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POPULAR ELECTRONICS

APRIL 1959

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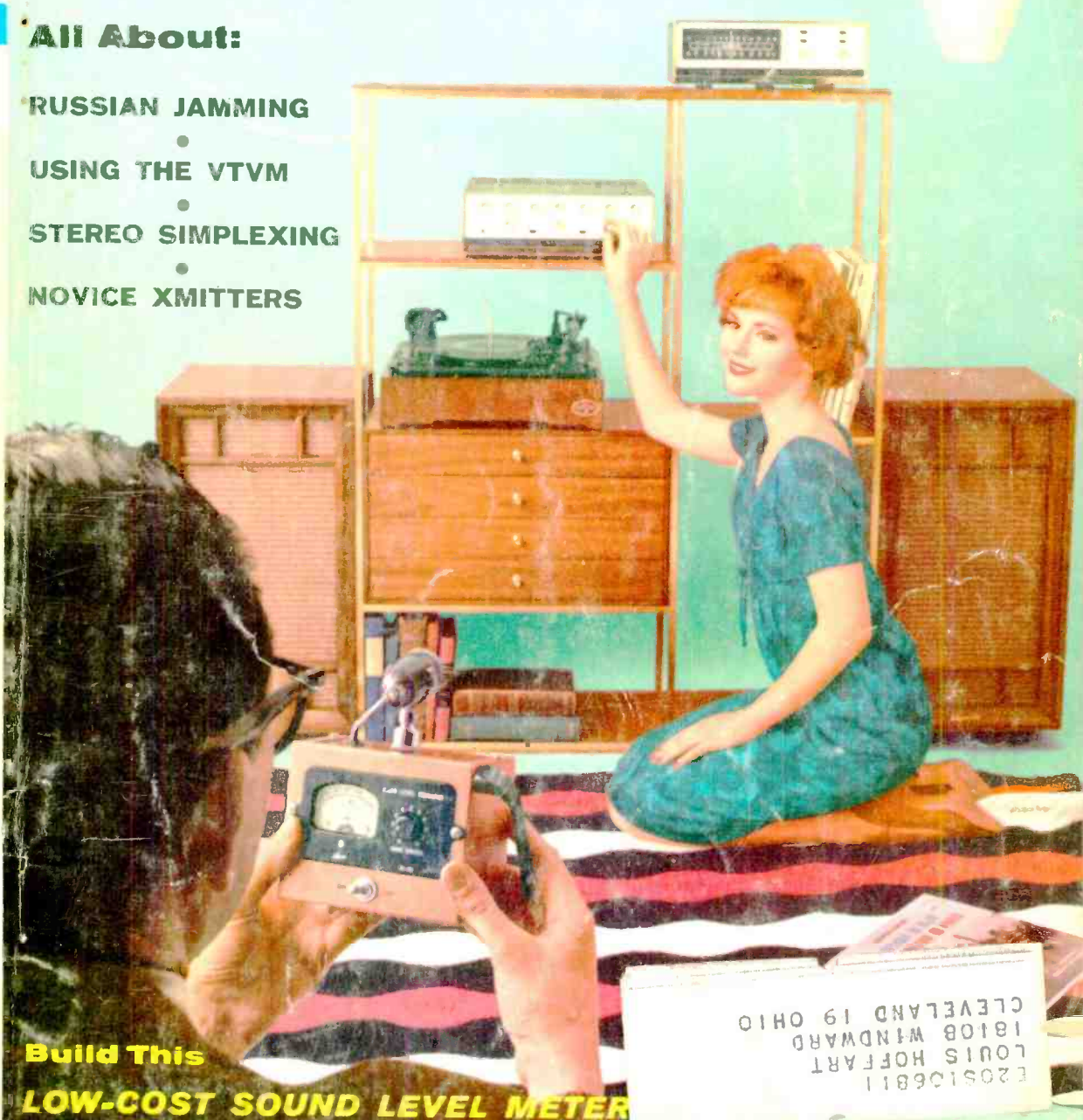

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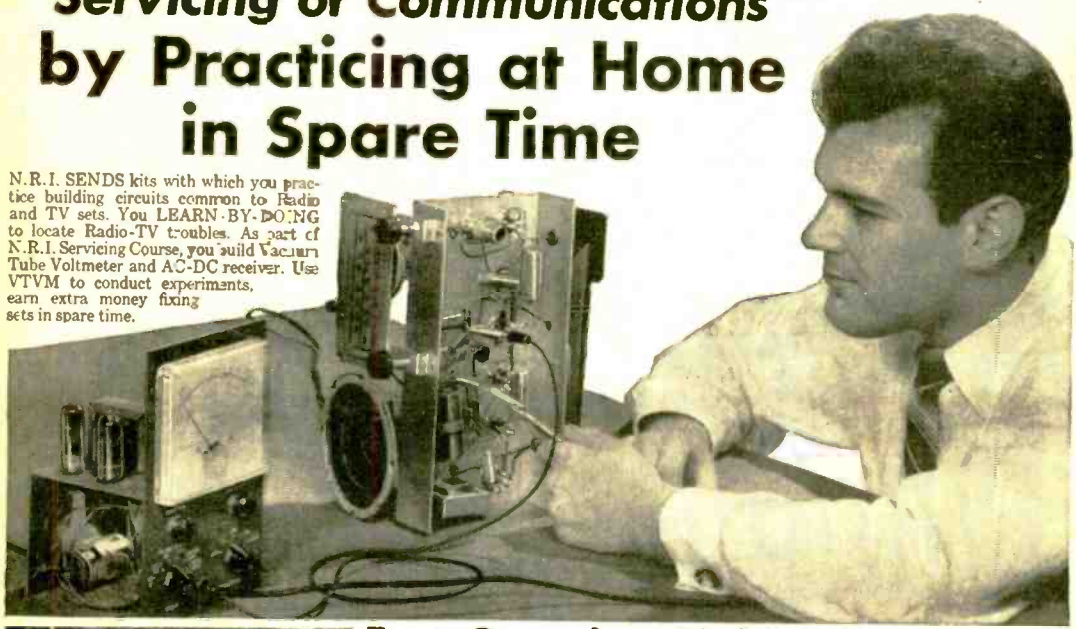

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POPULAR ELECTRONICS

APRIL 1959

VOLUME 10 NUMBER 4

Special Features

Electronic Construction Projects

Audio and High Fidelity

Electronic Features and New Developments

Amateur and SWL

Departments

POPULAR ELECTRONICS

World's largest-selling Electronics Magazine

This month's cover photo by Joe Petrovec Hi-fi equipment courtesy of Garrard Sales Corp. (record changer), Stromberg-Carlson (amplifier and tuner), and University Loudspeakers (speaker systems). Lamp courtesy of Arco Lighting Center.

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COMING NEXT MONTH

(ON SALE APRIL 23)

Our May cover will picture a new Swiss-made color television projection system which is setting new standards of quality. A feature article describing this device, called the Eidophor, explores the technical details of its operation.

Ordinarily, a complete six-meter station would be a complicated construction task for the beginner. However, through the use of four commercial subassembly model kits a complete six-meter rig can be built at a substantial saving in time and money. Our May issue tells you how. And as a hi-fi bonus for those audiophiles who are wondering what this electrostatic tweeter business is all about—we have in the works a build-it-from-scratch three-element system with a total construction cost of under $5.00.

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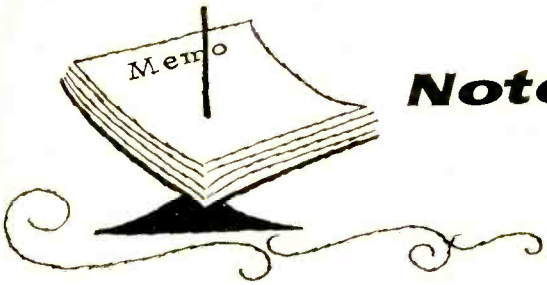


Notes from the Editor

EVOLUTION OF A MAGAZINE. In October of 1954, a new magazine appeared on the newsstands. Although many people doubted whether this magazine could survive the fierce competition for the attention of the American public, it not only survived, but it prospered--so much so, in fact, that it became the world's largest-selling magazine dealing with electronics. As you no doubt realize, the name of this magazine was, and is, POPULAR ELECTRONICS.

Through the years, one of our sorest points has been the use of a comparatively rough paper stock. You are now reading, for the first time, a copy of POPULAR ELECTRONICS which has been printed on a high-grade paper stock. You are also holding in your hands this month a magazine which contains a "bonus" of 32 extra pages of articles. We plan to continue this "bonus" feature indefinitely. And in the months ahead there will be more changes and improvements. We hope you will be as enthusiastic about their completion as we are about their inception.

SIMPLEX STEREO. A new circuit design from the laboratories of CBS should give another big boost to the stereo boom. This design, actually an improvement of an older circuit, makes it possible for what is basically a single amplifier to amplify two signals simultaneously, and each channel provides an effective power output equal to that supplied by the original amplifier.

For full information on how simplexing works, see "Stereo Simplexing Simplified" on page 45. Immediately following it, there is an article on how to build a simplexed amplifier.

COMPLETE SIX-METER STATION. Next month's issue of POPULAR ELECTRONICS will feature a project which should be popular with our ham readers. Don Stoner, W6TNS, has put together a complete six-meter station for us. This station, which consists of a 30-watt transmitter and a converter that connects to your regular broadcast receiver, is built in module form.

These modules are available either in kit form or as completed units, and the whole station fits on a 15" x 7" x 3" chassis. Sound interesting? Don't miss the May issue for all the details.

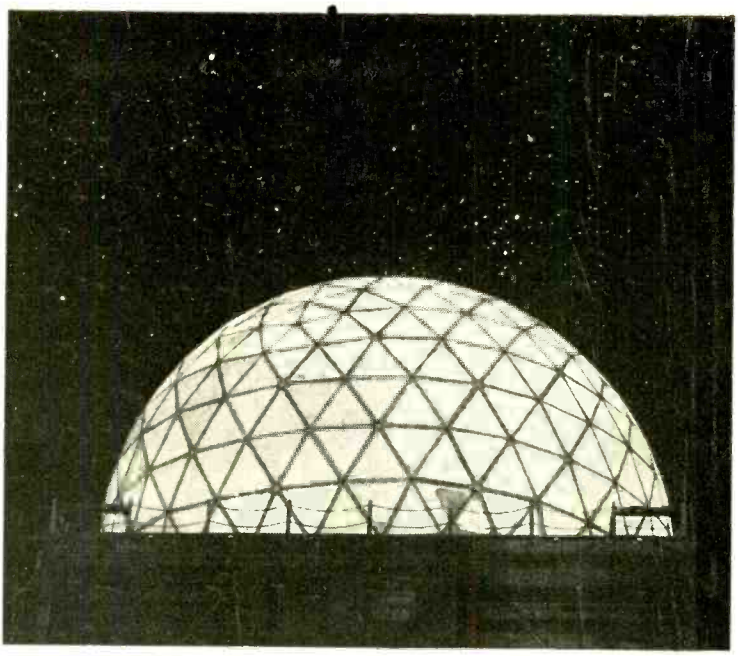
CONSTRUCTION PROJECTS. "Build-it-yourself" electronic gadgets are a very important part of our magazine. We're always on the lookout for good construction articles, so if you've worked up something that you think would be of interest to your fellow readers, drop us a line describing the unit.

If your gadget is "real hot," we will give you an assignment to write it up. You never can tell--you may see your name in print.

Oliver Read

POPULAR ELECTRONICS

THE ARCTIC EYE THAT NEVER SLEEPS



This plastic radome houses a radar antenna constantly scanning the skies to detect the presence of aircraft. A long line of these radars provides early warning of any threatening approach to the North American continent.

The Distant Early Warning Line is now on perpetual guard duty. Spanning the Arctic from Baffin Island to Alaska, this great system was conceived at the Lincoln Laboratory of M.I.T. and produced under the leadership of Western Electric.

But first the DEW Line had to be engineered into a workable system. This was done at Bell Telephone Laboratories.

The obstacles were formidable. Conventional means of communication—telephone poles, cables and even line-of-sight microwave radio—weren't feasible. A complicated system had to be made to operate reliably in a climate so cold that outdoor maintenance is impracticable farther than a few hundred feet from heated habitation.

Whenever possible, Bell Laboratories engineers utilized well-proven art. But as it became necessary, they innovated. For example, they designed and directed the development of a new and superior radar which automatically scans the skies, pinpoints a plane and alerts the operator.

To reach around the horizon from one radar station to another, they applied on a massive scale a development which they pioneered—transmission by tropospheric scatter. Result: at a DEW Line Station you can dial directly a station more than a thousand miles away and converse as clearly as with your home telephone.

Bell Laboratories' contribution to the DEW Line demonstrates again how telephone science works for the defense of America.

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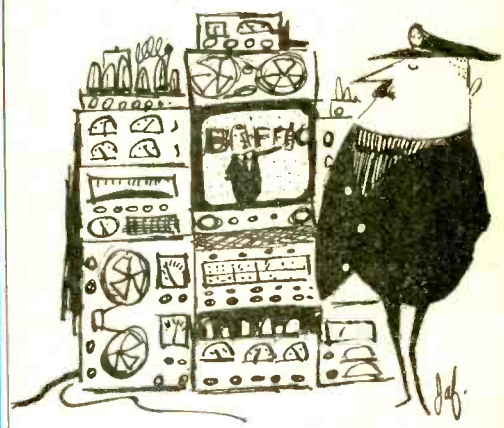
Letters from our readers

Attention, Circuit Designers

■ I am a radio officer aboard seagoing vessels, and would like to work out a system with my TV and recorder (tape) so that I can record TV pictures and sound on tape from my TV while in ports, and then play the taped TV programs back later while at sea.

I would be very grateful if your technical staff could design a small transistor transmitter to play the tapes back. Also, I would like to know how to build and wire into the TV set to convert the picture signals so that they can be recorded on tape—



would more than one recording head be required? Or would it be cheaper to wire into the same TV set for playback instead of a transmitter?

With this setup, one would make up his own TV tape library, and play the tapes years later if he wanted to. Any designs and suggestions from you and your staff will be appreciated very much.

RICHARD CARTER, W6JJY
Fullerton, Calif.

Since it took Ampex and RCA quite a while to develop the type of equipment you desire, we will have to admit that such design is beyond us. If you would like to buy one of these units prewired and tested, however, they can be had for about $50,000.

If you need other design information, we suggest that you contact manufacturers of electronic parts. We regret that it is impossible for the staff of POPULAR ELECTRONICS *to design specific items of electronic equipment for our readers.*

Contra-Polar Energy

■ I recently read your article on Contra-Polar Energy in the April 1955 issue of POPULAR ELEC-

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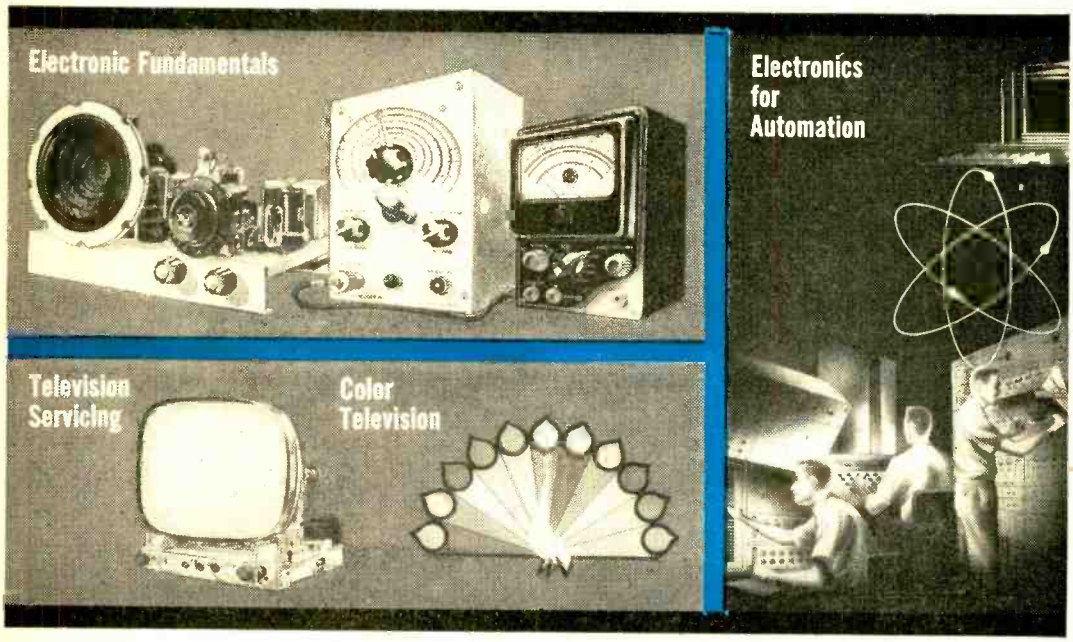

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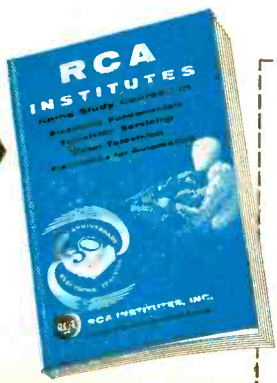

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Letters

(*Continued from page* 10)

TRONICS. I would like to know if this phenomenon has actually been produced or if it is purely theoretical. Also, if this is real, could you furnish information for obtaining a practical circuit. Finally, what are the properties of a negative frequency? Thank you for your trouble.

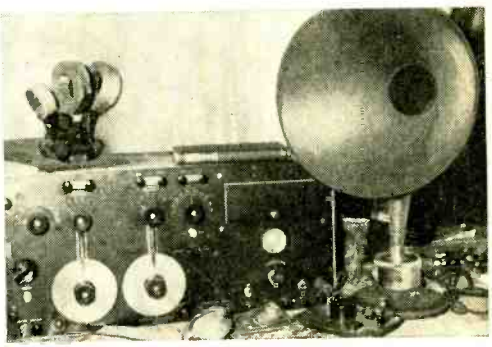
LAWRENCE JENKINS
Cuyahoga Falls, Ohio

The subtitle with this article read: "In keeping with the first day of April." If any of our readers who own the April 1955 issue haven't yet debunked this article, please write in ink across page 27, "April Fool."

Quality Holds Out

■ In your December 1958 issue, the article on "The VLF Receiver" was very interesting. I have a receiver of about that vintage along with four honeycomb coils and an old speaker. The picture will show you what they look like.

The receiver in the picture is a Radiomarine Corporation of America Type 1P-501-A receiver amplifier—wavelength 300-8000 meters. Two of



the coils are Duo Lateral, dated June 1, 1920—April 3, 1923, manufactured by Electra Products Co.; a third coil is Type 500 by DeForest and another is Type Trs 35 by Giblin Remler. The speaker is a Rola Re-Creator by Rola Co. of Oakland, Calif.

I have used this receiver to pull in the local airways beacon, and it does very nicely. Also, it is interesting to know that a speaker horn of this type is actually an amplifier. The volume without the speaker is very low, but by adding the speaker it is amplified considerably.

Some of the older equipment is pretty hard to beat. I use a 1934 Sargent receiver when the going gets bad here, and seem to do better than with a lot of the newer equipment—less adjustments on parts going out and lining up.

E. MOLLOHAN
Bristol Bay, Alaska

Oops!

■ We have recently received requests which indicate that in your January 1959 issue you mentioned that our publication, Air Navigation Radio Aids, is obtainable free. It is issued on January 1, April 1, July 1 and October 1 each year, with correction supplements at the beginning of every intervening month, and is charged for as follows:

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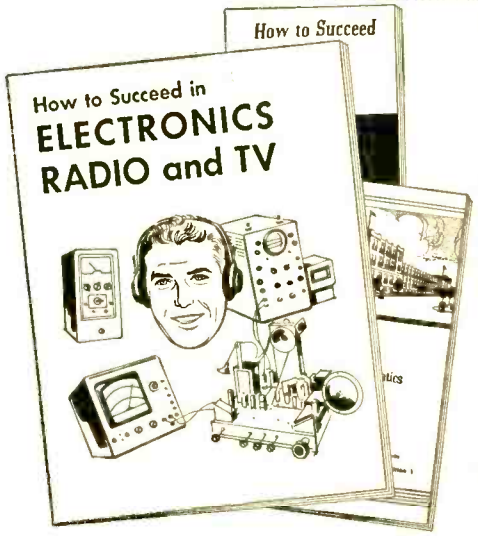

Here's your chance to find out where you're going—fast! And it won't cost you a thing except the time it takes to clip and mail the coupon at the bottom of this page.

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F. G. NIXON, Director
Telecommunications Branch
Department of Transport
Ottawa, Canada

Improved Electric Clown

■ I have completed and given to my son the electric clown that was described on page 53 of the November 1958 issue of POPULAR ELECTRONICS.

I did not follow the schematic exactly. I substituted a 6-volt radio A battery for the current supply of 100 volts. I also used a #47 pilot lamp for the nose. Instead of painting the face as suggested, I used felts of various colors cut and glued to the box.

One correction I would like to make on Mr. Smith's diagram concerns using the case as half of the circuit. Standard bells and buzzers also have half their circuits grounded to their cases. This means that they would have to be insulated from the case to work. None of the available insulators I found were sufficiently child-proof. Instead, I employed wiring as the case half of this circuit.

My son is only eighteen months old, but he has used this toy quite a bit, and is fascinated by it.

EDWARD BRUTSCH
Pittsfield, Mass.

Tube Switch in Receiver

■ In your December 1958 issue there is a very low frequency receiver circuit employing a medium-mu dual triode 6BK7A. If a high-gain dual triode is used, say a 12BZ7, much looser coupling in the receiver could be used for the same gain and greater selectivity would result. The lead dress would be more critical because of the higher gain of the 12BZ7 tube.

GEORGE MACHAMER
Chicago, Ill.

The 6BK7A was used in the basic design because of the non-critical wiring required. Feel free to experiment, however. This is one of the best ways to gain knowledge in electronics.

What's with Watts?

■ Your article in January POPULAR ELECTRONICS titled "High Power for Hi-Fi" contains errors that should be corrected.

Mr. Ward compares 2% distortion of a 10-watt amplifier with ½ of 1% distortion of a 60-watt amplifier. *At first glance,* it seems obvious that 2% is greater than ½ of 1%—but it is not. Two percent means .02 x 10 watts, or .20. One-half of 1% means .005 x 60 watts, or .30. Arguments for

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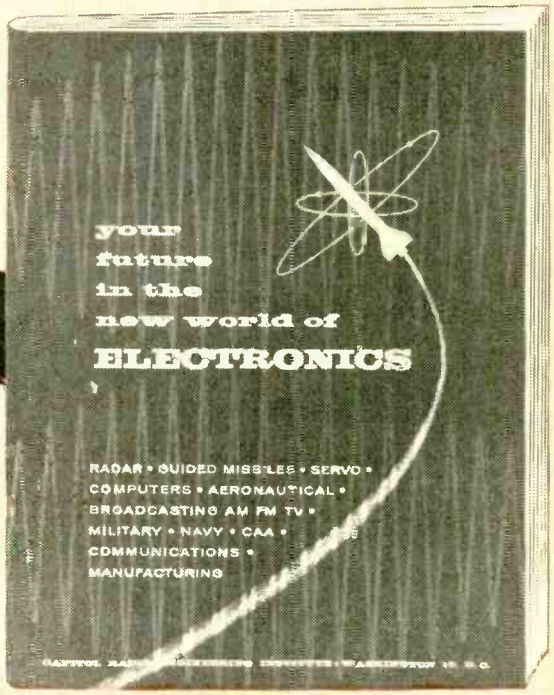

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CHECK FIELD OF GREATEST INTEREST

- ☐ Radar, Servo and Computer Engineering Technology
- ☐ Electronic Engineering Technology
- ☐ Broadcast (AM, FM, TV) Engineering Technology
- ☐ Television Engineering Technology
- ☐ Aeronautical Electronic Engineering Technology
- ☐ Automation and Industrial Electronics Engineering Technology

F1

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

Street .....

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

CHECK: ☐ Home Study ☐ Residence School ☐ Korean Veteran

TO OBTAIN FAST, IMMEDIATE SERVICE AND TO AVOID DELAY, IT IS NECESSARY THAT THE FOLLOWING INFORMATION BE FILLED IN:

Employed by.....

Type of Present Work.....

Education:

Yrs. High School.....

Other .....

Electronics Experience .....

.....

Letters

(*Continued from page* 14)

oversized, overheated amplifiers are about as logical as using a 10-ton truck to carry a 10-pound package.

I enjoy your construction articles, and hope to see more of them.

KEN MADSEN
Elmhurst, Ill.

Common sense says you should trust your first reaction, or first glance. Percentage figures can only be compared to other percentage figures. If you can prove that ½ of 1% is more than 2%, you have pulled off the mathematical stunt of the century.

Novice Talk

■ We Novices often hear General Class amateurs complaining about our signal reports. If these Generals but knew that the Novice system of RST reporting is dissimilar to that of everyone else, maybe they wouldn't squawk so loud. With

three full months of Novice experience behind me I shall try to translate some typical reports.

299—Who knows how to give signal reports?
358—I didn't like your report.
477—My receiver drifts.
489—This is the second time I've worked you.
539—My "S" meter is out of adjustment.
555—Five is the only number I can send with this bug.
579—We are on 15 meters.
589—We just changed to 80 meters.
599—You are my best DX, or, you and I have the same rig.

Keep this list on your wall at all times, Mr. General, and see if it doesn't give you a clearer picture of what's going on in the Novice bands.

ROBERT SALTZMAN
WV2BWC—WA2BWC
Great Neck, N. Y.

Sooner or later every Novice plans to become a General Class amateur. For this reason we think all Novices should learn and stick to the Q-signals. This way everyone will be talking the same language. —30—

UPGRADE YOUR INCOME

through Grantham Training and an F.C.C. License!

What's in Your Future?

Are you *planning* your future or just drifting into it? Now is the time to get ahead in electronics—the world's fastest growing major industry. Now is the time to add technical knowledge and an F.C.C. license to your practical experience. Now is the time to prepare for higher pay—time to make your future secure.

Grantham Training Prepares You

Grantham School of Electronics specializes in quality training in communications electronics, preparing students to pass F.C.C. operator license examinations. This training is available either by correspondence or in resident classes.

The Grantham Communications Course does not include actual work with practical kits or other equipment. That is, for example, it does not teach you how to solder or how to remove a TV chassis from the cabinet, etc. It is not a repair course but, instead, is bona fide technical training which teaches you to understand electronic theory—which teaches you the "*why*" of electronics.

If you are a beginner in this field, the Grantham course will give you the kind of detailed training in radio-electronics theory and operating practices that will enable you to obtain your first class F.C.C. license quickly. Then, this license plus your knowledge of theory will qualify you for certain types of employment, and you can improve your practical ability while on the job earning a salary.

If you already have practical experience in radio-electronics, the Grantham course can add a knowledge of theory and an F.C.C. license to that practical experience. This should qualify you for higher pay and greater job security.

Train by Correspondence or in Resident Classes

RESIDENT CLASSES—The Grantham Communications Electronics Course is offered in both DAY and EVENING classes in Washington, Hollywood, and Seattle. The DAY course meets five days a week, from 9 a.m. until 1 p.m., and prepares you for a *first class* F.C.C. license in 12 weeks. The EVENING course meets two nights a week, from 6:30 p.m. until 10:30 p.m., and prepares you for a first class F.C.C. license in 30 weeks. All courses "begin at the beginning"—NO previous electronics training required or assumed.

CORRESPONDENCE TRAINING—The Grantham Communications Electronics Course is offered by correspondence from all Divisions of the School—Washington, Hollywood, and Seattle. The course has two major objectives—(1) to *teach* you a great deal of electronics, and (2) to prepare you to pass all F.C.C. examinations required for a *first class* license.

This course can prepare you *quickly* to pass F.C.C. examinations because it presents the necessary principles of electronics in a simple "easy-to-grasp" manner. Each new idea is tied in with familiar ideas. Each new principle is presented first in simple, everyday language. Then after you understand the "what and why" of a certain principle, you are taught the technical language associated with that principle. You learn more electronics in less time, because we make the subject easy and interesting.

Which License for Which Job?

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

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

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

Here's Proof . . .

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

	License	Weeks
Walter Mengel, Jr., 423 James St., Crystal Lake, Ill.	1st	8
Serge G. Miller, 1315 W. 15th St., San Pedro, Calif.	1st	12
John A. Hayes, 1519 Madison Ave., Memphis, Tenn.	1st	14
Robert A. Morgan, 25 Barrow St., New York, N.Y.	1st	9
Hal Moon, Cook Hotel, 1334 Central, Kansas City, Mo.	2nd	5
W. R. Smith, 1335 E. 8th St., Long Beach, Calif.	1st	12
Erskin D. Davis, 4220 Clay St., NW, Washington, D.C.	1st	12
John R. Bahrs, 72 Hazelton St., Ridgefield Park, N. J.	1st	12
Earl A. Stewart, 3918 Modesto Dr., San Bernardino, Calif.	1st	14
Robert H. Moore, 807 Grace St., Baldwin, L.I., N.Y.	1st	12
Otis A. Towns, 3638 Bates St., St. Louis, Mo.	1st	12

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

MAIL COUPON FOR FREE BOOKLET: Our free booklet, *Careers in Electronics*, gives details of how you can prepare quickly for your F.C.C. license. For your free copy of this booklet, clip the coupon below and mail it to the Grantham School nearest you.

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Please mail me your free booklet telling how Grantham training can prepare me quickly for my commercial F.C.C. license. I understand there is no obligation and no salesman will call.

Name _____ Age _____

Address _____

City _____ State _____

I am interested in: ☐ Home Study, ☐ Resident Classes 93-D

POP'tronics BOOKSHELF

"TRANSISTORS, THEORY & PRACTICE" by Rufus P. Turner. Published by Gernsback Publications, Inc., 154 West 14th St., New York 11, N. Y. 160 pages. Paper cover. $2.95.

One of the better transistor books available for the past four years has now come out in a revised edition. The enlarged and up-to-date version of Rufus P. Turner's transistor "Bible" includes the chapters on fundamentals that made the first edition so popular, but each chapter has been expanded to include some of the latest circuits and techniques. Mr. Turner also describes last-minute developments such as thyristors, four-layer diodes, spacistors, double-based diodes and phototransistors. Expanded bibliographies further extend the usefulness of the book which can be heartily recommended to all the transistor gadgeteers among our readership.

"TECHNIQUES OF MAGNETIC RECORDING" by Joel Tall. Published by The Macmillan Company, 60 Fifth Ave., New York, N. Y. 472 pages. Hard cover. $7.95.

An excellent contribution to a fast developing field, this volume translates the complexities of tape recording and reproduction into practical, easy-to-follow techniques. It is a book for the professional who wants new ideas, and for the amateur just getting his feet wet in magnetic recording. The reader will gain "a working knowledge of both sound and magnetic recording theory" from this book, which provides an integrated, correlated description of the many ways in which recording is used to store and communicate sound, light and motion.

"A GUIDE TO NUCLEAR ENERGY" by R. F. K. Belchem. Published by Philosophical Library, Inc., 15 East 40th St., New

Bookshelf (*Continued from page 18*)

York 16, N. Y. 77 pages. Hard cover. $3.75.

The Nuclear Energy Industry has introduced a new language and new concepts into the business of power production. This small book attempts to explain to those with limited special knowledge how nuclear reactors function, and includes a general description of the more important types now being constructed or studied. A description of the constructional materials of importance to the nuclear energy industry is also included.

"A-C CIRCUIT ANALYSIS" edited by A. Schure, Ph. D., Ed.D. Published by John F. Rider Publisher, Inc., 116 West 14th St., New York 11, New York. 95 pages. Soft cover. $1.80.

Alternating current and voltage are the building blocks of not only the communications art but of the tremendously broad field of electronics. All of the fundamental principles necessary to the understanding of a.c. are presented clearly. R, L, and C functioning in series, parallel, and series-parallel combinations are explained in detail. Numerical examples show how the different equations contained in the book are solved.

Written at the intermediate level, this book is recommended to technicians, laboratory workers, students of technical institutes, and, in fact, to all who desire more than a casual knowledge of a.c. phenomena. Review questions appear at the end of each chapter.

"NEW SIDEBAND HANDBOOK" by Don Stoner. Published by Cowan Publishing Corp., 300 West 43rd St., New York 36, N. Y. 232 pages. $3.00.

According to Don Stoner, the author of this book, if you're on the air and you're not using single-sideband transmission, you're just not with it. To quote Mr. Stoner, ". . . when a sideband station switches over to AM, it is as if someone had pulled the chain and flushed the frequency. The db's went thataway . . ."

This should give you some idea of Mr. Stoner's writing style. It is indeed rare for

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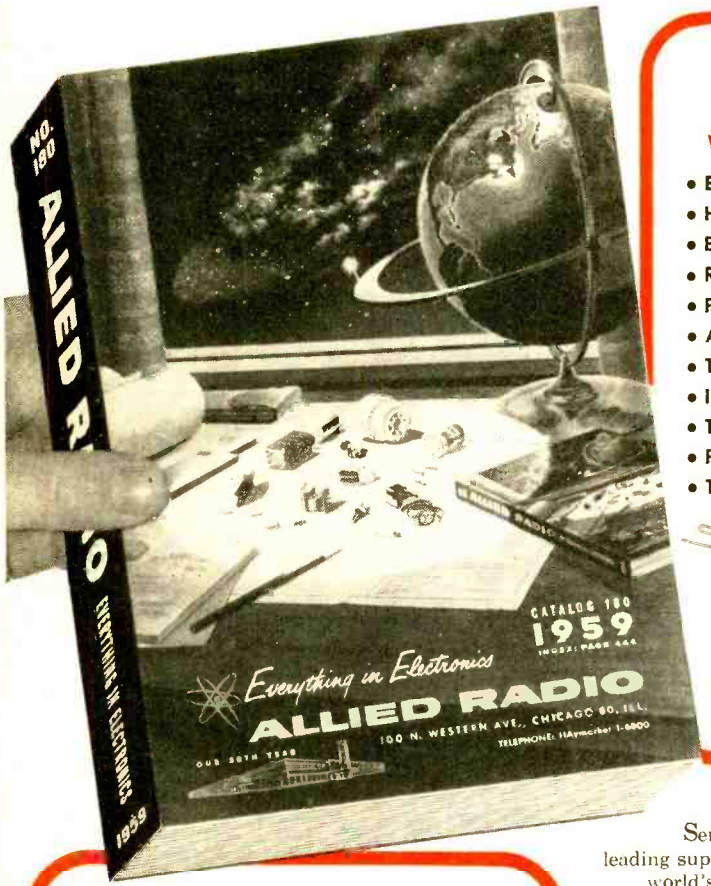

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- TV Tubes, Antennas, Accessories
- Parts, Tubes, Transistors
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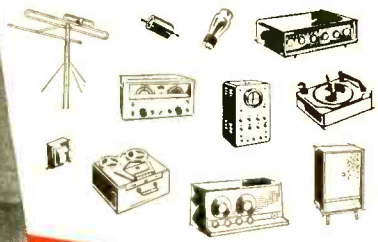

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Bookshelf

(Continued from page 20)

a book to offer so much technical information and still be such easy reading. If you want to go single sideband, or, if you're already operating on SSB, this book will have plenty of information for you. It is highly recommended.

"MOST-OFTEN-NEEDED RADIO DIAGRAMS (1926-1938)" compiled by M. N. Beitman. Published by Supreme Publications, Highland Park, Ill. 240 pages. $2.50.

From time to time we all run up against a radio which is really an old-timer. At such times a schematic would be most valuable, but one is rarely available. This book, a collection of 240 old-timers from 1926 to 1938, will fill in what is probably a big gap in your file of old schematics.

"UNDERSTANDING HIGH FIDELITY" published by Bogen-Presto, Box 500, Paramus, N. J. 64 pages. 25 cents.

This is the fourth revised edition of this inexpensive booklet, which has sold more than 250,000 copies in previous editions. The revisions made in this edition for the most part concern stereo. Results which may be expected from stereo and mono systems are discussed in detail, and lucid explanations of how to plan and install a stereo system are also presented. This "Stereo Edition" is highly recommended for the beginning stereophile.

Free Literature Roundup

Arnhold Ceramics, Inc., 1 East 57th St., New York 22, N. Y., is offering a new catalog which describes the "Isophon" line of hi-fi speakers. This attractive folder includes a special section explaining the factors that determine the performance of a good hi-fi speaker. All technical specifications of the Isophon speakers are given, including frequency response, power-handling capacity, resonance, impedance, gauss, etc.

The new Test Equipment Catalog No. 38-T, available from Triplett Electrical Instrument Co., Bluffton, Ohio, describes the latest electronic, electrical, radio, television, and industrial testers. —30—

AT LAST!

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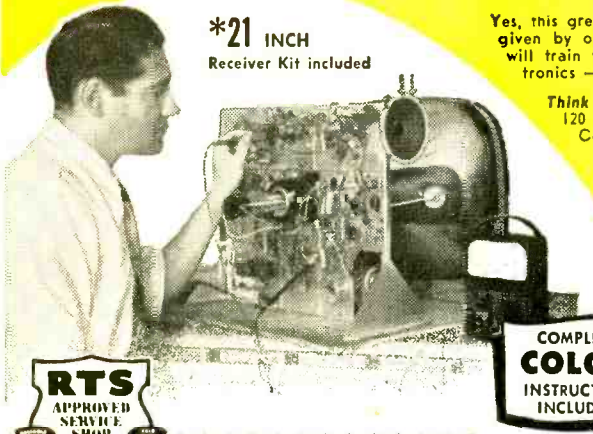

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When you are ready and qualified to operate one of our RTS-Approved TV Repair Shops ***WE WILL SUPPLY AND FINANCE EVERY BIT OF EQUIPMENT YOU NEED TO GET STARTED*** plus an inventory of parts and supplies. In other words ***we will stake you*** . .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

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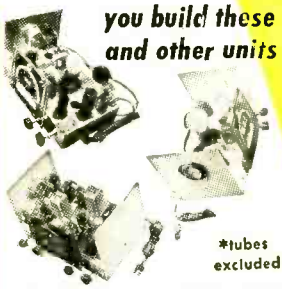
6. Plans for shop arrangement.
7. Instructions on how to go into business.
8. Continuous consultation and help.
9. The right to use RTS Seal of Approval, and the RTS Credo.
10. The right to use the Famous Trade Mark.



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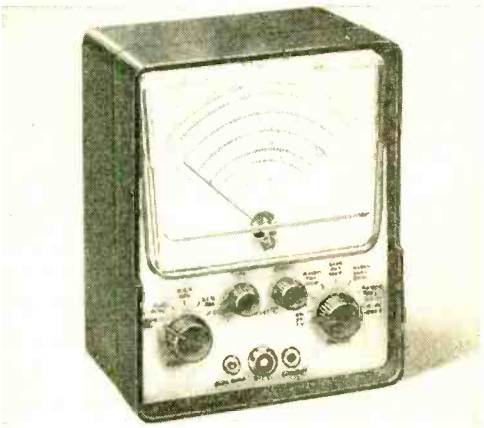
VACUUM-TUBE VOLTMETER

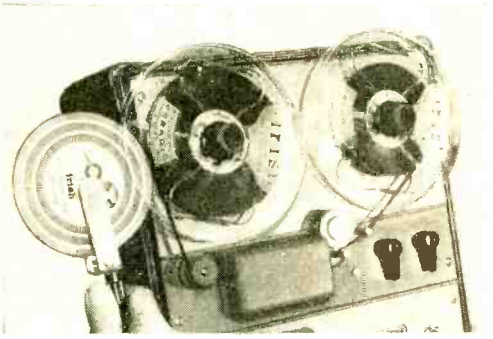
Available both in kit form and factory-assembled, the Arkay "VT-10" is a multi-purpose VTVM. It features a 400 micro-ampere movement, 1% precision resistors,



7 a.c. and d.c. ranges (plus a.c. peak-to-peak ranges), resistance from 0 to 1000 megohms, db, and other essential ranges. Price for the kit model, $25.95; factory-wired, $47.95. (*Arkay, Inc.*, 88-06 Van Wyck Expressway, Richmond Hill 18, N. Y.)

