mr. Gruber began to turn a control on the top panel clockwise;



he had hardly advanced it a fourth of a revolution when there was a brittle snapping sound, and the bottle flew to pieces.

"Literally shook to pieces by ultrasonic waves!" Mr. Gruber exclaimed happily as he examined the little pieces of glass scattered over the bottom of the carton. "But let's go back to the house. I want your opinion about something, and it's too cold out here for my tired blood."

"WHAT I'm going to suggest may sound pretty silly to you," Mr. Gruber warned as they settled down in the study and he took a little red notebook from his pocket; "but it's gotta come out; so here goes:

"For a long time now I've been interested in snow, especially in how it's produced naturally and in the experiments to produce it artificially. Snow is a solid form of water which grows while floating, rising, or falling in the free air of the atmosphere. It begins ordinarily in a cloud of moist air that's super-cooled below the freezing temperature of water, but the particles of moisture don't crystallize into snow until they find a nucleus around which they can cluster. Once a crystal is started, it moves up and down through the cloud, gathering more and more ice, until finally it's heavy enough to fall to earth as a snowflake; or, if the lower atmosphere is warm enough to melt it, as a rain drop. Yes, even on the hottest August afternoon, a rainshower was once a snowshower in the upper atmosphere.

"Back in 1946 Vincent Schaefer of the General Electric Research Laboratories transformed a super-cooled, four-mile-long, alto-stratus cloud into snow by 'seeding' it with only six pounds of solid carbon dioxide. Later B. Vonnegut, a co-worker of Schaefer's, found that silver iodide was particularly effective as a seeding nucleus because its structure matched the structure of ice to within 1%. But there is apparently another way ice crystals can be formed —by the sudden rarefaction of cold, moist air, such as is produced by detonation, adiabatic expansion, high-velocity missiles, or vortices which cool the air abruptly below the water transition temperature of −38° F. It's believed that this is what causes vapor trails behind high-flying planes.

"Now you boys know," Mr. Gruber con-

tinued slowly, "that a sound wave creates alternate areas of compression *and rarefaction* in the atmosphere. I've long wondered if powerful sound waves directed into a proper cloud might not produce ice crystals that could grow into snowflakes. I never hoped to have the apparatus to carry out such an experiment; but suddenly it's sitting right out there in my shop. Maybe you boys would like to help me try the experiment after supper. I've been watching the weather closely, and conditions should be about right."

"Would we ever!" Carl exclaimed.

"We'll be here," Jerry promised as he reached for his jacket; "but the forecast calls for cold and cloudy weather with no precipitation; so if we have any snow, I guess you'll have to make it."

IT WAS around eight o'clock when the three of them gathered in Mr. Gruber's shop. A lighted gas trash-burner in the corner took the chill off the interior, but it was bone-chilling cold and damp outside. Carefully they wheeled the amplifier and the transducer out on the concrete apron behind the shop and pointed the cone straight up.

The apparatus was turned on, and as it warmed up Mr. Gruber carefully noted the

temperature, humidity, and atmospheric pressure in his little red notebook. Then he threw on the power and firmly advanced the power output control as far as it would go. As the boys watched, their ear plugs in place, he used the hand-wheels to sweep the amplifier's ultrasonic beam carefully back and forth.

This went on for several minutes. Suddenly something that felt like a light cobweb brushed Jerry's cheek. At the same time Mr. Gruber snatched off his derby hat and dashed into the lighted shop with it.

"Diamond dust!" he shouted triumphant-

(*Continued on page* 102)

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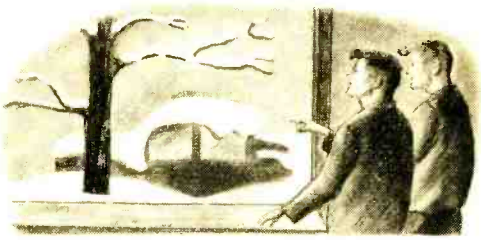
ly as he pointed to gleaming specks sprinkled over the crown of the derby. "That's what they call these tiny ice crystals that form close to the ground, usually in very cold weather. Now if they will just move up and down through the clouds, we may have some real snowflakes soon. Back to the snow machine, men!"

The little diamond dust particles must have danced up and down in the clouds just as Mr. Gruber hoped they would, for soon honest-to-goodness snowflakes began to fall. They were small and scattered at first, but they rapidly increased in size and frequency; it became necessary to shut off the amplifier and wheel it into the shop.

The old man stood in the open doorway watching anxiously to see if the snow would stop, but instead the flakes grew larger and thicker.

When the boys finally went home, there was already a couple of inches of snow on the ground, and it was snowing harder than ever; but the ten-o'clock TV weatherman said it was just a freak snowshower and would soon end.

The weatherman was wrong, though, very wrong. When Jerry was awakened



next morning by the sound of snow shovels scraping on the sidewalk, it was snowing so hard he could scarcely see across the street; and there was a good foot of snow on the ground. As soon as breakfast was over, he grabbed his snowshovel and headed for Mr. Gruber's house. Carl was already busy cleaning off the old man's walk; and the latter, a scarf tied over the top of his derby and beneath his chin, was literally dancing in his own personal snowstorm.

"Now these whippersnappers can see what an old-fashioned snow really looks like!" he gloated.

It never let up a minute the whole day. By evening, traffic in the city was at a complete standstill. The mayor went on the local radio station and asked everyone to remain calm in the emergency. Citizens

were requested to stay in their homes and to be exceptionally careful of fire, since fire trucks could not get through the snow-clogged streets.

All of the weather forecasters were frankly astonished at the storm. They said it was a freak affair that could happen only once in a thousand times. Warm, moist air coming up from the Gulf had been suddenly lifted by a narrow wedge of polar air that had knifed down from Canada; and the front that resulted had stalled directly over the city. With two feet of snow in town, bare earth could be seen not fifty miles away.

MR. GRUBER telephoned right after the news broadcast and asked both boys to come to his shop. They floundered through the high snow banks, and as they stepped through the door they saw Mr. Gruber toss the little red notebook with all his records of the snow-making experiment into the trash burner. He looked sick.

"This is a terrible, terrible thing, boys, and it's all my fault," he groaned. "This is what happens when you rashly undertake an experiment without considering all the possibilities. I want you two to promise me you will never tell anyone what we discovered last night. Power to make it snow is too dangerous to rest in human hands."

The boys promised and did their best to cheer him up, but it was no use. He turned off the lights and trudged wearily through the snow to his back door.

"Wait, Mr. Gruber!" Carl suddenly called, as he lifted a startled face to the sky. "It's stopped snowing!"

"Thank heaven!" the old man exclaimed. He straightened up and saw it was true. "Now I can sleep. Good night, boys."

Carl and Jerry stood outside between their houses for a few minutes and watched the stars peep out one by one. Finally the moon slid from behind a cloud and bathed the snowy landscape in a beautiful white light.

"Jer," Carl finally asked as he stared up at the sky, "do you really think that the machine caused all this snow?"

"We'll probably never know," Jerry said slowly; "but no one will ever convince Mr. Gruber that it didn't. As for me, whether the machine worked or not, it has taught me a lesson I'll never forget: power carries with it a terrible responsibility. Good night, Carl." —30—

Controlled Reverberation

(*Continued from page* 56)

The Knight reverb unit is also easy to install, and it accepts any high-level signal source, stereo or monophonic. The KN-701 can be connected to amplifiers equipped with a tape monitor switch, or it can be fed directly into the auxiliary input of any amplifier.

The circuitry of Fisher's "Space Expander" and Sargent-Rayment's "Reverbatron" differs slightly, but the results are similar. With both units, the reverberation signal is a blend of both stereo channels that's later applied to each of the channels for further amplification.