TAPE SPEED INDICATOR

A stroboscope designed for checking tape recorder speeds has been announced by the manufacturers of Irish tape, *ORRadio Industries, Inc.*, Shamrock Circle, Opelika, Alabama. The Irish stroboscope is held lightly against the surface of the moving



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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 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 16 Receiver, Transmitter, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for Television, Hi-Fi and Electronics.

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

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 profitable 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 learn 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 sixteen Receiver, Transmitter, Code Oscillator, Signal Tracer, 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 16 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, Instruction Manuals, hook-up wire, solder, 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.

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

J. 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.

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- ☐ Rush me FREE descriptive literature concerning "Edu-Kit."

Name .....

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.....

PROGRESSIVE "EDU-KITS" INC.

1186 Broadway, Dept. 555D, Hewlett, N. Y.

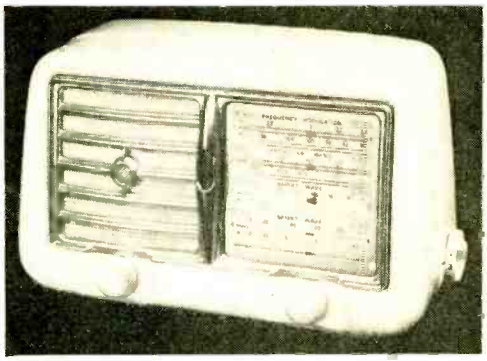
products

(*Continued from page* 24)

tape on the recorder's supply reel. If the speed is accurate, the radial lines on the stroboscope will appear to be standing still when viewed under artificial light. The stroboscope may be used at 3¾ ips, 7½ ips, and 15 ips. Retail price, $4.95.

"FOUR-BANDER" RECEIVER

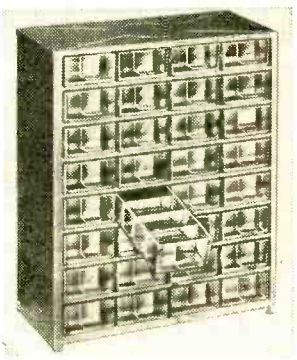
Model G-307, an AM/FM/short-wave receiver, has recently been introduced by *American Geloso Electronics, Inc.*, 312 Sev-



enth Ave., New York 1, N. Y. It features complete coverage of the AM and FM bands and covers the short-wave bands from 1.6 to 12 mc. Sensitivity is 3 microvolts for 20-db quieting and audio response is from 200 to 10,000 cps with built-in speaker. List price, $79.95.

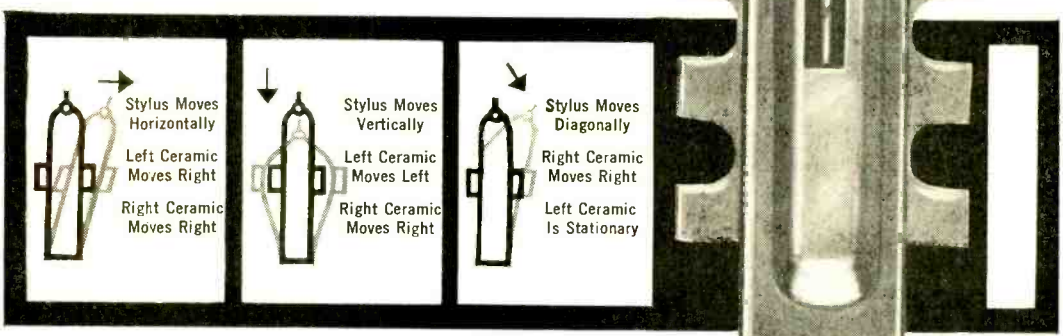
SMALL PARTS CABINETS

"Haz-Bin, Jr." J-2 Series cabinets feature a molded plastic one-piece four-compartment drawer. The compartments have cash-register-type bottoms so that parts too small to pick up with the fingers can be easily rolled out. Drawers are molded of clear styrene and have safety stops to prevent accidental spilling and press-on labels to facilitate indexing contents.



These cabinets are made of welded steel with a baked-on silver-gray hammertone

For Every Tonearm...
The Professional Touch



This differential ring is the heart of Weathers Ring Filter Technique. The diagrams show how each component of the mixed signal is separated and delivered to its proper ceramic. Three relationships are shown: 180° out of phase; in phase; and a signal on one channel only.

Made in USA
Patent Applied For

The StereoRamic Cartridge

Here is a stereo cartridge unlike any cartridge you have ever seen—in performance, construction and design. It is smaller, lighter, and it fits your tonearm or changer without modification. Completely wired and ready for use, the Weathers StereoRamic Cartridge C-501 is shielded against hum, and plugs directly into the phono magnetic input of your preamplifier. It tracks with optimum compliance over a wide range of tracking forces and has a flat matched response on both channels from 15 to 30,000 cycles. But the biggest feature is its complete lack of cross talk. This is possible through the use of Weathers Ring Filter Technique, the simplest and most efficient means of securing positive separation between channels—better than 25 db. And it is exclusive with Weathers. Ask your dealer for a demonstration. He has it in stock.

C-501 D	Diamond Stylus	$17.50
C-501 S	Sapphire Stylus	$9.75

Weathers Industries
DIVISION OF ADVANCE INDUSTRIES, INC.

66 E. Gloucester Pike, Barrington, N. J.

products

(*Continued from page* 26)

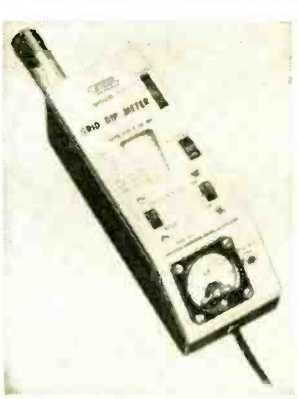
finish. They are available with 32, 48, 64, 96 or 128 drawers and have 128 to 512 permanently molded compartments. (*Akro-Mils, Inc.*, Akron 9, Ohio)

STEREO TAPE OFFER

Stereo tape enthusiasts will be interested to know that a special promotion offer by *Reeves Soundcraft* is still in effect. Whenever you buy two reels of Soundcraft tape, for only $1.00 additional one blank tape may be exchanged for a prerecorded tape of "Sweet Moods of Jazz in Stereo," featuring Coleman Hawkins, "Red" Allen, Chubby Jackson, and other greats of the jazz world. This is a wonderful way to supplement your stereo tape library inexpensively. Your record dealer can fill you in on the details.

GRID DIP METER

Basically a VFO with a microammeter in its grid circuit, the EICO Model 710 grid dip meter determines the frequency of other oscillators or tuned circuits. It features a sensitivity control and phone jack to facilitate "zero beat" listening. It is easy to hold and thumb-tune with one hand, and provides continuous coverage of broadcast, FM, ham and TV bands in seven ranges (with a complete set of pre-wound, pre-calibrated, 0.5% accuracy coils supplied). In kit form, $29.95. Factory wired, $49.95. (*EICO*, 33-00 Northern Blvd., Long Island City 1, N. Y.)



"HOBBYIST" TAPE SPLICER

The Gibson Girl "Hobbyist" is a low-cost tape splicer which consists of a tape alignment guide and a special curved blade. The tape guide has self-sticking adhesive on it for mounting directly on or near a tape recorder.

Tape to be spliced is placed in the tape guide in overlapping position. The blade is pressed down to cut a diagonal butt in the tapes. Splicing tape is applied and the

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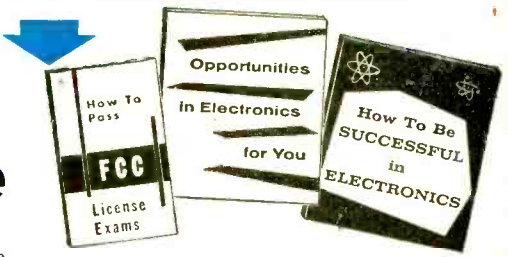

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American Airlines—Chicago, Detroit, St. Louis, Cincinnati and Cleveland—has openings for radio operators and radio mechanics. Operators must have a 2nd class FCC license and ability to type 40 wpm. Many company benefits.

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Harold E. Phipps, North Augusta, S. C.

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In what branch of Electronics are you interested?_____

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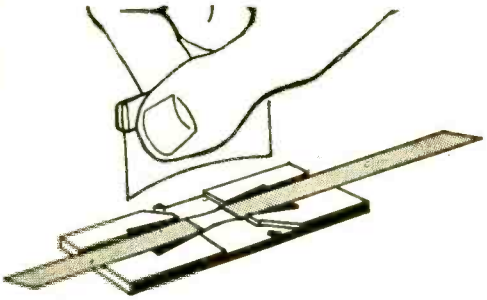
PE-50

products

(*Continued from page* 28)

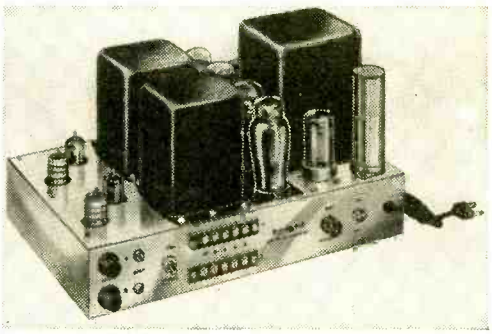
curved blade again pressed down to cut and trim the splicing tape and the edges of



the recording tape. List price for splicer plus extra cutter, $1.75. (*Robins Industries Corp.*, Bayside 61, N. Y.)

STEREO BASIC AMPLIFIER

The Knight-Kit 60-watt stereo basic amplifier provides dual 30-watt channels for stereo which may be used in parallel for 60-watts monaural output. Frequency response is flat from 9 to 42,000 cps, distortion only 0.8% at full output. Speaker output impedances are 4, 8, and 16 ohms for



both stereo and monaural operation. Price, in kit form, $84.50. (*Allied Radio Corp.*, 100 N. Western Ave., Chicago 80, Ill.)

HI-FI SPEAKER LINE

A new line of hi-fi loudspeakers systems is being marketed by the *JFD Electronics Corporation*, 6101 Sixteenth Ave., Brooklyn 4, N. Y., through its newly formed Audio Component Division. The "Mardi Gras" systems feature speakers with acoustically loaded cones. This feature, called ALC, makes possible a clean response from 50 to 15,000 cps. Model ALC1 sells for $45.00 including enclosure, Model ALC2 for $30.00 including enclosure. —30—

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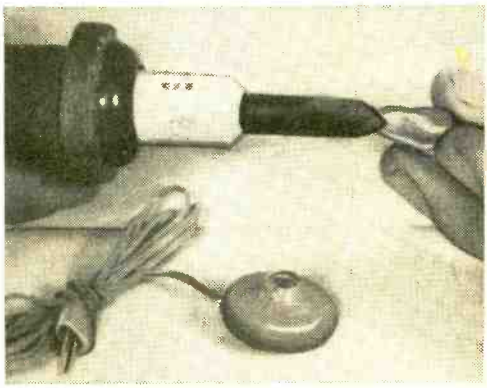
TIPS and TECHNIQUES

REPAIRING MINIATURE EARPHONES

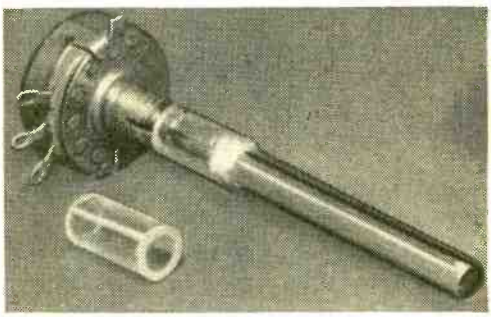
Occasionally the plastic plugs on miniature headphones become excessively loose after extended use. To remedy this, touch a hot soldering iron lightly to the threaded



portion of the plug. The heat will distort the surface sufficiently to form new, tighter fitting threads when the plug is replaced. —*Peter Barna, Wilmington, Calif.*

TUBING COUPLES SHAFTS

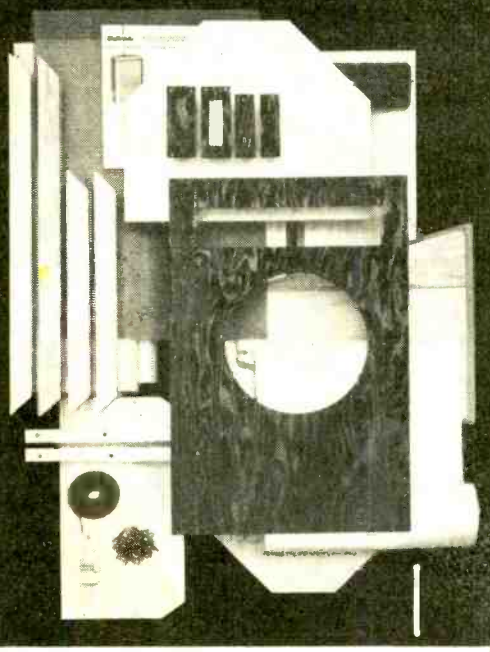
If you ever find yourself in need of a control shaft coupler and discover that you don't have the needed size on hand, use plastic tubing. Just cut a length of tubing



(with an appropriate inside diameter), force-fit it over the control shaft, and inset the extension as shown. If you need a reducer-type coupler, it's easy to cement a

HEAR

BASS NOTES DOWN TO 35 CPS... BUILD THE ELECTRO-VOICE ARISTOCRAT



DRAMATIC PERFORMANCE has made the Electro-Voice Aristocrat the world's most popular enclosure for 12" loudspeakers. The Aristocrat will make an exciting difference in the performance of your loudspeaker—hear deep, extended bass response without annoying boom; sharp, well-defined low frequency transients, and all with greatly increased power handling capacity.

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AS EASY AS ONE . . TWO . . . THREE. The KD6 Aristocrat Kit can be assembled in only one evening with E-V's exclusive sub-assembled parts and exploded view step-by-step instructions. All you need is a screw driver; the rest is in the box. And E-V's accurately milled, furniture grade woods and veneers plus a choice of six finishing kits create an enclosure that will match your finest furniture.

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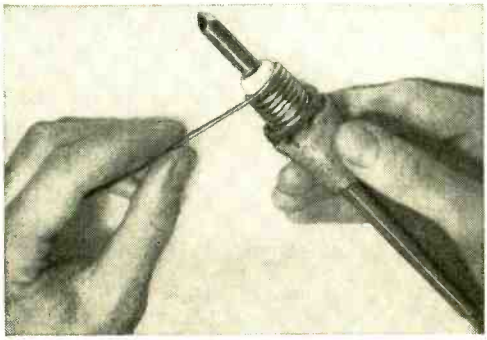
Tips

(*Continued from page 32*)

small piece of tubing inside a larger size piece. A little solder on the control shaft will help assure a tight fit when the tubing tends to slip.—*Charles A. Lang, San Francisco, Calif.*

LONGER LIFE FOR "PENCIL" IRONS

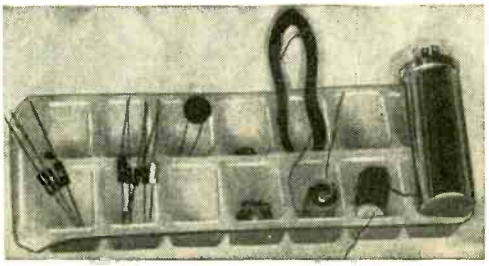
If you use a "pencil"-type soldering iron frequently or leave it plugged in for long periods of time, wrap some uninsulated,



heavy solid-copper wire around the element's porcelain insulator. The coil of wire will act as a radiator to dissipate the excess heat, thus increasing the useful life span of the iron.—*John A. Comstock, Wellsboro, Pa.*

PARTS TRAY

Plastic ice cube trays make excellent containers for small parts. These inexpensive



multi-partitioned trays come in handy particularly when you are assembling kits and making the initial count of nuts, bolts, and electronic parts.—*Herman Landsman, Forest Hills, N. Y.*

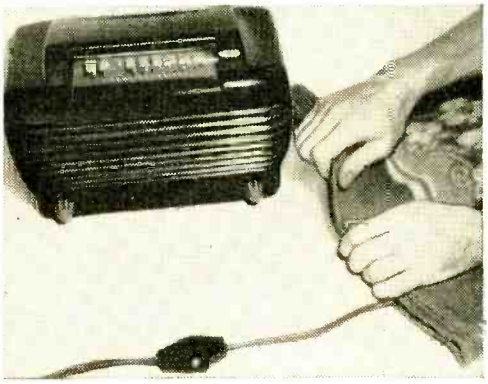
TROUBLE-SHOOTING ELECTRIC PADS

If you have an electric blanket or heating pad that operates intermittently, there is probably a break somewhere in the filament wires. But how does one go about lo-

Tips

(Continued from page 34)

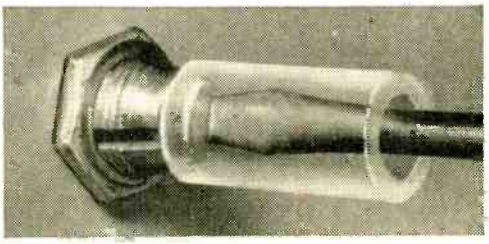
cating such a break without tearing the blanket or pad apart? Easily. Just plug in a nearby AM radio, turn it on, and turn up the volume. Now turn on the blanket or pad and start flexing it section by section



until you hear interference on the radio. The snapping and popping noises will indicate that you are near the place where the filament wires are broken.—*Jerome Cunningham, Chicago, Ill.*

NO-SLIP FOR DRIVER'S TIP

It's time-consuming and frustrating to have the tip of your screwdriver or alignment tool slip from the screwdriver slot of a trimmer capacitor or service control when making adjustments. You can prevent this by slipping a ¾" length of clear plastic tubing with ¼"-inside diameter over



your screwdriver or alignment tool's tip as shown. Slide the tubing up the blade of the screwdriver when it isn't in use. —*John A. Comstock, Wellsboro, Pa.*

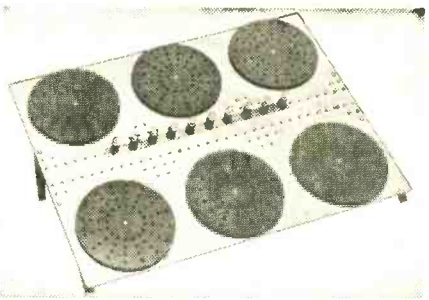
USING BURNED-OUT FUSES

When a fuse burns out, most of us just toss it in the wastebasket and reach for another. But burned-out fuses can be used as miniature coil forms. They have excellent low loss characteristics. Just wind the coil on the glass portion and coat with dope or

BUILD 125 COMPUTERS AT HOME WITH GENIAC®

ONLY $19.95

With the 1959 model **GENIAC®**, the original electric brain construction kit including seven books and pamphlets, over 400 parts and component rack, and parts tray, and all materials for experimental computer lab plus **DESIGN-O-Mat®**.



A COMPLETE COURSE IN COMPUTER FUNDAMENTALS

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

ANYONE CAN BUILD IT!

You can build any one of these 125 exciting electric brain machines in just a few hours by following the clear cut step by step directions given in these thrilling books. No soldering required . . . no wiring beyond your skill. But **GENIAC** is a genuine electric brain machine—not a toy. The only logic and reasoning machine kit in the world that not only adds and subtracts but presents the basic ideas of cybernetics, boolean algebra, symbolic logic automation, etc. So simple to construct that a twelve year old can build what will fascinate a PhD. In use by thousands of schools, colleges, etc., and with the special low circuitry you can build machines that compose music, forecast the weather, which have just recently been added.

TEXT PREPARED BY MIT SPECIALIST

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

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

KIT IS COMPLETE

The 1959 **GENIAC** comes complete with seven books and manuals and over 400 components.

1) A sixty-four page book **"Simple Electric Brains and How to Make Them."**

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

3) **"A Symbolic Analysis of Relay and Switching Circuits"** By Dr. Claude Shannon provides the basis for new and exciting experimental work by the kit owner who has finished book No. 1.

4) **DESIGN-O-MAT®** introduces the user to over 50 new circuits that he can build with **GENIAC** and outlines the practical principle of circuit design.

5) **GENIAC STUDY GUIDE** equivalent to a complete course in computer fundamentals, this guides the user to more advanced literature.

6) **A Machine to Compose Music** shows in an actual circuit what other GENIAC owners have been able to do on their own in designing new devices.

7) **A Machine to Forecast the Weather**—again a new adventure in scientific thinking created by one of our users who was trained on his GENIAC Kit.

Plus all the components necessary for the building of over 125 machines and as many others as you can design yourself.

OVER 20,000 SOLD

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

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

COMMENTS BY CUSTOMERS

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

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

Oliver Garfield Co., Inc. Dept. PE-49
108 East 16th St., N. Y. 3, N. Y.

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

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

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

Name .....

Address .....

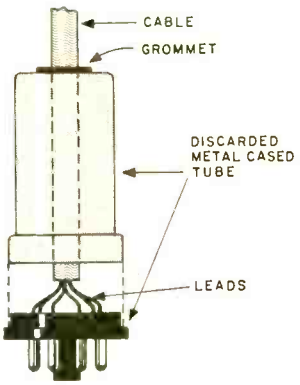
Tips

(*Continued from page* 36)

varnish. Then solder the ends of the wires to the small metal ends of the fuse. It can now be mounted in fuse clips. Coils can be changed in a matter of seconds.—*Bob Cutler, Oswego, Ore.*

OCTAL PLUG FROM TUBE

An octal plug can be made from a discarded metal-cased tube. First, remove the metal shell by prying it loose with a screwdriver; the glass envelope and shell will come loose when the base pins are heated. Now drill a ⅜" hole in the top of the metal case and install a rubber grommet. The cable is then brought through the shell and soldered to the pins.—*Edward Kuschner, New York, N. Y.* —30—



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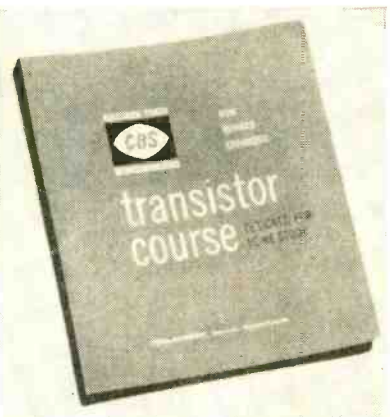

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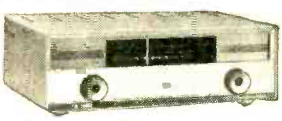

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By WILL BOHR

RUSSIAN JAMMING

The Electronic Iron Curtain

It is nearly 0400 hours, Moscow time. In a corner of the Soviet capital everyone sleeps except for one family which is huddled over an ancient short-wave receiver. The operator adjusts the tuning dial.

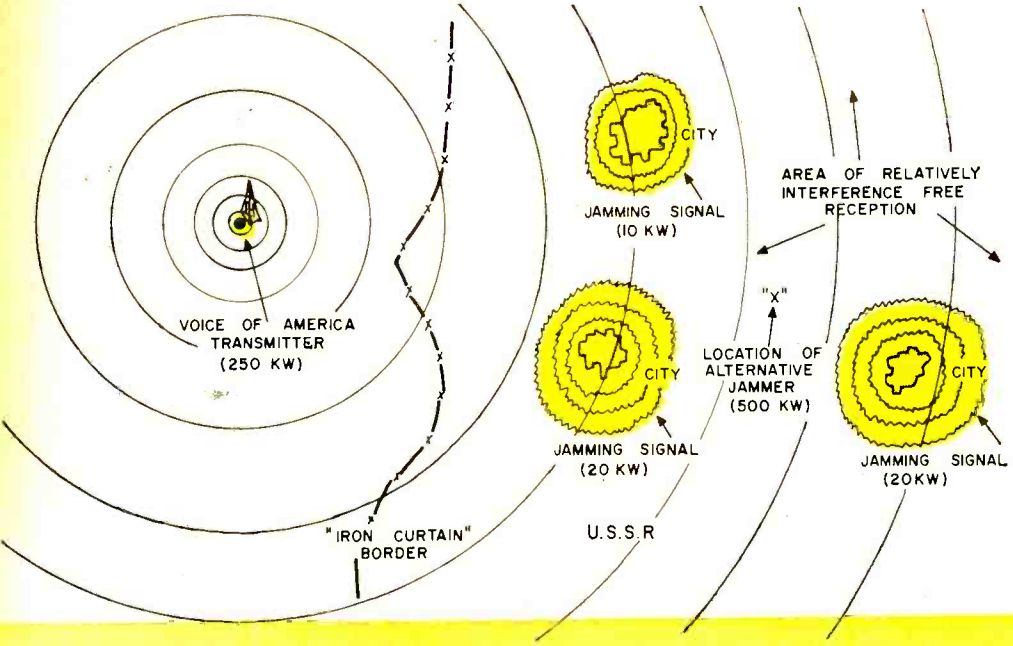
"Just one minute more," think the early-morning listeners.

The radio signal the Russians are listening to comes in loud and steady, with a slow rolling fade which indicates that there are thousands of miles separating these listeners from the transmitter about to speak. Everyone catches his breath as the voice from the loudspeaker comes to life:

"This program is coming to you from the United States of America. The following news program is brought to you in the Russian language . . ."

Suddenly the room is filled with a gathering roar that blots out the voice they are so eager to hear. The noise whipsaws across the signal and burns in their ears. Frantically the operator turns the dials of the receiver, trying to escape the unintelligible chaos of noise smothering the voice of the free world.

Sadly, the operator turns off the receiver, and the family disperses . . .



Three separate jamming transmitters must be employed to "protect" three cities from one Voice of America transmitter, as shown above. A single high-power jammer at point "X" wastes power over unpopulated areas. Separate jammers provide maximum suppression in the cities, but leave countryside free from interference.

THE Soviet Union started deliberate radio interference with the Russian language broadcasts of the United States and England shortly after the end of World War II. At the present time over 2500 separate jamming stations are scattered throughout the USSR and the satellites in an effort to blanket reception of the 85 transmitters of the Voice of America. They try to blot out all 16 frequencies used by the VOA.

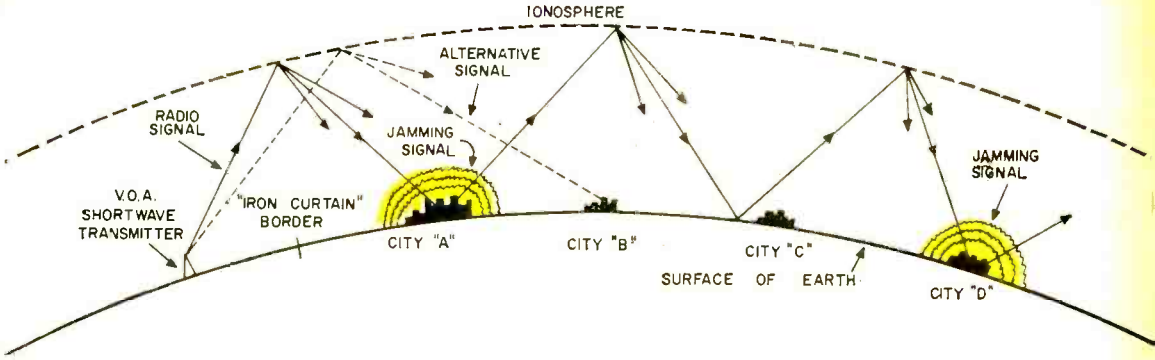
When the Polish government ceased its radio jamming operations a few years ago, it informed the world of the cost of these operations. For every dollar spent by the Voice of America to produce the Polish language programs, the Polish government spent over one hundred dollars in a vain attempt to obliterate reception!

The total cost of the Communist jamming effort is estimated at over 100 million dollars. The evident fear of Voice of America operations is shown by the fact that the Soviets jammed the United Nations broadcasts over the VOA, even during the periods when the Soviet delegates were speaking!

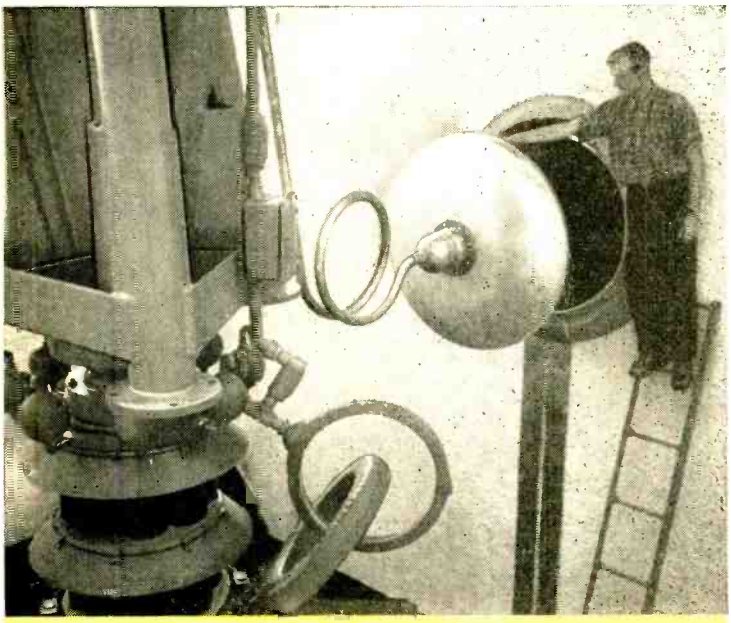
Jamming Techniques. Jamming a high-power radio station is a complicated as well as an expensive job. The general jamming technique takes the form of superimposing random noises and sounds upon the identical carrier frequency of the offending transmitter. Since it is usually impossible to locate the jamming equipment near the station to be jammed, the "jammer" is generally placed close to large population centers, where there are conceivably many receivers capable of tuning to the channel of the politically undesirable station.

The jamming signal usually consists of a buzz-saw-like noise, or random musical tones superimposed upon a steady buzz, much in the manner of a bagpipe. In rare instances, the jamming transmitter superimposes a program of its own atop the unwanted station. Jamming stations generally identify themselves by a two-character call sign, which may change frequently.

Ground-Wave Jamming. Radio communication during daylight hours in the broad-



Short-wave signals are reflected back to earth by the ionosphere so that cities "A" and "D" (in diagram above) must each have a jammer. A shift of frequency of the transmitter or a change in the ionosphere can project the signal to cities "B" and "C," so that all four cities must have separate jamming equipment to suppress a single transmitter completely.



Antenna tower base of the million-watt Voice of America transmitter in Munich, Germany (photo at left), showing the feedthrough insulator and lightning surge loop. The high-power broadcast station can override most jamming signals.

cast band (500-1600 kc.) normally takes place by means of the ground wave, that portion of the radio wave which travels along or over the surface of the earth. Its usable range is a hundred miles or so.

The power of many European broadcast stations is about 150,000 to 250,000 watts (compared to a maximum limit of 50,000 watts in the United States). These stations are capable of producing a strong signal on even the most primitive radio receiver. To obliterate this signal over a small area such as a single city, a jamming transmitter of 10,000 to 15,000 watts may be employed. However, when it is desired to jam a large area of several thousand square miles, it is either necessary to use many jamming transmitters of this power spread over the area, or else one or two high-powered jammers equal to or greater in strength than the undesired station.

In general, the former technique seems to be in use,

at the present time as twenty or thirty jammers are usually employed to block out the broadcast-band transmissions of the various VOA transmitters in Europe. The Soviets have found to their sorrow that a jammer signal weaker in strength than the undesired signal is worse than useless; it merely calls attention to the station that is condemned for obliteration!

Sky-Wave Jamming. During the evening hours, the characteristics of the broadcast band change, permitting excellent reception from stations many hundreds of miles away. This permits the VOA to reach deep within the Soviet Union with its programs of news and information.

Since the jamming equipment is not near the transmitting station, the jamming signal does not "overlap" the broadcast reception of the offensive station at points within Russia. This forces the Soviets to employ additional jamming equipment at various places. Dozens of jammers may be required to silence effectively a single radio station in a few populated areas, leaving relatively good reception of the unwanted station in sparsely settled areas.

Short-Wave Jamming. Due to the nature of short-wave propagation, a powerful short-wave transmitter is capable of blanketing tremendous areas of the Soviet Union, all of which must be covered by competing jammers in order to obliterate the signal. The action of short-wave "skip" is a result of the transmitted wave being radiated up into the ionosphere to be bent downward in a reflected ray returning to earth a considerable distance from the transmitter.

The amount of bending and distance covered depends upon many factors, most of which are uncontrollable. Separate jamming stations must be employed at each "skip point," since the "skip distance" of the jamming signal cannot be relied upon to be the same as that of the offending signal.

It can thus be seen that the problem of silencing literally hundreds of stations operating on various broadcast and short-wave frequencies is an extremely large operation.

Equipment Used. Special transmitting stations for jamming operations have been developed by Soviet engineers. These stations are designed for rapid frequency shifting and are capable of heavy noise modulation.

The usual modulation consists of a buzz-saw noise that completely fills a band of five or six kilocycles each side of the carrier frequency. Jamming equipment of this type is known to have power levels up to 1,000,000 watts!

As auxiliary jamming equipment, the Soviets sometimes press broadcasting stations into use, transmitting noise and chaos instead of the usual programs.

Anti-Jamming Techniques. Well aware of the jamming operations, the VOA and the British Broadcasting Corporation have several techniques at their disposal to combat jamming.

The most obvious and effective technique is to increase the power and range of the existing stations, and to add more stations, thus improving the coverage of the USSR. The VOA, for example, now broadcasts about 500 "transmitter-hours" (hours of broadcast multiplied by number of transmitters) daily to the Soviet Union, the satellites, and Red China.

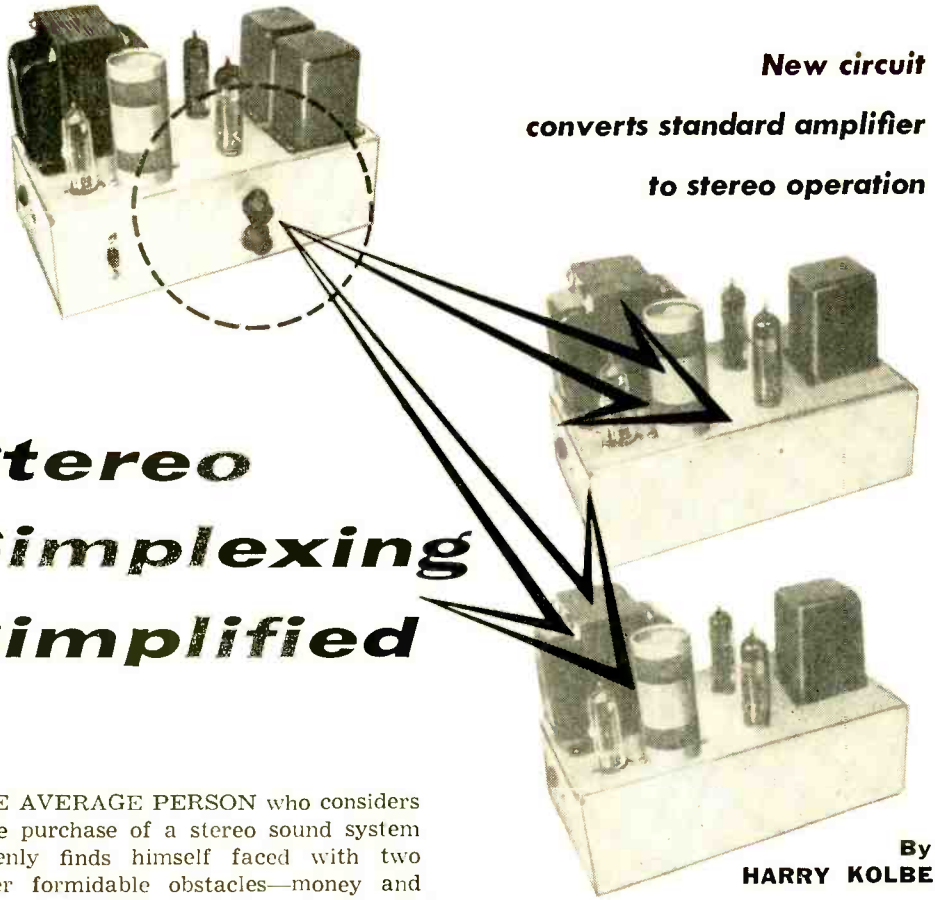
A second technique is to change the wavelength (frequency) of the transmitting station, thus evading the jammer. This is usually impractical, as the Russians monitor the station being jammed and are quick to retune the jamming equipment when any frequency change is noted. Also, abrupt frequency changes make reception difficult for the listener.

Another evasive action is to choose a transmitter frequency immediately adjacent to the frequency used by a Soviet broadcast station, so that the program cannot be jammed without jamming the Russian broadcast.

Is Jamming Effective? Proof that the VOA programs are penetrating the barrage of jamming is evident from the amount of abuse heaped upon this activity by the Soviet Government.

Careful screening of refugees pouring into Berlin from the east confirms the value of every dollar spent in the electronic war. Clandestine listening posts behind the Iron Curtain listen to the voices of freedom and report reception. Also letters smuggled out of the Soviet zones of influence attest to the impact these broadcasts have upon their audience.

It is therefore well known that the broadcasts do pierce the interference, and are successful in combating the efforts to prevent the flow of information and truth from reaching the citizens of the Soviet Union. —30—



New circuit converts standard amplifier to stereo operation

Stereo Simplexing Simplified

By
HARRY KOLBE

THE AVERAGE PERSON who considers the purchase of a stereo sound system suddenly finds himself faced with two rather formidable obstacles—money and space. A complete stereo system, after all, requires at least two preamplifiers, two power amplifiers, two speaker systems, two tuners, and a tape or phono playback unit. Even assuming we are able to save enough lunch money to finance a stereo system, where will we find space to put it all?

To a great extent, the audio industry has successfully alleviated these problems. The two preamplifiers have evolved into the stereo preamp, which is less expensive and occupies much less space. With the advent of FM multiplex, only an FM tuner and a converter will be needed to receive broadcast stereo. The phonograph playback unit remains essentially the same as the monaural unit except that the monaural cartridge must be replaced by a stereo cartridge. As far as speaker systems are concerned, manufacturers have designed smaller systems that provide true hi-fi performance.

Enter Simplex. One of the most expensive links in the stereo chain is the power amplifier. We face the same problems of cost and space. But some scientists at CBS Laboratories have found a solution. They call it "The Two-Way Stereo Amplifier." This amplifier uses a *single* push-pull output stage plus an extra output transformer to amplify *two* independent signals. Space requirements and cost are only slightly greater than those of a single-channel amplifier.

This new development has aroused considerable interest and it is very probable that *simplexing,* as it is called, will revolutionize the design of stereo amplifiers. The Heath Company has recently announced that it will soon bring forth a stereo system using the CBS simplex system.

Operation of the stereo simplex amplifier is based on an old technique used by broadcast line engineers for years. The principle of simplex is best illustrated by Fig. 1. The circuit looks like a conventional push-pull output stage except for an additional transformer (*T2*), connected in series with

what would normally be the B-plus center-tap of push-pull output transformer *T1*.

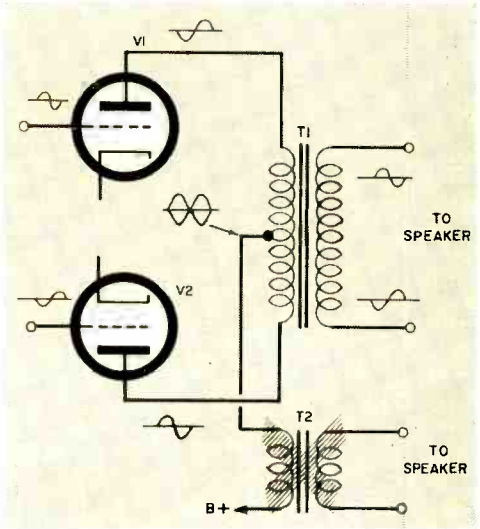
Let us consider what happens when two equal but *opposite* (180° out-of-phase) signals are applied to the grids of the output tubes (*V1* and *V2*). The two signals will appear at each end of the primary winding of the output transformer *T1*, and induce a signal into the secondary winding. Everything is working exactly as a push-pull output stage should. But what happens with *T2*? The answer is—nothing, as long as the push-pull output stage is perfectly balanced. Since the signal currents at the center-tap of *T1's* primary winding are equal and opposite, they cancel each other and no signal current flows through *T2*.

Now consider Fig. 2. If we apply two equal but *inphase* signals to the grids of *V1* and *V2*, the signal will be equal and inphase at the primary of *T1*. The induced signals in each half of the secondary winding will now be 180° out of phase and thus will cancel each other. Due to this cancellation, no signal will appear at the secondary winding of *T1*. But the signal *does* appear at the secondary winding of *T2*. How? Well, if the two signals from the plates of the output tubes are equal and inphase, the total inphase signal voltage will appear at the center-tap of *T1's* primary winding. This voltage will be developed across the primary of *T2* and thus will be induced into the secondary of *T2*.

CBS Simplex. So far, what we have been describing is just plain "simplex." Since such a circuit can handle two independent signals with very little interaction, it could be used to amplify the left and right stereo channels independently and simultaneously. However, in such a setup, the stereo channel using the push-pull output transformer (*T1*) channel would have greater power-handling ability than the channel using *T2*. Here is where the CBS modification of the simplex system comes to the rescue.

This modification is based on the relationships between the vertical and horizontal components of the 45-45 stereo record groove. Although the two channels of information in the stereo groove are usually thought of as being left and right, the channels can also be analyzed for the degree that they appear as vertical and horizontal motion. The horizontal swing of the groove contains information from both channels which we will refer to as left plus right, or

Fig. 1. Out-of-phase signal voltages applied to grids of output tubes cause a signal voltage to be developed across T1, but no voltage appears across T2.



(L+R).* The vertical motion is equal to left minus right (L−R), or the "difference" signal. In general, the sum signal (L+R) carries the bulk of the power, while the difference signal (L−R) carries the stereophonic information.

Each channel engraved on the stereo record contains portions of *both* the sum and the difference signals, but in different phase relationships. When the cartridge terminals are connected (phased) normally, one channel contains the difference signal *plus* the sum signal, or (L−R) + (L+R); the other channel contains the difference signal *minus* the sum signal, or (L−R) − (L+R).

Let's see what happens when the cartridge connections are phased for use in the CBS simplex system.

Referring to Fig. 3, the output of one channel of the stereo cartridge, (L−R) + (L+R), is applied to the grid of *V1*. The output of the other channel, (L−R) − (L+R), is fed to *V2*. Since (L+R) and the − (L+R) are 180° out of phase, they will

* This is evident since we know a monophonic cartridge can yield a balanced sum signal from a stereo record (not taking into consideration that most mono cartridges will damage the delicate grooves of a stereo record).

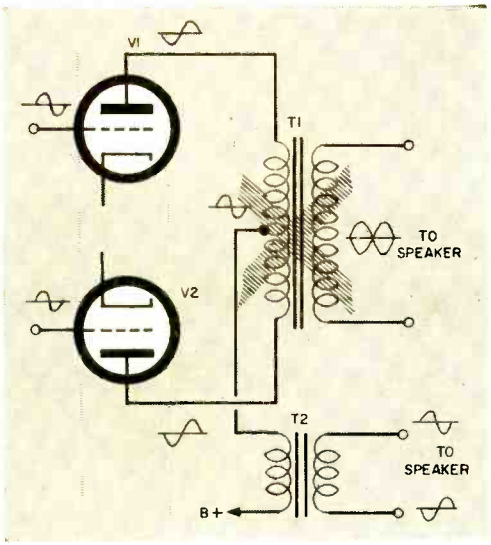
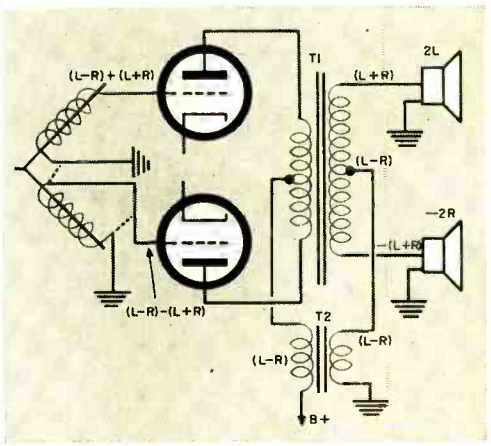


Fig. 2. Inphase signal voltages applied to grids of output tubes cause a signal voltage to be developed across T2, but no voltage appears across T1.

Fig. 3. The CBS simplex circuit uses a "45-45" stereo cartridge as a signal source. Conventional cartridge phasing is reversed. The dotted lines indicate conventional connections.



be amplified in push-pull. The (L−R) components are *inphase* and thus will be handled by transformer *T2*.

At the secondary of *T1*, we have at the top of its winding the induced signal (L+R); and at the bottom we have −(L+R). When the (L−R) signal is induced across *T2* and is fed to the center-tap of the secondary of *T1*, it will combine with (L+R) at the top of *T1* to form 2L, or the *left* channel: (L+R)+(L−R)=2L. At the bottom of *T1*, (L−R) combines with −(L+R), or −L−R, to form −2R, or the right channel. The minus sign before the 2R means only that the speaker phasing must be reversed.

Double Output. Now what have we achieved by all these algebraic acrobatics? Plenty, because a stereo amplifier that employs the CBS simplex system, when used with a properly phased 45-45 stereo cartridge, will furnish two-channel operation with *each* channel providing an output as high as that achieved by a single standard push-pull amplifier. Naturally, full power won't be obtained from each channel simultaneously. But on most stereophonic program material simultaneous full power from both channels is rarely called for. Each channel of a CBS-simplexed stereo amplifier will also provide the low-distortion operation characteristic of push-pull output circuits.

The necessary phasing relationships between the outputs of a stereo cartridge can easily be made with any four-terminal stereo cartridge merely by reversing the connections from *one* of the stereo output pairs. Stereo cartridges with three terminals pose a more difficult problem. If the manufacturer doesn't supply a three-terminal cartridge already phased for CBS simplex operation, there's not much you can do about it. At this writing, one manufacturer, CBS-Hytron, is supplying three-terminal stereo cartridges in two models, one for conventional hookup, and one for the CBS simplex hookup. Perhaps more manufacturers will follow suit in the near future.

Stereo program sources other than 45-45 records can be handled by a CBS-simplexed amplifier, but the second channel will operate at a lower output level. If an amplifier has an effective output of 10 watts on each channel when playing 45-45 stereo records, the outputs per channel will be about 10 watts and 6 watts for the push-pull and the parallel channels, respectively, when playing stereo tapes, AM-FM broadcasts, FM-FM multiplex, etc.

A simplexed stereo amplifier is presented with all necessary construction details in the article beginning on the next page. —30—

Build the Stereoplex

By HARRY KOLBE

THE AMPLIFIER to be described here was designed and built as a practical application of stereo simplex principles. High quality stereo at maximum economy was the goal, and anyone who has been reluctant to shell out the money for two amplifiers, or who would like a second stereo system for his playroom or summer house, will find that the "Stereoplex" is an excellent choice.

The Stereoplex consists of a simplex-connected push-pull feedback amplifier plus a power supply on a 5"x7"x3" chassis. It employs only three tubes: two 6BM8/ECL82 voltage amplifier-output tubes, and one 6X4 rectifier.

The compactness and low cost of the Stereoplex is made possible through the recent introduction of a new audio tube by Amperex and a recent modification of the simplex circuit by CBS. The new tube—the 6BM8/ECL82—is a 9-pin miniature tube combining a high-mu triode and a power output pentode in the same envelope. These combined characteristics of the 6BM8/-ECL82 allow the design of a medium-power amplifier with but two tubes plus rectifier. The further advantages of simplex operation permit this amplifier to serve as a complete two-channel stereo amplifier.

Features. Despite its compactness and simplicity of construction, the Stereoplex boasts an effective output of 10 watts from each channel. At an output level of one watt, the frequency response is flat within ±1 db from 30 cps to 20,000 cps and is down only 1.8 db at 20 cps. Use of negative feedback results in a total harmonic distortion of only 1.5% at full output.

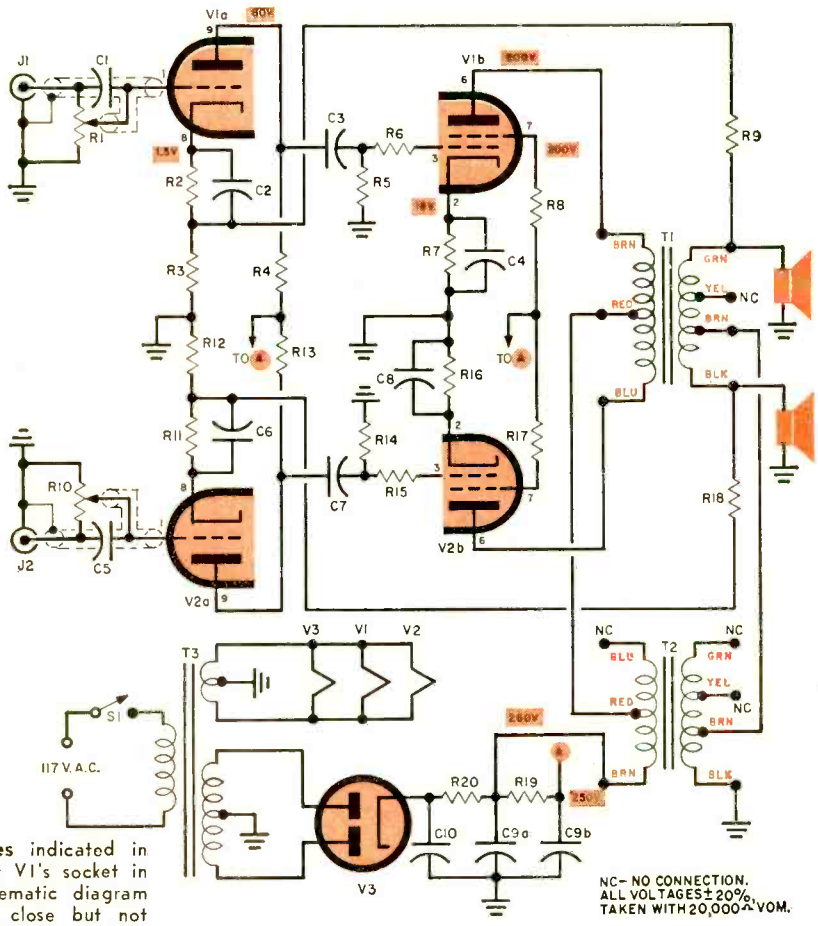
Channel separation is 25 db at 1000 cps; hum and noise is down 70 db. Each channel is equipped with its own volume control, and a power take-off socket may be added to provide power for auxiliary equipment.

The input sensitivity is high enough so that most ceramic or crystal stereo cartridges may be plugged in directly, thus eliminating the need for a preamplifier. These stereo cartridges usually have .25 to 0.5 volt output, and are relatively inexpensive. The author has had excellent results with the Sonotone 8T, the CBS-Hytron SC-2, and the Ronnette BF-40 stereo cartridges.

Construction. The first step in construction is the preparation of the chassis. A light aluminum chassis is recommended since it is easily worked and helps minimize stray hum paths. Lay out the chassis as shown. If you have a set of chassis punches, the task will be greatly facilitated. For a professional-looking job the drilled and punched chassis may be rubbed with fine steel wool, then sprayed with clear Krylon lacquer to preserve the luster. Application

For the first time anywhere—

how to construct a simplexed stereo amplifier

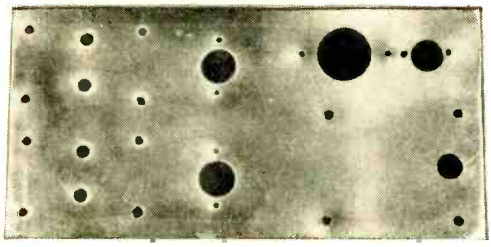


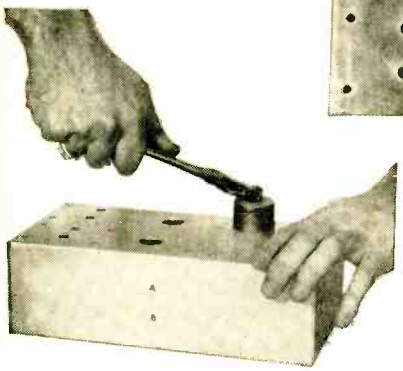
Voltages indicated in color at V1's socket in the schematic diagram will be close but not identical to those of V2.

PARTS LIST

C1, C5—30-μμfd. disc capacitor
C2, C6—50-μfd., 15-volt electrolytic capacitor
C3, C7—.05-μfd., 400-volt tubular capacitor
C4, C8—50-μfd., 50-volt electrolytic capacitor
C9a/C9b—50-50 μfd., 450-volt dual electrolytic can-type capacitor
C10—10-μfd., 450-volt capacitor
J1, J2—Phono input jack (RCA type)
R1, R10—3-megohm potentiometer
R2, R11—2200 ohms
R3, R12—47 ohms
R4, R13—220,000 ohms
R5, R14—680,000 ohms
R6, R15—10,000 ohms
R7, R16—330 ohms, 2 watts
R8, R17—56 ohms, 1 watt
R9—470 ohms
R18—1600 ohms
R19—470 ohms, 2 watts
R20—1500 ohms, 25 watts, wire-wound
S1—S.p.s.t. slide or toggle switch
T1, T2—Output transformer (Stancor A-3872)
T3—Power transformer 540-volt C.T., 6.3-volt C.T., 5-volt winding unused (Stancor-PC8405 or equivalent)
2—9-pin sockets
1—7-pin socket
1—Octal socket (for power takeoff if required)
1—5" x 7" x 3" aluminum chassis
2—3-lug terminal boards

All resistors ½-watt composition unless otherwise indicated





The chassis as it appears after drilling and punching. Use of Greenlee punches greatly facilitates chassis preparation.

of Walsco audio decals will add the finishing touch.

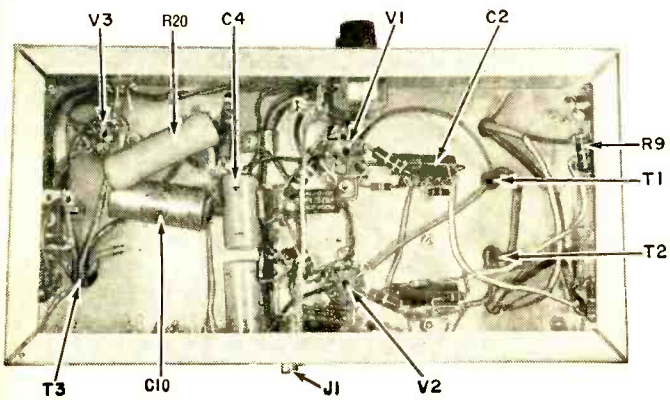
Mount the tie points first since it may be awkward to do so later. No difficulty in wiring should be encountered if the usual wiring practices are followed. Be sure to twist all filament leads together tightly and keep the input and output wiring as far apart as possible. Use shielded wire between the input jacks and the volume controls and between the volume controls and the tube input grids.

Use three-lug screw-type terminal boards at the speaker outputs; only two lugs are required for each speaker, but the third provides a handy spot to mount the feedback resistor. It is of the utmost importance to follow the color coding and connection of the output transformers as indicated on the schematic.

Operation. Proper operation of a simplex-connected amplifier is dependent on the phase relationships between the two input signals. A standard 45-45 stereo cartridge is capable of presenting this relationship to the amplifier if properly connected. Proper connection of the four-terminal stereo cartridge requires only the reversal of one set of leads. See "Stereo Simplexing Simplified" on page 45 for more information. In any case, to return the amplified signals to their proper phase relationship, simply change the phasing of one of the speakers.

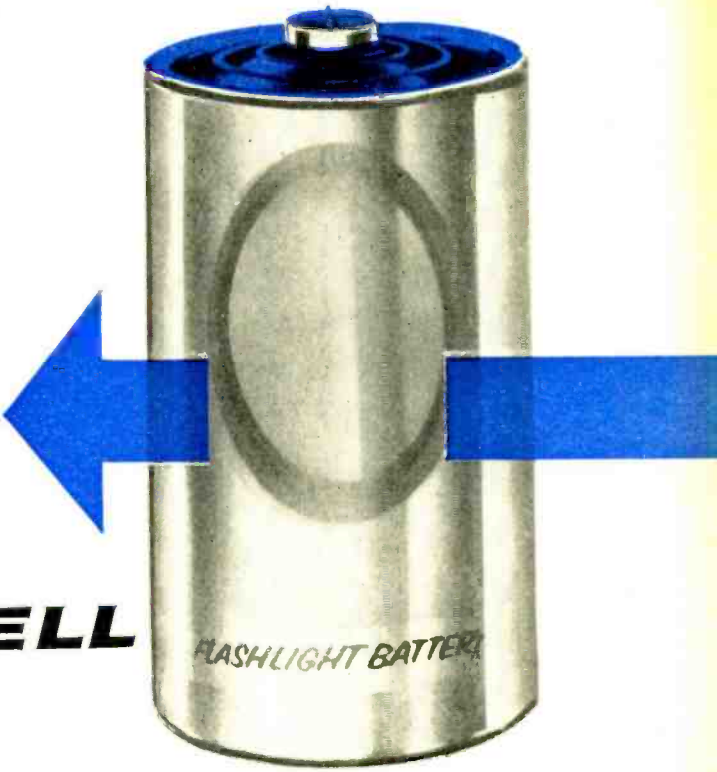
This amplifier has been used with two "Duo-Flex" speakers (see POPULAR ELECTRONICS, Feb. '59) and the over-all quality from this small and inexpensive system is quite good. The highs are crisp and clean while the bass is present in ample quantity. And with more expensive speaker systems, results are excellent.

The sound output is more than adequate for the average living room. With the level controls cranked up only halfway, the room is filled with sufficient sound to drown out all conversation. Anyone who constructs the Stereoplex will be rewarded with many hours of pleasant listening. —30—



Underchassis view of completed amplifier. The high-voltage secondary winding of T3 may vary in value from the one specified. Also adjust R20 for about 250 volts at point A in the schematic.

INSIDE the DRY CELL



By
SAUNDER HARRIS
W1NXL

A DRY CELL is a "package of electricity" which produces electrical energy by chemical means. A quick look inside a portable radio, a flashlight or a hearing aid will reveal one or more of these compact power sources ready to deliver the juice at the flip of a switch.

How does the dry cell produce electricity? Without going into chemical reaction formulas, let's take a look at what goes on inside a dry cell.

What Goes On. In Fig. 1, a typical dry cell is shown in cross section. Its zinc outer case serves as the negative electrode of the cell. The positive electrode is formed by a cylindrical carbon rod in the center of the cell. Separating the two electrodes is a pasty substance composed of an *electrolyte* and a *depolarizing mix*.

Due to chemical action between the electrolyte (ammonium chloride) and the zinc case, electrons pile up on the sides of the zinc container and bubbles of hydrogen gas travel through the electrolyte and cling to the sides of the carbon rod. As the bubbles pile up, they tend to choke off the action of the cell.

Here is where the depolarizing mix goes to work. Since it is composed of manganese dioxide, which has a high content of oxygen, it mixes its oxygen with the hydrogen bubbles and water is formed. This gets rid of the unwanted hydrogen and also keeps the electrolyte from drying up.

When someone connects the battery into a circuit, the electrons leave the zinc and travel into the circuit in the form of an electrical current. Then they return through the carbon rod to complete the circuit. But what's happening to the zinc while all this is going on?

As the battery action takes place, the zinc is gradually eaten away. While the battery is in use, hydrogen bubbles are

formed even faster than they can be removed by the depolarizing mix. This is why your battery must be given a rest every so often. The depolarizer must be allowed to catch up on its work.

Now let's see what happens when the battery is exhausted. The zinc walls of the cell get thinner and thinner, and the electrolyte—instead of being in paste form—dries out into powder. The depolarizing mix stops doing its job and the hydrogen bubbles around the positive carbon element just about stop all flow of electrons. Figure 2 will give you some idea of the condition of the cell at this point. This dry cell has had it.

Life of a Battery. Knowing what goes on inside the cell, it is now time to answer the question most important to you as a battery user. How long will your batteries last?

According to the National Bureau of Standards, in 1910, under standard testing procedures, a size "D" cell would give 260 minutes of service under intermittent use. In 1951, the testing of 12 to 15 brands of the same size "D" cell showed an average service life of over 800 minutes, with some cells giving 1000 to 1100 minutes of service. Today's batteries will do even better than that with proper care.

The five factors that determine the life of a dry cell battery are:

(1) Initial current drain
(2) Hours of use per day
(3) End point voltage
(4) Temperature
(5) Storage period prior to use

It is impossible to say that any battery has an exact number of hours of service life. If a battery is operated under conditions which draw a large current from it in a short period of time, the depolarizing mix cannot do its job properly and the voltage will drop off very rapidly. This is the situation we have already discussed. On the other hand, if the battery is used too slowly, its normal aging will cause the output to be reduced. The shelf life of a battery can range from a few months to as long as two years, depending upon the type of battery and the conditions of storage.

While in use, your battery should periodically be given "time off" to allow the depolarizing mix to work and remove the hydrogen and other waste products developed in the cell. This point is emphasized because it is so important in proper battery care. It will pay you to have two sets of batteries for frequently operated devices. By switching from set to set, you will increase the operating life of both sets.

Fig. 1. Cross-section view of a typical dry cell.

The end point voltage is of interest mainly to the designer of the battery-operated device rather than the user, and so we will only touch on it here. The end point voltage is the voltage below which the battery can no longer operate the device in question. If it takes one volt per cell to operate

Photos courtesy National Carbon Co.

a radio receiver, the unit will not operate when the battery voltage goes to 0.9 volt per cell. The best designs make the end point voltage as low as possible to allow the maximum to be gotten from a battery as its voltage drops off with time and use. Figure 3 will give you some idea of the manner in which battery voltage drops off with time.

The Temperature Story. Dry cell batteries designed for normal use operate best at room temperature, about 70° F. When batteries are exposed to continual high temperatures, they will break down in a much shorter time due to increased chemical action and a drying up of the electrolyte. Low temperatures, however, are a different story.

From the standpoint of storage, a battery loves cold weather. For example, as you may know, batteries which were frozen in the Arctic ice on polar expeditions were thawed out years later by other explorers and found quite usable. Cold will slow up the chemical action within a dry cell battery and in some cases make it inoperative; but when it is brought back to room temperature, the battery will return to normal operation none the worse for the chilling.

If you are going to store a dry cell battery for any length of time, store it in a cool spot. A temperature of about 45° F is ideal, and a shelf in the refrigerator is an excellent storage spot (if you can get away with it). According to tests made by the National Carbon Company's Battery Engineering Department, a battery which has been stored in this manner for nine months will give as much useful service as will a battery stored at room temperature for three months. Just remember to take the battery out of the cold about six hours prior to using it, and allow it to get back to room temperature for normal operation.

"Batteries" and "Cells." Before we complete this discussion of basic dry cells, there are a few things which deserve clarification. You will note that we have used the term "cell" and "battery." A *cell* is one unit consisting of positive and negative electrodes separated by an electrolyte. A *battery* is two or more cells, connected in series to add their voltage, and packaged in one container.

Actually, the "battery" you put in your flashlight is a cell, while the B+ unit you use in your portable radio is a true battery because it consists of more than one cell.

You should also be aware that every cell, no matter what its electrode materials, develops about 1½ volts. The physical size of the cell determines the amount of current that can be drawn from it.

There is, of course, much about dry cell batteries that we haven't discussed. There are also many new types of batteries such as the mercury battery, the solar battery and the new rechargable dry cells, all of which are now important means of developing portable power. These we will cover in a future issue. However, the dry cells that we have considered are still the workhorses of the battery world and, with a little care, will pay you many dividend hours of extra, dependable service. —30—

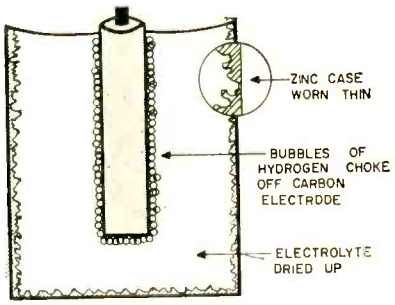
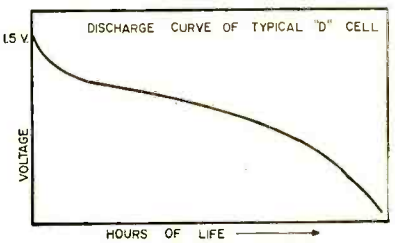


Fig. 2. Internal condition of dry cell at exhaustion.

Fig. 3. Gradual battery voltage drop with time and use.



Test Instruments

.....Part 4

THE VACUUM-TUBE VOLTMETER — *D.C. Ranges*

By
LARRY KLEIN
Technical Editor

THE LAST THREE installments of this series were devoted to the volt-ohm-milliammeter. Now let's take a look at its chief competition—the vacuum-tube voltmeter (or VTVM).

Why put tubes in a voltmeter? To answer this question, it is necessary to understand the exact meaning of "sensitivity." As we found when checking out the VOM, the accuracy of any voltmeter reading depends upon the extent to which it affects the circuit under measurement. After the voltmeter is connected, the voltage at a particular point in a circuit frequently no longer has the value it had before the instrument was attached.

For example, with two equal-value resistors connected across a 100-volt source, the voltage across each resistor is 50 volts. (See Fig 1). However, a voltmeter connected across either resistor will read less than 50 volts. Why?

Well, if the VOM in Fig. 1 is a 1000-ohms/volt job, it has an internal resistance of 100,000 ohms (on the 100-volt range). Therefore, when the meter is connected, the total resistance between points *B* and *C* falls to 50,000 ohms. Since this is only half as great as the resistance between points *A* and *B*, the voltage divides unevenly and less voltage now appears between points *B* and *C*.

Of the total 100 volts, 66⅔ volts will appear from *A* to *B*, and 33⅓ volts will appear from *B* to *C*. The voltmeter therefore reads 33⅓ volts even though 50 volts was present before the measurement was made.

The higher the internal resistance of a voltmeter, the less current it will drain from the circuit under test and the more accurate the reading will be. This is the advantage of the VTVM. Because of its very high input impedance, the VTVM provides a reading practically identical to the voltage existing before the test leads were connected.

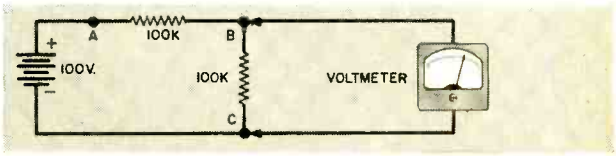


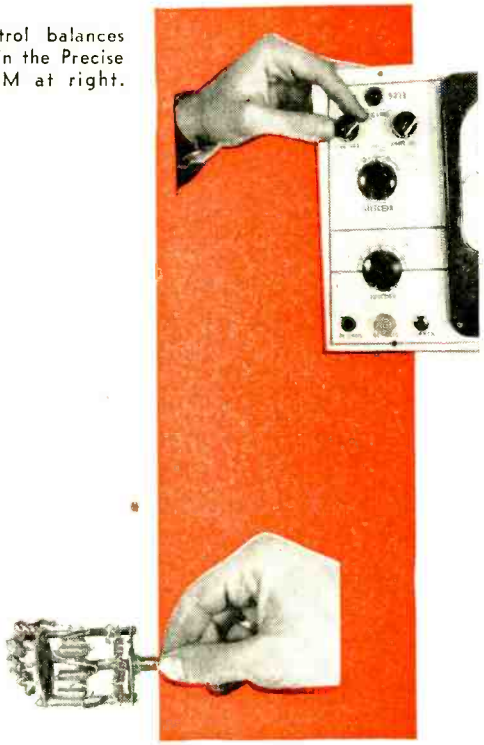
Fig. 1. Before measurement is taken, the voltage drops across the two 100,000-ohm resistors are equal. Shunting effect of meter causes an unequal voltage division and the meter reads less than half the voltage applied across A and C.

Balanced Bridge. A check of the VTVM circuits shows that most current models use one or the other of the two bridge amplifiers in Fig. 2. In both circuits vacuum tube *V1* serves as a d.c. bridge whose basic job is to effect an *increase* in the sensitivity of meter movement *M1*. Either circuit can also be considered as a means of *decreasing* the input current requirements for deflection of the meter—which comes down to the same thing. More on this point later.

Tube *V1* is usually a 6SN7 or 12AU7 dual triode, and the indicating meter (*M1*) is connected from plate to plate or from cathode to cathode of the triodes. In both circuits, *R1* adjusts for the normal differences between the operating currents of the two triodes and appears on the front panel of the VTVM as the *Zero Adjust* control.

Calibration control *R2* is usually mounted inside the VTVM cabinet and adjusts for the small changes in *total* tube current over long periods of use.

Zero adjust control balances the bridge circuit in the Precise Model 9071 VTVM at right.



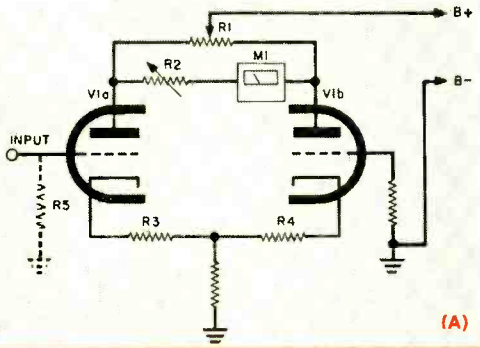
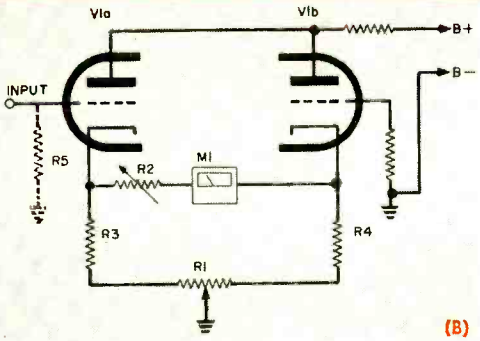


Fig. 2. Alternate versions of the VTVM bridge circuit. Their basic difference is mainly in the placement of the meter movement.



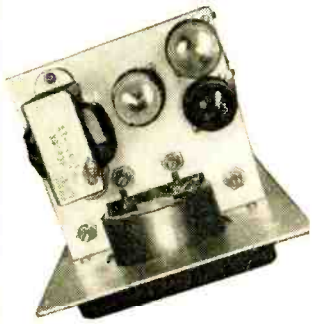
Range switch of the Eico Model 221 with precision divider resistors wired directly to the switch terminals for rigidity.

Internal view of the Heathkit V7A VTVM. The range switch is on the left, function switch on the right.

If you're wondering why the VTVM circuits is referred to as a "bridge," as you can see Fig. 2 (B) can be easily redrawn to the standard bridge configuration (Fig. 3) and may even be more easily understood that way.

The theory of the bridge is quite simple. Triode *V1b* is the "reference" triode — in that its grid is grounded and the amount of current flowing through the tube is determined by the bias developed across cathode resistor *R4* and the plate voltage of about 100 volts d.c. Triode *V1a* is operating under the same conditions except that its input grid is connected to a 5- or 6-resistor voltage divider which for the present discussion we will treat as a single resistor and call *R5*.

Zero Adjust control *R1* varies the plate voltages to tube *V1* in Fig. 2 (A) and varies



Four calibration controls of the Eico Model 221 are grouped around the meter movement as seen from the top of the chassis.

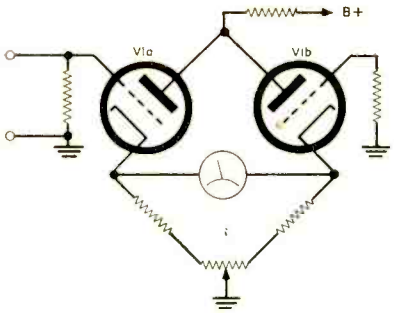
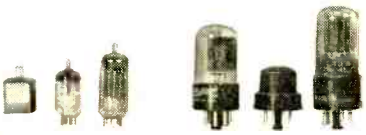


Fig. 3. The circuit of Fig. 2 (B) redrawn in the standard bridge configuration.



The "active" elements in the VTVM. Standard models usually have a lineup comprising (from left to right) a 50-ma. power supply selenium rectifier, a 6AL5 a.c. rectifier and a 12AU7 bridge tube. An alternate arrangement consists of a 6X5 power rectifier, a 6H6 a.c. rectifier and a 6SN7 bridge tube.

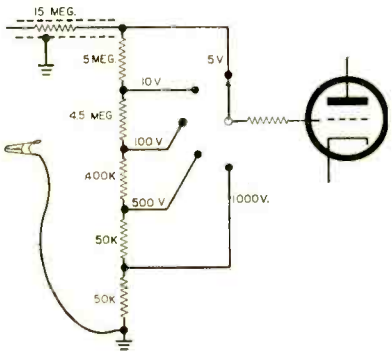


Fig. 4. Voltage divider which sets the amount of the input voltage reaching the grid of the input triode.

the cathode bias in the circuit of Fig. 2 (B). By adjustment of *R1,* the voltage *differences* between the two plates or two cathodes can be reduced to zero—and the meter therefore will also read zero. We have a balanced condition.

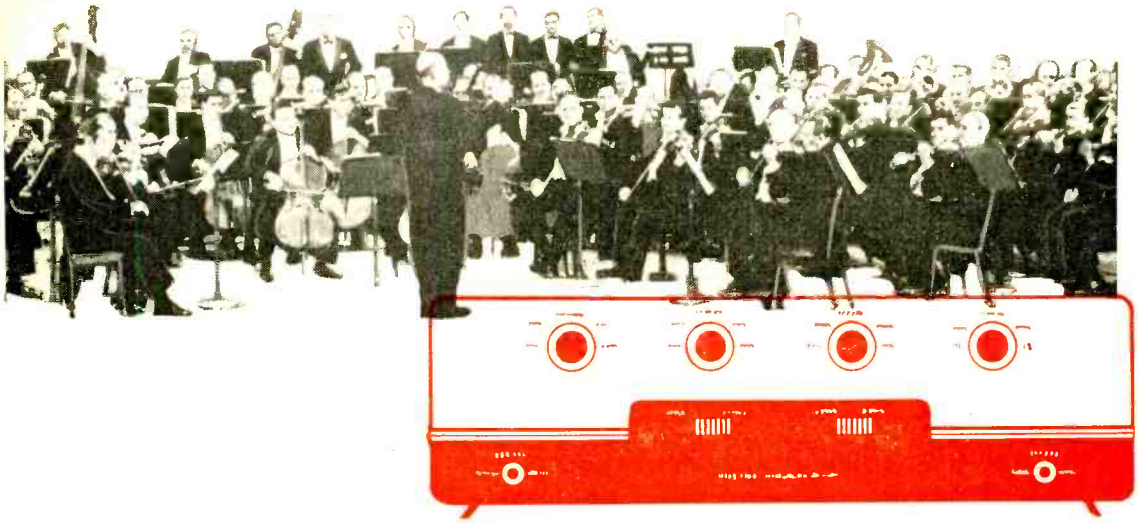
Unbalancing the Bridge. Now that we have a stable balanced bridge, how do we go about making practical use of it? Referring back to Fig. 2, let's apply 1 volt d.c. between the input grid of *V1a* and ground and see what happens. When the applied positive voltage reduces the bias on *V1a,* the tube immediately reacts with an increase in current flow through *R3.* This, in turn, as Ohm's law tells us, causes an increased voltage drop across *R3.* Meter *M1,* up to this moment, has been comparing the drops across *R3* and *R4* and—not finding any difference—read "0." Now, though, *M1* responds to the voltage difference between the plates or cathodes of *V1,* swings upscale—and we have a VTVM at work.

Let's take a look at *R5.* In a practical VTVM, *R5* appears as the voltage divider shown in Fig. 4. The total voltage to be measured is always applied across the complete string of resistors in the input circuit.

For higher voltage ranges, the input grid of *V1* is tapped farther down on the voltage divider circuit. Note that the input resistance remains constant and equals the *total* resistance of the voltage divider plus the isolating resistor in the d.c. probe. Adding up the resistances in the divider, you can see that the sensitivity of the VTVM is quite high.

The usual VTVM d.c. input resistance is 11 megohms and can be as high as 25 megohms. This is most important on the low voltage ranges of the VTVM which are often used for measurements in high impedance circuits. Note that, unlike the VOM, the input impedance of the VTVM remains constant regardless of which voltage range is used.

Next month we will continue our investigations and see what makes the VTVM able to respond to a million cycles a.c. and read up to a billion ohms resistance. —30—



INSIDE the PREAMPLIFIER

Part 3:
Tone and Loudness Controls

IF A high-fidelity system is flat from 20 to 20,000 cycles—as a hi-fi system is supposed to be—why is it necessary to have tone controls? After all, any change in the response from complete flatness is in itself a form of distortion; why, then, provide a deliberate means for creating distortion?

The trouble with this frequently asked question is that little word *if*, and the very big assumption behind it. The fact is that there are few, if any, hi-fi systems that are completely flat from 20 to 20,000 cycles.

It is true that the *electronic* units of modern hi-fi systems—tuners, preamplifiers, and amplifiers—are capable of flat response, but transducers (microphones, pickups, and loudspeakers) and tape or disc recordings are another story. For example, there are few commercial speaker systems that cover the complete audio range with any real resemblance to flatness. And there are very few rooms which possess the acoustic properties that would be needed to reproduce the full 20-to-20,000 cps range faithfully even if such a speaker system *were* obtainable.

The Human Problem. Even if the ideal system and room were available, we would still have a problem. The human ear itself is reasonably flat only at very loud volume levels. At lower levels the response of the ear slopes off both at the low and the high ends.

Suppose we record a symphony orchestra at its original volume level. The frequency balance of such a recording is represented by Curve *A* in Fig. 1. Very few of us could play this recording back at its original volume level in our homes. If we attempted to do so, it's probable that our neighbors would soon be paying us some rather unfriendly visits. Most of us must reduce the level to

By
JOSEPH MARSHALL

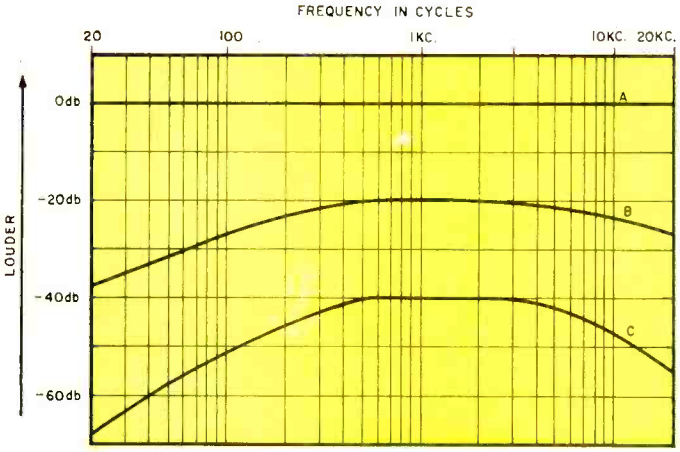


Fig. 1. The natural frequency balance of a symphony orchestra at full volume is represented by Curve A. At one-tenth of the original volume, the response of the human ear is similar to that of Curve B. At one-one-hundredth of the original volume, the ear's response is that of Curve C.

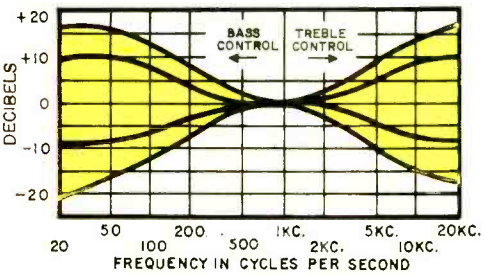
one-tenth or one-one-hundredth of the original.

But at one-tenth the original level (20 db down), the response of the average human ear is roughly that of Curve *B*. At one-one-hundredth of the original level (40 db down), the ear's response is that of Curve *C*. Thus, if the loudspeakers delivered the original frequency balance into a room at these lower levels, both the lows and the highs would seem much softer than they did in the concert hall—as if the instruments that played them were further back. The listener would not be given a good facsimile of the original tonal balance that existed in the concert hall.

In view of these and other factors, every hi-fi system must have some means of modifying the tonal balance. With few exceptions, the general practice is to permit adjustment of the extremes of the sound spectrum—the low bass and the high treble. In almost all preamplifiers this is done with separate and independent bass and treble controls, each providing about 15 db boost and cut.