In Motorola's special console, however, the reverberated blend of stereo channels is sent through a separate amplifier and speaker. Since the reverb unit operates mainly in the 300-4000 cps frequency range, Motorola cuts the cost of the extra channel by using simpler amplifier circuitry and a small reverberation speaker.

Do They Work? At demonstrations of the reverb units at this year's hi-fi show in New York, visitors invariably approached with two questions. Are these reverberation units really new? And, more important, do they really work? The answer is yes on both counts.

The present reverberation units shouldn't be confused with some earlier devices which promised to make every living room a concert hall. One earlier entry—the presence control—boosted mid-range frequency response, sometimes giving the illusion that a soloist or section of an orchestra had stepped forward into a living-room spotlight. Earlier reverb units used a time-delay effect, not to deal with room acoustics, but to try to create a stereo illusion from a monophonic source.

The new reverberation units *can* help your living room take on concert-hall dimensions, but with limitations. Offering from 30 milliseconds to two full seconds of time delay, the new units can make any walls seem to swell outward, but they require some self-control and willingness to experiment on the part of the user. Chances are that the use of the full echo potential of any of these units will make your living room sound more like the Grand Canyon than Carnegie Hall. In addition, distortion starts to become excessive when any reverb control is used at its extreme setting,

and transient response from your system becomes blurry.

Look Them Over. Since none of the units designed for connection to your present rig carries an astronomical price-tag ($69.50 for the Fisher, $49.95 for the Knight, $47.75 for the Sargent-Rayment), they are worth hearing in action.

Keep in mind that no reverb unit can do anything about a listening room that already has too much echo. And if you decide that one will bring realism to your living room, remember that its purpose isn't to supply some hair-raising special effects but to provide a realistic balance for your listening situation.

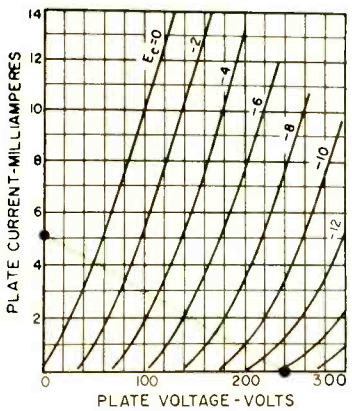
Like bass and treble controls, reverb units have more potential than you'll probably ever need, and you'll come up with the best blend of clarity and spaciousness if you take time to find the right setting for different kinds of recordings. If you can resist the temptation of turning your living room into an echo chamber, a reverb unit may help you to hurdle the last obstacle on the road to high fidelity. —30—

ANSWER TO LOAD LINE PROBLEM

At the end of *The Load Line Story* last month, we suggested that our readers might like to work along with Larry in computing the 47,000-ohm load line for the 6J5 tube. Since plate supply voltage is still 240 volts, point *A* remains at the same point on the tube characteristic curves. To find point *B*, we simply substitute the new resistance in the Ohm's law equation. Thus,

$I \times 47{,}000 = 240$ volts
$I = 240 \div 47{,}000$
$I = 0.0051$ amperes $= 5.1$ ma.

Connecting points *A* and *B*, we have our new load line, as shown below:



The Receiver

(*Continued from page* 49)

Turn *S2* to *Ext.* Remove the jumper between terminals *4* and *5*. Connect a 1-meg. resistor and your test leads between terminals *1* and *4*. The leads are then connected across the source of the signal you want to check, with the lead from *4* serving as the hot lead. The amount of eye closure indicates the relative signal level.

Code Practice Oscillator. Connect your audio probe to one terminal of a key (the ground lead is not used), and plug the other end into *J1* (see Fig. 3). Connect a clip lead between the key's other terminal and terminal *5*. Close the key and adjust the volume control. If there is no tone from the loudspeaker, reverse *T3*'s secondary connections.

Audio Signal Source. For a steady-tone test signal, connect your audio probe between *J1* and terminal *5*. Connect a 10-ohm, 2-watt potentiometer between terminals *1* and *5* to serve as *T3*'s load. Take the test signal from the pot's center pin and terminal *1* (Fig. 3).

If you prefer a voice or music test signal, simply remove the audio probe and tune in a station carrying suitable program material.

Test Loudspeaker. Often, a separate loudspeaker is needed for testing an audio amplifier. Your receiver's loudspeaker makes an excellent test unit; the connections are shown in Fig. 3. A resistive load (the 10-ohm pot) is connected between terminals *1* and *5*, the jumper between terminals *5* and *6* is removed, and terminals *1* and *6* are used as connection points for the test speaker.

Audio Signal Tracer. To follow signal paths in audio gear, just plug the audio probe into *J1*. Make sure that terminals *4*, *5*, and *6* are connected together. Move *S2* to the *Ext.* position. The signal can be heard through the receiver's speaker while its relative strength will be indicated by eye closure.

R.F. Signal Tracer. To use the receiver as an *untuned* r.f. signal tracer, simply plug the detector probe into *J1*. See Fig. 1.

To use it as a *tuned* (455-kc.) r.f. signal tracer, place *S2* in the a.v.c. position. Close the tuning capacitor and kill the local oscillator by shorting point A to ground. Connect the low-capacitance probe to the converter's signal grid (grid 3). Connect

the chassis of the test receiver to the chassis of the device being tested.

Signal Generator. To use the receiver as a source of *modulated* r.f. signals at its intermediate frequency, connect your low-capacitance probe to the output terminal of *T2* (point *B*). Connect both chassis together and tune in a local station.

If you want an *unmodulated* r.f. signal, attach your r.f. probe to point A of the converter. The signal frequency will be *approximately* your receiver's dial reading plus the set's intermediate frequency.

Auxiliary Power Supply. The receiver can supply heater and B voltages for experimental circuits. The heater voltage is taken from terminals *1* and *2*, the B voltages from terminals *1* and *3*.

If you need a lower B voltage than that

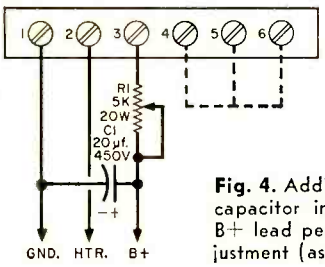


Fig. 4. Adding a resistor and capacitor in series with the B+ lead permits voltage adjustment (as well as filtering).

supplied, use a 20-watt adjustable wire-wound resistor and electrolytic capacitor as shown in Fig. 4. Turn off the set and bleed *C1* before making any adjustments.

Tube Tester. Vacuum tubes like those used in your receiver or with similar characteristics (and identical pin connections) can be checked roughly simply by substituting them for the proper tubes in your set. Tubes with different base connections can be tested in the same manner if you make up a suitable adapter. Mount a tube socket and a tube base at opposite ends of a piece of fiber tubing; a tube manual will tell you how to interconnect the two.

Capacitor Checker. *Electrolytic capacitors* with a working voltage equal to or higher than the B voltage of your receiver may be given a quick test for both leakage and capacitance. Charge the capacitor using the circuit in Fig. 4. Now place the capacitor across a 1000-volt d.c. meter which should read near the B+ supply voltage for non-leaky capacitors.

After a couple of seconds, remove the capacitor; wait an additional few seconds, then short the capacitor's leads together

through a 10-ohm resistor. The intensity of the spark obtained is proportional to the unit's capacitance. If the spark is very lean or there is no spark at all, the capacitor is either leaky or has lost most of its capacitance.

Medium-sized *paper capacitors* (0.002 to 0.1 μf.) can be checked for both opens and leakage. Remove the jumper between terminals *4* and *5*, connect a 1-meg. resistor between terminals *1* and *4*, and place *S2* in the *Ext.* position. Now tune in a local station.

When the unknown capacitor is connected between terminals *4* and *5*, the eye should flutter in time with the program material. If it does not, the capacitor is open. When the capacitor is connected between terminals *3* and *4*, the eye should open wide and then resume its normal opening almost immediately. If the eye stays open wider than normal, the capacitor is leaky.

Vacuum-Tube Voltmeter. The eye is a basic VTVM and can be used to estimate d.c. voltages. The eye's sensitivity (voltage needed to close it completely) will depend on the B voltage of your receiver. In general, from three to nine volts will close it.

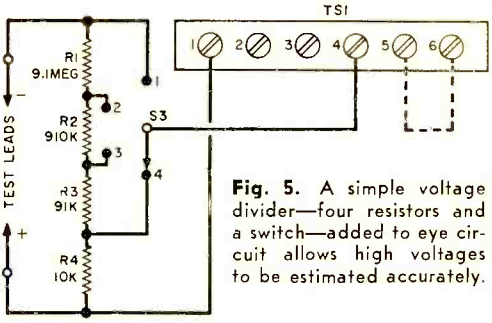


Fig. 5. A simple voltage divider—four resistors and a switch—added to eye circuit allows high voltages to be estimated accurately.

ADDITIONAL PARTS

R1—9.1-megohm, ½-watt, 5% resistor
R2—910,000-ohm, ½-watt, 5% resistor
R3—91,000-ohm, ½-watt, 5% resistor
R4—10,000-ohm, ½-watt, 5% resistor
S3—S.p., 4-pos. rotary switch and knob

You can use the eye to measure higher d.c. voltages without it "overlapping" if you make up a simple voltage divider, using ½-watt, 5% resistors. (See Fig. 5.) With the switch in its topmost position, the eye will be at full sensitivity. As the switch is moved to other positions, the sensitivity is reduced by a factor of 10 each time. —30—

Short-Wave Monitor Registration

If you haven't yet registered for your Short-Wave Monitor Certificate and call letters, now is the time to fill out the form below and mail it with ten cents in coin to: Monitor Registration, POPULAR ELECTRONICS, One Park Ave., New York 16, N. Y. Be sure to include a *stamped, self-addressed* envelope so we can mail your certificate at once. If you live outside the United States, send either two International Reply Coupons or equivalent value postage stamps. Canadians may send ten cents in coin.

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

Receiver — Make ..... Model .....

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

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

Type of Antenna Used .....

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

Harmonic Distortion Analyzer

(*Continued from page 77*)

like waveform *G*. As you can see, it still looks a great deal like the pure sine wave in waveform *A*, but it has begun to show slight signs of clipping, or flattening, on top. This is the distortion we will measure.

Set the *Range* switch of the distortion meter to the 200-2000 range. Carefully adjust the *Tuning* control for a minimum reading on the meter. Then adjust the *Balance* for a minimum also. Reset the *Sensitivity* switch one position clockwise (30%); this increases the sensitivity of the meter and allows you to tune for a sharper null with the tuning and balance controls. Go back and forth between tuning and balance several times in each position (they interact with each other) until you have the lowest possible reading. The reading on the 30% scale is now below 10%, so we can switch to a still lower range, the 10% scale. Once again, adjust *Balance* and *Tuning* for a null. If the null reading is below 3%, we can switch to the 3% scale.

Obviously, the procedure here is to switch to more and more sensitive scales as long as possible, tuning and balancing carefully each time. When you can get no further reduction, the resultant reading is the percentage of distortion. Waveforms *G, H, I,* and *J* tested 2%, 5%, 10% and 20%, respectively.

The first thing to do on completing any distortion measurement is to turn the sensitivity switch back to 100%. This protects the meter from sudden shocks if the frequency or input level settings are changed.

Measuring Power Response. Although many amplifier specifications give distortion measurement readings at only one frequency, it's a good idea to take distortion measurements over a wide range of frequencies if you really want to know how an amplifier operates. You might even want to plot a power response curve.

For such a curve we might select an arbitrary standard distortion level, such as 2%. This means that we can see just how much power the amplifier will put out at each of a number of frequencies before the distortion reaches 2%.

Since the reading we took at 1000 cps exceeded 2%, turn down the audio generator a little and check distortion again. Incidentally, once you have tuned and bal-

anced the distortion meter carefully, you won't have to readjust these settings. Simply lower the amplifier input, switch *Range* to "set level," and adjust *Level* to full scale. Switch *Range* back to the proper scale and read distortion on the meter.

When you have reached 2% distortion by this method, check the output power. Our VTVM in this case reads 10.8 volts, which, by using the formula $P = E^2/R$, we see to be 14.6 watts. Now, similar readings are taken at various frequencies down to about 30 cps, and all the way up to about 20,000 cps.

Incidentally, we used a separate meter to measure output power during the distortion measurements just described. Although this is convenient, it is not necessary. The VTVM built into the distortion meter can be switched across the load and used to measure power. Other distortion meters may have still other features. The Barker & Williamson Model 400, for example, is set up for making hum and noise level tests.

Other Distortion Tests. In the example above, we measured the harmonic distortion of a complete amplifier. But designers and experimenters find the distortion meter useful for checking the distortion of single stages or circuits as well, pinpointing possible sources of distortion within the instrument. With the help of a good microphone of known characteristics, we can even check the distortion of a loudspeaker.

Incidentally, it's always a good idea to check the audio signal generator for distortion before beginning any measurement. Simply connect the output of the audio generator directly into the distortion meter and make the measurements as usual. If everything is in working order, you will generally find that the distortion of the oscillator is a fraction of 1%—for all practical purposes a negligible quantity. If, by any chance, a significant percentage of distortion shows up, the audio generator or the distortion meter—or possibly both—should be checked before any further testing is done.

Another kind of distortion, possibly not as well known or as widely understood as harmonic distortion, but capable of producing sounds just as unpleasant, is intermodulation distortion. We'll have a look at this phenomenon and the instrument designed to measure it next month. —30—

Across the Ham Bands

(*Continued from page 85*)

quency 25 to 100 kc. or more. Individual crystals differ quite a bit in how much their frequencies can be shifted. However, the average 3.5-mc. crystal can be shifted at least a kilocycle, and higher-frequency crystals can be shifted correspondingly greater amounts.

Construction. The oscillator is housed in a 6" x 5" x 4" aluminum box (Bud AU-1029 or equivalent). Mount all of the components on one of the 6" x 5" removable sides, as shown in the photograph. Ground pins 2, 3, and 7 of the tube socket and one terminal of output plug *P1* to a solder lug under one of the tube socket mounting screws. Connect pin 1 of the tube socket to the stator of capacitor *C1a* (next to the front panel) and to one terminal of the crystal socket. Connect pin 6 of the socket to the stator of *C1b*.

Coil *L1* is made up of 44 turns of No. 22 wire, wound 1" in diameter and spaced 1⅜" long; you can use a portion of a B&W 3016 "Miniductor" if you wish. Tap the coil at 12, 20, 28, 36 turns from one end, using 2" lengths of bare wire. The end of the coil near the 12-turn tap should be connected to the arm of *S1*. Solder the coil taps to successive switch contacts; the end of the coil connects to the last contact. Connect one terminal of the crystal socket to the top end of *L1;* the other crystal terminal connects to the stator of *C1b*.

The three resistors used are 47,000-ohm, ½-watt composition units. Connect *R2* from tube socket pin 1 to ground, and connect *R3* from pin 6 to the B+ tie point. Choke *L2* should be connected from socket pin 5 to the same tie point. And the 220-$\mu\mu$f. ceramic capacitor (*C2*) should be connected between pin 5 of the tube socket and the ungrounded pin of output plug *P1*. (A short length of 300-ohm TV ribbon should be terminated in a plug which matches

FRENCH AMATEUR & SWL CLUB

The *Club Des Jeunes Operateurs* (Young Operators' Club) is the only French amateur and SWL club in the world. Membership is open to anyone, and new members are welcome—especially hams and SWL's of French descent who operate in the Montreal area. The club has free code and theory classes and yearly field trips. If interested, write directly to M. St. Hilaire, VE2PEIL, 7199 De Gaspe Ave., Montreal, Quebec, Canada.

the VFO input socket of your transmitter.)