Losser Tone Controls. Today's tone control circuits fall into two general types: the losser-type and the Baxandall-type circuits, plus a number of special circuits. The losser-type is used, with minor variations in the values of components, in a great many preamps.

It would take an article in itself to analyze the operation of these circuits in detail. In general, losser-type circuits consist of two frequency-discriminating networks, one for bass and one for treble. These two networks are so designed that when



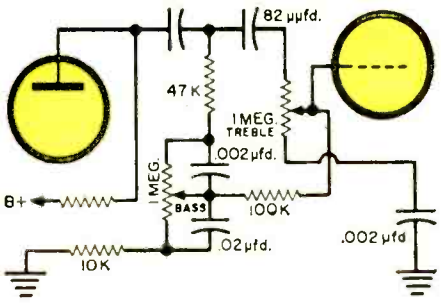
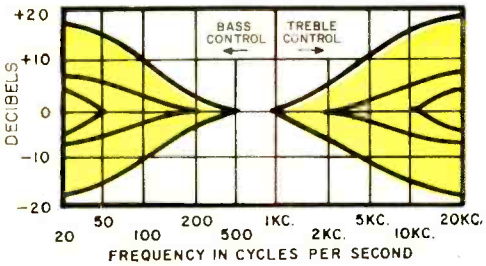


Fig. 2. Typical "losser-type" tone control circuit. The tone control action of this circuit is depicted in the accompanying graph.

the potentiometer of each is at mid-position, the *entire* audio spectrum is attenuated from 15 to 20 db and the response is perfectly flat over the full range.

Referring to Fig. 2, when the bass control slider moves to the top, the loss for mid and high frequencies remains the same, but the loss for bass frequencies is reduced. Thus the bass receives special emphasis while the rest of the spectrum remains the



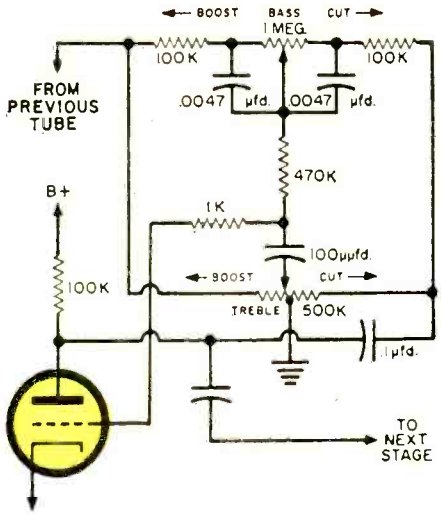
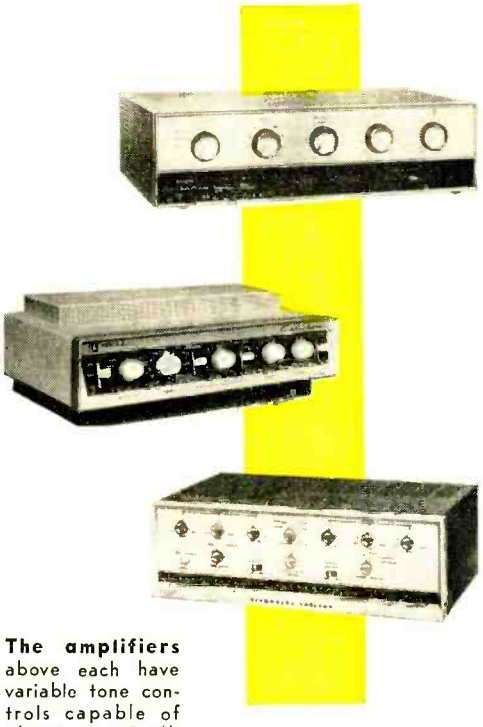


Fig. 3. Baxandall-type tone control circuit (below, left). Graph illustrates the "sliding" crossovers produced by this type of circuit.



The amplifiers above each have variable tone controls capable of about ± 15 db boost and cut. Loudness controls differ, however. The Knight KN700A (top) has three positions of compensation; the Bell "Carillon" (center) features a continuously variable control; and Stromberg-Carlson's ASR-433 has an in/out loudness switch.

same. On the other hand, when the control moves down, the mid- and high-frequency losses remain constant, but the loss for the bass is increased, thereby causing attenuation of the bass.

It took many years to develop this clever circuit which achieves so much with so relatively few parts, and it is no wonder that it has become fairly standard. Because there is a loss of about 20 db for all frequencies in the "flat" or middle setting, additional amplification must be provided. The circuit is therefore frequently preceded by one section of a twin-triode used as an amplifier and followed by the other section operating as a cathode-follower.

The bass and treble sections of losser-type tone controls "hinge" at about 1000 cps. For example, as bass boost or cut is supplied, the frequency response begins to slope up or down below 1000 cycles and the maximum boost or cut occurs at some point between 20 and 50 cycles. On the treble end, the slope starts above 1000 cycles and maximum effect is achieved between 10,000 and 20,000 cycles.

This "hinge" arrangement at 1000 cycles is a good compromise for most applications. However, the very best speaker systems have a fairly even response below 200 cycles and do not require any bass boost above this point. Indeed, they sound boomy, especially on voice, if there is an appreciable boost of the bass frequencies above 150 cycles. For best results with these speakers, most of the boost should be concentrated at the *very* low end—below 50 cycles.

Similarly, the finest tweeters do not need much—if any—boost below 10,000 cycles. If boosted too much in this region, they will sound overly bright and shrill. Consequently, many of the recent preamps designed for use with high-quality speakers have a dif-

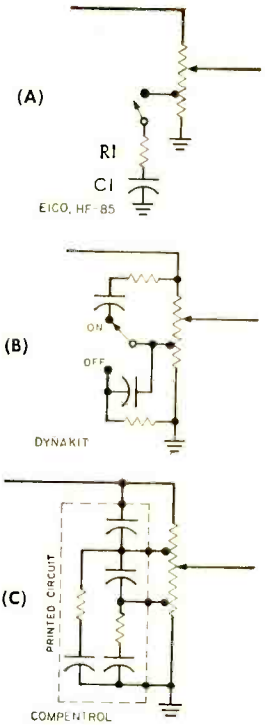


Fig. 4. Three commonly used loudness control circuits are: (A) the tapped volume control; (B) the tapped volume control with an additional high-frequency compensating network; and (C) the circuit used in the Centralab "Compentrol" which features a dual-tapped volume control.

ferent type of tone control, the Baxandall-type control.

Baxandall Tone Controls. The Baxandall control setup permits "sliding" crossovers; the "hinging" points vary as the controls are adjusted. When only a little boost is applied, the bass crossover point may be at 125 cycles and the treble at 10,000 cycles; when medium boost is applied, the crossover points may be at 250 and 5000 cycles; and at full rotation, they may move to 500 and 1000 cycles.

In the Baxandall circuit (named for the gentleman who developed it), "variable crossover" tone control action is achieved through a frequency-discriminating network incorporated into a feedback loop, as in Fig. 3. Because of the feedback loop, the Baxandall circuit has a low output impedance and does not have to be followed by a cathode-follower to achieve a low output impedance. However, it works best if it is *preceded* by a cathode-follower. The use of feedback in the Baxandall circuit results in lower distortion than is achieved with losser-type circuits.

Baxandall-type controls may seem "slow-acting" when first tried. Although they deliver large boost at the extremes of the spectrum, the effect is not prominent until the control approaches the maximum boost position.

Because there are almost as many theories as to what constitutes good tone control curves as there are concerning good speaker design, a number of combination losser and feedback type controls are available which are capable of producing a wide variety of curve shapes.

Loudness Controls. With the modern speaker systems, these tone control circuits provide adequate means for correcting various factors which influence tonal balance at a given level. But if we change the level substantially, the tonal balance will also change because the response of our ears changes. If we decrease volume and maintain the same tone control settings, the bass end will seem attenuated; if we increase the volume, it will seem boosted. Thus, to maintain the same apparent tonal balance at all levels, we would have to readjust the tone controls every time we changed the volume level significantly. As a matter of fact, some people prefer this method of compensating for the "loudness" effect; most, however, find it a nuisance. Consequently, it is general practice for a hi-fi system to provide some type of automatic or semi-automatic "loudness" control which compensates for the ear's frequency discrimination.

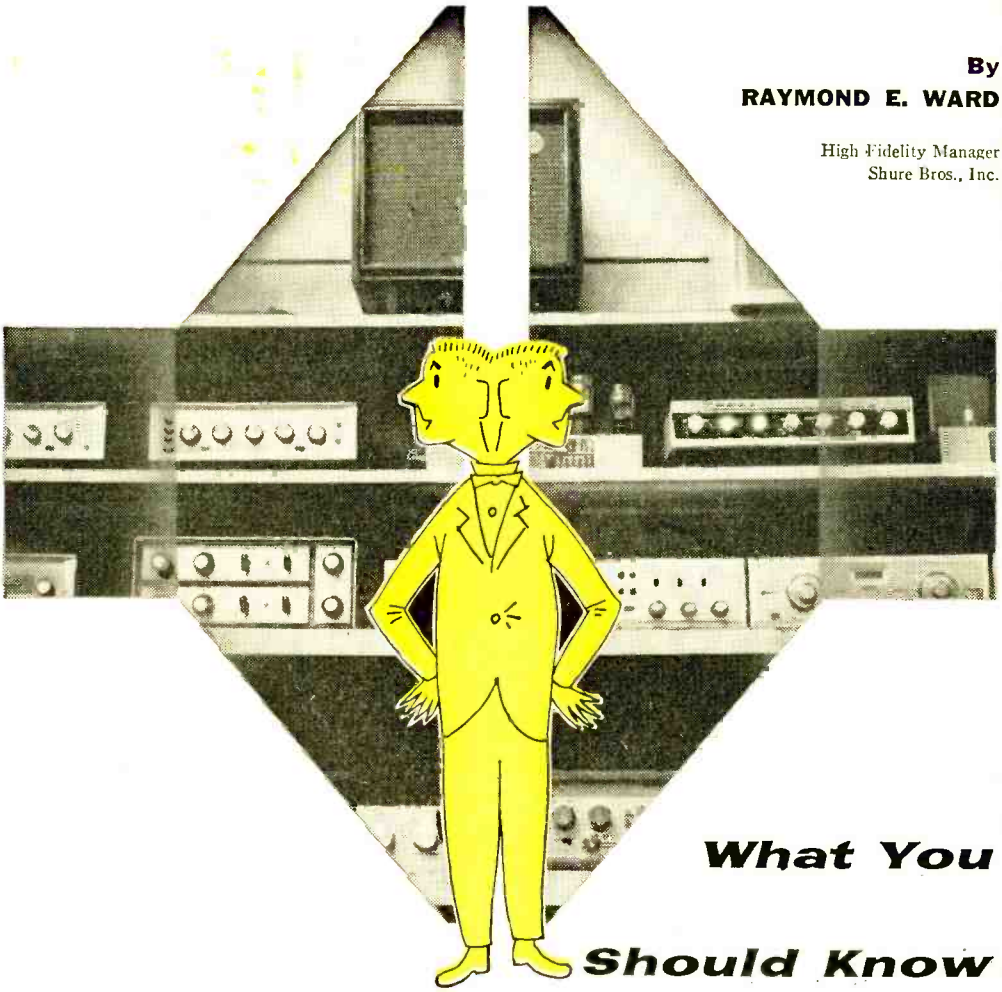
One relatively simple circuit which deals with the loudness compensation problem uses a tapped volume control. (See Fig. 4(A)). With a network consisting of a capacitor (*C1*) and a resistor (*R1*) connected between the tap and ground, we offer the incoming signal two paths—one of which is through the volume control itself to the grid of the following tube, the other through the network to ground. The impedance of the network to ground will vary with the frequency of the signals due to the capacitive reactance of the network. The high frequencies will find that *C1* and *R1* present an easy path and are partially bypassed to ground. But the low frequencies will find that the capacitor presents a high impedance and they will take the other path through the potentiometer to the grid of the tube. Thus, this simple network will boost the lows in relation to the mid and high frequencies.

By choosing the proper values of capacitance and resistance and tapping the control at a proper point, we can achieve a curve which starts where we want it to and

(*Continued on page* 141)

By
RAYMOND E. WARD

High Fidelity Manager
Shure Bros., Inc.



What You Should Know Before Buying Stereo

WITH great ballyhoo and hoopla the stereophonic record era is upon us. "If it isn't stereo, it isn't high fidelity," over-enthusiastic advertisers assert. But this statement is no more true than is its converse, "If it's stereo, it's got to be hi-fi." Let's take a more sober look at what's happening in stereo and try to appraise stereo in terms of what it actually does, and doesn't do, for sound reproduction.

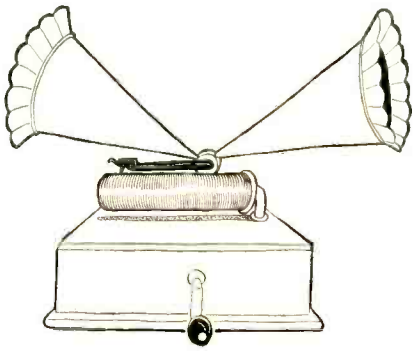
When stereo is first heard, it usually has tremendous impact. A fascinating new dimension of "depth" is added to sound reproduction. After some experience with stereo however, the critical listener soon realizes that the addition of a new "dimension" does not eliminate other requirements of high fidelity such as good frequency response and low distortion.

Consider the fact that it's possible to pump two channels of music through two table-model radios costing $19.95 each. The result may be *stereo* but it won't be hi-fi. Two mediocre amplifier-speaker combinations do not equal one good amplifier-speaker any more than two bad singers equal one good one.

Personal Taste Factor. To some extent, the value of stereo to each individual depends on personal *musical* tastes. One of

the most effective uses of stereo is in opera or dramatic performances, where action shifts across a stage. A person who is an opera or theatre fan will find that stereo is tremendously effective in imparting to a recording a feeling of depth and spaciousness. On the other hand, stereo has much less to add to the performance of a single soloist or small ensemble.

Remember that stereo demands careful listening, and the place where you listen is critical and restricted. You must sit in the "stereo area" (see "Your Stereo Listening Area," P. E., November, 1958) or you will get over-emphasis of one channel. Music in the home is often background music, and while fidelity is important in heightening pleasure and reducing listener fatigue, stereo is mostly lost unless you are sitting in the right spot.



Much has been made of the fact that the stereo effect tends to "mask" inadequacies in equipment. This is true, but only in the same sense that color television "masks" inadequacies in programing. At first, a viewer is so interested in looking at the colors that he doesn't really care what's going on. But such a masking effect is hardly permanent. A danger in these times of stereo hoopla is that a hi-fi fan, in his excitement over this new development, may be persuaded to buy an inadequate stereo system and then, as the novelty wears off, may find himself stuck with a substantial investment in poor equipment.

Stereo Cartridges. The heart of any stereo record system is a stereo phono cartridge. One erroneous impression which has gained currency is that the new stereophonic phono cartridges are superior in every way to monophonic cartridges, even for monophonic records. Most of the time, your own two ears will tell you differently.

Manufacturers who assert that their stereo cartridges are better than their mono cartridges are probably not speaking about cartridges of equal quality in the first place. It is true that a stereo cartridge can be used to play monophonic records. It is also true that a fine stereo cartridge will sound better in such use than a poor mono cartridge. But a cartridge especially designed for stereo records is seldom the equal of a really good mono cartridge.

For one thing, more muscle is needed to operate two electrical systems than one. This means that stereo cartridges tend to have less compliance and more dynamic mass than equivalent monophonic units. Decreased compliance necessitates increase in tracking force, with resulting wear and tear on the stylus and record. Increase in the dynamic mass of the needle cuts down on high-frequency response as the needle gets too heavy to follow the rapid groove wiggles above a certain frequency. Since a stereo cartridge has to be sensitive to vertical movement, imperfections in mono records may show up as noise when played with a stereo cartridge.

The best mono cartridges feature wide frequency response, low distortion, and low record wear. Because of the peculiar problems involved in stereo cartridge design, no stereo pickup yet made quite comes up to the standards set by the best monophonic units now available.

Of course, a chain is no stronger than its weakest link. The quality of the final sound from your loudspeaker can be no better than the quality of the poorest component in your system. And so the imperfections of a stereo cartridge on a standard record may be entirely swamped out by the distortion, noise, etc., contributed by an inadequate turntable, amplifier or speaker.

If you have top components all along the line, and you are adding stereo, it is probably wisest to keep both a monophonic and a stereo cartridge in operation—at least for the time being.

Preamps and Speakers. A stereo preamp is a good investment even if you are going to stay with monophonic sound for the present. Then, when you decide to go stereo, you need only add the second amplifier and speaker. Get either a separate power amplifier and duplicate it later for stereo, or try one of the new single-chassis

(*Continued on page* 147)

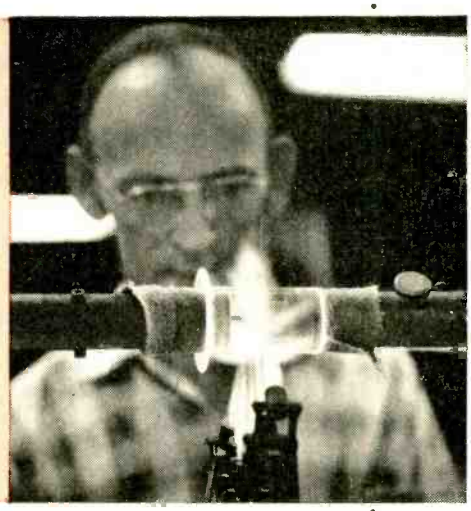
POPULAR ELECTRONICS visits

a tube manufacturer to observe while . . .

A TRANSMITTING TUBE IS BORN

THE MANUFACTURE of a high-power transmitting tube involves more than just assembling a number of metal and glass parts. In order to meet the demands of industry, the manufacturer must pay ever-increasing attention to reliability and long life. The manufacturing processes which most affect tube life are those relating to the precision with which the electrodes are manufactured and assembled, the extent to which all impurities and foreign particles have been eliminated, and the degree of vacuum obtained inside the tube.

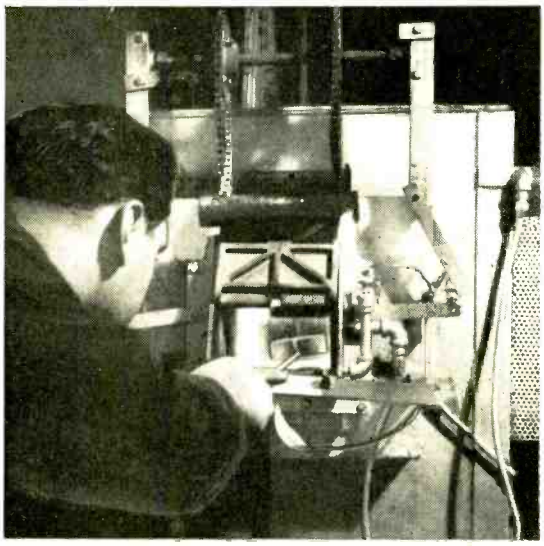
Recently POPULAR ELECTRONICS visited the Amperex Electronics Corporation plant in Hicksville, N. Y., to find out how a manufacturer of high-quality electron tubes handles the problem of building long life and reliability into a modern high-power, high-quality transmitting tube. A typical transmitting tube, the 5924A, was followed through the different stages of its manufacture, and photographs of each of the key steps were taken.



Photos by Joe Petrovec

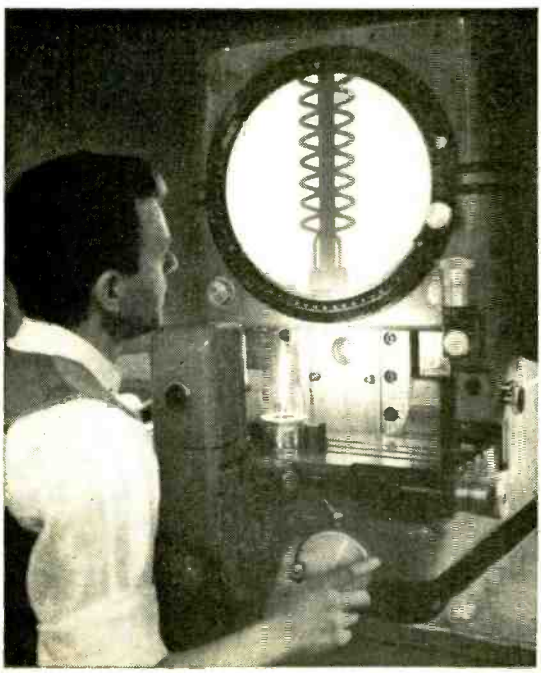
1 Glass technology is an important aspect of tube manufacturing. The glass is softened by jets of flame from a specially designed fixture. When the glass is soft enough, the operator shapes it with special glass-shaping tools.

2 Cleanliness is more than a byword to the tube manufacturer. Tube life and reliability are decreased when impurities, such as oxides, are deep within the metal elements. Here the electrodes are placed in a hydrogen atmosphere furnace to "reduce" oxides.

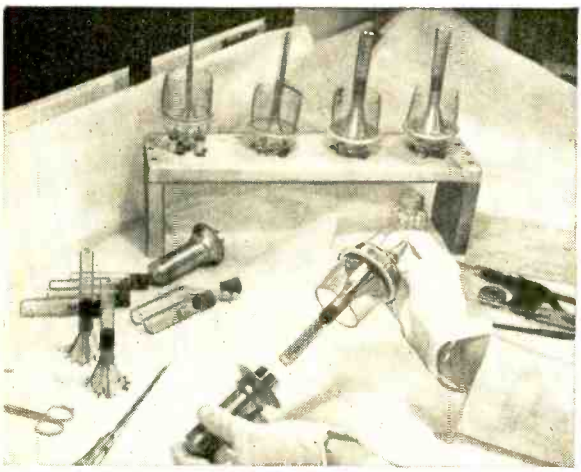


3 The cleaning process goes on. The most modern and efficient cleaning equipment is used by Amperex at various stages of tube manufacture. Here an ultrasonic cleaner eliminates the last vestiges of surface contamination which may exist on the tube's metal electrodes or glass parts.

4 The care exercised in fabricating and cleaning all the tube components naturally extends to the inspection procedures. Parts are projected many times their actual size on a screen so that even the slightest degree of misalignment is easily detectable.

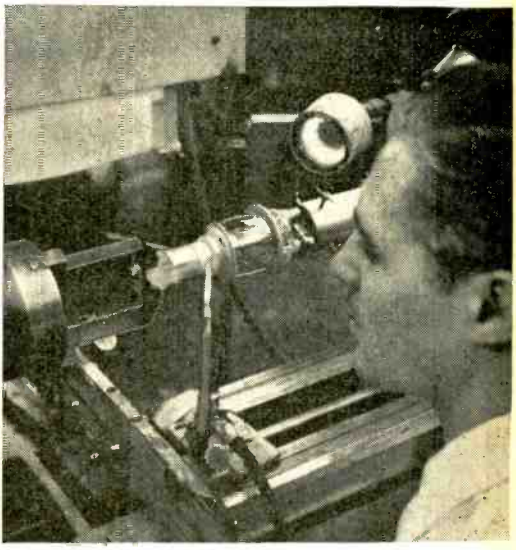


5 Having insured the cleanliness and accuracy of all components of the tube, the assembly procedure begins. The first step is to assemble the delicate filament structure with hand tools.



6 The metal anode is now mounted. In background, note the different stages of assembly of the 5924A tube. The assembler always keeps the working area immaculately clean.

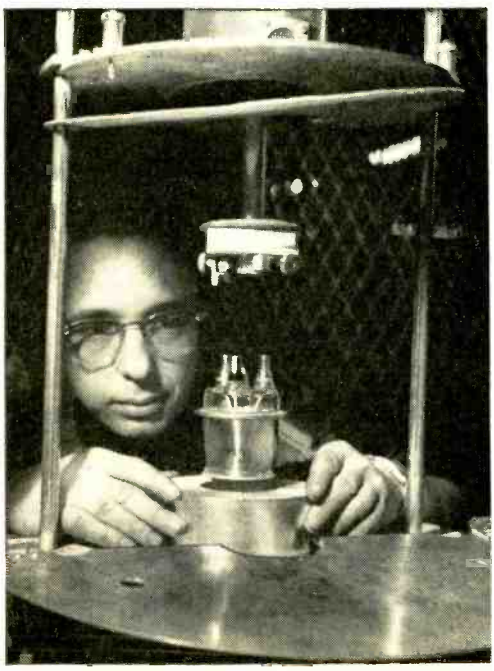
7 Anode is sealed to the grid and cathode mount. A highly skilled operator performs this exacting procedure on a lathe-like machine which was designed for this operation.



8 Creating the vacuum inside a tube involves more than just pumping out gas. It also includes removing gas trapped within the tube elements. To do this, the electrodes are heated until the impurities are driven off. Here the gas is pumped out (through the horseshoe-shaped glass tubing) while the tube elements are heated.

9 After all gases and impurities are pumped out of the tube, it is necessary to make certain no other impurities enter. This is done by "sealing off" the opening through which the gas was evacuated. A 5868 tube is shown here.

10 Now for the finishing touches. With the same care exercised in the internal fabrication and assembly, all the external surfaces are carefully silver plated and, at the same time, specific areas are painted for purposes of identification of tube elements.



11 The final step is to "fire it up" and subject it to a thorough testing. All electrical characteristics are tested to insure that the tube will not only meet, but exceed, specified ratings.

"Nifty Novice" 15-Meter Transmitter

Get on the air with this pretuned easily constructed rig

By
DONALD L. STONER
W6TNS

THE 15-meter band (21 mc.) holds a world of adventure for the Novice class radio amateur. It is possible for a Novice to communicate with hams all over the world on this band which is "open" to many countries during daylight hours. The "Nifty Novice" 15-meter transmitter is designed especially for the Novice and runs 25 watts input power.

Although operating only on this one band, the Nifty Novice has many features that will appeal to prospective operators. The transmitter circuits are pre-tuned as much as possible and only two adjustments are required to get on the air. No meters are used during adjustments, as an inexpensive pilot lamp serves quite well as a tuning indicator. The two controls are set for maximum lamp brilliancy, and the transmitter is ready to operate.

The 25-watt power level is high enough for world-wide communication, yet low enough to minimize television interference. Another feature of this rig, usually found only in very expensive transmitters, is the provision for keying of the oscillator stage only. This produces very good keying notes, and the rig never fails to get a T9 (tone) report. This same circuit also protects the final amplifier so that it is virtually impossible to damage the tube or components by mistuning the transmitter.

Construction. Cut and drill the chassis holes and the aluminum capacitor brackets for later mounting of the tuning controls *C10* and *C11* as required.

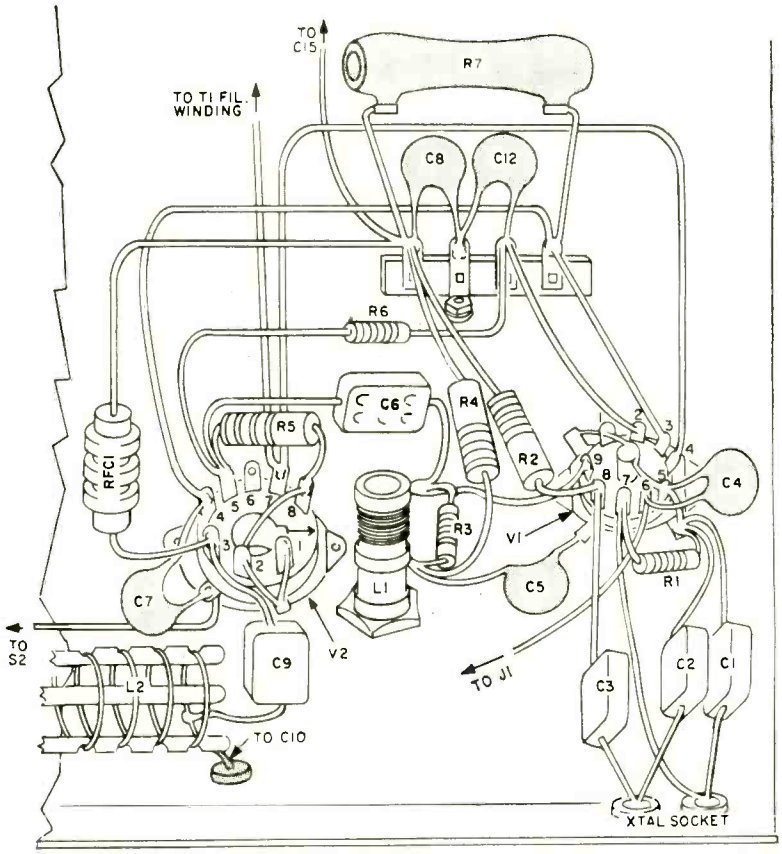
The sockets for the two r.f. tubes (*V1* and *V2*) should be the type with ground lugs on the mounting ring to facilitate wiring, with the associated components grouped tightly around the sockets to keep the leads short. Coil *L1* is located between the two tubes, and *L2* is located under the chassis, below *C10* and *C11*.

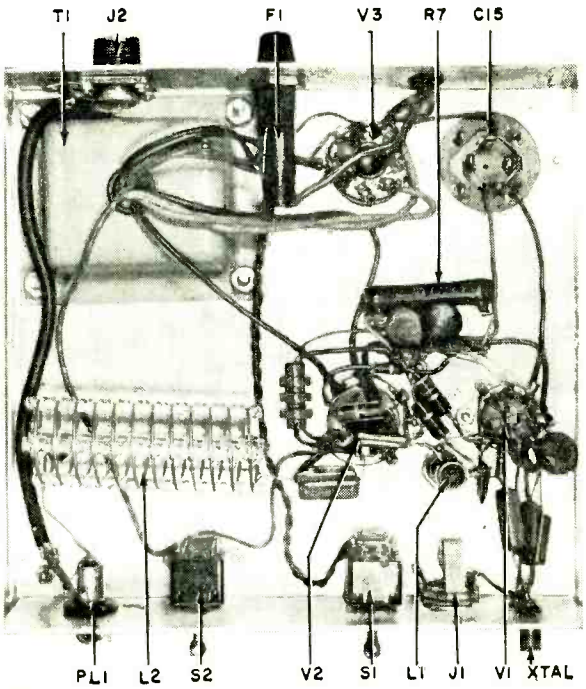
Coil *L2* is held in place by its own leads passing through the chassis (insulated by rubber grommets) and connected to *C10* and *C11*. *C9* is connected to *L2* at a point just before it passes through the chassis. In a similar manner, the wire to *PL1* is connected to the other end of *L2*. After all the wiring is completed, recheck all connections carefully.

Testing the Transmitter. Use a volt-ohm-milliammeter (or preferably a VTVM) for the following checks:

(1) Remove all the tubes and measure the resistance across the line cord plug. With power switch *S1* off, the VOM should read infinite ohms. With *S1* on, the ohmmeter should read about 4.2 ohms. If readings are incorrect, there is a short or open in the power supply circuits.

(2) Insert *V1* only and switch on the transmitter. The tube filament should

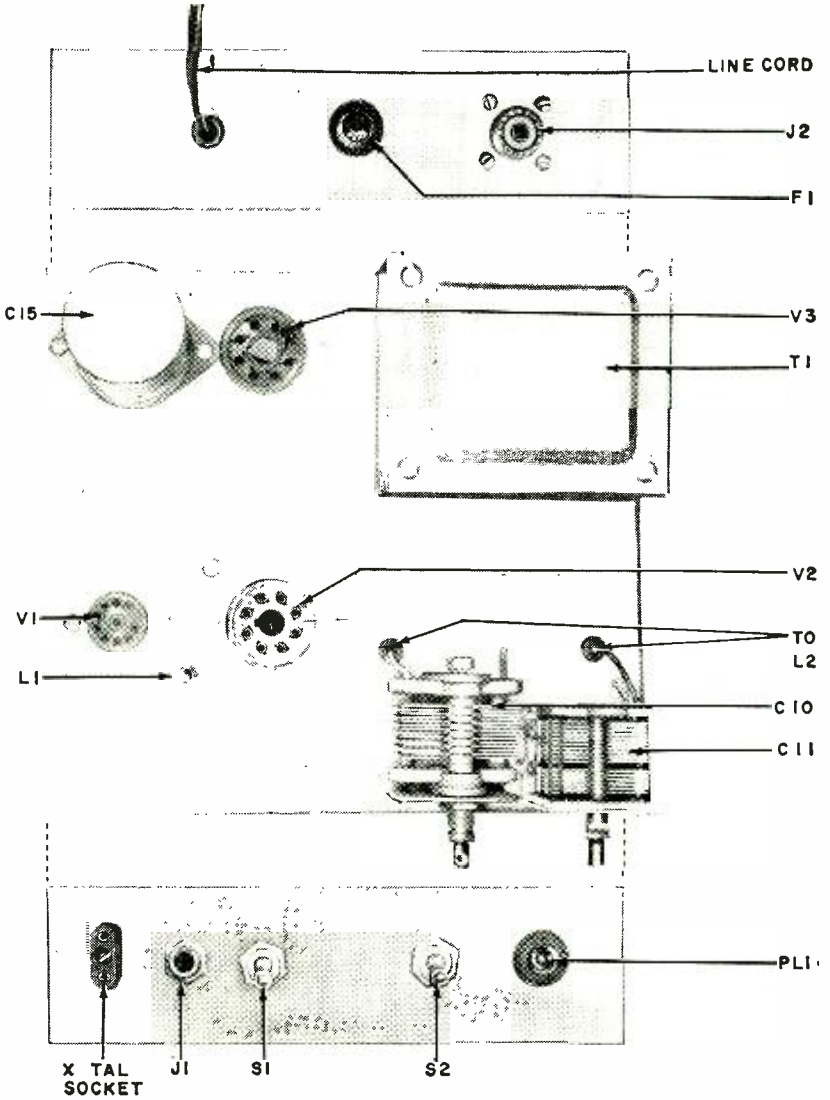




Pictorial diagram above details the connections to tube sockets V1 and V2. The leads need not be as long as this but should connect to points indicated.

Underchassis view at left shows general layout of completed transmitter. Capacitor C15 may have four 20-μfd. sections or be a single 80-μfd. unit.

Chassis layout on the facing page indicates convenient parts placement. Front and back aprons of the chassis have been "folded out" for clarity.



light. If it doesn't, check filament wiring.

(3) With the transmitter off, remove *V1* and measure the resistance from pin 2 of the 5Y3 rectifier (*V3*) socket to the chassis ground. The VOM should read close to zero ohms, and then slowly drift back to 50,000 ohms or higher.

(4) Place switches *S1* and *S2* in the "off" position and insert *V3*. Turn on *S1*, and *V3*'s filaments should light up immediately. Connect the meter (500 volts d.c. scale) from pin 2 of *V1*'s socket to chassis ground. Flip the *standby* switch on and read the B-plus voltage. It should read about 370 volts (±10%).

(5) Install *V1* and *V2*, and again check the B-plus voltage. It should drop to about 330 volts. If it does not, this may indicate that a connection has been omitted and the tubes are unable to draw power from the supply.

If these simple tests have produced satisfactory results, you are now ready to tune up the transmitter.

Tune-Up Instruction. Connect a key and crystal to the transmitter, and set *L1* fully counterclockwise so that the slug is all the way out of the coil. Set *C10* and *C11* at maximum capacity. Connect the negative lead of your voltmeter to pin 2 of *V1* and the positive lead to ground.

Switch on the transmitter, and observe

PARTS LIST

C1—47-μμfd. mica capacitor
C2—39-μμfd. mica capacitor
C3—.001-μfd. mica capacitor
C4, C5, C7, C8, C12, C13, C14—.005-μfd., 600-volt disc ceramic capacitor
C6—10-μμfd. mica capacitor
C9—.002-μfd. mica capacitor
C10—100-μμfd. variable capacitor (E. F. Johnson 100R-12 or equivalent)
C11—365-μμfd. variable capacitor (J. W. Miller #2111 or equivalent)
C15—80-μfd., 450-volt electrolytic capacitor (Sprague TVL-1735 or equivalent)
F1—3-ampere fuse and mounting assembly
J1—Open-circuit phone jack (key)
J2—Coaxial connector (Amphenol 83-1R or equivalent)
L1—18 turns of #26 enameled wire, wound on 3/8" slug-tuned form (J. W. Miller #4405)
L2—12 turns of #18 tinned wire, 1" diameter, spaced 1/4" between turns (Air Dux #408)
L3—6 turns of #22 enameled wire, 1/4" diameter (see text)
PL1—#49, 2-volt, .06-amp. pilot lamp
R1, R6—100,000-ohm, 1/2-watt resistor
R2—47,000-ohm, 1-watt resistor
R3—15,000-ohm, 1/2-watt resistor
R4—1000-ohm, 1-watt resistor
R5—15,000-ohm, 1-watt resistor
R7—25,000-ohm, 10-watt wire-wound resistor
RFC1—2.5-mh. r.f. choke
S1, S2—S.p.s.t. toggle switch
T1—Power transformer, 525 volts ct., 90 ma.; 6.3 volts, 5 amp.; 5 volts, 2 amp. (Triad R-10B or equivalent)
V1—6AU8 tube
V2—6L6 tube
V3—5Y3 tube
XTAL—Quartz crystal, 7035 to 7080 kc.
1—Chassis or chassis box approx. 7" x 7" x 2" (L. M. Bender # 20—plain, or equivalent)
Misc. crystal socket, octal tube sockets (2), 9-pin socket, rubber grommets, knobs, 8" length of RG-59/U coaxial cable, 4-lug terminal strip

the d.c. reading while rotating the slug of *L1*. Set the slug for maximum voltage and glue it in place. Measure the power supply voltage, and set capacitor *C10* at the point where maximum *B*-plus is obtained.

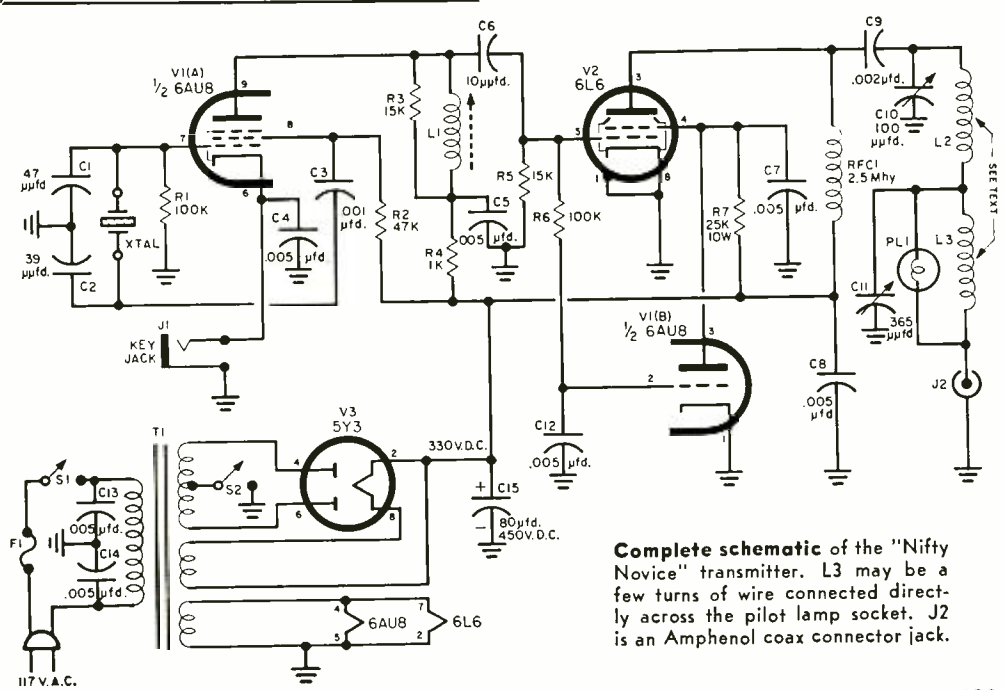
The coil (*L3*) across the pilot lamp (*PL1*) should be adjusted so that the bulb can be used as an antenna current reference. Connect a 75-ohm, 2-watt carbon resistor from the center pin of the antenna jack (*J2*) to chassis ground. If *PL1* has not been lit before, it should light now. Adjust *C10* and *C11 for* maximum brilliancy but do not leave the power on too long or the 75-ohm resistor will overheat.