When the wiring has been completed, feed 6.3 volts at 0.3 amp. to tube socket pin 4, and 250 to 300 volts, d.c., at approximately 10 ma., to the B+ tie point (both power points are bypassed to ground with .005-μf. ceramic capacitors *C3* and *C4*), and connect the B− return and the remaining 6.3-volt lead to chassis ground.

Operation. With *L1* shorted out and *C1* near minimum capacitance, the crystal used will oscillate close to its marked frequency. With some crystals, the position of *S1* has little effect on the oscillating frequency. With others, it has a relatively large effect. In any event, increasing the capacitance of *C1* lowers the frequency. Always check the frequency of oscillation before putting a signal on the air.

News and Views

Brian Kincaid, KN1PIF, 12 Prospect St., Winchester, Mass., uses a Heathkit DX-40 transmitter and a Hallicrafters S-86 receiver. He has two antennas—a 40-meter dipole and an 80-meter dipole. In three weeks on the air, Brian has worked 10 states, including California on 15 meters. However, his favorite activity is rag-chewing with the locals on 80 meters; he wants to bring up his code speed so he can get his General ticket . . . **Ken Gilbert, WA6GCB,** 704 Kingsford St., Monterey Park, Calif., worked 47 states and 25 countries in all continents as a Novice, transmitting with a Johnson Adventurer and receiving with a Heathkit AR-3. His three-element home-built beam had something to do with this record. Ken now has a Hallicrafters SX-101A receiver and has added two states and three countries to his total. He is a member of the Rag Chewers Club . . . **Thomas Zajkowski, WA2KGA,** 32½ Cornell St., Amsterdam, N. Y., made 400 contacts in 25 states in three months as a Novice using a Globe Chief 90A transmitter. Then he got his General ticket, an EICO 720 transmitter, and a Heathkit VFO. He now has over 1000 contacts in 40 states. Tom receives through a Hallicrafters SX-99 with an added Q-multiplier. A 20-wpm code certificate hangs on the shack wall. All of Tom's operating has been on 40-meter c.w., but an EICO modulator is in the works, and he has his eye on 20-meter phone DX, too.

Don Gwynne, Jr., K5EVI, 1204 NW 47 St., Oklahoma City, Okla., already has his Novice and Technician licenses and will soon have his General. He runs 40 watts on 40 meters to a converted BC-459 transmitter feeding a dipole antenna. In three weeks on the air, he has worked 16 states. Don offers to help prospective hams get their tickets and would like to be nominated for the Rag Chewers Club . . . **Marcia Guest, WV6MAZ,** 701 Ash St., Vandenberg AFB, Calif., has worked 32 states—27

(*Continued on page* 116)

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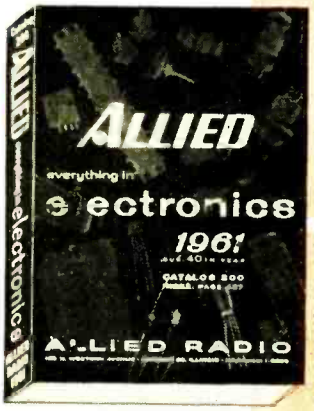

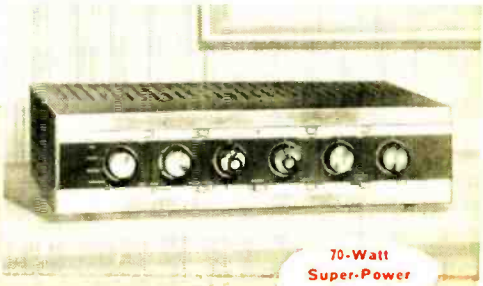

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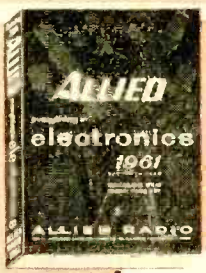

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confirmed—including many contacts with Hawaii and Alaska in her 2½-month Novice career. All contacts have been on 40 meters with a Globe Scout Deluxe feeding an inverted "V" antenna, which Marcia calls her "droopy dipole." She receives on a Hammarlund HQ-170. Marcia has a new Globe Champion on order to match her new General license. With it and the Mosley tri-band beam which her OM, WA6MFZ, already uses, she expects to get in some 20-meter phone and 20-meter c.w. operation.

Jim Demler, K9OXW, 5041 N. St. Louis Ave., Chicago 25, Ill., worked 42 states and Canada as a Novice with his Heathkit AT-1 transmitter, feeding a 120' wire, and a Hallicrafters S-38C receiver. Jim now has a 720 transmitter, a 730 modulator, a Knight R-100 receiver, and a two-element Thunderbird tri-band beam. He needs Wyoming and Nevada for his WAS. Although Jim has phone equipment, he prefers 10 and 15-meter c.w. He offers to help prospective hams get their licenses . . . **Art Roberts, KNØZQR,** 2895 Isabell, Golden, Colo., spent the first three months after he received his Novice license getting his equipment in order. He gathered together a DX-40 transmitter and an AR-3 receiver, he put up a home-brew vertical antenna, and he constructed the transmit/receive switch described in our August column. Then, in a single week on the air, he worked 21 states, all on 7191 kc. Art's best DX is Alaska, and his big question is "Where are all the VE's?" . . . If you need a Wyoming contact for WAS, **Dave Robertson, KN7LHZ,** 1101 East 18th St., Casper, Wyoming, will sked you. Forty meters is his favorite band. He uses a home-brew transmitter at 70 watts, an AR-3 receiver, and a dipole antenna. Dave also built the "Economy T/R Switch" in the August *Across the Ham Bands*—he says it works fine!

Bill, K7KST, 831 Shoremount Ave., Seattle, Wash., worked 30 states, including Alaska and Hawaii, in all U.S.A. call areas in his five-month Novice career. Now that he has his General, he is becoming interested in 6-meter operation! . . . **Dick McGlinn, KNØZSG,** 929 Garfield St., Emporia, Kans., is president of his high school radio club. He operates on 40 meters with a Heathkit DX-35 most of the time, but he also works 80 and 15 once in a while. His DX record is 23 states. Dick is another member of the Rag Chewers Club. Work him if you want to be nominated for it . . . **Bob Jones, W6EDG,** now stationed in the Philippines, cannot transmit, since he lacks a Philippine call. He does a lot of listening, however, and has recently heard the following stations on the 21-mc. Novice band: WV2JBP, WV2NAX, KN4ORD, KN4ZHI, KN4WRC, W4QDF, KN5ZTQ, KN5EEB, K5QFH, KN5CKD, WV6KJJ, WV6LHL, WG6AJI, KN7KVV, KN7KYR, KN7MGQ, KN7NHI/7, K7BBG, KN9YUE, KN9OQZ, K9HPY, KN9WIE, KN9ZJK, K9KUN, KN9ZKA, KN9UCQ, KN9WEZ, KN9YSH, KNØOQZ, and KNØBPO.

Let's have *your* reports, pictures, etc. Send them to: Herb S. Brier, W9EGQ, c/o POPULAR ELECTRONICS, One Park Ave., New York 16, N. Y. Merry Christmas, 73,

Herb, W9EGQ

Short-Wave Report

(*Continued from page* 80)

The following is a resume of current station reports. All times shown are Eastern Standard and the 24-hour system is used. At time of compilation reports are as accurate as possible; however, stations may change schedule and/or frequency with little or no advance notice. Please send all reports to P. O. Box 254, Haddonfield, N. J., in time to reach your Short-Wave Editor by the eighth of each month. (If you haven't yet sent for your Short-Wave Monitor Certificate and call letters, you'll find the registration form on page 109.)

Albania—Tirana apparently has moved to 7152 kc. and carries French news at 1700-1710, then music and talks to 1729 s/off, with closing ID in English. Tentatively noted is the Arabic Service at 2230. *(WPE1BM)*

The 9700-kc. outlet was tuned at 1930-2000 in Albanian. *(RK)*

Antigua—*R. Antigua*, 3255 kc., was noted from 1814 to 1849 s/off with pop music and Eng. anmts but severe QRM from aircraft. *(WPE1BD)*

Canada—There are conflicting reports on the Northern Service from *R. Canada*. Two reports show that the xmsn at 2300-2345 on Sundays on 11,720 and 9585 kc. has been discontinued while other reports show that the Northern Service has been extended to a full six-hour segment, running from 2300 to 0500 daily. A letter from *R. Canada* mentions that two 50-kw. xmtrs at Sackville, New Brunswick, will shortly begin regular eight-hour xmsns; no other details were given, so further inquiries are being made. *(WPE4BVK, VE2-PE3W, VE2PE4Y, CBC)*

Canary Islands—A new station is *La Voz de la Isla de la Palma* (located on the Isla de la Palma, *not* at Las Palmas on the island of Santa Cruz) on 7388 kc. It has been noted from 1530 to 1800/close, all-Spanish, with news at 1600 and 1700. *(WPE1BM, WPE1BY, WPE3NF)*

Cape Verde Islands—CR4AC, *R. Barlavento*, is readable after 1715 on 3950 kc. with classical music and Portuguese anmts. The signal is best after 1745. *(WPE3NF)*

Chile—Two stations from this country which are currently being noted are: CE1190, 11,940 kc., at 2000-2200; and CE960, *R. Presidente Balmaceda*, Santiago, 9600 kc., at 1900-2000. The latter is rated at 10 kw. and reports go to Nueva York 53, 10° Piso, Santiago. *(WPE3-HP, WPE6BAB)*

Cook Islands—*R. Raratonga*, ZK1ZA, 4965 kc., is now using a 1500-watt xmtr on Wednesday only at 2330-0130. *(WPE8HF)*

Cuba—COBZ, *R. Salas*, 9030 kc., Havana, is back on the air "after major repairs to equipment outside of the city," according to Guillermo W. Salas of COBZ. This station is noted at 2230-0000 with various musical programs and many talks. *(WPE1AGM. WPE4-AE, WPE7AT, KP4PE1G)*

A station tentatively identified as CMWB, Havana, has shown up on 15,180 kc., where it

(*Continued on page* 120)

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is heard in Spanish from 1630 to 2243/closing. *(WPE4AE, WPE6EZ, WPE9KM)*

Another station has been found on 7162 kc. with ID of *Transmite Radio Liberacion de Habana*. It carries many talks by Prime Minister Castro. This station was monitored from 0250 to 0305. *(WPEØAE)*

Dominican Republic—*R. Caribe* has moved HI2U from 6088 to 6210 kc. and HI3U from 9505 to 9485 kc. A mailbag program in Eng., French, and Spanish is given on Monday, Wednesday, and Friday at 1630-1730. *(WPE1RM, WPE2AXS, WPE2DM, WPE2FY, WPE3NF, WPE3OZ. WPE4AE, WPE4BC, WPE4HJ, WPE6EZ, WPE6UK, WPE8AIJ, WPE8FV, WPE9KM. WPE9YD, WPEOAE, SH)*

England—The British B/C Corp. operates to N.A. at 0600-0615 on 15,310 kc., at 0915-1315 on 21,675 kc., and at 1100-1315 on 25,840 kc. The General Overseas Service to N.A. is aired at 1615-1715 on 15,375 kc., at 1615-1915 on 11,860 kc., at 1715-2200 on 9510 kc., at 1730-2200 on 9825 kc., and at 1915-2200 on 6110 kc. An interesting note is the fact that the BBC will replace some of its 1932 xmtrs during the coming year. *(WPE1AAG, WPE1AW, WPE3NB, WPE8MS)*

Ethiopia—*R. Addis Ababa*, 9610 kc. (a move from 15,345 kc.), has an international music program at 1400-1500. You will have to dig deep to pull this one through. The ID is given every quarter hour. *(WPEØAE)*

Fiji Islands—The Fiji B/C Commission, Suva, operates currently with 500 watts on 3980 kc. and 250 watts on 5980 and 6005 kc. There will be a new 10-kw. unit on the air in March, 1961, and this will be followed by another 10-kw. xmtr scheduled to go into operation in October. *(WPE8MS, WPE6BAB)*

Germany—Here is the schedule for *Deutsche Welle*, Cologne. First Program: 0145-0445 on 21,650, 15,275, and 11,795 kc.; 0445-0745 on 21,705 and 17,815 kc.; 0745-1045 on 21,700 and 17,875 kc.; 1100-1400 on 15,405 and 11,795 kc.; 1215-1515 on 15,275 and 11,945 kc.; 1415-1715 on 15,405 and 9640 kc.; 1730-2030 on 11,945 and 9735 kc.; 1900-2200 and 2200-0100 on 11,795 and 9640 kc.; and 2045-2345 on 9735 and 5980 kc. Arabic Service: 0645-0730 on 21,650, 17,845, and 15,405 kc.; and 1415-1500 on 11,905 and 9735 kc. Test Programs: 0300-0430 on 21,735 and 17,815 kc.; 0500-0630 on 21,650, 17,845, and 15,405 kc.; 0845-1015 on 15,405 and 17,815 kc.; 1030-1200 on 17,815 and 15,275 kc.; 1230-1400 on 15,285 and 11,905 kc.; 1530-1700 on 15,310 and 11,795 kc.; 1715-1845 on 11,795 and 9605 kc.; 1900-2030 on 9735 and 5980 kc.; and 0000-0130 on 11,945 and 9735 kc. *(WPE1BDB, WPE1BDD, WPE1BM, WPE2ANW, WPE2AXS, WPE2TN, WPE5ANJ, WPE6AA, WPE6ATO, WPE6BKE, WPE8MS, VE7PE1R, BC)*

Ghana—Accra is scheduled as follows: 3366 and 4915 kc. at 0030-0300 and 1130-1715 (Saturdays to 1800); 4915 and 9640 kc. at 0700-1130. *(WPE2CRX, WPE6EZ)*

Greece—Reports for reception go to: The Hellenic National Broadcasting Institute, Technical Services Directorate, 7 P.P. Germanou, Athens, Greece. *R. Athens* has been heard on 17,778 kc. at 1230 with Eng. news. The IS is played on a flute. *(WPE8HF, WPE8MS)*

Guatemala—TGQB, Quetzaltenango, 11,700 kc., is definitely on the air on Sundays. The schedule reads: 0600-2300 on weekdays; 1100-2200 on Sundays. News in Spanish is given at 1150, 1245, 1345, and 1450. *(WPE4AE, WPE4-BC, WPEØAE)*

Liberia—ELBC, 3255 kc., Monrovia, is scheduled at 0145-1845 (to 1745 on Sundays), with news from London three times daily. There are newscasts in Bassa, Vai, Kpelle, Kru, Gola, Mandingo, and Larma. *(WPE1BM)*

Malaya—The BBC Far Eastern Station, Singapore, is heard well at 0445 on 9725 kc.