If the bulb is extremely bright, spread or reduce the number of turns on *L3*. You won't want the bulb to be very bright for the power it uses up could be working for you in the antenna. Have it just bright enough so that it can be seen easily.

After these steps are completed, remove the 75-ohm resistor, and the transmitter is ready to connect to your antenna.

Antenna System. The antenna that you use with this transmitter will determine how successful you are on 15 meters. No matter how much power you run, you will not "get out" with a poor antenna. About the simplest antenna that will produce good results is the dipole.

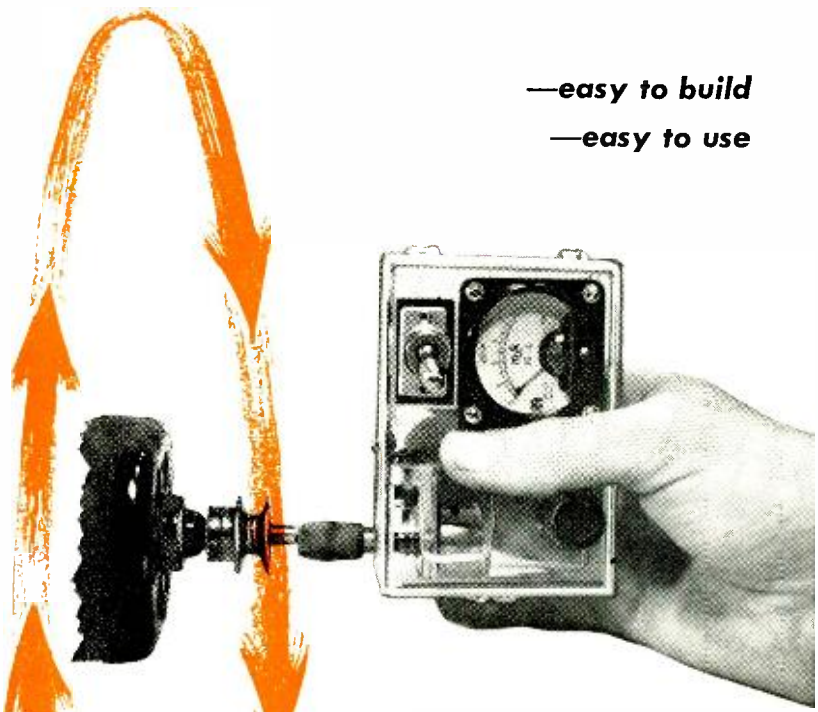
(*Continued on page* 149)



Complete schematic of the "Nifty Novice" transmitter. L3 may be a few turns of wire connected directly across the pilot lamp socket. J2 is an Amphenol coax connector jack.

—easy to build

—easy to use



Measure R.P.M. with this Simple Tachometer

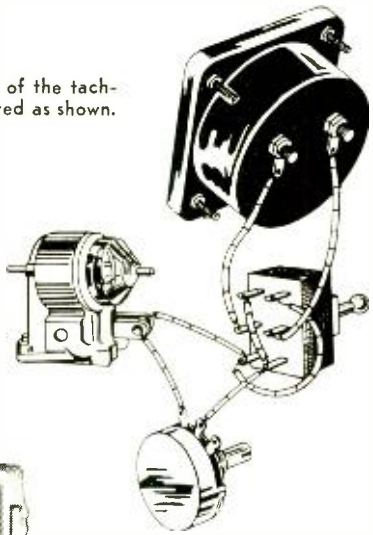
By
FORREST H. FRANTZ, Sr.

THE EXPERIMENTER and do-it-yourself'er will find that a tachometer is a handy instrument around the shop. This article describes a self-contained tachometer which can be built for about six dollars. An alternate version which works in conjunction with a multitester can be built for less than three dollars.

Small, inexpensive, permanent-magnet d.c. motors such as the Supermite are available in most hobby shops for about a dollar. If a motor of this type is connected to a miniature 0-1 ma. meter as shown in the schematic diagram, the voltage indicated by the meter is a function of the speed at which the shaft is rotated.

A miniature 10,000-ohm volume control connected as a rheostat is used as a calibration control. And since a tachometer may be required to measure rotational speed in either direction, a d.p.d.t. reversing switch is also included in the design.

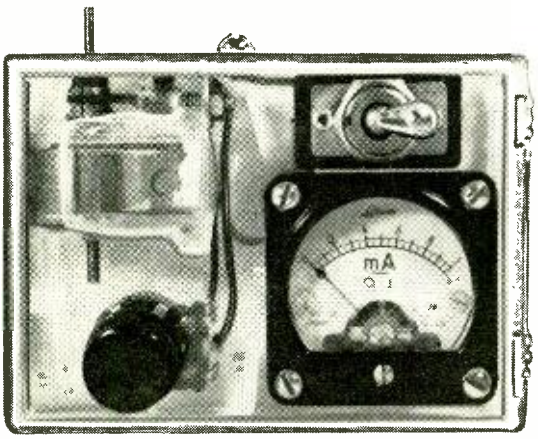
The tachometer is housed in a small plastic case. It's a good idea to purchase all



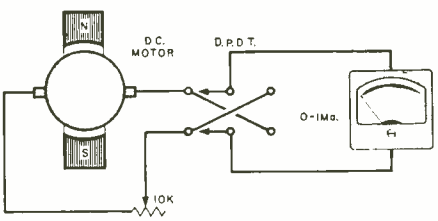
The four components of the tachometer are interconnected as shown.

the components first and then use a case in which they will fit comfortably.

Mount the motor in the case with a right-angle bracket on the side and with Duco cement to the front. Before you apply the Duco, rough up the surface of the motor and the front of the case with coarse sand-



Meter polarity reversal switch shown in photo and in schematic diagram below may be either a toggle or a slide type.



paper. The meter terminals extend through holes in the back of the case.

After all wiring is completed, the meter leads (which must be pulled through the holes behind the switch when the back is put on) are connected. A piece of Scotch tape should be placed over the meter terminals. Rubber strips can be glued to the back of the case to keep the meter terminals from marring table surfaces.

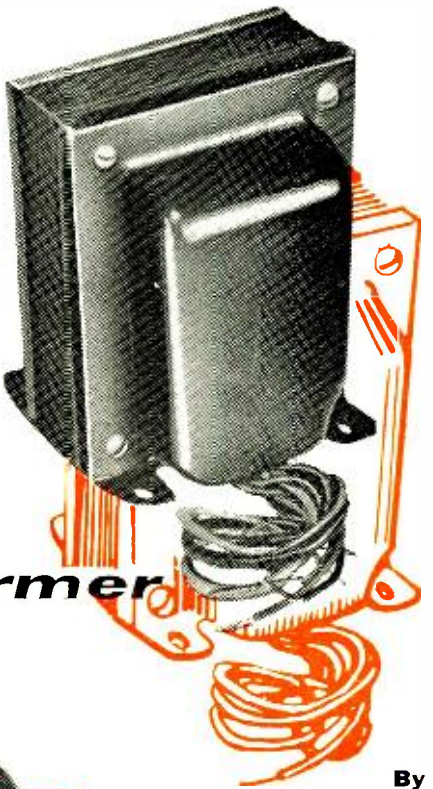
The tachometer shaft is equipped with a collar $\frac{3}{16}$" in diameter and $\frac{1}{2}$" long (a small pulley obtained in a hobby shop was used on the model). This collar fits on the motor shaft, which is $\frac{3}{32}$" in diameter, with a set-screw. Take a rubber pencil slip-on eraser and place it on the collar. Flatten the end and round the sides of the eraser with sandpaper.

You can calibrate the tachometer by coupling its shaft to the shaft of a motor rotating at a known speed and setting the rheostat for the appropriate meter deflection. Thus, if the tachometer is coupled to a 3600-rpm motor, the rheostat should be adjusted till the meter reads 0.36 ma. A 1-ma. deflection would then correspond to 10,000 rpm. Any reading of the meter multiplied by 10,000 gives the shaft speed in rpm.

After the 10,000-rpm range is calibrated, a second calibration mark for a 1000-rpm range may be placed on the front of the case. This range can be selected simply by adjusting the rheostat.

To use the tachometer, just set the rheostat to the appropriate range and push the eraser against a rotating shaft. If you need high accuracy, calibrate the tachometer on a variable speed motor against a laboratory stroboscope. —30—

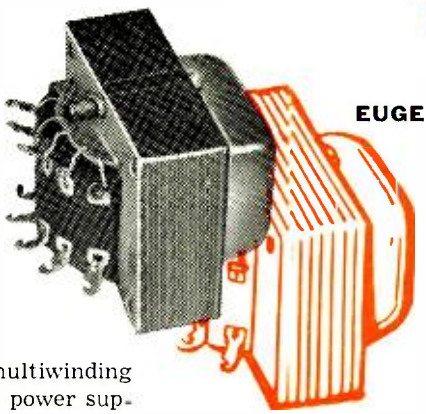
How to Make Power Transformer Substitutions



By
EUGENE RICHARDSON

POWER TRANSFORMERS—those bulky heavy, and expensive items—are found in all types of electronic equipment. Whatever your interest in electronics, you're sure to have noticed one or more of these steel-clad components quietly humming to itself off in a corner of the chassis. When a replacement is needed, or you're searching for a particular item for a construction project, it's necessary to know the inside story of the power transformers; how interchangeable are the units and what do the specs mean?

The purpose of a power transformer is simply to convert the a.c. line voltage into the higher and lower voltages required by electronic circuits. The two types you'll come across are known as *high-voltage plate* and *filament* transformers. In receivers and amplifiers you'll find the functions of both combined in a single multiwinding general-purpose unit. A typical power supply is in Fig. 1.



Size and Frequency. Physical size of a power transformer depends upon both its power handling capacity and operating frequency. The higher the unit's power rating, the larger the diameter of the wire needed in its windings and the greater the amount of iron laminations in its core. A transformer designed to power a one-tube audio preamplifier may measure a little over an inch on each side and may weigh but a few ounces. However, the power transformer of a moderately large television receiver will measure several inches on each side and be quite heavy.

The lower the frequency, the more iron is needed in the transformer core to main-

tain operating efficiency. Hence, transformers designed for 25-cycle line operation are larger and heavier than the more familiar 50-60 cps units. Since higher frequency transformers require less iron, military equipment transformer frequencies may range from 400 to 1000 cps.

Unless you live in an area supplied with 25-cycle power (a common frequency of hydroelectric power plants), the chances are you use 60-cycle transformers in all your projects. However, 400-cycle (or other high frequency) transformers are encountered on the surplus market. As a general rule, a transformer will overheat, and may burn out, if used at frequencies appreciably lower than those for which it was designed. Thus, a 60-cycle transformer may overheat if connected to a 25-cycle line, as will a 400-cycle transformer connected to a 60-cycle source.

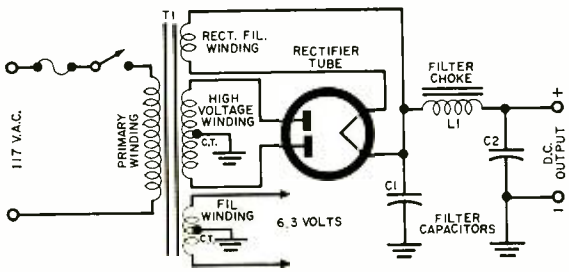


Fig. 1. Schematic wiring diagram of a typical power supply.

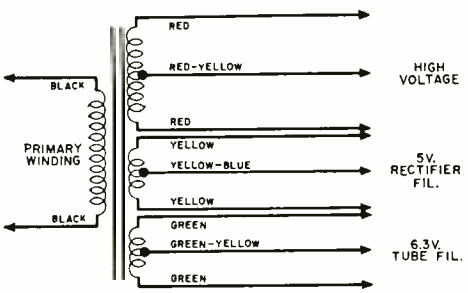


Fig. 2. Standard color coding for power transformer leads.

Specifications. Aside from operating frequency, a power transformer's electrical specifications are given in terms of primary voltage, secondary voltages and rated currents. In some cases, the unit's power-handling capacity may be indicated in watts or *volt-amperes* (*va.*=primary voltage multipled by current in amperes).

A typical filament transformer may have the following specifications: *Primary,* 105-120 volts, 60 cycles; *Secondary,* 6.3 volts, CT, 2 amps. Such a transformer is designed for operation on a standard 60-cycle power line. Although line voltage is nominally 115 volts, it may vary from 105 to 120 volts, depending on local conditions.

This unit's center-tapped (CT) secondary winding has a nominal rating of 6.3 volts, and is capable of delivering a current of 2 amperes without overload. The exact secondary voltage will vary with the applied primary winding voltage and the secondary load. If overloaded, the transformer will supply *more* than 2 amperes, but the voltage will be low and the unit may overheat. Conversely, if less than 2 amperes are drawn, the secondary voltage may be somewhat higher than 6.3 volts.

Frequently, the presence of a center tap is indicated in the secondary voltage specification rather than the abbreviation of "CT". For example, a transformer might carry the following specs: *Primary,* 105-120 volts, 60 cycles; *Secondary,* 350-0-350 volts, 50 ma. This transformer has a standard primary winding and a secondary winding delivering 350 volts *on each side* of its center tap; rated secondary current is 50 milliamperes. The secondary winding could also be described as 700 volts—CT, 50 ma.

Where a multi-winding power transformer is used, such as in Fig. 1, the voltage and current rating of *each* secondary winding are listed separately. A typical set of specs reads as follows: *Primary,* 105-120 volts, 60 cycles; *Secondary* No. 1, 300-0-300 colts, 50 ma.; *Secondary* No. 2, 5.0 volts, 2 amps; *Secondary* No. 3, 6.3 volts, CT, 3 amps.

Lead Identification. Connections to transformers are made to fixed terminal

lugs or to wire leads. If you purchase a new transformer, you'll find that lead connection instructions are printed on the box, on a label on the transformer, or on a separate sheet. But if you have a transformer salvaged from another project or taken from a piece of used equipment, these connections probably will have to be determined anew.

If the unit is of recent manufacture, and equipped with color-coded leads, you can identify the leads by referring to the standard power transformer color code given in Fig. 2. Filament center taps are not included in all transformers.

If the transformer is not equipped with color-coded leads, a simple technique will indicate which is which. With the transformer disconnected, use an ohmmeter to determine pairs of leads and center-tap connections. Check the resistance of each winding. The winding having the highest resistance is usually the high-voltage secondary and may read from 25 to several hundred ohms. The winding having a medium resistance—generally from 5 to 25 ohms—is the primary. Finally, the lowest resistance windings, usually less than 1 ohm, are the filament windings.

Having made a tentative identification, connect a standard 100-watt lamp in series with the leads chosen as the primary leads and a source of line voltage as in Fig. 3. The lamp should light, but not at normal brilliance. If it lights to normal brightness, either the transformer is shorted (and should be discarded) or you've made an error in choosing the primary leads.

Next, using an a.c. voltmeter, check the voltage across each winding, *including the primary*. The ratios of these voltages will help you to identify the windings.

As a final step, remove the series lamp, applying full line voltage to the transformer primary. Use your a.c. voltmeter to check the unit's output voltages and to identify each winding positively. Remember that the voltage will read slightly higher than normal because of the absence of a load.

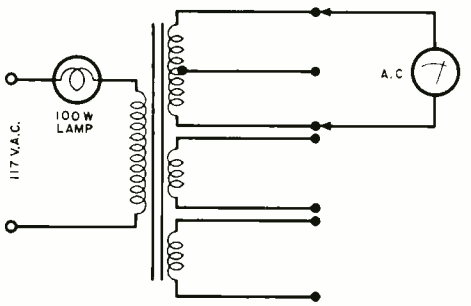


Fig. 3. Basic test which you can make to identify power transformer windings using an a.c. voltmeter.

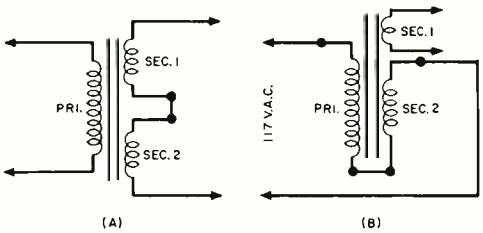


Fig. 4. Two tricks to use in making emergency substitutions: (A) two filament windings can be connected in series to supply higher voltages; (B) a filament winding can be connected in series with the primary to lower all secondary voltages.

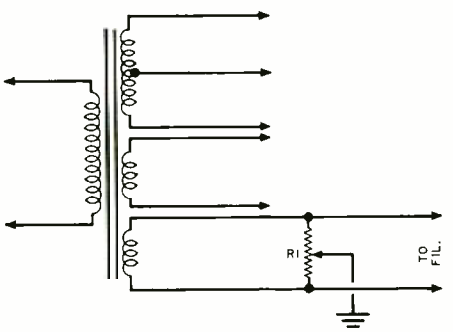


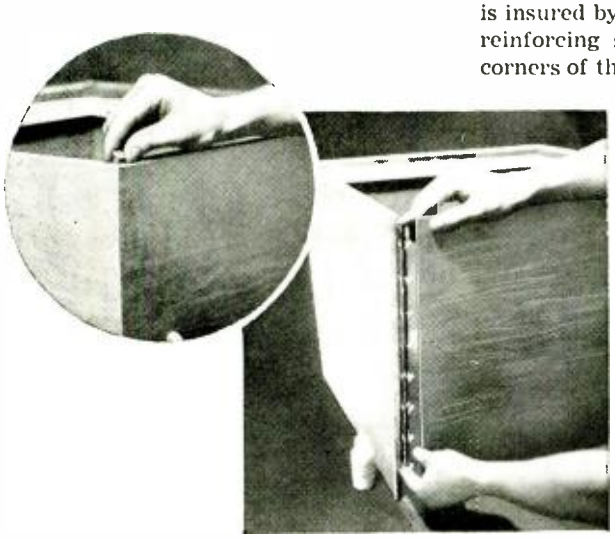
Fig. 5. How to obtain an "artificial" center tap on a filament winding.

Making Substitutions. A substitute power transformer should be used *only* if the specified component is unobtainable.

(*Continued on page* 145)

POPULAR
ELECTRONICS Builds a Loudspeaker Enclosure

FOR the hi-fi'ers who assemble their rigs component by component, here is a new and economical solution to the choice between expensive custom cabinets and homemade boxes. The cabinet kits of Artizans of New England (Dept. 9A, Route 39 North, Sherman, Conn.) are noteworthy because of the new method of construction used. Ease of assembly is insured by utilizing hidden steel locking and reinforcing supports, which join the mitered corners of the cabinets without nails or screws.

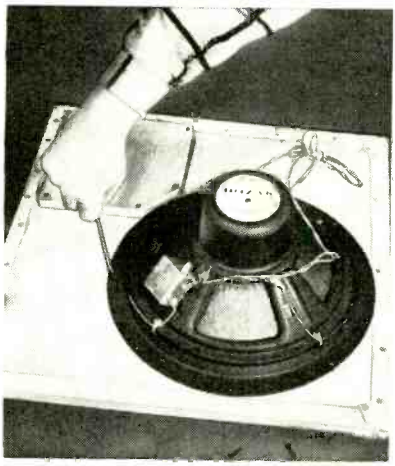


2 After assembly of the four sides of the cabinet, the metal leg brackets are attached to the bottom. Since the four sides are equal size, choose the side with the best grain design as the top of the cabinet. The leg brackets permit either straight or tilted leg mounting to match your listening room decor.

1 The four sides of the Model 501 cabinet are fitted together with a metal "fishbone." The joint is then pressed together. As the "fishbone" is tightened with a screwdriver, the fishbone barbs pull the adjoining surfaces together. The assembled sides are then finished with the wipe-on oil stain provided and the front edges of the cabinet are trimmed in black varnish.

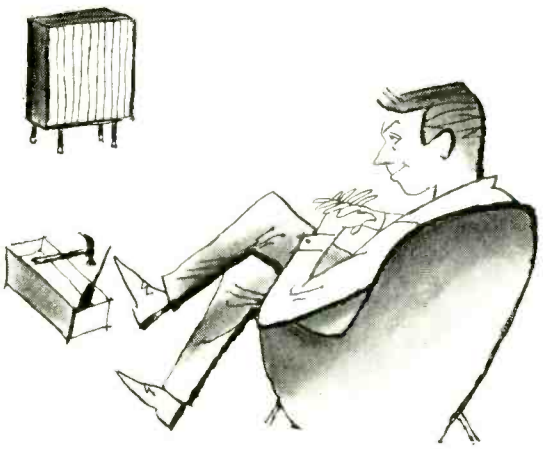
3 Glass wool is stapled to all internal surfaces in the cabinet, except the speaker mounting board. Adequate cabinet damping is insured by the liberal use of acoustic absorbent material.

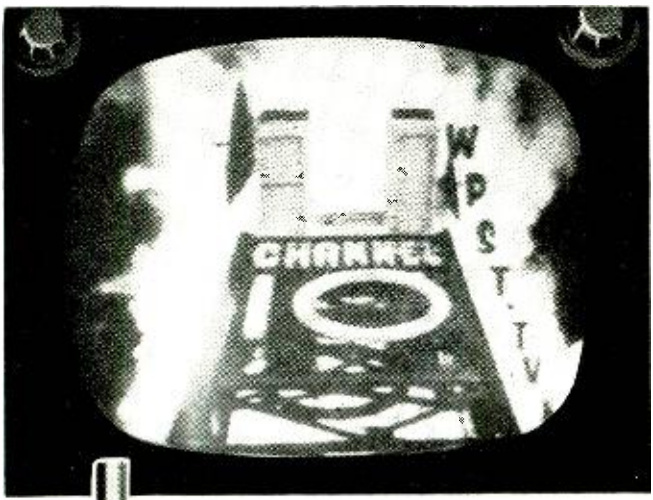
TESTED By POPULAR ELECTRONICS



4 A Bozak 207A loudspeaker is mounted on the front panel. The 8" hole intended for a tweeter or port is sealed with a ¾" plywood panel supplied with the kit, thus providing the infinite baffle required by the Bozak speaker. The grille cloth is stretched over front panel and tacked down inside.

5 To install the front panel, prop up the speaker mounting board with books, then ease cabinet into position on board. The front panel now rests flush against the recessed cleats in the cabinet, and can be screwed into place from the rear. Install rear panel with cabinet upright. And, finally, hook the cabinet up to your hi-fi system and enjoy the fruits of your labor.

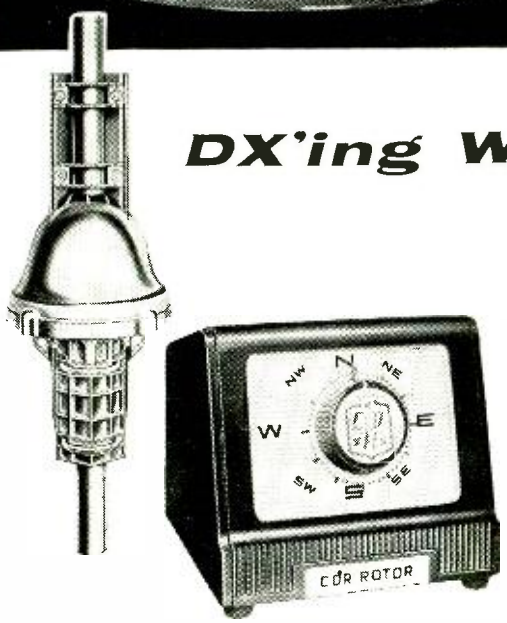




A quick finger on the camera shutter gives permanent proof of TV reception. The station at left was received in Havana, Cuba, with a standard conical antenna during peak sunspot activity.

By
ARNALDO CORO, Jr.

DX'ing With Your TV Set



Antenna rotators, such as this Cornell-Dubilier unit shown with its control box, are useful in getting the best DX signals from different directions, especially when a high-gain directive antenna is employed.

A GOOD TV SET and antenna combination, some leisure time, and a massive dose of patience are all you need to get started on a fascinating new hobby.

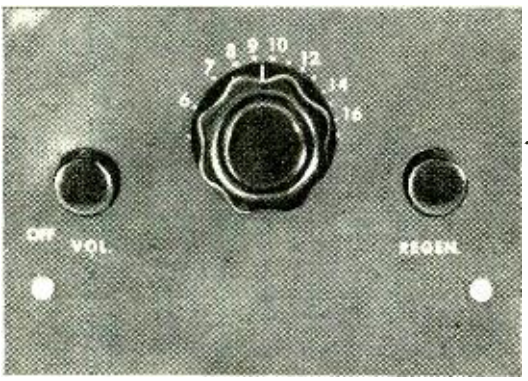
Television waves can travel long distances when special propagation conditions play havoc with standard high-frequency communications. That's your chance to tune in stations located hundreds or even thousands of miles away. Normally, television waves do not propagate beyond the horizon. But under special conditions, such as those produced by sunspots, they can easily reach you from distant places.

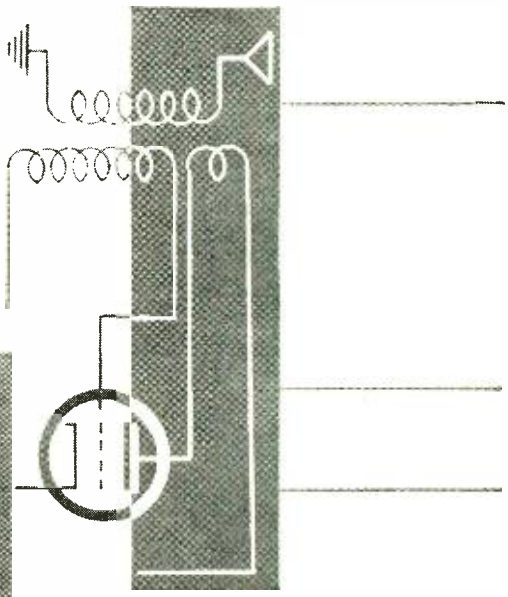
A good antenna, necessary for boosting the signal, possesses a sharp directivity. This is very helpful when you are trying to tune in a particular station, but it becomes a handicap when you want to tune in stations around the compass. To cover all possible signal sources, you'll need a rotator, so you can point the antenna in any direction. A signal booster can also be of great help on the weaker ones.

Television channels are divided into v.h.f. and u.h.f. channels. The former are the only suitable ones for DX'ing, the better ones being Channels 2 to 6. Channels 7 to 13 don't get as far as their lower frequency brothers, but even so they sometimes travel a neat 3000 miles.

Photographs of your best loggings will verify your program reception with the TV stations, which will gladly acknowledge your reports. Just keep a camera handy when you start your new adventures in DX. —30—

This two-transistor receiver features a.v.c. and tuning compensation





Transistorized Regenerative Receiver

By
JAMES E. PUGH, JR.

THE regenerative circuit is one of the simplest and most sensitive receiver circuits available. But, as you probably know if you've had any experience with these "squealers," it is necessary to readjust the regeneration control constantly over a fairly wide range when tuning from one end of the band to the other. The two-transistor receiver described below uses a very simple compensation circuit to overcome this weakness and provides nearly constant regeneration over the entire broadcast band.

The chassis and front panel can be aluminum or Bakelite, with aluminum preferred to eliminate hand capacity effects. A 3¼" x 5" plastic chassis was used in the author's model with turret terminal lugs installed for parts mounting.

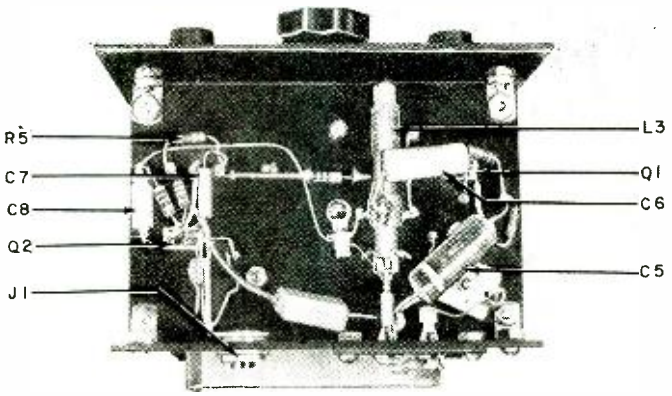
Various sections of the chassis are fastened together with small angle brackets, and the tuning capacitor is mounted to both the front and chassis panels for maximum panel rigidity. If a non-metallic front panel is used, ground the shaft of *C3* to the frame of *C4* with a flat metal grounding strip.

A built-in ferrite rod antenna (*L1*) provides good reception for portable use;

PARTS LIST

B1—5.0-volt mercury battery (Mallory TR-134R or equivalent)
C1—9-180 μμfd. trimmer capacitor (optional)
C2—33-μμfd. ceramic or mica capacitor
C3—10-365 μμfd. miniature variable capacitor (Lafayette MS-215 or equivalent)
C4a/C4b—Two-gang variable capacitor, 365-μμfd. each section (Miller 2112 or equivalent)
C5—0.5-μfd. tubular capacitor
C6—.01-μfd. tubular capacitor
C7—2-μfd., 6-volt electrolytic capacitor
C8—10-μfd., 6-volt electrolytic capacitor
C9—.001-μfd. ceramic or mica capacitor
J1—Phone jack
L1—Ferrite core antenna (Lafayette MS-166 or equivalent)
L2—10 turns of #30 enameled wire added to bottom end of L1
L3—Adjustable ferrite core coil (Miller 2002 or equivalent)
Q1—2N247 (or 2N274) transistor
Q2—2N109 (or 2N217) transistor
R1—15,000 ohms
R2—5600 ohms
R3—39,000 ohms
R4—1800 ohms
R5, R7—3300 ohms
R6—18,000 ohms
R8—1000 ohms
R9—10,000-ohm potentiometer (logarithmic taper) with S1
S1—S.p.s.t. switch (part of R9)
1—5-pin transistor socket
1—3-pin transistor socket
1—Chassis and panel
1—Battery holder (Acme #69 or equivalent)
Misc. screws, nuts, lugs, washers, wire, terminal strip, knobs, etc.

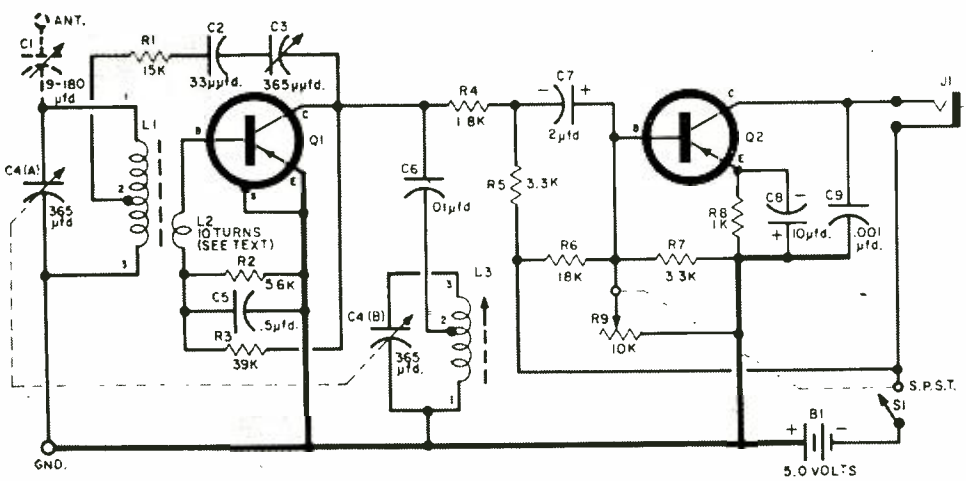
All resistors ½-watt composition



use the largest antenna that your chassis will accommodate (4" or more) and mount it as far away from any metal as possible. An external antenna and ground can be hooked up for peak performance.

Before mounting *L1*, wind 10 turns of #30 or #32 wire around the lower end of the present winding and fasten it with coil dope or wax. Leave the leads of the new winding (*L2*) about 6" long. They can be clipped to the correct length after you check to see which way they need to be connected in order to obtain regeneration.

Antenna *L1* can be mounted at the rear of the tuning capacitor (*C4*) with a small angle bracket and further supported with heavy (about #16) bus wire connections to *C4*. *L3* should be mounted at right angles

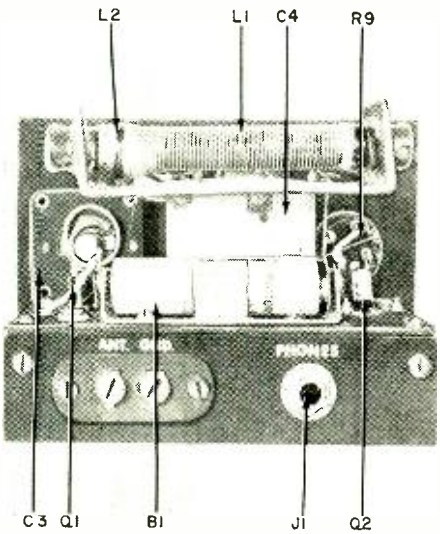


ohm headphones present the best match to *Q2*'s output impedance.

Receiver alignment is achieved by varying the spacing of the *L1* primary windings (near the #1 terminal end) at the low end of the broadcast band (530 kc.) and the setting of the trimmer on *C4a* at the high end of the band (1620 kc.) until the complete broadcast band can be tuned in.

Next, tune in a station at about 600 kc., and adjust the *L3* core for maximum output. Adjust the *C4b* trimmer for maximum broadcast signal output at about 1500 kc. Repeat these two adjustments until maximum output is obtained at both frequencies. *C3* should be set near optimum

Major parts placement is shown in bottom and rear views of chassis. Phone jack J1 should be insulated if metal chassis is used. Note use of two-gang tuning capacitor (C4) and one-gang regeneration control (C3).



HOW IT WORKS

This receiver uses a modified class B detector (*Q1*), followed by a single-stage audio amplifier (*Q2*). Regenerative feedback variation is minimized by resistor *R1* in series with *C2* and regeneration control *C3*.

Resistor *R4* is connected in series with *R5* and the audio amplifier stage to reduce the effects of load variation with frequency. *R4* reduces the signal fed to the audio stage but the improved performance more than compensates for the loss in gain.

The second tuned circuit (*C4b* and *L3*), ganged with the tuned-input circuit (*L1* and *C4a*), is used to give an increase in selectivity. A small amount of automatic gain control has been provided by returning *R3* to the collector of *Q1*.

to and as far as possible from *L1*. Place *L3* so that you will have easy access to its adjustment screw. Other than this, parts layout is not critical.

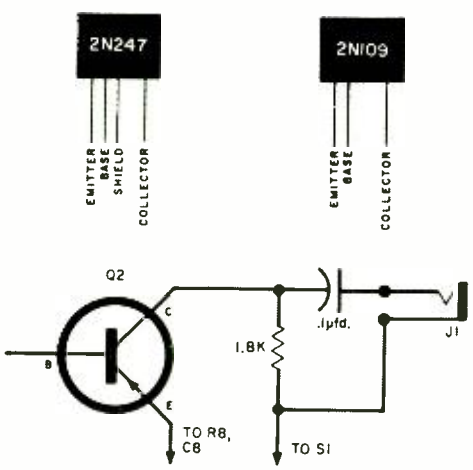
A large tuning dial should be used, since the high selectivity makes tuning somewhat critical on weak stations, and 20,000-

regeneration point for the adjustments.

Now, with the dial set at 600 kc., make sure that *C3* is set just below the oscillation point. Reset the dial to 1500 kc. and note whether the regeneration control must be changed to obtain the same condition as at 600 kc. If not, you're ready to go.

If *C3* must be increased to obtain optimum regeneration at 1500 kc., a higher value should be used for *R4*. If *C3* must be backed off, reduce *R4* slightly. The proper condition is obtained when the two ends of the band are balanced. A slight rise in regeneration will probably be noted as you turn toward the center of the band, as it is not possible to get perfect compensation.

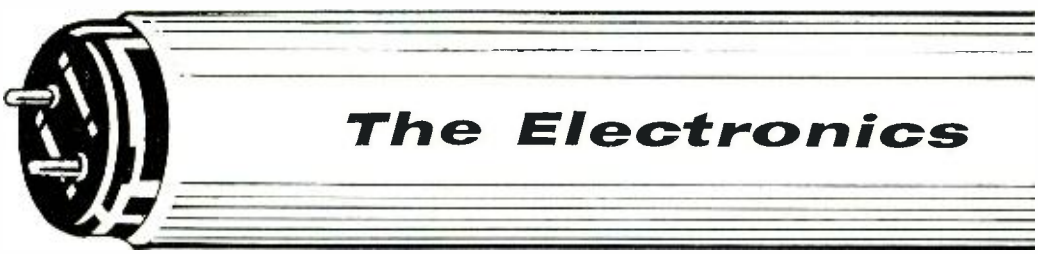
The receiver is tuned the same way as any other regenerator except that the regeneration control can be operated slightly above the oscillation point for maximum output. —30—



Complete schematic is at far left. Alternate output circuit for use with crystal earphone is at left. A matching transformer can also be used with original circuit to match transistor to earphone.

FLUORESCENT LAMPS, once a novelty, are now an accepted part of the American scene. Their gentle blue-white glow is encountered everywhere, from the tops of skyscrapers to the depths of the New York subway system. However, the operating principles of fluorescent lamps are little understood even by technicians.

Invisible Light. Many people know that fluorescent lamps are among our most efficient light producers, and that they operate with a mercury vapor arc. But few realize that over 80% of the radiation produced by that arc is in the ultraviolet region and invisible to the human eye, and that every effort is made to keep as much energy as possible in the invisible ultraviolet end of the spectrum. Sounds foolish, doesn't it?



The Electronics

By
EDGAR D. MORGAN

The *visible* light actually comes from chemical compounds coated on the inside of the glass tube. Called phosphors, these compounds have the property of emitting visible light when they are excited by ultraviolet radiation. They have been termed "light transformers" because of their ability to absorb energy at one wavelength and radiate it at another.

The fluorescent lamp depends upon ionization for the production of the necessary ultraviolet arc. Here's how it's done. The free electrons in the gas are accelerated by an applied voltage, and each time a collision occurs between an electron and a gas molecule, one or more additional electrons are displaced. These electrons in turn, are accelerated enough to repeat the process on other molecules, and a chain reaction takes place.

As each molecule returns to a stable state, it gives off its excess energy in the form of radiation. It's the frequency of the radiation that determines whether visible

or invisible light will be obtained. In commercial lamps, the pressure of the gas sealed in the lamp is adjusted very carefully so that nearly all of the radiation occurs at one given ultraviolet wavelength, 2537 Angstrom units. This frequency is selected for optimum excitation of the tube's phosphor coating.

Each chemical compound in the phosphor coating radiates light at a certain wavelength. For instance, zinc silicate releases its radiation as green light, cadmium borate radiates a predominately pink color, and calcium tungstate when excited gives off blue light. By carefully blending these and other compounds, almost any desired color can be obtained.

# of Fluorescent Lamps

Warming to the Job. The electrons required to facilitate the starting of the arc are provided by coated tungsten filaments in the ends of the fluorescent tube—similar to the filament in an ordinary vacuum tube. Once the arc is achieved, the heated filaments are no longer required and are automatically switched off. A small amount of argon or krypton gas present in the tube facilitates the initial arcing, which also serves to evaporate the globule of mercury in the tube. From this point on, the arc is basically mercury vapor.

There are two pieces of auxiliary apparatus necessary to operate a fluorescent lamp. One of these is a starter which acts as the automatic filament circuit switch mentioned above. The second additional element required is the ballast, which serves as a choke coil to regulate arc current as well as an autotransformer to provide the high voltage kick needed to start the arc.

An Inductive Kick. The basic lamp circuit is shown in Fig. 1. When the switch is closed, the ballast and the two filament windings are placed in series across the applied voltage, and the filaments heat. When the switch is released a moment later, the inductive kick of the iron-core ballast coil causes a momentary voltage surge across the lamp which starts the arc. As the ballast is now in series with the lamp, the arc current is limited by the impedance of the ballast. This simple circuit is widely used on small desk lamps, but has too many disadvantages for general lighting use.