SHORT-WAVE CONTRIBUTORS

Stan Schwartz *(WPE1AAC)*, Bridgeport, Conn.
John Murphy *(WPE1AAG)*, Lowell, Mass.
Jim Silk *(WPE1AGM)*, Madison, Conn.
David Eastman *(WPE1AW)*, Ashton, R. I.
Anson Boice *(WPE1BD)*, New Britain, Conn.
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G. Brent Woodbridge *(GW)*, Ancaster, Ont.
Canadian Broadcasting Corp. (CBC), Montreal, Que.

and at 0700-0730 on 11,920 kc. *(WPE3HP, WPE4BC)*

R. Malaya, Kuala Lumpur, 7200 kc., has Eng. news and variety music at 0600-0630, with amateur QRM at times. *(WPE2CRX)*

Monaco—*R. Monte Carlo* has moved from

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	kw.—Kilowatts
BBC—British Broadcasting Corp.	N.A.—North America
Eng.—English	QRM—Interference
ID—Identification	R.—Radio
IS—Interval signal	s/off—Sign-off
kc.—Kilocycles	xmsn—Transmission
	xmtr—Transmitter

7140 to 7135 kc. and is strong at 1730 with music and French anmts. The 6035-kc. outlet carries Billy Graham's program on Mondays at 1705-1735. *(WPE1BM, WPE6BDO)*

Netherlands—Hilversum now uses 15,425 kc. for the xmsn at 1100-1230 (Sundays) and at 1700-1920 (daily). The frequencies replaced were 17,775 kc. and 15,220 kc., respectively. *(WPE2BRH, WPE3AJC, WPE4CAD, WPE9AGB, WPE9DN, WPEØBAP, VE7PE1R, IS)*

New Zealand—*R. New Zealand*, Wellington, operates as follows: to the Pacific Islands at 1200-1345 on 11,780 kc., at 1400-0045 on 15,280 kc., and at 0100-0345 on 9540 and 6080 kc.; to Australia at 1500-0045 on 15,280 kc., and at 0400-0645 on 9540 and 6080 kc.; to Samoa on Monday at 1540-1555 (repeated on Tuesday at 0200) and to the Cook Islands and Niue on Wednesday at 0210-0230 (repeated on Saturday at 0300) on 6080, 9540, 11,780, and 15,280 kc. The program to the Antarctica is broadcast on Sundays only at 0315-0345 on 11,780 kc. *(WPE3HP, WPE4FY, WPE6ATO, WPE6AWL, WPE8MS, WPE9ADW, and VE7PE4B)*

Norway—*R. Norway* has "Norway This Week" in Eng. on Sundays at 2105-2125 on 15,175, 11,850, 9610, and 6130 kc. The latter channel is usually blocked by Madrid, which operates at this time. *(WPE4BWQ, GW)*

Pakistan—Karachi has been noted on 9603 kc. at 1455 with classical music; s/off at 1459. English news is given at 0300 on 21,590, 17,745, 11,845, and 9645 kc. *(WPE3NF, GG)*

Paraguay—*R. Encarnacion*, ZPA5, Encarnacion, 11,940 kc., has pop music at 1800, a full ID at 1809, then more music. Reception of this station is generally from poor to fair. *(WPE1BM)*

Peru—*R. La Voz Del Altiplano*, 5820 kc., Puno, has been noted at 2200 with a request program titled "Correspondencia Musical." S/off at 0000. The listed channel is 5960 kc. Reports go to P. O. Box 130, Puno. *(GP)*

Portugal—Lisbon is beamed to Eastern U.S.A. and Canada in Eng. at 1900-1945 on 15,125 kc. and at 1945-2300 on 11,840 kc.; and to Western U.S.A. at 2100-2300 on 11,840 kc. *(GW)*

Rhodesia—The African Service from Lusaka, 3346 kc., is heard at 2310 with dance music and ID in native language. Check an Eng. ID at 2300. This is weak. *(WPE3NF)*

Senegal—Former *R. Mali* is now identifying as *R. Senegale*. It has been noted on 15,385 kc. at 1720 with music and French anmts; on 11,895 kc. at 1545 with Eng. news, dual to 7210

kc. The two latter channels close at 1830, but the 11,895-kc. channel operates again at 2220-0000. *(WPE1BD, WPE1BM, WPE2BRH, WPE4AE, WPE6UK, WPEOVB)*

Tanganyika—Dar-es-Salaam can be tuned on 5050 kc. in Swahili, from 2230 fade-in until about 2300 fade-out, on Sunday when *R. Cultura*, Venezuela, is off. Reports and comments go to Box 9191, Dar-es-Salaam. *(WPE1AAC, WPE1BM, WPE1BY)*

Turkey—Ankara operates to Europe at 1600-1645 on TAU, 15,160 kc., and to N.A. with a mailbag program on Sundays at 1815-1900 on TAT, 9520 kc. *(WPE9AGB)*

United Arab Republic—Cairo is now on 11,940 kc. to Europe with German to 1600, Italian at 1600-1630, Eng. at 1630-1730. S/off is at 1730 after ID in Arabic. *(WPE1BM)*

United Nations—Xmsns from the Geneva office are listed as follows: 0800-0815 on Mondays in Hungarian and 0845-0910 Monday to Friday in Russian on 9545 kc.; 0930-0945 on Saturdays in Persian on 17,770 and 11,905 kc.; 1420-1435 Monday to Friday in Arabic on 11,-810, 9575, and 6010 kc. The 9545-kc. outlet is a regular Swiss outlet; the others are Rome outlets. Geneva's verification card is the same as the one used by the New York headquarters. *(WPE1BM)*

WSK37, New York, 17,430 kc., operates at 1400-1414 with a U.N. Report in French. Dual channels: WLWO on 21,485 and 15,250 kc. *(WPEOAE)*

Vatican City—The Vatican Radio broadcasts on 17,840 kc. in Eng. at 1100-1115 (Monday, Wednesday, Saturday only) beamed to India and Pakistan. Other Eng. periods are scheduled at 1315-1328 and 1000-1015 on 9646, 11,685, 17,735, 21,515, and 21,740 kc. *(WPE3-AJC, WPE7UQ)*

Vietnam—*R. Saigon* can be tuned on 9754 kc. with native music at 0500-0520, and on 7265 kc. in Eng. at 0800-0845 with news, music, and dictation news. They verify with a large card. *(WPE2CRX, WPE7AT)*

Clandestine—*R. Free & Fighting Algeria* was noted at strong level with talks in Arabic at 1630. *(WPE3NF)*

—30—

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Solution to crossword puzzle appearing on page 68.

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Transistor Topics

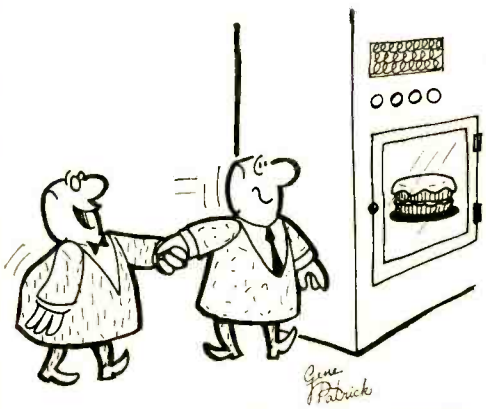
(*Continued from page 89*)

teristics of germanium and silicon, semiconductor manufacturers have been investigating a variety of alternate materials. To date, the material showing the greatest promise is a compound made up of elements from the III and V columns of the Periodic Table—gallium arsenide. Although mass-production problems have not been completely solved as yet, this compound of gallium and arsenic already is being used in tunnel diodes. Tests and theoretical studies indicate that its future possibilities are tremendous—that its temperature characteristics are roughly twice as good as silicon, and that it can be employed in diodes, transistors, thermistors, and solar batteries, in every case performing better than currently used materials.

Product News. Out on the West Coast, Pacific Semiconductors, Inc. (Culver City, Calif.) has developed a solid-state generator delivering one watt at 1000 mc. This represents a power output about 100 times greater than has been achieved previously using commercially available semiconductor devices.

Not to be outdone in the u.h.f. field, Philco's Lansdale Division has just announced the pilot production of the highest frequency transistor commercially available. Identified as a coaxial micro-alloy diffused-base transistor, this unit has a maximum frequency of oscillation of approximately 4000 mc. The current price for pilot quantities is $125.00 *each*—in the event you'd like to order a dozen or so.