One of the disadvantages of the single lamp circuit is its poor power factor. As the circuit is primarily inductive, due to the

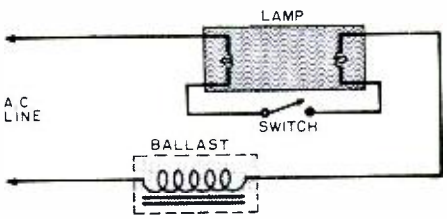
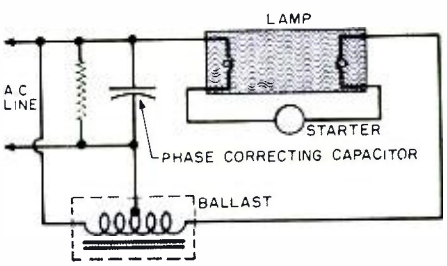


Fig. 1. Basic fluorescent lighting circuit in general use only on small desk lamps. A manual switch performs the starting function.

Fig. 2. This circuit is sometimes used to correct the poor power factor in the circuit of Fig. 1. The ballast is shown here functioning as autotransformer as well as choke coil.



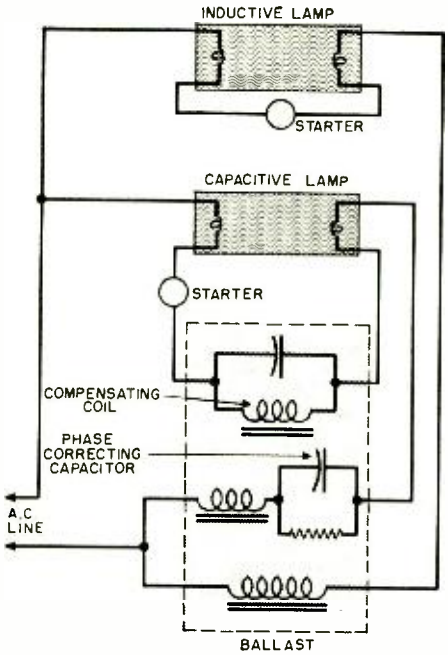
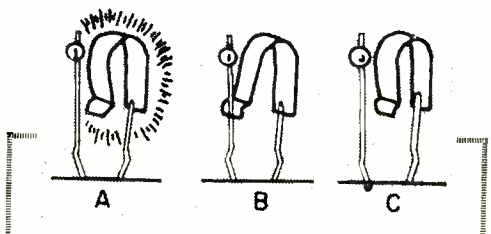


Fig. 3. For the control of two lamps, this circuit is in widespread use and has excellent power factor characteristics.

ballast, the current and voltage have a phase relationship which makes for inefficiency in light output compared to current drawn. A partial solution to this problem is the circuit shown in Fig. 2.

Here the starter is an automatic device although its function is the same as the switch in Fig. 1. The power factor in this unit is improved by a shunt capacitor. As a capacitor and a coil have an opposite effect on power factor, one offsets the other; and the resistor serves to bleed off any charge which remains on the capacitor. The circuit of Fig. 2 has been drawn to indicate that the ballast is also serving as an autotransformer. The number and size of the lamps used determines whether this is necessary or not.



HOW GLOW STARTER WORKS

The line voltage produces a glow discharge between the bimetallic strip and the fixed contact (A); the heat from the glow actuates the bimetallic strip, the contacts close and the filament preheating begins (B); this shorts out the glow discharge, the bimetallic strip cools and the contacts open (C). The resulting inductive kick from the ballast then starts the tube.

Factors and Flickers. Another objectionable feature of the single lamp circuit is its flicker, due to the 60-cycle line. Since incandescent lamp filaments operate at a very high temperature, there isn't time for them to cool sufficiently from cycle to cycle for the variation of light to be seen. The fluorescent lamp must extinguish and restrike its arc 120 times per second as the voltage reverses polarity. This causes a disturbing stroboscopic effect around machinery with cyclical motion.

Probably the most common circuit in use today is shown in Fig. 3. This is a two-lamp circuit and corrects several of the disadvantages inherent in single lamp setups. The lamp indicated as *inductive* is connected in the same way as the lamp in Fig. 1. The other lamp, however, has a capacitor in series with its ballast. This serves to

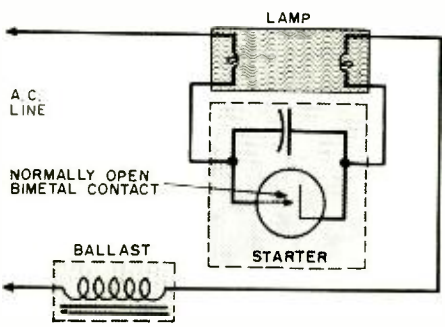
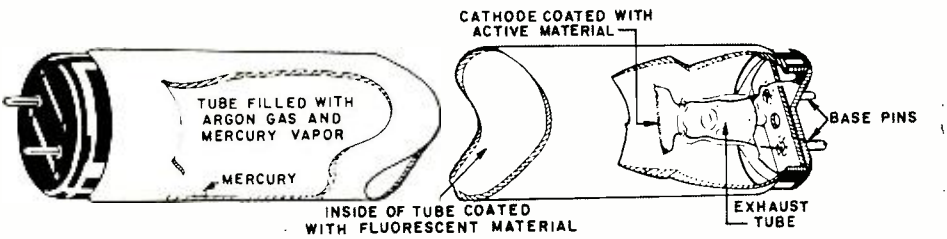


Fig. 4. Typical glow-type starting circuit used in home-type fluorescent circuits.

change its phase relations so that its current leads rather than lags the voltage, and corrects the over-all power factor. Thus, the two lamps operate more efficiently as a unit.

The addition of this series capacitor, though, produces another problem. When starting, the capacitive circuit sometimes limits the current required to preheat the filaments. This effect is overcome by adding another compensating coil in series with the starter on this lamp only.

Use of this type of two-lamp circuit is also beneficial in overcoming flicker. Because the lamps operate out of phase, they



Cutaway view of a fluorescent lamp. All fluorescent lamps are constructed as shown here. Only the glass tube changes in size and shape from model to model.

reach their peaks of illumination at different times and the combined light is relatively free from disturbance.

The Starter Story. One of the most fascinating pieces of auxiliary equipment is the fluorescent starter. Its task is to close the circuit containing the filaments when voltage is first applied, and after a preheating period of several seconds, to open the filament circuit and keep it open as long as the lamp remains on. A bimetallic strip is used which bends when heated, and serves as sort of a time switch.

The most common type of starter is the glow starter. The entire unit is sealed within a small glass envelope containing neon or argon gas and connected as shown in Fig. 4. A bimetallic strip controls a contact which is normally open.

When first turned on, the full line voltage is applied across the glow lamp, causing the gas to ionize and conduct. The heat of the ionized gas is sufficient to cause the bimetal strip to close the filament circuit. The contact closing shorts out the glow discharge and the bimetal begins to cool. After cooling (which takes long enough to preheat the filaments satisfactorily), the contact within the starter opens and the fluorescent lights. The starter is now across the lamp voltage, which is not enough to ionize the neon gas, and so the unit is inoperative as long as the lamp remains on.

The glow-type starter consumes no energy from the circuit after the starting period is over. Its timing is not accurate, however, and as it is difficult to maintain the proper gas pressure over a long period, sometimes the timing tends to become very erratic.

A great many of our present-day starters incorporate modifications such as a manual reset. If the lamp does not light after repeated attempts by the starter, it ceases functioning until the trouble is corrected and the starter is reset by pushing a spring-loaded button. There are others that use different contacts for restarting so that it isn't necessary to wait for a bimetal strip to cool completely before it can recycle.

The starter shown in Fig. 4 also contains a capacitor across the lamp contacts, which acts to suppress radio interference.

Manufacturers of fluorescent lamps publish handbooks which elaborate on these principles. They also give many more lighting circuits and their applications. The very fact that fluorescent lamps are so readily accepted and so seldom studied in detail is in itself a fine tribute to their efficiency and dependability. —30—

Build This Transistorized SOUND LEVEL METER

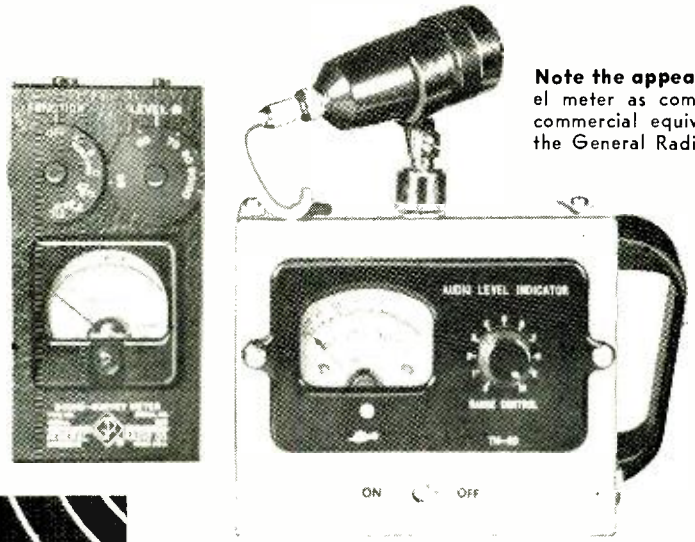
By
R. MORROW

THE sound level meter is a device for measuring the intensity of sound. Typically, it consists of a microphone, a high-gain amplifier and an a.c. meter. The circuit is so designed that the deflection of the meter is proportional to the amount of sound reaching the microphone.

For the audiophile and experimenter, the sound level meter has innumerable applications. Here are just a few examples of the uses to which it may be put: (1) balancing the sound issuing from each speaker of a stereo system; (2) measuring the noise level in the listening room; (3) measuring the loudness of the hi-fi two rooms away;

(4) determining the effectiveness of sound absorbent material on a wall; (5) measuring the noise output of a particular piece of machinery and determining how much lubrication decreases that noise output; (6) measuring the noise level inside the family car; (7) using it as an applause meter; and (8) determining the best speaker placement in the living room.

Commercial sound meters are high-precision, and therefore costly, instruments. Thus, their possession by an amateur is rare. However, the uses to which the average individual may put his sound meter will not demand the high precision of the professional instrument. It is not necessary for



Note the appearance of this sound level meter as compared to the precision commercial equivalent manufactured by the General Radio Co. shown at its left.

the non-professional to measure the absolute value of sound intensity; his concern is the measurement of relative differences between sound levels. In this area the inexpensive meter described here (total cost is about $17.00) is more than adequate.

Completely contained in a 5"x4"x3" Bud Minibox, and battery-powered, this sound meter is portable and easy to operate. Use of a commercially available audio level indicator eliminates a costly meter and meter rectifier, and has the added advantage of providing a built-in 20-db attenuation control. The cost is further reduced at the input end by using an inexpensive high-impedance dynamic type of microphone. Any one of a number of mikes can be tried.

Actually the only real construction involved in the assembly of the sound meter is the two-transistor amplifier strip. The two high-gain low-noise transistors provide enough output to peg the meter with a hoarse whisper two feet away from the mierophone.

Construction is started by preparing the case. Placement of components is not critical and you can use the photographs as a guide in cutting the chassis.

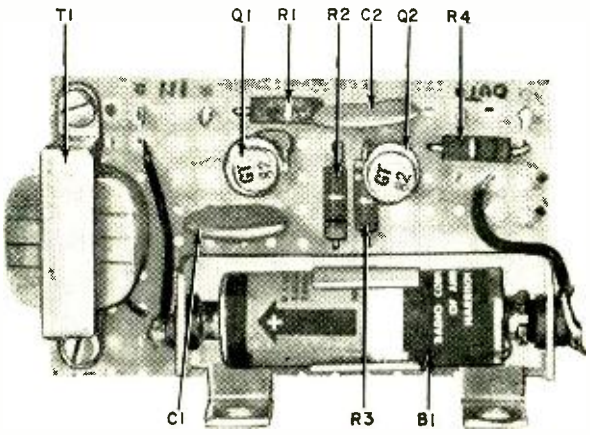
Lay out the 3⅞"x2" rectangular hole on the larger section of the Minibox with a scribe. Drill a ½" hole in each of the corners of the rectangle and use a hacksaw blade and file to cut out the rest of the rectangle. (Use of Greenlee rectangular chassis punches would greatly facilitate this job and make for neater holes.) Then drill a ⅛" hole on each side of the rectangle for the mounting screws of the audio level indicator. (The indicator front panel is removed from the plastic cabinet.)

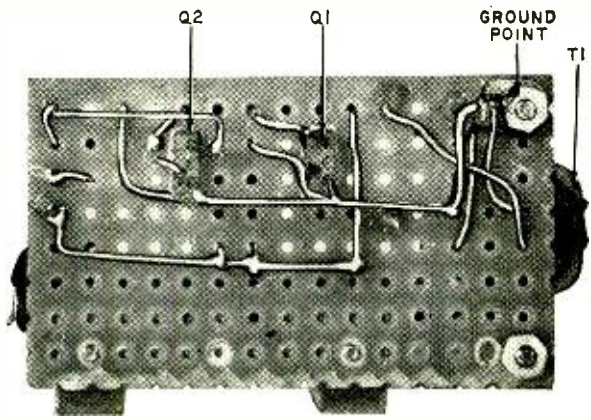
The on-off switch is mounted in a ½" hole centered directly beneath the audio level indicator hole. Provide two centerline ⅛" holes on one of the side panels for the mounting of the amplifier strip. On the other side panel drill a ⅜" hole for the phone jack and two ⅛" holes for the handle. Only two holes are drilled in the second section of the case: a centered ½" hole for the microphone and a ⅜" hole for the microphone cable.

For that professional look, we painted the case and applied Walsco decals.

The transistor amplifier construction is clearly shown in the photographs. The base for the amplifier is a 2⅞"x1⅞" piece of perforated phenolic board. Simply mount the parts by running their leads through the perforations and solder the necessary connections on the reverse side.

We mounted sockets for the transistors





Front and back views of transistor amplifier board. The small brackets are used to mount it to the side of the cabinet. Parts placement is not critical but should follow a logical order from input to output. Certain microphones may not require transformer T1 for proper match to the input impedance of transistor Q1.

PARTS LIST

B1—9-volt battery (RCA VS309)
C1, C2—0.1-μfd., 60-volt ceramic disc capacitor
J1—Phone jack
R1, R4—1 megohm — *All resistors ½-watt composition*
R2—5600 ohms — *All resistors ½-watt composition*
R3—6800 ohms — *All resistors ½-watt composition*
Q1, Q2—GT-82 transistor
S1—S.p.s.t. toggle or slide switch
T1—Input transformer (Argonne AR-141)
MIC.—High-impedance dynamic microphone (Lafayette PA-48 or equivalent)
1—Audio level indicator (Lafayette TM-20 or equivalent)
1—5" x 4" x 3" chassis (Bud Minibox)
1—2⅞" x 1⅞" perforated phenolic board
2—Transistor sockets
1—Battery bracket for B1

but they are not necessary. The leads of the transistors may be run through the holes in the board and connections soldered directly to them. Be sure to use a heat sink and solder as quickly as possible, since transistors are very easily damaged by excessive heat.

If transistor sockets are used, enlarge two adjacent board holes with a ⅛" drill and cut the proper size rectangle with a small file (a nail file will serve nicely). The two small mounting brackets are mounted with the same bolts used to hold the battery holder.

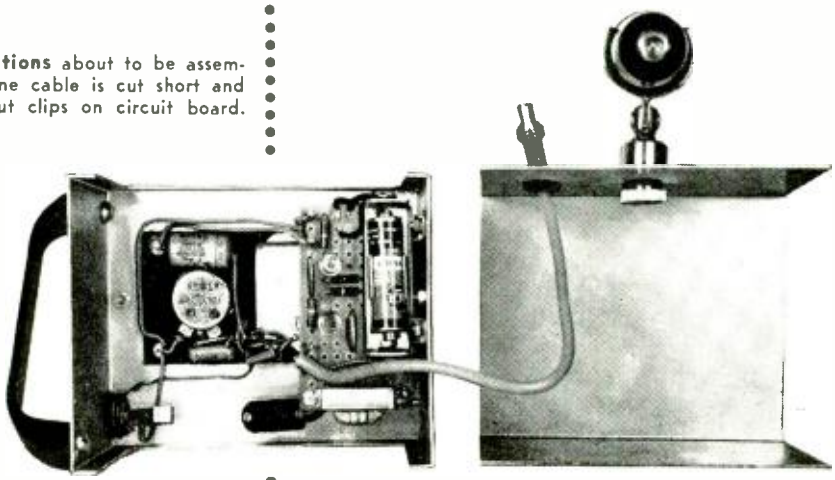
Be careful to observe the polarity of the battery to avoid damaging the transistors. Flea clips used at the amplifier input and output make for neater construction and facilitate connections to the microphone and audio indicator.

Using the meter is a simple operation. Just flip the switch to the *"on"* position and point the microphone toward the sound source.

For example, to use it as an applause meter, point the microphone toward the audience and have everybody applaud as loudly and evenly as possible. Now adjust attenuation for full scale deflection, which corresponds to 100% audience response. Subsequent applause will correspond to meter deflection.

To balance a stereo system, feed a constant signal into one channel and note meter deflection at the desired listening level. Then feed the same signal into the

Completed sections about to be assembled. Microphone cable is cut short and soldered to input clips on circuit board.

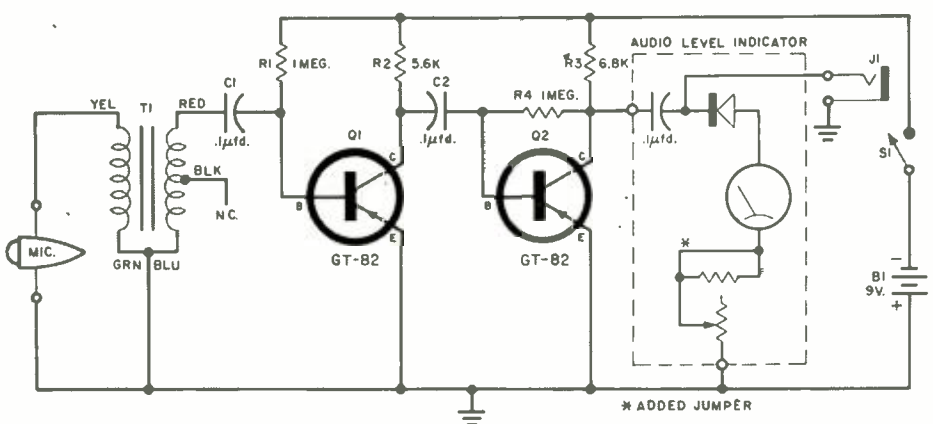


other channel and adjust the second channel gain to give the same meter deflection as the first.

To measure decibels, the sound meter must be calibrated against another previously calibrated sound level meter (such as General Radio Type 1551-A). Place the two instruments as close together as possible with both microphones pointing toward an adjustable sound source. Set the standard meter to its lowest range and adjust the sound source for full scale deflection. Now adjust the attenuator of the second meter for full scale deflection, noting the attenuator setting and the db reading on the standard meter to which it corresponds. The same procedure is repeated for the higher ranges of the standard meter.

As we mentioned earlier, calibration is not necessary for most applications. The meter's greatest value is realized in making comparative measurements. In order to do this, simply note meter deflection for each of the sound sources being compared. If you want to express the sound intensity of one source in terms of another, use the formula: $D1/D2 \times 100$ = the percentage $D1$ is of $D2$; where $D1$ and $D2$ are the meter deflections given by two different sound sources. —30—

Part of schematic shown in white is audio level indicator described in text. Output jack J1 is optional; if used, connect it between the built-in 0.1-μfd. capacitor and the rectifier.



DANNY JABBED disconsolately at the tube socket connection with his soldering iron, the tip of which was pitted and black with a little solder shining resolutely through in a spot or two. Just then the door opened and Jim, his neighbor, walked in. Turning on his stool, Danny pleaded, "Jim, why can't I ever make a decent solder connection? I've been on this job for two hours and I'm not getting anywhere."

Jim stepped over and surveyed the job. The soldered connection was dull and crystallized, and a huge pitted, black and scarred tinsmith's iron was staring at him from the bench alongside a little box labeled "Acid Core Solder."

He smiled ruefully, looked at Danny's dejected face and asked, "Where shall we start?"

"At the beginning, I guess," was Danny's reply. "From your expression I must need some instruction bad."

"Do you have a file?"

"Sure . . . here."

Jim took the file and looked at it. It was badly clogged and far too coarse. "Just a minute," he said, "I'll be right back."

Jim returned, carrying a tool box from which he took a file.

"Do you have an iron smaller than this monster here?" he asked.

"Sure," said Danny, "but I can't get anything hot with this, let alone the small one." He dug a smaller iron out of a bench drawer and handed it to Jim. This, too, though the right wattage, was pitted and scarred like an ancient warhorse. Jim clamped the iron gently but firmly between the jaws of a bench vise, then proceeded to file the tip to a neat pyramid shape.

"What's that for?" Danny wanted to know.

"Well, Danny, one of the most important requirements in soldering is cleanliness. Second perhaps is plenty of heat delivered to the right spot. But let's go back a little.

"WE HAVE in the radio industry many ways to connect conductors. But the average man's major resource is still the mechanically strong soft-solder connection.

Soldering

... without Tears

Yet this is one of the most neglected and mistreated fields in electronics.

"First, as I mentioned, cleanliness is of utmost importance. All your soldering equipment should be kept clean. Let's consider the iron first.

"The iron should be filed clean with a medium file, using gentle forward strokes, lifting the file on return strokes." He continued to file the tip, one surface at a time, till it was clean, bright and free of pits . . . he plugged it in.

As the iron heated, Jim continued, "There are many ways to furnish the heat for soft soldering. For convenience we use the electric soldering iron, with or without some type of thermostatic control. If the iron has a thermostat, fine. If not, it is a good idea to buy or build a bench thermostat like the one published in the February '57 issue of POPULAR ELECTRONICS. It will prevent excess oxidation of the iron tip which causes pitting.

"Then there's the soldering gun. This

usually consists of a transformer, the tip forming the load for a high current secondary, which is made up of a few turns of heavy wire. The tip heats fast and the gun is normally equipped with an on-off trigger switch in the primary. The tip is hot only when needed, thus preserving it and saving on the electric bill.

"And let's not slight the small soldering 'pencils' which supply adequate heat for light general work. These are ideal for printed-circuit boards, transistors and instruments. With the right tips they can be used for anything, including soldering di-

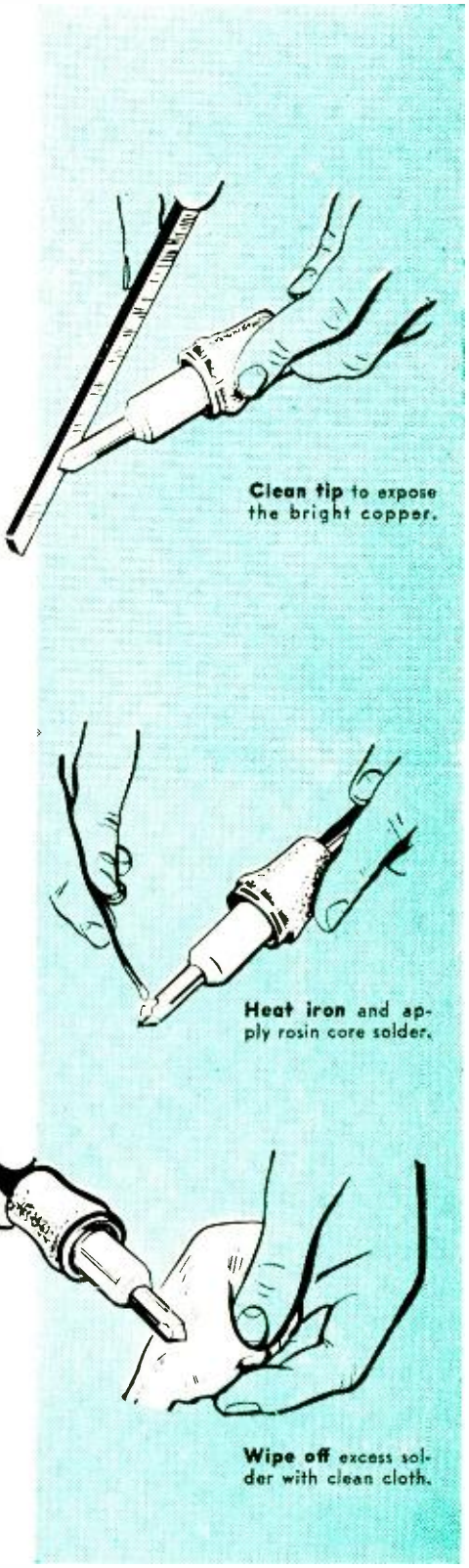
By BRICE L. WARD

rectly to chassis. Some pencil soldering irons have several replaceable tip types."

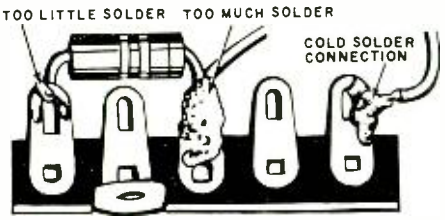
JIM took a small can from his tool box and opened it. "Rosin solder paste," he said, answering Danny's unspoken question. Then he picked up the iron, which was just warm and dipped the tip in the mixture. The iron melted its way slowly into the paste and came out with a light coat of flux on the exposed copper.

"That," said Jim, "prevents oxidation of the copper until the tip is hot enough to tin. Fluxes in all types of welding, brazing and soldering have one to three purposes: they prevent excess oxidation of the materials during the heating process; they contribute to the cleaning of surfaces to be joined and, by reducing surface tension, they increase the wetting power of the solder.

"Fluxes can be broken down into two basic types, corrosive and non-corrosive. In the first category we find weak hydro-

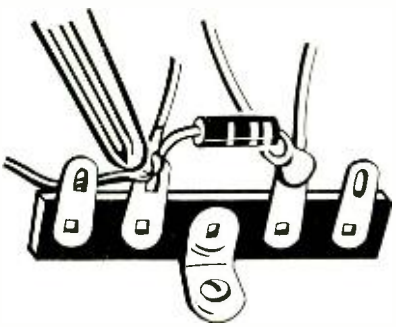


chloric acid, better known as muriatic acid, zinc chloride, borax and ammonium chloride, more commonly called sal ammoniac. Used mostly in hard soldering and welding, they have cleaning power due to their corrosive tendencies and must be washed away or the residues will tend to cause oxidation when they mix with moisture from the air. These fluxes should not be used in electronics for several reasons. Most important is



Learn to recognize bad soldering joints.

A good connection is bright and smooth.



the fact that they cannot be adequately removed. The residues tend to become conductive in the presence of water vapor and form low resistance paths on the surface of insulators.

"The non-corrosive fluxes are solid rosins and rosins mixed with alcohol or glycerine to form pastes. Non-corrosive fluxes have little or no cleaning power and, except for those pastes made with glycerine, they have no wetting power. They simply serve to prevent excessive oxidation. This is one of the biggest reasons for stressing cleanliness in radio soldering. One thing that makes our job much easier is pre-tinned leads and components. Most manufacturers pre-tin socket lugs, pigtails, etc."

As the rosin on the iron began to smoke, Jim removed a roll of rosin core solder from his tool box and started to apply it liberally to the iron tip. Danny watched, fascinated.

"I've never had that old iron looking that good before," he said. "What kind of solder is that?"

"Well, it's not just the solder . . ." Jim replied, looking critically at the iron, then brushing it lightly with a piece of dampened rag, ". . . but it does help a lot. That solder is composed of 60% tin and 40% lead with a rosin core, and is known as 60/40 rosin core solder.

"SOFT soldering is, by definition, any job in which the solder melts at less than 800° F. In soft solders we have a mixture of tin and lead with the addition in some instances of antimony, silver or bismuth. As a rule, we don't use any of these latter materials in electrical solders. Antimony and bismuth, though they decrease the melting point of the solder, also decrease the wetting power. Silver raises the melting point and is normally used for solder of increased mechanical strength.

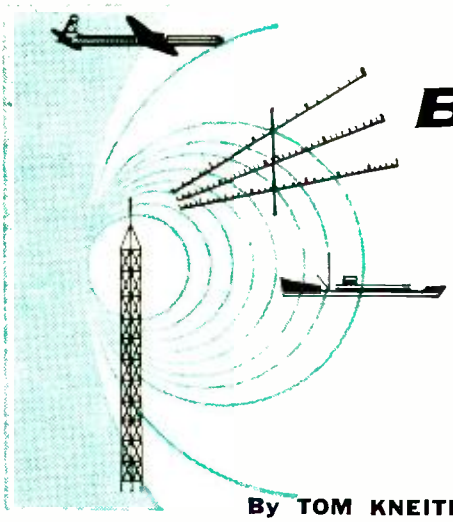
"Of interest from a technical point of view is the way solders melt. They begin usually in a solid state at room temperature, though there are some alloys using mercury and bismuth that are liquid at room temperatures. At some temperature known as the *solidus* temperature, solders go from a solid to a plastic state. You have probably noticed it in using that 40/60 solder on the bench. The solder does not flow but can be pushed around and molded like clay. This is the plastic state between the *solidus* and *liquidus* temperatures. At the *liquidus* temperature, solder will flow almost like water. To do a good solder job, the *liquidus* temperature *must* be reached.

"In the solders we use in electronics, the melting point of the alloy is lower than the melting point of either metal. For instance, pure tin melts at 450° F. Lead melts at a somewhat higher temperature, but a mixture of 62% tin and 38% lead melts at 361°. This is known as a *eutectic* mixture, because it melts at the lowest point of any combination of tin and lead.

"A 60/40 solder has a *solidus* temperature of 370°, a difference of only 9°. Practically, this means we can solder with less heat and burn up fewer components," Jim said.

"Incidentally, the lower melting point

(*Continued on page* 148)



Bandspread

By TOM KNEITEL

Special Fare for DX'ers

WHAT MIGHT very well be considered a sort of Oriental WWV is Japan's Station JJY, which, like WWV, transmits standard frequency and time signals, and even radio propagation disturbance warnings to the world. Through several vertical antennas, they broadcast their 1000-cps time signal on six frequencies strung out between 2.5 and 15 mc.

This station is operated as a public service by The Radio Research Laboratories, Koganei-machi, Kitatama-gun, Tokyo, Japan. Not an easily heard station in the Eastern U. S., it nevertheless can be lured out from under the QRM by the diligent epicure of DX, wherever he may be located.

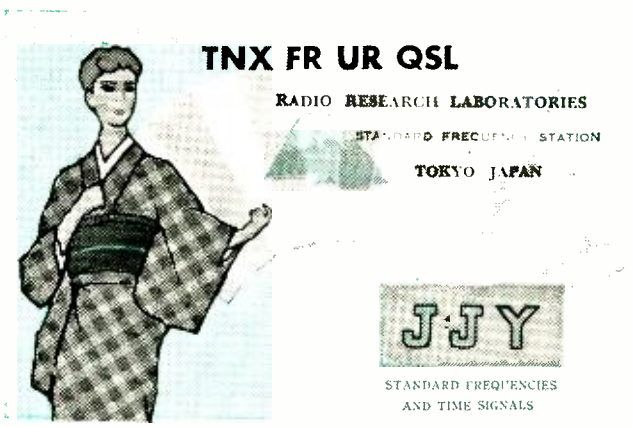
You boys with the high-powered receivers can try your hand at pulling JJY through WWV on the frequencies that both of these stations share.

In order to verify numerous reception reports, JJY has whipped up a novel QSL card with ham-talk written over a picture of a Geisha girl, in Technicolor!

Mr. Shiego Kurachi, top man in JJY-ville, eagerly seeks reception reports and has supplied the following schedule of his station's operations:

Frequency (kc.)	*GMT*	*kw.*
2500	0659 to 2259	1
4000	24 hours	2
5000	2359 Sun. to 2349 Mon.	1
8000	2059 to 1059	2
10000	2359 Tues. to 2349 Wed.	1
15000	2059 to 1059	1

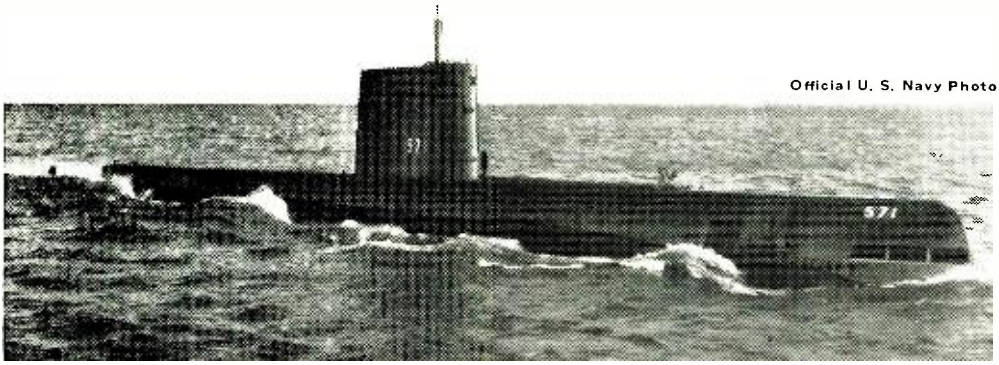
QSL'ing the "Nautilus." We don't like to brag (much), but we have recently become the very proud possessor of a QSL from the U.S.S. "Nautilus," history making nuclear sub of the U. S. Navy that showed its stern to the walruses at the



An oriental version of WWV is Japan's station JJY, which sends out a kimono-clad QSL. They broadcast standard frequency and time signals, and warn of any radio propagation disturbances.

North Pole. They were heard on 2126 kc. calling the New York Marine Operator during their return voyage to the U. S. from "way up thar."

This QSL makes a nice companion for the card we collected from U.S.S. "Glacier," which was at McMurdo Sound, Antarctica, when we listened in during 1956's "Operation Deepfreeze II."



Official U. S. Navy Photo

The U.S.S. "Nautilus" was heard and QSL'd on its return voyage from the North Pole, calling the New York Marine Operator on 2126 kc.

Scrambled Speech. One of the most often asked questions about utility stations is: "How do you listen to scrambled speech (SSB) transmissions?" These are heard from commercial overseas telephone stations and sound somewhat like a chipmunk with his tail in Fido's incisors. Heard in all parts of the short-wave spectrum, they can provide you with some good DX'ing if you can unscramble them.

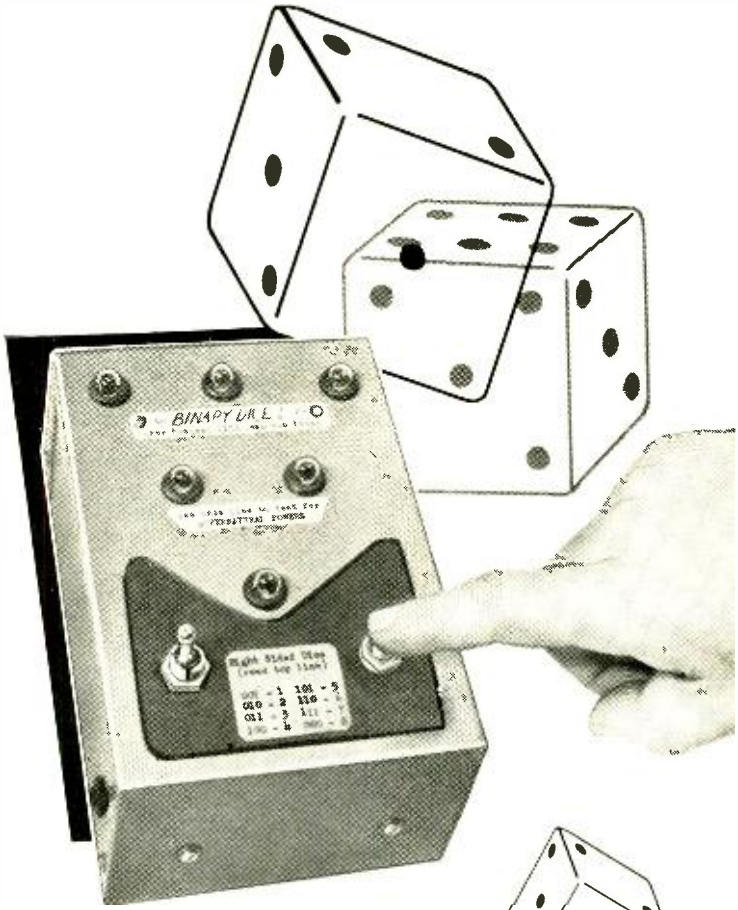
The generally accepted and recommended way of making sense out of these transmissions is as follows: (1) tune to a sideband of the signal; (2) pull your sensitivity control down a few pegs; and (3) fiddle around with the BFO (c.w. pitch) very slowly. If this doesn't work, try doing steps 2 and 3 on the other sideband. With some luck you should be able to get a fairly readable signal, sounding only slightly like "Robby the Robot."

Among the most commonly heard commercial telephone stations, heard on many frequencies using both scrambled and unscrambled speech, is the one in Paris, France. They announce "Ici Paree," followed by a racket that sounds like a one-armed marimba player with St. Vitus' Dance. They can be reached for QSL'ing at: Administration des Postes, Telegraphes et Telephones, Paris, France. Don't forget the reply card.

Special Stations. The Diana Moon Radar transmitter (Sept. '58 POP'tronics, p. 64) has been reported testing on 151.11 mc. with c.w. and pulse for about four hours a day, Monday through Friday. Power on this frequency is 50 kw. If you hear their transmissions on this channel, or on their 108-mc. channel, send a report to: Commanding Officer, U. S. Army Research & Development Laboratory, Ft. Monmouth, N. J. (Att: SIGFM/EL-SX). Their multi-colored glossy QSL is about as avant-garde as you can get!

The Burned-out 12SK7 Award for unusual-station-of-the-month goes to Station IRM, Rome, Italy. This station is operated by "Centre International Radio-Medical," Via Torino 122, Rome, Italy, for the sole purpose of providing medical advice to ships at sea which do not carry their own doctor. Aside from the advisory transmissions, they run regularly scheduled c.w. and phone broadcasts. Look for them on c.w. at 12,760 kc. on Tuesday, Thursday, and Sunday at 1130 to 1145 GMT, and 1830 to 1845 GMT. They also have a daily c.w. broadcast for five minutes at 0755 and 1955 GMT on the same frequency. Their regular phone transmission can be heard every Sunday on 12,643 kc. at 1850 GMT for ten minutes. This is an interesting catch, and a QSL from Station IRM will be a nice addition to your wall, especially if your XYL has put up floral design wall paper in the shack.

Are there any utility stations that you would like to see a photo story on? Let us know and we will start the wheels grinding in that direction. —30—



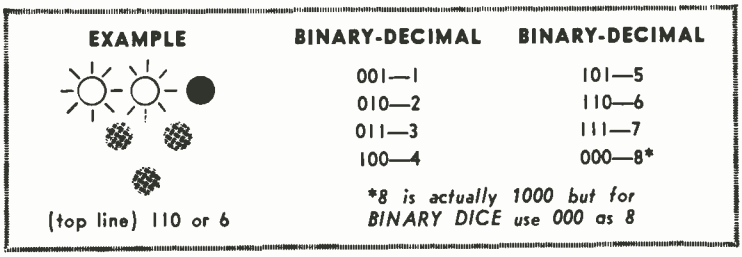
Eight-Sided Dice

By
IRA GLICKSTEIN

THIS multi-purpose project can be used as eight-sided dice, or as a tester of extrasensory perception. As an added bonus, it will give you a chance to learn simple binary arithmetic as used in digital computers.

In a game of chance, you refer only to the top three flashing lamps of the BINARY DICE. At any instant some will be "on" and some "off." When the push-button switch is pressed, the lamps that were on at the instant of switching remain on, those that were off remain off. A little figuring will show that there are eight possible

Electronic "DICE" teaches binary arithmetic and tests for supernatural powers



How to convert binary numbers to the decimal system. Only the top line of bulbs is read, giving eight possible "on-off" combinations.

combinations of the three lamps being on or off, and the lamps will indicate from 1 to 8 in the code of binary arithmetic.

Binary Arithmetic. Digital computers use a calculating system based on the number 2. This system is called "binary." Our ordinary number system is called a "decimal" system because it is based on 10.

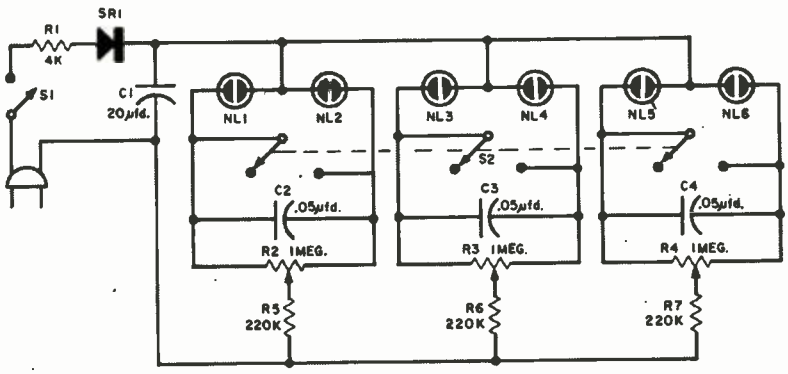
In the BINARY DICE, a lamp that is "on" represents the binary digit "1," a lamp that is "off" represents "0." Using the binary notations 1 and 0, read the top three lamps; then look up the resulting binary number in the chart shown above. After you use the device for a short time, you will be able to recognize 101 as 5 and 110 as 6.

Construction. The BINARY DICE is built in a 5" x 7" x 3" aluminum box. For ease of wiring, a subchassis for the three calibrating potentiometers and associated capacitors and resistors is used. This small 4½" x 3" aluminum panel should be wired first; see the photo for details.

When constructing the main cabinet, the neon lamps are press-fit into rubber grommets and leads are soldered directly to them. The remainder of the construction is self-explanatory. Be careful *not* to ground any part of the circuit to the metal box.

Plug in the BINARY DICE to the 117-volt line with the on-off switch to "*on*." All six lamps should start flashing at a rapid rate. Press the button and three lamps should remain on and three lamps should be off. If this doesn't happen, adjust each potentiometer to its approximate center position and/or change the value of *R1*. This resistor may be safely made as small as 100 ohms or as large as 6000 ohms. The optimum value is that at which the lamps flash so rapidly that you can just see the flicker.

Calibration. Because of inevitable differences between individual components, a



PARTS LIST

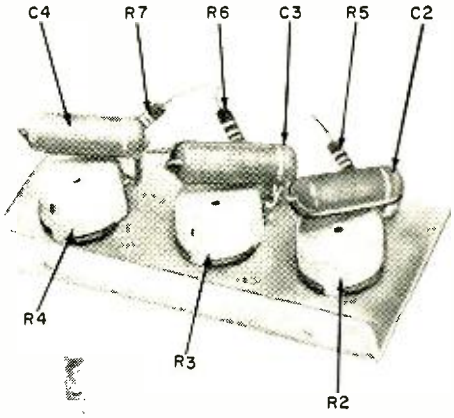
C1—20-μfd., 250-volt d.c. electrolytic capacitor
C2, C3, C4—0.05-μfd., 400-volt d.c. molded tubular capacitor
NL1-NL6—NE-51 neon lamp
R1—4000-ohm, ½-watt resistor (see text)
R2, R3, R4—1-megohm linear taper potentiometer with slotted shaft (Mallory SU-54 or equivalent)
R5, R6, R7—220,000-ohm, ½-watt, 10% resistor
S1—S.p.s.t. toggle switch
S2—3p.s.t. push-button switch (Switchcraft 9001 or equivalent)
SR1—150-ma. silicon rectifier (Sarkes Tarzian M-150)
1—4½" x 3" aluminum subchassis
1—3" x 5" x 7" metal box (Bud Minibox CO-2108)
6—⅜"-i.d. rubber grommets for ½" mtg. hole
Misc. mounting clip for silicon rectifier, insulated lug, wire and hardware

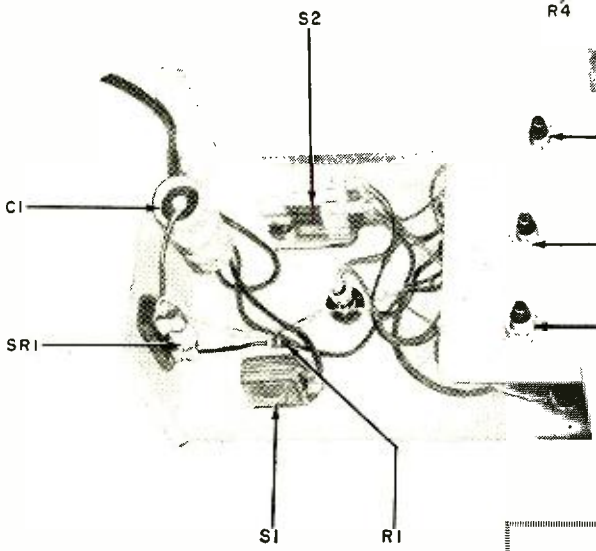
calibrating potentiometer has been built into each of the three random indicators. Calibration assures that each indicator will behave like a perfectly balanced coin, and the whole unit will behave like a perfectly balanced eight-sided die. Time, patience and a screwdriver are required.

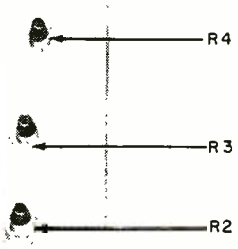
Set each potentiometer to approximate center position. Observe neon lamp *NL1* (top row, far left). Press the button (*S2*) 30 times and record how many times *NL1* stays lit. Twelve to 17 out of 30 is good—don't touch *R2*. If *NL1* stays on more often, turn *R2* (directly behind *NL1*) slightly counterclockwise. If it stays on less than 12 times, turn *R2* slightly clockwise.

Repeat this procedure. Don't stop until lamp *NL1* falls into the safe zone twice in succession. Calibrate *NL3* (top row, middle) with *R3*, and lamp *NL5* (top row, far right) with *R4*.

Extrasensory Powers. Some scientists contend that certain people can control the fall of dice or other chance occurrences by some type of mental energy. Others believe it may be possible to predict chance happenings. All of these special "talents" are lumped into the category of ESP or "extrasensory perception." Since BINARY DICE provides random selection and cannot be influenced, mechanically, by the person operating it, the unit is ideal for testing for presence of ESP.







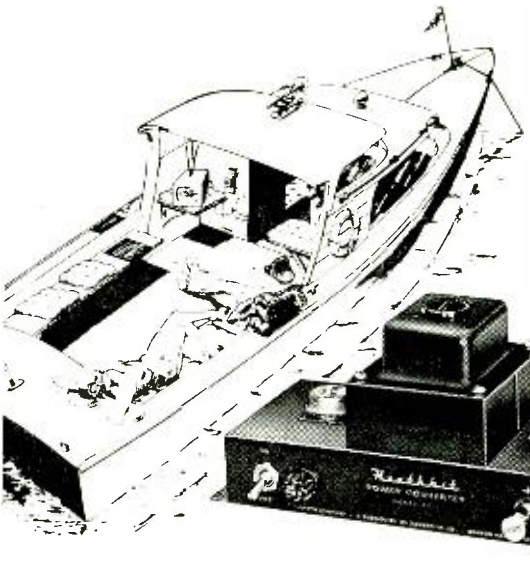
Subchassis holds the calibrating potentiometers. Three holes in the back panel provide access for screwdriver calibration.

HOW IT WORKS

The BINARY DICE is made up of three separate indicator circuits using a common d.c. power supply. Each circuit has a capacitor, a potentiometer and two neon lamps, which form a relaxation-type oscillator circuit. As one lamp of each pair goes on, the other goes off, and vice versa. When switch *S2* is pressed, the two neon lamps are connected in parallel, and the one which was on at the instant of switching will remain on, while the other remains off.

The second row of BINARY DICE is used for ESP testing. There are two lamps and the four possible combinations are: 00, 11, 10, 01. Blindfold your subject, ask him to pick one of the four combinations and concentrate on it. Press the button to see if he "guessed" right. Do not tell the subject if he was right or wrong. Ask him to pick again, then press the button. Run through it about 20 times. By the law of chance he will be right about 25% of the time. If your subject does better than 5 out of 20, he may have extrasensory powers . . . or he may be plain lucky!

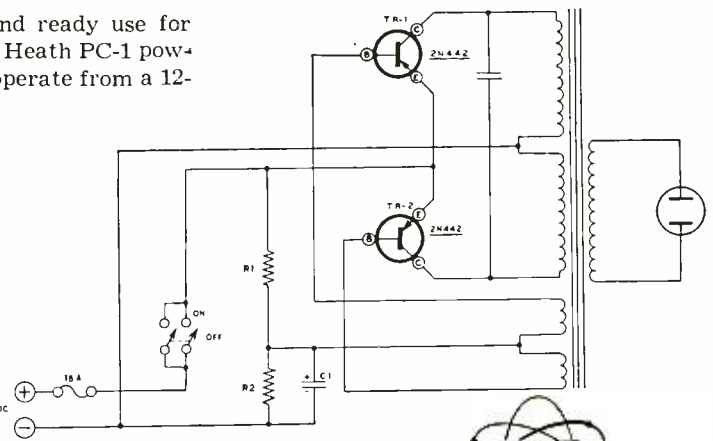
If a subject *always* does much better than 5 out of 20, contact the psychology department of the nearest university . . . he's a mental miracle man! —30—



Household Current Afloat

. . . with a Heath power converter kit

BOAT OWNERS will find ready use for the new transistorized Heath PC-1 power converter, designed to operate from a 12-volt storage battery. By means of electronic switching and without moving parts, this versatile unit will operate small television sets, hi-fi systems, or certain appliances while cruising.



The d.c. input, at a normal 12 volts, is electronically switched to and fro in the primary winding of the transformer by a pair of power transistors. These act as an automatic switch without moving parts, allowing the input voltage to pass first in one direction and then in the opposite direction through the transformer primary winding. This switching occurs approximately 60 times every second, thus effectively making 60-cycle a.c. out of the 12-volt d.c. input.

The transformer is so designed that the action of the switched input voltage in the primary is coupled to the much larger secondary winding via the magnetic field caused by the switched voltage. In effect, the voltage developed in the secondary winding is a much larger (115-volt) replica of the switched input (12 volts). This 115-volt, 60-cycle a.c. voltage is available for use in powering numerous items of equipment normally requiring household or shore power.

TESTED By POPULAR ELECTRONICS

On being tested under 125 watts load for eight hours continuously, the power converter operated without failure but heated considerably. The chassis acts as a heat sink and becomes hot to the touch after long use. This heat is not excessive and should be considered normal for the unit.

The output voltage of the PC-1 power converter is not a pure sine wave. Therefore, a D'Arsonval type a.c. voltmeter cannot be used to measure the output voltage. In its place, an iron vane voltmeter should be employed. -30-

A New Electronic Development

The Dielectric Pump

...No Moving Parts!

ONE warm summer day, two years ago, two physical chemists stood behind a table in the General Electric Research Laboratory at Schenectady, New York. Before them lay a piece of experimental apparatus consisting of an ordinary glass containing two small wire screens separated by a short piece of glass tubing. The glass was filled with nitrobenzene, a highly insulating liquid. Each screen was connected to one side of a high-voltage d.c. power supply.

One of the men switched on the power supply and adjusted its output to 10,000 volts. The other injected a brightly colored dye solution into the glass on the far side of one of the screens. Suddenly, the dye began to swoosh through the screens. The liquid was moving!

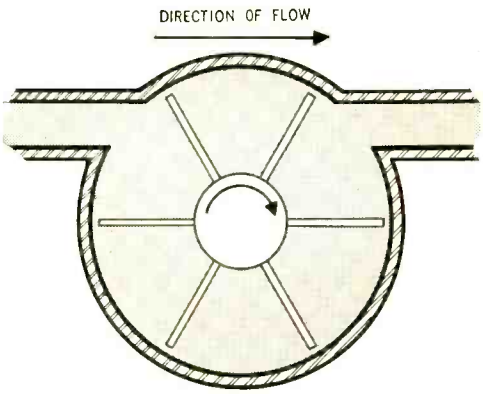
The scientists were Dr. P. L. Auer and Dr. A. H. Sharbaugh. They were investigating some strange reports from a group of research workers at the University of Cincinnati concerning the behavior of insulating liquids in the presence of strong electric fields. Their research efforts led to the invention of a novel method of pumping liquids which involved no moving parts—the *dielectric pump*.

Direct Energy. Conventional electric pumps, such as the common "paddle-pump," mechanically push or pull liquids along with paddles or pneumatic pistons powered by electric motors. Since the efficiency of this type of pump can never exceed the efficiency of the electric motor operating it, as much as 80% of the electrical energy supplied to it is wasted.

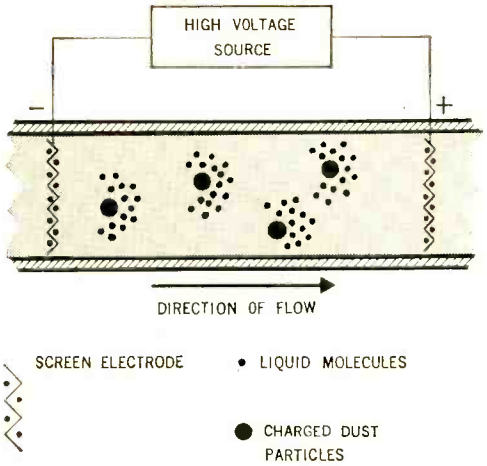
Dielectric pumps use electrical energy *directly* to pump liquids. The simplest type consists of two wire-screen or perforated metal disc electrodes with a d.c. potential difference of about 10,000 volts between them. If the electrodes are placed parallel to each other in an insulating liquid, such as kerosene or mineral oil, the liquid will move slowly towards the positively charged electrode.

The reason for this is rather simple. If

By
JAMES G. BUSSE



"PADDLE-PUMP." In the conventional electric pump, liquids are mechanically pushed along by paddles that are rotated by an electric motor.



SIMPLE DIELECTRIC PUMP. Liquids are pumped electrostatically. Negatively charged dust particles, present in most liquid insulators, drag liquid molecules with them as they move through the electrostatic field between two screen electrodes.

the liquid were an ideal dielectric, there would be no movement at all, but ideal dielectric solutions are extremely difficult to obtain. Even liquids designated as chemically pure contain large amounts of suspended dust. As these dust particles move through a liquid, they become charged with static electricity. For some reason, they are more often charged negatively than positively.

Pumping Action. When a sufficiently high voltage is applied across the electrodes, the electrostatic field produced between them causes the charged dust particles to move toward the anode, where they are collected and discharged. As the particles move through the liquid, they drag along molecules of the liquid with them, producing a pumping action.

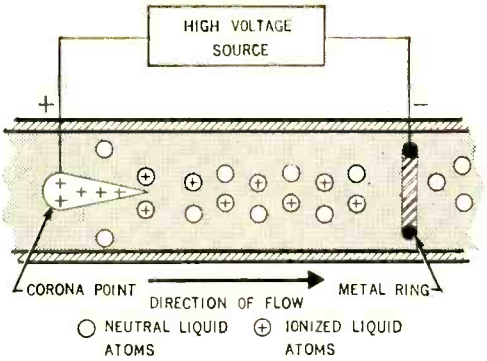
Unfortunately, as more and more dust particles are collected and discharged at the anode, the pumping action gradually ceases. However, since the strength of the pumping action in the dielectric pump depends upon the number of charged particles in the liquid, if a source of such particles could be found, the pumping action would continue indefinitely.

One solution to this problem is to add small amounts of a chemical "dust" to the liquid being pumped. This keeps the pumping action going, but it eventually clogs the screen electrodes and the added impurities in the liquid are undesirable. A more efficient solution to the problem is to charge (ionize) some of the atoms of the liquid being pumped, with some sort of electrical device. Such a device is the corona discharge.

Corona Discharge. The amount of static electric charge on any conductor is proportional to the curvature of the surface of the conductor. That is why all high-voltage electrical apparatus have smooth, rounded surfaces. When a high voltage is applied to a conductor with a pointed surface, the electric charge concentrated at the point is so intense that air or liquid atoms near it are ionized. In air, the ionized air atoms near such a corona point cause a wind strong enough to blow out a candle. This is called a corona discharge.

In electrical transmission lines, a corona discharge represents wasted electrical power. In the dielectric pump, it is a convenient source of ions for pumping a liquid.

The improved dielectric pump, employing the corona discharge as an ion source, does not need to depend upon the number of dust particles in a liquid. In fact, with such



IMPROVED DIELECTRIC PUMP. A corona point ionizes liquid atoms. These positively charged ions move towards the negatively charged metal ring, dragging neutral liquid atoms with them, thus causing the liquid to move through the "pump."

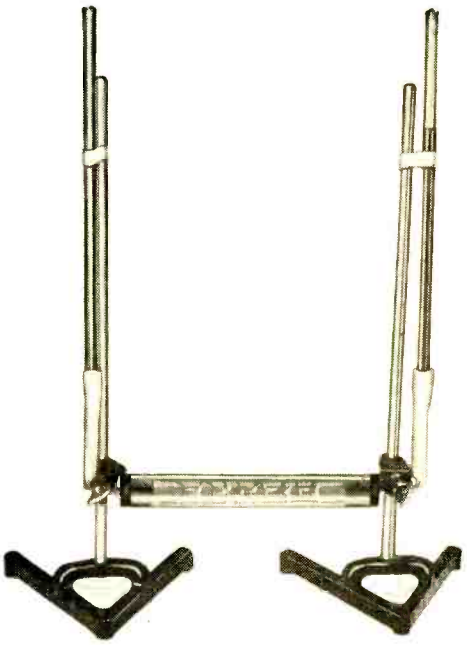
a pump it is possible to pump even an ideal dielectric liquid.

"Stolen" Electrons. This type of pump consists of a positively charged pointed anode at about a voltage of 20,000 volts d.c., mounted about a quarter of an inch away from and perpendicular to a grounded metal ring. When these electrodes are placed in an insulating liquid, the intense electric charge concentrated at the point of the anode "steals" electrons from liquid atoms near it, turning them into positively charged ions.

The static electric field between the corona point and the metal ring causes these ions to move toward the cathode, dragging liquid molecules and uncharged atoms with them and thus causing a pumping action in the liquid. Actually, the polarity of the electrodes can be reversed without changing the pumping power of the device.

Dielectric pumps can be "stacked" by alternating corona points with ring electrodes to produce powerful units. Simple screen electrode dielectric pumps, operated at 10 kv., can move liquids at the rate of one-twentieth-of-an-inch per second. The corona type of dielectric pump can pump liquids at a rate of one inch per second. The distance between electrodes depends upon the voltage the pump is operated at and the dielectric strength of the liquid being pumped. Using higher voltages, the pumping action can be increased somewhat.

Many Advantages. Although dielectric pumps can only pump liquids that are insulators, they can handle a great number of liquids, such as fuels and lubricants, that are currently being handled with conventional pumps. The dielectric pump has the advantages of high efficiency, compact design, and inexpensive construction. In certain applications, its smooth pumping action is much more desirable than the jerky pumping motion of the paddle type and other mechanical pumps.



IMPROVED PUMPING UNIT. This is composed of five separate corona-type dielectric pumps "stacked" in glass cylinder to produce more powerful pumping action.

Although still in the developmental stage, a corona-type dielectric pump has been constructed to run directly with high-voltage a.c. power, thus eliminating the need for a high-voltage d.c. power supply. Simple step-up transformers could supply the a.c. power. An atomic battery, with a power output of 50 micromicroamperes at a voltage of 10 kv., could power a dielectric pump for years because there is nothing in the pump to wear out and no moving parts to replace. —30—

VLF Radio Can Detect Nuclear and Rocket Tests

SCIENTISTS from East and West met in Geneva recently to discuss an international plan for detecting nuclear tests. They suggested four monitoring methods which might make world disarmament feasible. The most interesting system, from the standpoint of electronics, is the detection of nuclear explosions and the firing of heavy missiles by monitoring the very low frequency radio waves which such weapons generate. These radio signals can be detected readily over great distances.

Radio waves generated during a missile launching are due to the violent motion of charged particles in the high-velocity exhaust of the rocket motor, and to a discharge of potential between the earth and the atmosphere by the vertical column of intensely ionized gasses which is left behind the missile. This column, which extends from the launching pad, also acts as an efficient vertical antenna at these very low frequencies. In the case of an atomic explosion, the radio waves produced are similarly due to the violent motion of particles in the actual blast, and to the column of ionized gasses which rises afterward.

Very low frequency signals travel great

By CHARLES H. WELCH

Build The Black Box

MISSILEMEN, in the jargon of their trade, refer to a missile's guidance system as a "black box." The POP'tronics "black box" is really a very low frequency radio—it won't let you tell a missile where to go . . . but it will tell you when one went. Relying on ionization noise for its information, this little transistorized tuned preamplifier will not only indicate when one of the larger rockets takes off, but it will permit you to eavesdrop on the normal clicks, shrieks and whistles of the upper atmosphere's "dawn chorus."

The output of the black box is fed into an audio amplifier or a high-gain oscilloscope. Your tape recorder will serve nicely to give you a permanent record of upper atmosphere events, man-made—or otherwise.

The signals shown in the chart at right were detected with the black box during the firing of the lunar probe rocket "Pioneer" on October 11, 1958, at 3.42 a.m., EST. The monitoring site was at Orlando, Florida, and the time of the firing was confirmed by radio reports and by visual sighting of the rocket's exhaust flare as it neared the top of the first stage of flight. Though Orlando is only 50 airline miles from Cape Canaveral, the excellent propagation conditions in the very low frequency band would have made these signals detectable over distances many times that great.

One of the big difficulties in missile monitoring is knowing when to listen, since the Defense Department is not prone to advertise its firings in advance. However, accurate advance information is frequently given out on firings of test vehicles such as the "Pioneer" and the "Vanguard." Even with military missiles, it is usually possible to confirm observations afterwards since the time of firing is often announced shortly after the test.

The loop-preamplifier combination has a frequency range between 4 and 16 kc. This response is a compromise between good sensitivity and wide coverage of the v.l.f. spectrum.

The loop antenna is 200 turns of #25

distances with little attenuation, because at these frequencies the surface of the earth and the ionosphere act as good reflectors and function as a sort of duct or wave guide. Most frequencies in the v.l.f. band are propagated through this wave guide with very little loss. There is a band of frequencies from 2 to 4 kilocycles where absorption is high, but in the vicinity of 10 kc. attenuation is only about 2 db per 1000 kilometers (about 621 miles). This means that any missile-generated v.l.f. radio waves which rise significantly above the noise level near the launching pad could be detected easily at great distances.

Unfortunately, these excellent propagation characteristics also apply to the noise generated by the 50,000 or so thunderstorms that occur every day, and this portion of the spectrum is rife with crashing static and eerie whistlers and chirps. In the extremely low portion, the 50- and 60-cycle power line frequencies and their harmonics add to the noise level. All these signals have known characteristics, however, and can therefore be separated from the desired signal.

Since propagation characteristics of the v.l.f. band are so constant, the time required for a signal to cover a given distance can be predicted much more accurately than at the higher frequencies where ionosphere effect varies. For this reason, three or more monitoring stations could compare the time at which they received the same signal and pinpoint the location of its origin with extreme accuracy.

VLF radio may be our best bet for survival at present, either as part of a disarmament weapons-test monitoring project, or as our early warning system in a push-button war. —30—

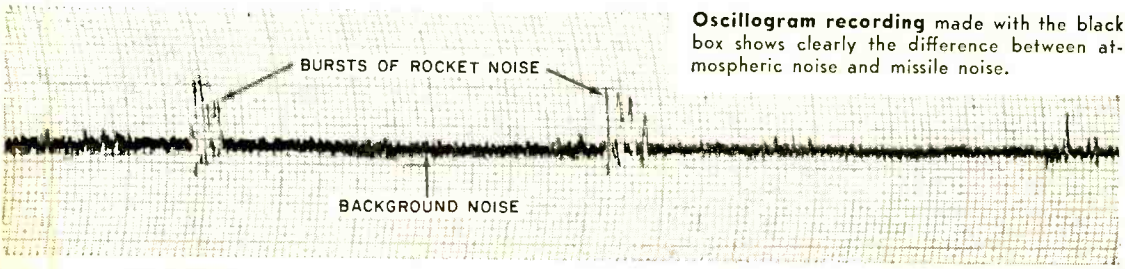
That Hears Missiles

enamel-covered wire wound into a square loop on a wooden frame measuring 48" diagonally. The ends of the winding are brought up on two binding posts, and lamp cord is used to connect these terminals to the input jacks (*J1* and *J2*) of the preamplifier. Capacitor *C1* may be mounted on the terminals of the loop or within the preamplifier cabinet.

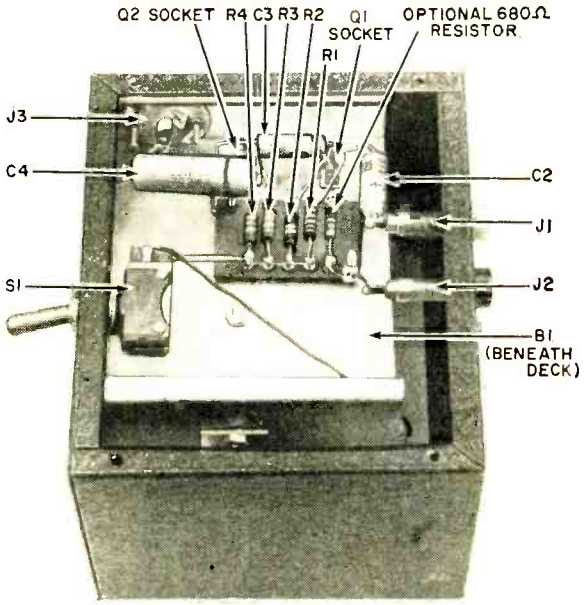
Since one of the big problems of this type of rig is power-line frequency hum, a battery-powered transistor amplifier was chosen. The two-stage resistance-coupled circuit used has a measured voltage gain of 1330 at 10 kc. and construction is straightforward. Parts layout is not critical. The original unit was built on a 1" x 3" x 4" chassis and enclosed in a 3" x 4" x 5" steel utility box. Any small 6-volt battery can be used, as current drain is very low.

Sensitivity of the completed unit may be tested by listening in on thunderstorms. If you can hear "whistlers" with the unit, or if chirps and clicks from a thunderstorm which is miles away are loud and clear, then the sensitivity is adequate.

Of course, the best way to determine the exact bandpass of the unit is to run a curve with an audio oscillator and a VTVM, but a rough estimate of correct bandpass can

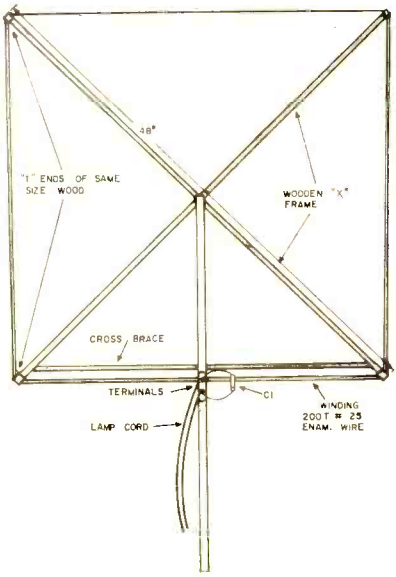


Oscillogram recording made with the black box shows clearly the difference between atmospheric noise and missile noise.



Bottom view of black box with cover removed. The two transistors and the battery are on the other side of the deck. A 680-ohm resistor can be wired across J1 and J2 to widen bandwidth, but sensitivity will be lost.

Schematic of the black box. C1 is mounted on the loop antenna. A line cord connects them to the black box through pin jacks J1 and J2. The output from J3 can plug into any good audio amplifier.



Extra-large loop antenna and capacitor C1 form a tuned circuit covering the very low frequency band. The antenna should be positioned for best sensitivity and least noise.

be made. The higher frequency harmonics of the 60-cycle power line will make a steady whine which is overridden by the pops and clicks of atmospherics from distant lightning. These clicks should be sharp, clear and unmuffled.

Remember that the characteristics of the v.l.f. band vary from one time of day to another and several tests should be made before any definite conclusion is reached.

The audio amplifier should be adjusted for flat response when the missile detection system is operating. The output of the audio amplifier may be fed into a speaker or viewed on a scope. If you have a tape recorder, it is a good idea to record the entire monitoring period, as this will enable you to reproduce any desired portion of the received signals later for detailed study.

The loop antenna should be rotated slowly until a sharp null in the hum level is apparent. When it is located, the antenna should be left in that position. However, if the antenna is not broadside to the noise source, there will be a large drop in gain. To prevent this, try a new site.

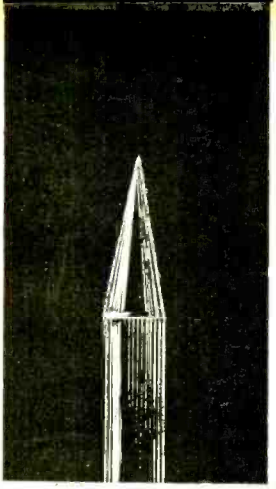
Missile noise and transient noise impulse interpretation is a study in itself, and a great deal of elaborate and expensive equipment is involved. However, the experimenter with limited equipment can recognize the noise of a missile when he knows what he is looking for.

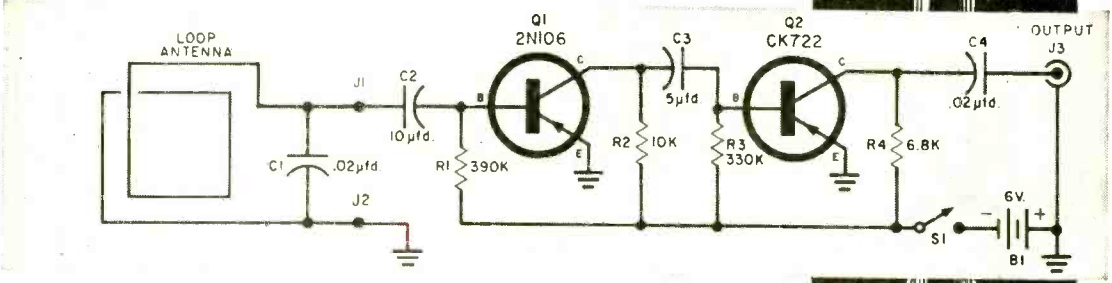
Unfortunately, describing the differences between noise produced by a missile and atmospheric noise is a little like trying to explain the differences between a Rebel yell and a Comanche warwhoop to someone who

PARTS LIST

B1—6-volt battery
C1, C4—.02-μfd. low-voltage paper or disc capacitor
C2—10-μfd., 25-volt electrolytic capacitor
C3—5-μfd., 25-volt electrolytic capacitor
J1, J2—Insulated pin tip jacks
J3—Phono jack
Q1—2N106 transistor
Q2—CK722 transistor
R1—390,000 ohms
R2—10,000 ohms
R3—330,000 ohms
R4—6800 ohms
S1—S.p.s.t. switch

All resistors ½-watt composition

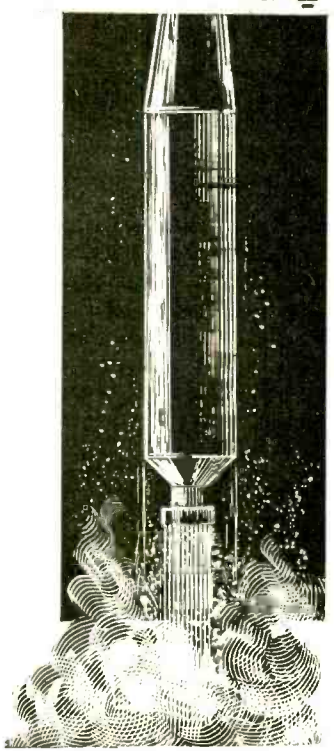




HOW IT WORKS

The loop antenna, with capacitor *C1*, makes a parallel-tuned circuit which is resonant at 4.85 kc. The impedance of this tuned circuit is considerably higher than the input impedance of low-noise transistor *Q1* to which it is coupled. This deliberate mismatch loads the loop antenna and broadens its response to cover the desired portion of the v.l.f. band.

Transistors *Q1* and *Q2* make up a two-stage resistance-coupled preamplifier with a voltage gain of 1330 in normal operation, and with an over-all frequency response from 4 to 15 kc. The output of the unit may be plugged into the high-impedance input of a normal high-fidelity amplifier for further amplification to display, recording, or listening levels.



has heard neither. The key lies in the difference between the two. Become familiar with the sound of normal atmospherics, and their appearance on a scope, and the slightly different sounds of a missile will be easy to spot.

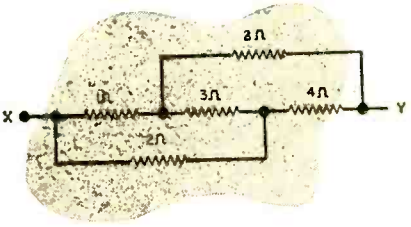
At the time of the "Pioneer" shot, oscillograph recordings of random noise taken just before the firing and about an hour afterwards showed spikes rising 3 db above the background, about one during each second. When the missile was under first-stage power, however, the noise peaks were 16 db above the background noise and occurred in bursts instead of at random. In addition, analysis of the individual noise peaks shows that they changed in character from the single spike of distant atmospherics to multiple oscillations several cycles in length. Such changes are easily detected when the signal is displayed on an oscilloscope.

—30—

Electronic Sticklers

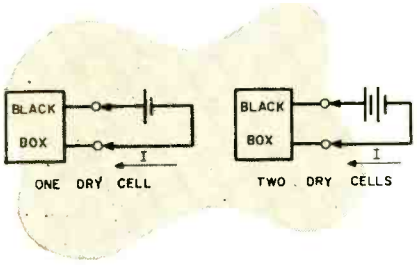
These four thought-twisters are arranged in order of increasing difficulty

(Answers on page 146)



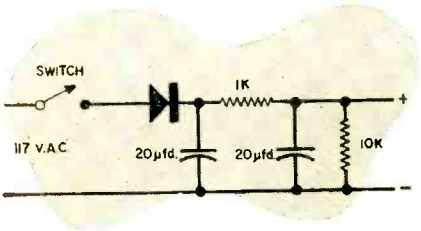
1 Harvey Matrix discovered this network, covered with solder, in his junk box. Rather than trust his ancient ohmmeter, he tried unsuccessfully to compute the resistance mathematically. Show Harvey you are slicker and quicker by solving the problem in one minute.

—Dennis Wroblewski



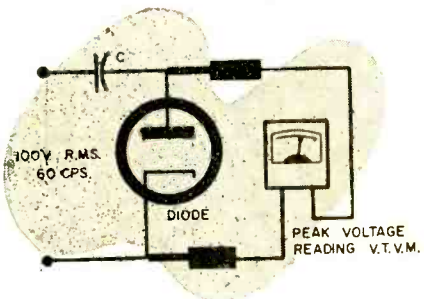
2 Joe Whatsit had a black box with only two terminals showing. To find out what was in the box, Joe connected a 1½-volt dry cell to the two terminals and noted the current flow. He then connected a second identical dry cell in series with the first cell and repeated the experiment. The same current was noted. With this information, Joe figured out what was in the box. Can you?

David Borenstein



3 Mr. Pennypincher, in order to save money on batteries for his portable radio, built this little voltage supply to substitute for the batteries. When he plugged in the unit, he was running a risk of a blown-out component. Any idea why?

—Ronald Wilensky

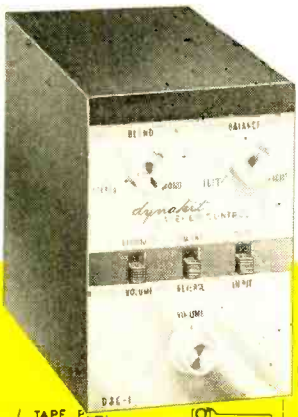


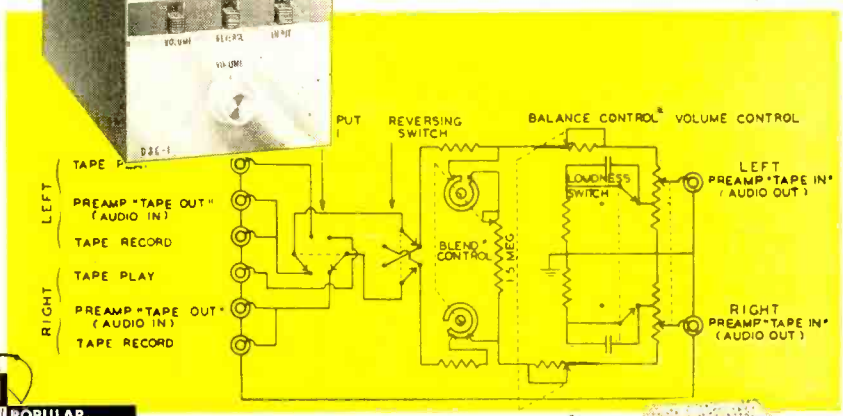
4 With the setup shown, a diode in series with a capacitor, Harold Tinkertoy applied 100 volts r.m.s. across the circuit. Then he used his vacuum-tube voltmeter to measure the *peak* voltage across the diode. How much did he measure? To make the problem easy, assume that a sine wave is applied to the circuit.

—Louis E. Garner, Jr.

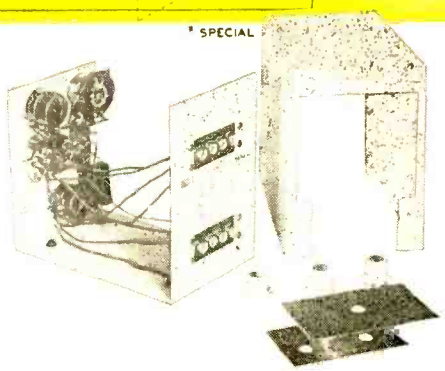
POPULAR
ELECTRONICS Builds a Stereo Control Unit

Dynakit DSC-1 simplifies the switch to stereo





TESTED By POPULAR ELECTRONICS



THE STEREOPHONIC record brought a great number of changes into the world of hi-fi. Preamplifiers sprouted new controls, turntables were redesigned for lower rumble content, smaller speakers took the spotlight, and an entirely new type of unit hit the market.

Usually known as stereo adapters, these new units are designed to enable the owner of a hi-fi set to centralize the stereo control functions, such as *balance* and *master volume,* in one compact package. The Dynakit stereo control unit, Model DSC-1, a fine example of the species, is designed to operate with a pair of Dynakit preamps.

Construction. As can be seen from the schematic, the DSC-1 uses relatively few components. Construction is a start-after-supper, finish-before-bedtime deal. There are a few tight corners met in the construction process but, in general, the U-type chassis layout prevents any wiring difficulties.

The Dynakit stereo control unit has a number of interesting features beside the *balance* and *master volume* control. For instance, there is a control in the upper left-hand corner labeled *blend* whose func-

tion is to compensate for the "ping-pong" or hole-in-the-middle effect.

A *loudness* switch permits a choice of a plain or compensated master volume control, and a *channel reverse* switch enables you to interchange right and left signals. A *tape input* switch is extremely useful to those of us who own a tape recorder with a separate monitoring channel, as direct comparison can be made between the input signal to the tape recorder and the output of the monitor head.

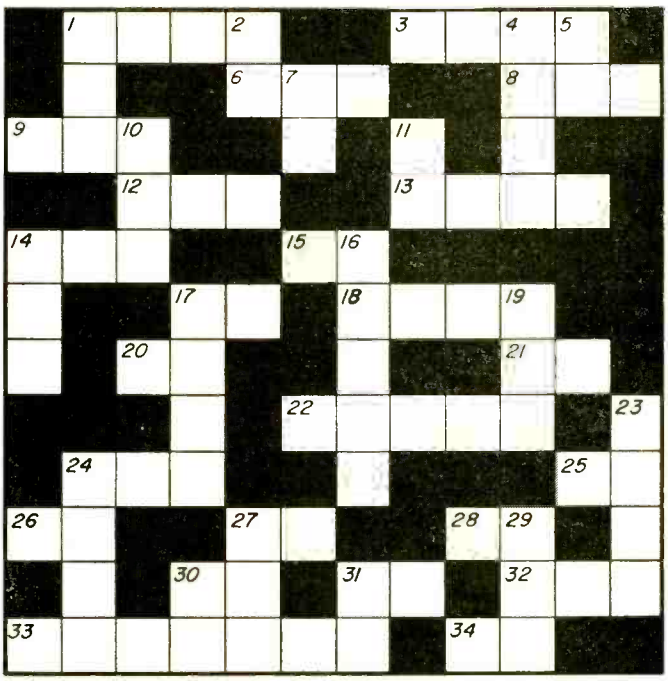
The Circuit. The *blend* control is a type of integrating network which mixes the input signals to the desired degree across a 1.5-megohm potentiometer. When set at one end of its rotation, the *blend* control enables full stereo reproduction. As the control is turned, the channels are mixed, until at the full clockwise position mono reproduction results.