—Lou



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3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

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MATTHEW T. BIRMINGHAM, JR.
Business Manager

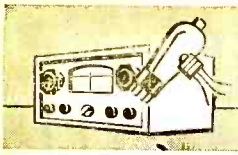
Sworn to and subscribed before me this 6th day of October, 1960.

(SEAL) WILLIAM PROEHMER,
Notary Public
(My commission expires March 30, 1962)

POPULAR ELECTRONICS

Advertiser's Index

DECEMBER 1960



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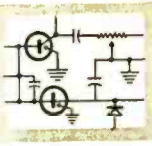

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BUY War Surplus Direct from the Government—Jeeps; Trucks; Tractors; Boats; Airplanes; Helicopters; Walkie-Talkies; Radar; Electronics; Misc.—Send for Brody's "U. S. Depot Directory & Procedures" $1.00. Box 425-(PE), Nanuet, New York.

DRAFTING Service; Blue print drawings made from sketches, layouts or actual parts. Write: Nicholas Peters, 15 Lorelei Dr., Box 2110, Yorktown Hgt's, N. Y.

FREE! New 1960 catalog of all photographic books available. For your copy, send postcard with name and address to Catalog, Popular Photography Book Service, One Park Ave., New York 16, N. Y.

SHOPPING GUIDE
Classified

A HANDY REFERENCE TO PRODUCTS AND SERVICES NOT NECESSARILY ELECTRONIC, BUT OF WIDE GENERAL INTEREST.

STAMPS & COINS

BACK-UP coin file, nothing like it—ten year visible storage unit $1.95. Holdit Plastics, 8160 Orion Avenue, Van Nuys, Calif.

OVER 400,000 buyers and sellers will read your ad when placed in this space. It costs only 50¢ per word; minimum of 10 words including your name and address.

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GIGANTIC Collection Free! Includes triangles, early United States, animals, commemoratives, British Colonies, high value pictorials, etc. Complete collection plus big illustrated magazine all free. Send 5¢ for postage. Gray Stamp Company, Dept. Z2, Toronto, Canada.

WRITE Martin Lincoln, Popular Electronics, One Park Avenue, New York 16, N. Y. for information on how to place a classified ad in this section.

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NEW Liquid Casting Plastic, clear, colors. Embed real flowers, butterflies, photos, coins. Send 25¢ for two handbooks "How to Cast Liquid Plastics" and "How to Make Extra Money at Home." Castolite, Dept. P-108, Woodstock, Illinois.

INVENTIONS WANTED

INVENTIONS wanted. Patented; unpatented. Global Marketing Service, 2420-P 77th, Oakland 5, Calif.

INVENTIONS wanted, patented, unpatented. J. T. Invention Sales Company, 25 Fayette St., Brooklyn 6, N. Y.

MAGNETS

ALNICO Permanent magnets. Hobbyist Assortment (surprises). $2 (refundable). Postpaid. Magnetics, 7777 Sunset Dept. PC, Los Angeles 46.

PHOTOGRAPHY—FILM EQUIPMENT, SERVICES

FREE! New 1960 catalog of all photographic books available. For your copy, send postcard with name and address to Catalog Popular Photography Book Service, One Park Ave., New York 16, N. Y.

GUARANTEED quality processing, 35mm, 8mm Kodachrome $1.00. Send for free mailers, photographic discount catalogue. Carterchrome, Box 645, Utica 1, New York.

FREE! Blackhawk's big sale catalog 8mm., 16mm. movies, 2" x 2" color slides. Biggest selection anywhere! Projectors, cameras, supplies—big discounts! Get free every three weeks, 12-page newspaper size bargain list! Blackhawk Films, Davenport 24, Iowa.

OPTICAL-Science-Math Bargains—Request Free Giant catalog "CJ"—128 pages—Astronomical Telescopes, Microscopes, Lenses, Binoculars, Kits, Parts, Amazing war surplus bargains. Edmund Scientific Co., Barrington, New Jersey.

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FREE "Do-It-Yourself" Leathercraft Catalog. Tandy Leather Company, Box 791-R36, Fort Worth, Texas.

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GROW Mushrooms. Cellar, shed and outdoors. Spare, full time, year round. We pay $4.50 lb. dried. We have 29,000 customers. Free Book. Mushrooms, Dept. 334. 2954 Admiral Way, Seattle, Wash.

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RADIO Parts Stores & Hi-Fi Salons! Someone "borrowing" your personal copy of Popular Electronics each month? You ought to be taking advantage of Popular Electronics' convenient resale plan. Sell copies in your store . . . perform a good service for your customers . . . with no risk involved. For details, write: Direct Sales Department, Popular Electronics, One Park Avenue, New York 16, New York.

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DETECTIVES—Experience unnecessary. Detective Particulars, Wagoner, 125-Z, West 86th, N. Y.

PLENTY Jobs. Nationwide-Worldwide. Hel. Elsinger, Box 12, Detroit 13, Mich.

MISCELLANEOUS

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INVESTIGATE Accidents—Earn $750 to $1,000 monthly. Thousands of insurance companies, airlines, steamship lines urgently need Accident Investigators. Free Book. WRITE: Universal Schools CZ-11, 6801 Hillcrest, Dallas 5, Texas.

FUN gifts and jokes galore. Catalog 10¢. Greenland Studios, Miami 47, Florida.

WHATEVER your needs, Popular Electronics classified can solve them. Simply place an ad in these columns and watch your results pour in.

ELECTRO-Scribe! Engraves all Metals. $2.00. Beyer Mfg., 10511-ZD, Springfield, Chicago 43.

WIN contest money. Our Contest Bulletin gives hundreds of tips. Lists current contests, rules. Sample, 25¢. General Contests, 1609-F, East Fifth St., Duluth, Minn.

"HOMEBREW." Make it yourself. Complete instructions $1.75. Homecrafts, Box 587-A, Bellevue, Nebraska.

DIESEL injector parts and fuel pumps wanted—GM51-53-71-110. Ted, 2093 East 19 Street, Cleveland 15, Ohio.

SPORT stop wristwatch $9.95, Checkwriter $8.95, Golf Cart $14.95. Tweco, 155, Indio, Calif.

AUTHORS! Learn how to have your book published, promoted, distributed. Free booklet "ZD" Vantage, 120 West 31 St., New York 1.

"WINEMAKING, Beer, Ale." Highest powered methods. Illustrated. $2.20. Eaton Bookstore, Box 1242-C, Santa Rosa, California.

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NEVER FAIL— **ZONE** YOUR MAIL

The Post Office has divided 106 cities into postal delivery zones to speed mail delivery. Be sure to include zone number when writing to these cities; be sure to include **your** zone number in **your** return address—after the city, before the state.

EXAMINE ANY OF THESE TESTERS *BEFORE* YOU BUY!!

Yes, we offer to ship *at our risk* one or more of the testers described on these pages.

The Model 88.... A New Combination

TRANSISTOR RADIO TESTER and DYNAMIC TRANSISTOR TESTER

The Model 88 is perhaps as important a development as was the invention of the transistor itself, for during the past 5 years, millions of transistor radios and other transistor operated devices have been imported and produced in this country with no *adequate* provision for servicing this ever increasing output.

The Model 88 was designed specifically to test all transistors, transistor radios, transistor recorders, and other transistor devices *under dynamic conditions*.

Model 88 TRANSISTOR RADIO TESTER & TRANSISTOR TESTER . . . Total Price . . . $38.50

Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

AS A TRANSISTOR TESTER

The Model 88 will test all transistors including NPN and PNP, silicon, germanium and the new gallium arsinide types, *without referring to characteristic data sheets*. The time-saving advantage of this technique is self evident. A further benefit of this service is that it will enable you to test new transistors as they are released!

The Model 88 will measure the two most important transistor characteristics needed for transistor servicing; leakage and gain (beta).

The leakage test measures the collector-emitter current with the base connection open circuited. A range from 50 ohms to 100,000 ohms covers all the leakage values usually found in both high and low power transistor types.

The gain test (beta) translates the change in collector current divided by the base current. Inasmuch as the base current is held to a fixed value of 50 microamperes, the collectar current calibrated in relative gain (beta), is read directly on the meter scale.

AS A TRANSISTOR RADIO TESTER

We feel sure all servicemen will agree that the instruments and methods previously employed for servicing conventional tube radios and TV have proven to be impractical and time consuming when used for transistor radio servicing. The Model 88 provides a new simplified rapid procedure — a technique developed specifically for radios and other transistor devices.

An R.F. Signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble whether it be a transistor, some other component or even a break in the printed circuit is located and pin-pointed. The injected signal is heard on the front panel speaker as it is followed through the various stages. Provision has also been made on the front panel for plugging in a V.O.M. for quantitative measurement of signal strength.

The Signal Tracing section may also be used less the signal injector for listening to the "quality" of the broadcast signal in the various stages.

Model 88 comes housed in a handsome portable case. Complete with a set of Clip-On Cables for Transistor Testing, an R.F. Diode Probe for R.F. and I.F. Tracing; an Audio Probe for Amplifier Tracing and a Signal Injector Cable. Complete — nothing else to buy! Only **$38.50**

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Order merchandise by mail, including deposit or payment in full, then wait and write . . . wait and write?

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Obviously prompt shipment and attention to orders is an essential requirement in our business . . . We ship at *our* risk!

NO CONTRACT TO SIGN
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The sample order authorization included in this offer is *all* you sign. We ask only that you promise to pay for or return the goods we ship in good faith.

EXAMINE ANY ITEM YOU SELECT IN THE PRIVACY OF YOUR OWN HOME

Then if completely satisfied pay on the interest-free terms plainly specified. When we say interest-free we mean not one penny added for "interest" for "finance" for "credit-checking" or for "carrying charges." The net price of each tester is plainly marked in our ads—that is all you pay except for parcel post or other transportation charges we may prepay.

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

THE *ONLY* 20,000 OHMS PER VOLT V.O.M. SELLING FOR LESS THAN $50 WHICH PROVIDES *ALL* THE FOLLOWING FEATURES:

- **6 INCH FULL-VIEW METER** provides large easy-to-read calibrations No squinting or guessing when you use Model 80
- **MIRRORED SCALE** permits fine accurate measurements where fractional readings are important
- **CAPACITY RANGES** permit you to accurately measure all condensers from .00025 MFD to 30 MFD in addition to the standard volt, current, resistance and decibel ranges
- **HANDSOME SADDLE-STITCHED CARRYING CASE** included with Model 80 Allmeter at no extra charge enables you to use this fine instrument on outside calls as well as on the bench in your shop.

SPECIFICATIONS

7 **D.C. VOLTAGE RANGES**
(At a sensitivity of 20,000 Ohms per Volt)
0 to 15/75/150/300/750/1500/7500 Volts.

6 **A.C. VOLTAGE RANGES**
(At a sensitivity of 5,000 Ohms per Volt)
0 to 15/75/150/300/750/1500 Volts

3 **RESISTANCE RANGES**
0 to 2,000/200,000 Ohms. 0-20 Megohms.

2 **CAPACITY RANGES:**
00025 Mfd. to .3 Mfd., .05 Mfd. to 30 Mfd.

5 **D.C. CURRENT RANGES**
0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.

3 **DECIBEL RANGES:** — 6 db to + 18 db.
+ 14 db to + 38 db + 34 db to + 58 db

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. Only $42.50

Model 80 ALLMETER . . . . . .
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.

NOTE: The line cord is used only for capacity measurements. Resistance ranges operate on self-contained batteries.

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

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.

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-824 3849 Tenth Ave., New York 34, N. Y.

Please send me the units checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

☐ **Model 88 Total Price $38.50**
$8.50 within 10 days. Balance $6.00 monthly for 5 months.

☐ **Model TV-50A . . Total Price $47.50**
$11.50 within 10 days. Balance $6.00 monthly for 6 months.

☐ **Model 85 . . . . . Total Price $52.50**
$12.50 within 10 days. Balance $8.00 monthly for 5 months.

☐ **Model 77 Total Price $42.50**
$12.50 within 10 days. Balance $6.00 monthly for 5 months.

☐ **Model 80 Total Price $42.50**
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Superior's New Model 85—*a DYNAMIC type* **TRANS-CONDUCTANCE**

TUBE TESTER

Model 85—Trans-Conductance Tube Tester. Total Price—$52.50.
Terms: $12.50 after 10 day trial, then $8.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary

● Employs latest improved TRANS-CONDUCTANCE circuit. Tests tubes under "dynamic" (simulated) operating conditions. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured as a function of tube quality. This provides the most suitable method of simulating the manner in which tubes actually operate in radio, TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

● **SYMBOL REFERENCES:** For the first time ever in a trans-conductance tube tester, Model 85 employs time-saving symbols (★, +, ●, ▲, ■;) in place of difficult-to-remember letters previously used. Repeated time studies proved to us that use of these scientifically selected symbols speeded up the element switching step. As the tube manufacturers increase the release of new tube types, this time-saving feature becomes more necessary and advantageous.

● **THE "FREE-POINT" LEVER TYPE ELEMENT SWITCH ASSEMBLY** marked according to RETMA basing, permits application of test voltages to any of the elements of a tube. The addition of an extra switch position permits the application of the necessary grid voltage needed for dynamic testing and insures against possible obsolescence due to changes in basing design.

● **NEW IMPROVED TYPE METER** with *sealed air-damping chamber* provides accurate, *vibrationless* readings.

● **FREE FIVE (5) YEAR CHART DATA SERVICE.** The chart provided with Model 85 includes easy-to-read listings for *over 1,000 modern tube types*. Revised up-to-date subsequent charts will be mailed to all Model 85 purchasers *at no charge* for a period of five years after date of purchase.

● **SPRING RETURN SAFETY SWITCH** guards Model 85 against burn-out if tube under test is "shorted."

● **7 AND 9 PIN TUBE STRAIGHTENERS** have been included on the front panel to eliminate possibility of damaging tubes with bent or out-of-line pins.

● **AN ULTRA-SENSITIVE CIRCUIT** is used to test for shorts and leakages up to 5 megohms between *all* tube elements.

Model 85 comes complete, housed in a handsome portable cabinet with slip-on cover. Only..... **$52.50**

Superior's New Model TV-50A **GENOMETER**

7 Signal Generators in One!

Model TV50-A—Genometer
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

- **R.F. Signal Generator for A.M.**
- **R.F. Signal Generator for F.M.**
- **Audio Frequency Generator**
- **Marker Generator**
- **Bar Generator**
- **Color Dot Pattern Generator**
- **Cross Hatch Generator**

This Versatile All-Inclusive **GENERATOR** Provides **ALL** the Outputs for Servicing:
● **A.M. RADIO** ● **F.M. RADIO** ● **AMPLIFIERS** ● **BLACK AND WHITE TV** ● **COLOR TV**

R. F. SIGNAL GENERATOR: 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: Provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

MARKER GENERATOR: The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency)

BAR GENERATOR: Pattern consists of 4 to 16 horizontal bars or 7 to 20 vertical bars.

DOT PATTERN GENERATOR (FOR COLOR TV): The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

CROSS HATCH GENERATOR: The pattern consists of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

Complete with shielded leads **$47.50 Net**

TRY FOR 10 DAYS *BEFORE* you buy *THEN* if satisfact

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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