As is standard practice, the *balance* control is a ganged dual potentiometer in series with the ganged *volume* control. The balance control taper and internal connections are so arranged that in the center or balanced position there is no resistance in series with either control. Depending upon which direction the *balance* control is rotated in, a certain amount of resistance is put in series with the selected volume control section.

The Dynakit stereo control unit is a perfect physical and electronic match for the characteristics of the Dynakit preamplifiers and amplifiers. —30—

CROSS*NUMBER* PUZZLE

By John A. Comstock



ACROSS

1 Year Fleming invented diode vacuum tube.
3 This quantity multipled by r.m.s. value of a.c. voltage will give peak voltage.
6 Slow record player speed.
8 Difference frequency in kilocycles produced by mixing 1000-kc. signal with 50-kc. signal.
9 Quantity by which peak value of a.c. voltage is multiplied to obtain r.m.s. value.
12 One-half kilowatt expressed in watts.
13 Output frequency in kc. of transmitter having crystal frequency of 2017.5 kc. and two doubler stages.
14 Lower limit of u.h.f. frequency band expressed in megacycles.
15 Large-size hi-fi woofer.
17 Very slow record speed.
18 Year tetrode (screen-grid) vacuum tube was developed, in reverse.
20 Mid frequency in megacycles of TV Channel 6 when lower frequency limit equals 76 mc.
21 Total resistance of two 44-ohm resistors connected in series.
22 Upper frequency limit in mc. of super-high-frequency band.
24 Voltage drop across 20-ohm resistor when current flow is 10 amperes.
25 Number of feet in 12 yards of hookup wire.
26 Mid frequency of TV Channel 2 when upper channel frequency limit is 60 mc.
27 Actual filament voltage rating of 6-volt vacuum tubes.
28 Popular-size TV screen.
30 Heater voltage of 35Z5 vacuum tube.
31 Separation in megacycles between TV sound and video carrier frequencies.
32 Number of zeros represented by letter K in stating resistor values.
33 Cycles in one megacycle.
34 Total voltage drop in series circuit when applied voltage equals 50 volts.

DOWN

1 Degrees of phase shift in voltage fed back to produce degeneration in amplifier circuit.
2 TV aspect ratio; ratio of picture width to height.
4 Year Lee de Forest invented triode.
5 Voltage drop across 90-ohm resistor when current flow equals ½ ampere.
7 Tape recorder slow speed in ips.
10 Wavelength in meters of 400-kc. signal.
11 Fast record player speed in rpm (approx.).
14 Electrical degrees in one cycle of alternating signal.
16 In resistor color code, number represented by green, white and yellow.
17 Year pentode was developed.
19 Electrical degrees in one alternation of sine-wave signal.
23 Capacitance reactance of 1.0-μfd. capacitor at frequency of 60 cps.
24 Express 0.00271 henrys in microhenrys.
27 Convert 650,000 watts to kilowatts.
29 Amount of capacitance in farads that will store 100 coulombs of electricity when applied voltage equals 1.0 volt.
30 This number means "the end."
31 Grade of solder often used in electronics work.

(Solution on page 144)

Short-Wave Report

By HANK BENNETT

RECEPTION VERSUS JAMMING

FOR SEVERAL YEARS one of the chief scourges of the short-wave broadcast bands has been the jamming stations. It is virtually impossible to tune across any of the main short-wave bands without hearing at least one jammer and often as many as a dozen.

These jamming stations are largely located behind the Iron and Bamboo Curtains and their purpose is to prevent listeners in those areas from hearing newscasts and commentaries beamed to them from outside countries. (See article starting on page 41 of this issue.)

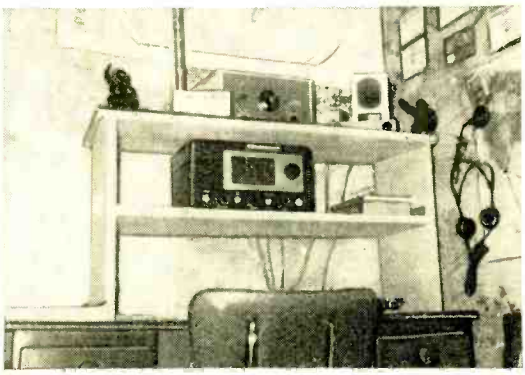
The jammers are often so strong that they also prevent listeners in the U.S.A. from tuning in on certain channels. Many readers report that this, alone, is enough to turn them away from their receivers in disgust.

The International Shortwave Club of London has, for months, been asking their members to avoid listening to stations that are located in countries responsible for jamming and, of course, to avoid sending reception reports to those stations. Whether this has or has not had any effect on the stations is difficult to ascertain.

On days when jamming signals blanket the regular short-wave bands, you might try tuning in some of the off-beat channels where the jamming is almost non-existent (although you may run into a good bit of Morse code interference from time to time). These channels include many rarely heard stations that may prove to be new countries for your log. Let's check some of them.

If you want to snag a rare one, try for

The receiver at Kevin Jessup's listening post in Westville, Ill. (right), is a Hallicrafters S-53A. He uses a six-meter doublet antenna.



Dave Lund, of Holstein, Iowa, DX's with a Hallicrafters S-40B and a long-wire antenna.

V3USE, Forest Side, Mauritius. This station wanders from about 14,980 kc. up as high as 15,020 kc. and is currently being reported on 15,018 kc. at 2300 with English news. You may need a lot of patience with this one but it *is* being reported in Eastern states.

Another relatively clear channel is 9009 kc., where you can find Israel afternoons between 1400 and 1600. Reports indicate that it is well heard in most areas.

If you can understand Spanish, go after the Nicaraguans in the 7000-kc. band. Some of these are: YNMS, *R. Phillips,* Leon, 7650 kc.; YNCA, *R. Atlantico,* Bluefields, last reported on 7755 kc.; and YNRM, *R. Musun,* Matagalpa, 7593 kc. You may need a bit of extra tuning for them as they seem to wander around a bit. Try during mid-to-late evenings.

If you can tune above 40 megacycles (40,000 kc.), try for the British Broadcasting Corporation's television Channel I (audio only) on 41,500 kc. Two stations, Crystal Palace and Divis, can be heard late mornings and they are just a few cycles apart although listed for the same frequency. (Your editor has both of them verified.) Another TV channel that is usually well heard at the same time is the French Channel II at Caen on 41,250 kc.

Other stations that can be found occasionally include: Beirut, Lebanon, on 8000 kc. (varies up to 8036 kc.); a station in Ecuador, as yet unidentified, on 8899 kc.; *Radio Espana Independiente* (Spanish Clandestine) on or near 6948 kc.; and JOZ, Tokyo, 3925 kc. A real tough one to log is the Falkland Islands station on 3958 kc., noted in Western areas around 1800-1900.

Check this list the next time you are baffled by the jammers. You'll find that you can have as much fun tuning the off-beat channels as you will have in the standard bands. Be sure to send reception reports; many of these stations are strictly regional and reports from outside areas enable their engineers to know where their signals are going. Let us know how you make out.

(*Continued on page* 155)

SHORT-WAVE MONITOR REGISTRATION

Register your monitoring station with POPULAR ELECTRONICS and receive an attractive Short-Wave Monitor certificate with your individual call letters.

To obtain your certificate, fill out the registration form below and mail it to The Editor, POPULAR ELECTRONICS, One Park Avenue, New York 16, N. Y.

Please include ten cents to help cover the cost of mailing and processing your certificate.

(Please Print)

Name .....

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

Receiver — Make ..... Model .....

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

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

Type of Antenna Used .....

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

By
HERB S. BRIER
W9EGQ

Among the Novice Hams

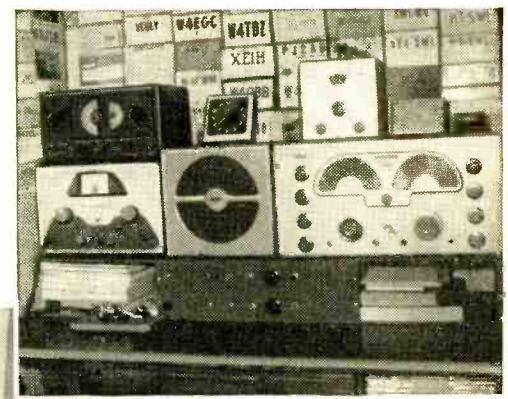
THE NOVICE BANDS — WHICH TO USE

WHAT BAND should you operate on when you first get on the air? Should you use "voice" or should you use code? If you start your amateur career as a Novice, these questions are partially answered for you by the FCC.

A Novice may operate in segments of only four amateur bands: 3700 to 3750 kc. in the 80-meter band, 7150 to 7200 kc. in the 40-meter band, 21,100 to 21,250 kc. in the 15-meter band, and 145 to 147 mc. in the 2-meter band. You can use code, usually called "c.w." (for *continuous-wave telegraphy),* in the first three bands, and either phone or c.w. in the 2-meter band.

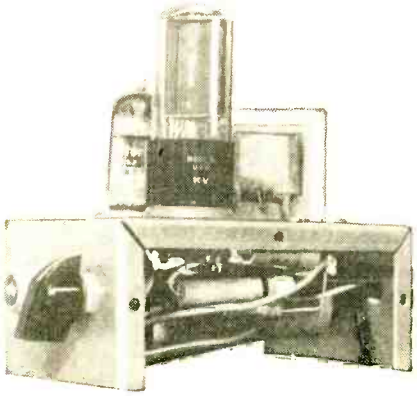
Most prospective amateurs are interested only in phone operation at first, because "it is more fun to talk than to learn the code and use the key." Then they discover that they *must* learn the code to obtain an amateur license, whether they plan to use phone or not, at a speed of 5 wpm for the Novice and Technician licenses and 13 wpm for the General/Conditional Class licenses.

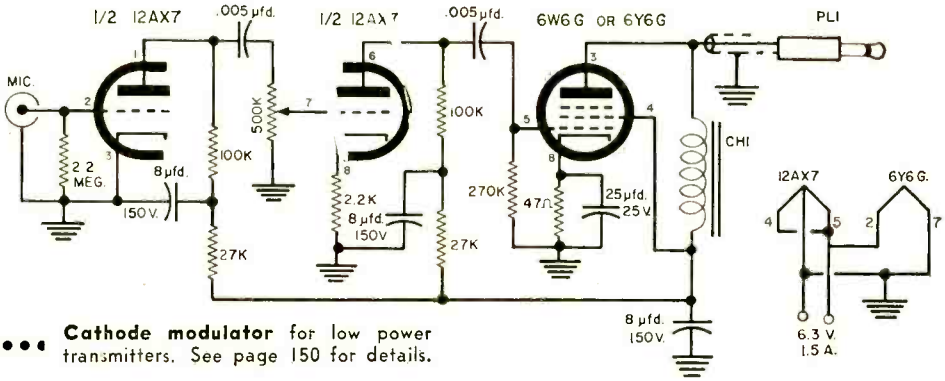
Code vs. Phone. Actually, code has quite a few advantages over phone, especially for beginners. A c.w. transmitter is simpler and far less costly than the equivalent phone transmitter. Watt for watt, a c.w. signal has a far greater communications range than a phone signal. A c.w. signal may occupy a bandwidth of 100 cycles compared to 3 or 6 kc. occupied by single-sideband or double-sideband phone signals; therefore,



KN4TSF's station, Chattanooga, Tenn.

Nick, K9KLR, operates in Gary, Ind.





Cathode modulator for low power transmitters. See page 150 for details.

be pushed out to about 100 miles. Under certain atmospheric conditions, which occur fairly frequently in the warmer months, distances up to several hundred miles may be spanned for periods up to a couple of hours.

Because of its limited range, most 2-meter activity is concentrated in or near the larger cities, except for serious experimenters, who, by means of skilled operating and elaborate equipment, manage to cover amazing distances.

Eighty Meters. The 80-meter Novice band is the easiest one to get started on with simple equipment. From sunset to sunrise, distances of 200 to 1000 miles can be readily achieved with a low-power transmitter and a simple antenna, although static sometimes limits range in the summer. On good nights, especially in the winter, much greater distances can be covered.

Daytime signals on 80 meters are usually quite weak, and the distance spanned may be less than 100 miles. However, the lack of interference during the day permits many excellent contacts.

Forty Meters. Daytime signals on 40 meters over distances up to 500 miles or more are usually possible with low power. As evening approaches, "skip" increases, often making it impossible to work nearby stations, but greater distances are easily covered. On many winter evenings, you can't work stations closer than about 1500 miles, except for "locals" within 25 miles; unfortunately, it may be very difficult to work anyone at all with low power then, unless you have a better-than-average antenna.

As on 80 meters, nighttime interference

(*Continued on page* 150)

many c.w. stations can operate in the space occupied by a single phone station.

The space factor is one reason why phone is not permitted in the lower frequency Novice bands. It also explains why interference is so bad in the low-frequency phone bands. This interference, combined with the superior "getting-out" ability of c.w., is why many General Class operators prefer c.w. to phone.

Of course, phone has its advantages, too, especially for casual rag-chewing. But there are a couple of other reasons why few Novices use phone. As a Novice, you must qualify for a higher class of license within the year that your license is valid or leave the air. By sticking exclusively to the c.w. bands, you give yourself the greatest opportunity to build your code speed up to the 13 wpm required for a General or Conditional Class license. And, besides, c.w. is fun.

Two Meters. The 2-meter band, the only one on which Novice phone operation is authorized, has a reliable range of about 25 miles with typical Novice equipment; with more elaborate rigs, this range may

POPULAR ELECTRONICS Builds a Clock Radio

. . . Knight-Kit "Ranger"

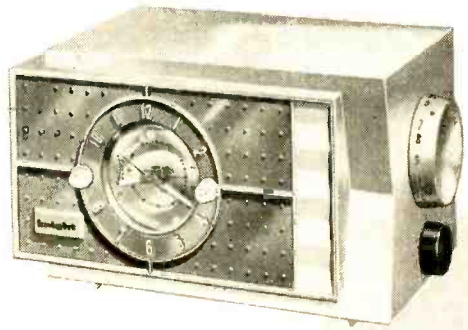
ONE of the finer quality clock-radio kits available, the Knight-Kit "Ranger" has an efficient superhet circuit which provides excellent reception of the entire broadcast band. In addition, the Telechron clock has a versatile sleep-switch timer plus an automatic wake-up alarm switch.

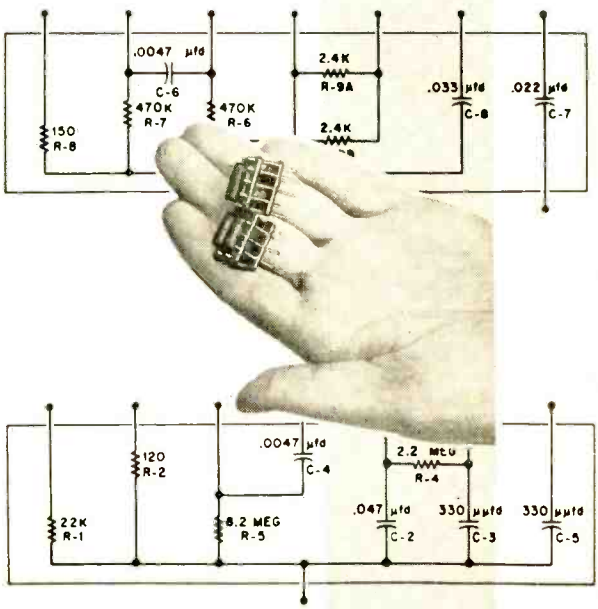
Besides providing listening pleasure and the correct time, here is what this clock radio can be set up to do for you:

- Shut off the radio automatically after any interval up to one hour, so you can drift off to dreamland with music.
- Turn on the radio in the cold light of dawn to provide wake-up music.
- For heavy sleepers, sound an alarm 10 minutes after wake-up music comes on.
- Turn on your electric coffee-maker at the same time you wake up to music.

Printed-Circuit Board. Assembly is simplified by the use of a printed-circuit board. There's no chance for error here, since the component identification markings are stenciled directly on the board. Two special ceramic modules which incorporate all the resistors and capacitors used by the receiver are soldered on the board.

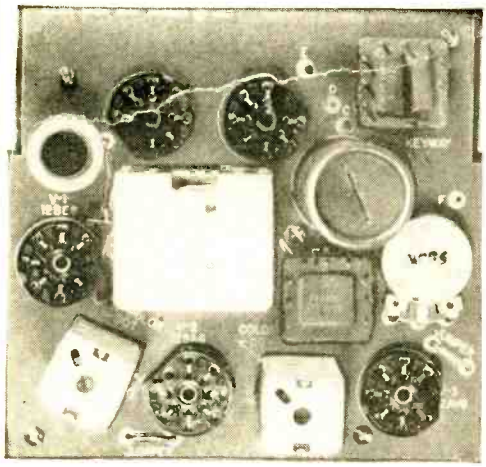
The Telechron clock and a.c. power circuits are wired as a unit. Then the clock power circuit and PM speaker are con-





TESTED By POPULAR ELECTRONICS

Assembly is simplified by a printed-circuit board and two ceramic modules. The modules contain nine resistors and seven capacitors as shown in the schematic diagrams above.



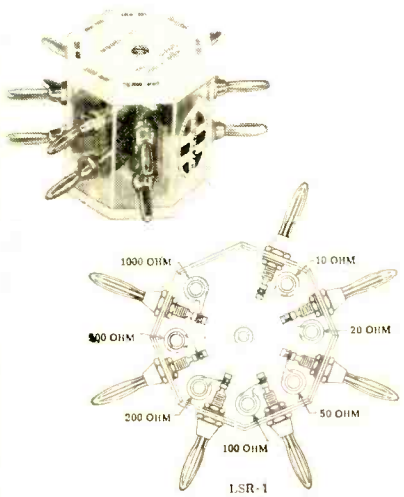
All parts of the "Ranger" except the Telechron clock and speaker are mounted and soldered on the printed-circuit board. Square cardboard sleeves are slipped over the i.f. transformers to reduce shock hazards.

nected to the printed-circuit board and the board is mounted in the plastic cabinet.

Alignment of the "Ranger" is no problem. When the set built by POPULAR ELECTRONICS was first turned on, it worked *without* alignment—all local stations came in clean and clear. But as a check of the Knight-Kit instructions, the set was purposely misaligned. Using the plastic alignment tool supplied with the kit, the clock radio was successfully retuned in a matter of minutes.

Comment. The expertly designed module components and printed-circuit board reduced assembly time to two hours. No special tools were used—only pliers, cutters, screwdriver and soldering iron. The clearly written, step-by-step instructions and giant-size diagrams helped in assembling the professional-looking clock radio. Anyone can build this kit—try it, it's fun. —30—

Plug-in Laboratory Standards

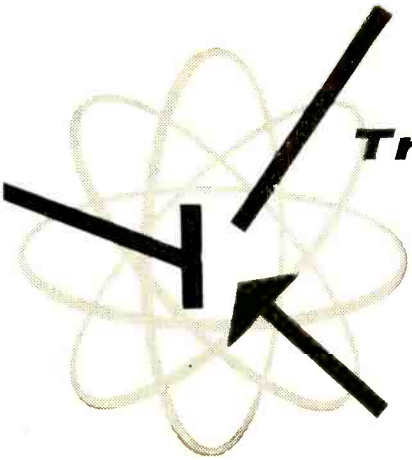


IN MANY stages of experimental circuit tinkering, the need arises for high-tolerance resistors and capacitors. The Heath Company now offers a resistance and capacitance plug-in laboratory standard in kit form. This kit consists of four separate units, each containing seven highly accurate precision standards. Banana pin connectors with standard ¾" spacing are used to enable the units to fit directly into most laboratory instruments.

These units are designed for calibrating or checking calibration of test equipment such as ohmmeters, capacity meters, impedance bridges, and other measurement equipment. They can also be used for determining circuit parameters, where precision components are necessary. —30—

UNIT	VALUES	TOLERANCE
LSR-1	10, 20, 50, 100, 200, 500 and 1000 ohm resistors	±0.5%
LSR-2	1000, 2000, 5000, 10,000, 20,000, 50,000 and 100,000 ohm resistors	±0.5%
LSC-1	100, 200, 500, 1000, 2000, 5000 and 10,000 μμfd. capacitors	±0.25%
LSC-2	.001, .002, .005, .01, .02*, .05* and 0.1* μfd. capacitors	±0.25% ±0.5%*

All resistors are 1 watt and all capacitors are 350 volts, d.c., maximum.



Transistor Topics

By LOU GARNER

ALTHOUGH not widely publicized, transistor applications in medical electronics are rapidly increasing in importance. The light weight and small size of the transistor make possible the design and manufacture of pocket-sized electronic stethoscopes, recorders, and similar gear needed for field tests and diagnosis. Its very low voltage and power requirements make possible the design of instruments which are safe to use in the explosive atmosphere of operating rooms, as well as shock-free equipment for use in close proximity to patients.

Since the transistor is basically a current amplifying device, it is ideally suited to the design of direct-current and low-frequency amplifier and measuring devices, thus simplifying the measurement of electrical signals produced by body muscles and organs. Most of these are very low frequency signals. The human pulse rate, for example, approaches *one cycle per second.*

But perhaps the most unusual use of transistors in medical research is in self-contained capsule-size radio transmitters. These can be passed through an animal's system, telemetering data on pressure, temperature and other internal conditions to the scientists, much like artificial earth satellites and moon probes telemeter data on the conditions in outer space—and all without injury to the subject.

Looking to the future, we can reasonably expect to see portable diathermy equipment, transistor-controlled servomechanisms for use in artificial limbs, and radically new types of diagnostic and treatment apparatus. The "telemetry capsule," for example, may one day be modified to act as a miniature drug carrier, holding a small

In-Circuit Tester. The first tester capable of checking the performance of a transistor while it is wired in a circuit is being produced by Philco for the Bureau of Ships. A commercial model should be available soon.

reservoir of a potent antibiotic or serum which can be released by remote control when the capsule reaches the proper point in the patient's body.

Readers' Circuits. It is no trick at all to pick up local broadcasts using a six-transistor factory-wired superhet. But to do the same job with a one- or two-transistor set—*that* requires ingenuity in design, skill in wiring, and patience in operation! The schematic diagrams of four simple one- and two-transistor receivers, submitted by as many readers, are given this month.

Optimum performance can be obtained from each of these receivers with a moderately long outside antenna. Standard crystal diodes (1N34A, 1N48, CK705, etc.), are used in all of them. Each circuit has some unique feature which distinguishes it from receiver circuitry of a completely conventional nature.

Figure 1 was submitted by reader John Dunn. This circuit employs a standard *loop antenna* (*L1*) instead of the more popular "loopstick." Two Burgess No. 7 penlight cells (*B1, B2*), controlled by a d.p.s.t. toggle or slide switch (*S1*), serve as the power supply.

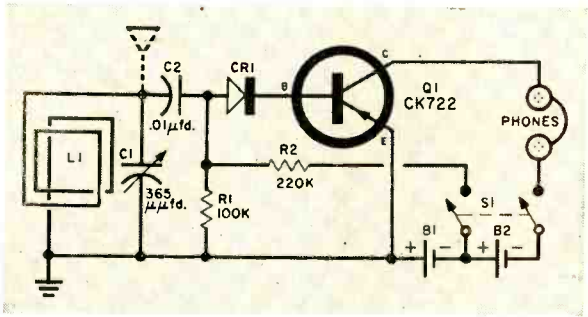


Fig. 1.

John indicates that he wired his receiver directly on the flat-fiber loop-antenna board. He suggests that any reader duplicating his project might do the same . . . or might assemble the circuit on a small chassis or Bakelite board. It may be worthwhile to experiment with the values of *R1* and *R2*, choosing the final ratio which gives best operation. Magnetic headphones (4000 to 8000 ohms) should be used, and best results are obtained with *both* an external antenna *and* ground.

In operation, signals picked up by the antenna-ground system are selected by tuned circuit *L1-C1* and coupled through blocking capacitor *C2* to diode detector *CR1*. Bias is provided by *B1* and voltage-divider *R1-R2*. The demodulated audio signal applied to the transistor is amplified and used to drive the magnetic headphones.

Figure 2 was turned in by Bob Marty, K4SLU (1660 Old Shell Rd. Mobile, Alabama). At first glance, the set seems to use "conventional" circuitry, but closer inspection shows that a two-stage direct-coupled complementary amplifier is employed, with the second stage serving as an emitter-follower.

Standard parts are used. *L1* is an adjustable transistor loopstick coil (Lafayette No. MS-299), and *C1* is a fixed ceramic or mica capacitor. The 3-volt power supply (*B1*) is made up of two penlight cells connected in series.

Wiring and parts layout are non-critical, and the receiver can be assembled on a small metal, fiber or plastic board. Use magnetic headphones with an impedance of from 1000 to 4000 ohms. The set is tuned by adjusting *L1*'s slug.

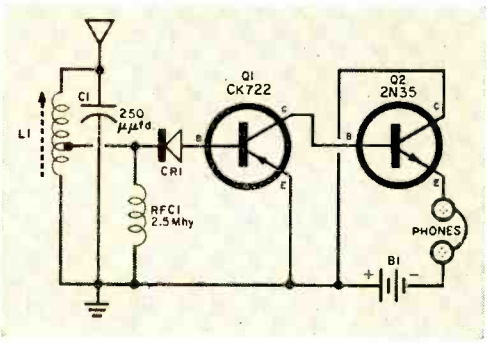


Fig. 2.

Figure 3 comes from Robert Bari (1580 President St., Brooklyn 13, N. Y.). This circuit has several interesting features: (1)

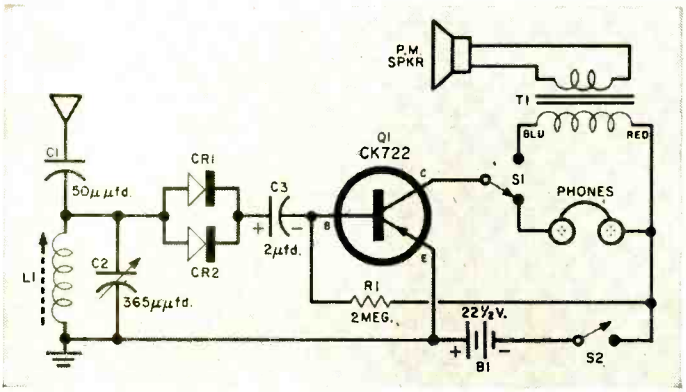


Fig. 3.

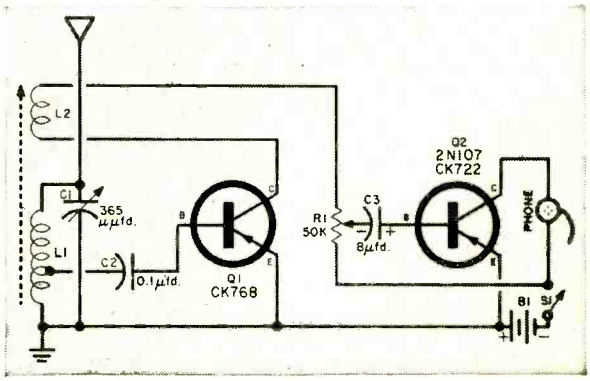


Fig. 4.

two diodes are used in parallel as a detector, (2) the circuit is wired for *both* earphone and loudspeaker operation, and (3) a moderately high operating voltage is used.

Capacitor *C3* is a 2.0-μfd., 25-volt electrolytic and *L1* is a standard ferrite loopstick. Two switches are used in this circuit . . . a s.p.s.t. *Power* switch *(S2)* and a s.p.d.t. *Speaker-'phones* switch *(S1)*. Headphones of 1000 to 8000 ohms impedance should be employed.

Robert used a "universal" vacuum-tube output transformer, connecting to the primary's *Blue* and *Brown* leads, but somewhat better results may be had with a standard transistor transformer, such as an Argonne AR-164. The PM loudspeaker should have a 4 to 8 ohm voice coil and may be any convenient size. In general, the larger the speaker, the more efficient, and the better the tone quality. Finally, the power supply battery is a 22½-volt B battery, such as a Burgess Type U15.

Figure 4 was submitted by reader Walter Thompson. According to its designer, this circuit can be assembled in about an hour. It differs from the first three discussed in that a regenerative feedback arrangement is used for increased sensitivity and gain.

Referring to the diagram, *L1* is an adjustable transistor loopstick antenna coil, *C2* a 0.1-μfd. ceramic or paper capacitor and *C3* a 6-8 μfd., 15-volt electrolytic. *L2* consists of 8 turns of #28 enameled copper wire, scramble-wound on *L1*. *Gain* control *R1* is a standard 50,000-ohm carbon potentiometer. The power supply battery may be from 3.0 to 9.0 volts, and is made up by connecting penlight cells in series. Best results are obtained with 1000 to 4000 ohm magnetic earphones.

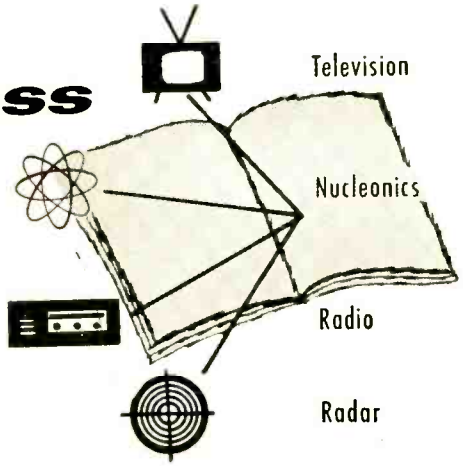
If you decide to assemble Walter's receiver, you may want to make one experimental change to insure best performance. Connect a moderate-length external antenna and good earth "ground," and turn the *Gain* control *(R1)* full up. Next, gradually adjust *C1* to tune through the broadcast band, listening for a fairly weak station. With a weak station tuned in, try *reversing* the connections to feedback coil *L2*. Use the connections which provide maximum sensitivity.

In-Circuit Tester. Theoretically, transistors have an almost infinite service life. It is not surprising, then, that manufacturers of military and industrial gear as well as home entertainment devices will often solder transistor connections permanently in place.

Unfortunately, this theory doesn't always work out in practice. A transistor may fail if abused electrically (operated too close to

(*Continued on page* 142)

After Class



WHAT IS A SERVOMECHANISM?

By HARVEY POLLACK

BEFORE the age of electronics, machinery was controlled directly by the hands of the operator—hands which would shift a gear, pull a lever, or apply a brake. Today's machinery is controlled by the push of a button or the twist of a knob, and many measurements and decisions are made automatically by electronic circuits. Wherever electronics and machinery work together we are apt to find some kind of servomechanism in operation.

An automobile driver is the human counterpart of a servomechanism—he watches and controls a machine. As he steers his car along a winding highway, he constantly makes small corrections on his steering wheel to keep the car on the road. His eyes measure distances, his brain makes simple decisions, and his arm muscles exert corrective pressures on the steering wheel. A servomechanism performs the same function, but it is faster, more sensitive, does not make mistakes in judgment, and operates continuously.

The definition of a servomechanism recommended by the Feedback Control Committee of the American Institute of Electrical Engineers is: "A feedback control system in which the controlled variable is mechanical position." Let's examine, in practical terms, what that means.

The ABC's of Servos. Consider our automobile driver again. From his reactions we can determine the requirements of a machine that could capably replace him.

Before the start of the drive, he accepts the fact that the road divider must always remain from six to fifteen inches from his

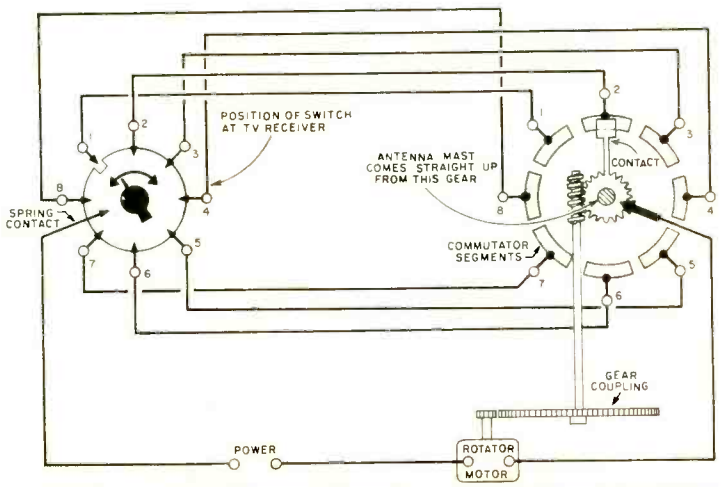


Fig. 1. Example of an "open-loop" type servomechanism. It serves practically as an antenna rotating mechanism for TV installations. "Open loop" refers to the need for a human control element in the servomechanism system.

front left wheel if he is to navigate the highway turns and straightaways safely. During the trip, he must be aware of the separation that actually exists during every instant of time. Then he must compare the actual separation between his wheels and the white line with the desired separation that was initially stipulated. This might be called the *error* in the car's path at that instant. Once the error is determined, he must then dictate a corrective order to his arm muscles so that they can apply a force in the proper direction to eliminate the error.

If we now analyze these steps, we can state the ABC's of servos. A servo must: (A) Accept instructions that tell it what should be done; (B) Be aware of the actual conditions that exist at every instant; (C) Compare what is being done with what should be done; (D) Dictate orders that will correct the error noted by this comparison; and (E) Energize some mechanism that can follow these orders.

Open-Loop System. Consider the antenna rotator servo shown in Fig. 1. This is referred to as an "open-loop" servo system because a human operator is required as one of the links in the ABC chain. The knob at the TV set is secured to a disc in contact with all the contact points save the one that happens to be in line with the notch cut in the disc. A permanent spring contact is made to the disc as shown.

Suppose the TV viewer decides that he would like to rotate his antenna from position 2 to position 1. He turns the knob to position 1, bringing the notch in line with contact point 1 at the same time; but when he does this, contact point 2 touches the disc and feeds electrical energy to the motor through commutator segment 2. Each time the commutator arrives at a new segment, the power flows uninterruptedly to the motor until it reaches segment 1, when the circuit is again opened and the motor stops, leaving the mast in the desired position.

Note that the human operator must *dictate* the necessary instructions to the servo by rotating the positional switch to the desired setting. In a "closed-loop" system, a human operator is totally unnecessary.

Closed-Loop System. Imagine that the course of a ship is to be due west and that its gyro-compass has been set for this direction. Along comes a gust of wind or an ocean current that tends to swing the prow of the ship to the north. The gyro-compass, of course, continues to point to the west as the boat turns under it, thereby producing an error angle between itself and the boat's axis.

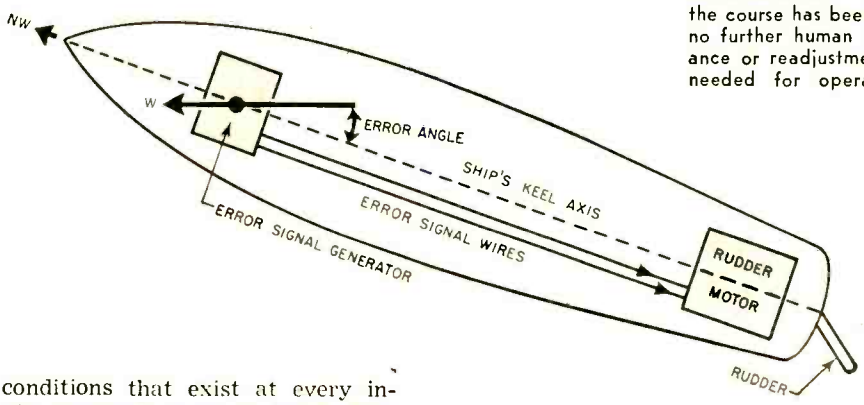


Fig. 2. A course control system as used in ocean-going vessels is a typical application of a "closed-loop" type of servomechanism. Once the course has been set, no further human guidance or readjustment is needed for operation.

If the compass is coupled to an electrical generator of a suitable type which can feed an error signal proportional to the error angle to a rudder motor at the stern, then the rudder will swing over to an extent that will just correct the deviation from the proper course.

The error angle represents the comparison between what is actually being done and what *should* be done. Corrective orders

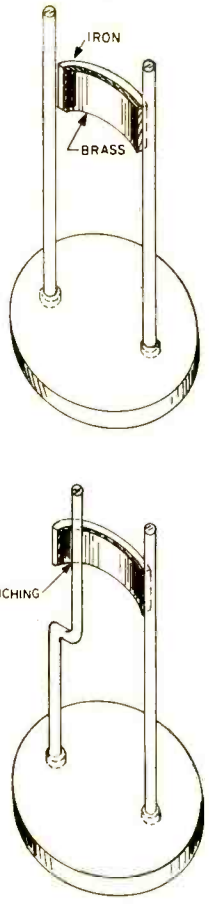


Fig. 3. Modification required to convert a fluorescent lamp starter into a sensing element of a thermostatic control circuit. "Before" view (top) shows internal assembly of starter after protective glass is broken. "After" view illustrates modification made to the contact to enable use of the starter as a thermostatic switch.

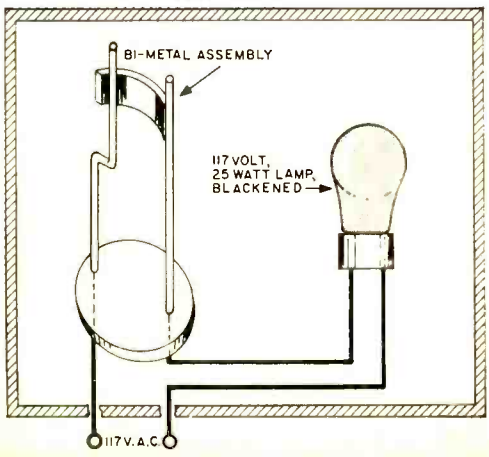


Fig. 4. Wiring and installation of modified bi-metallic element in a homemade experimental thermostatically controlled incubator or crystal (oscillator) oven.

are dictated by means of an electrical signal that varies with the amount and direction of the error; this order signal then energizes a rudder control motor which makes the necessary correction in course.

Thermostat Control. When you set the thermostat of your oil-burner, you have issued instructions that it keep the house at, say, 70°F. The bi-metallic strip inside the thermostat retains "awareness" of existing temperatures by bending toward an electrical contact as the house cools. When the contacts finally close as the temperature goes below 70°F, the thermostat issues a corrective signal in the form of a current to the relay of the oil burner.

If you would like to experiment with thermostatic control to get the "feel" of the ABC's of servos, you can pick up an old fluorescent starter and use it as the base for a thermostatically controlled chick incubator or a transmitter crystal oven. Pry up the four sheet-metal fingers that secure the disc base to the metal casing and lift out the whole inside structure. If a capacitor is present (some starters omit the capacitor), clip it out by cutting its leads close to the disc base.

Wrap a single layer of cloth around the glass tube, place it between the jaws of your vise, and apply pressure gradually until the glass just cracks. Be careful not to damage the bi-metallic assembly that is now exposed. The concave portion of the curved strip is brass and the convex section iron. Since brass has a higher coefficient of linear expansion than iron, this bar will tend to *straighten* when heated, i.e., it is normally off and makes contact when its temperature rises.

To reverse this action, bend the free vertical bar as shown in Fig. 3 so that the inner brass face of the strip barely touches the bent bar at room temperature. The temperature at which contact will be broken will then depend upon the extent to which the strip presses on the vertical bar. This can easily be adjusted experimentally by further bending either to the right or left.

An incubator or oven thermostat may be set up easily using the circuit of Fig. 4. The "heater" is a 25-watt incandescent lamp blackened with candle-black or sprayed lightly with flat black lacquer. The enclosure in which it is placed should be fairly well insulated so that it retains its heat.

—30—

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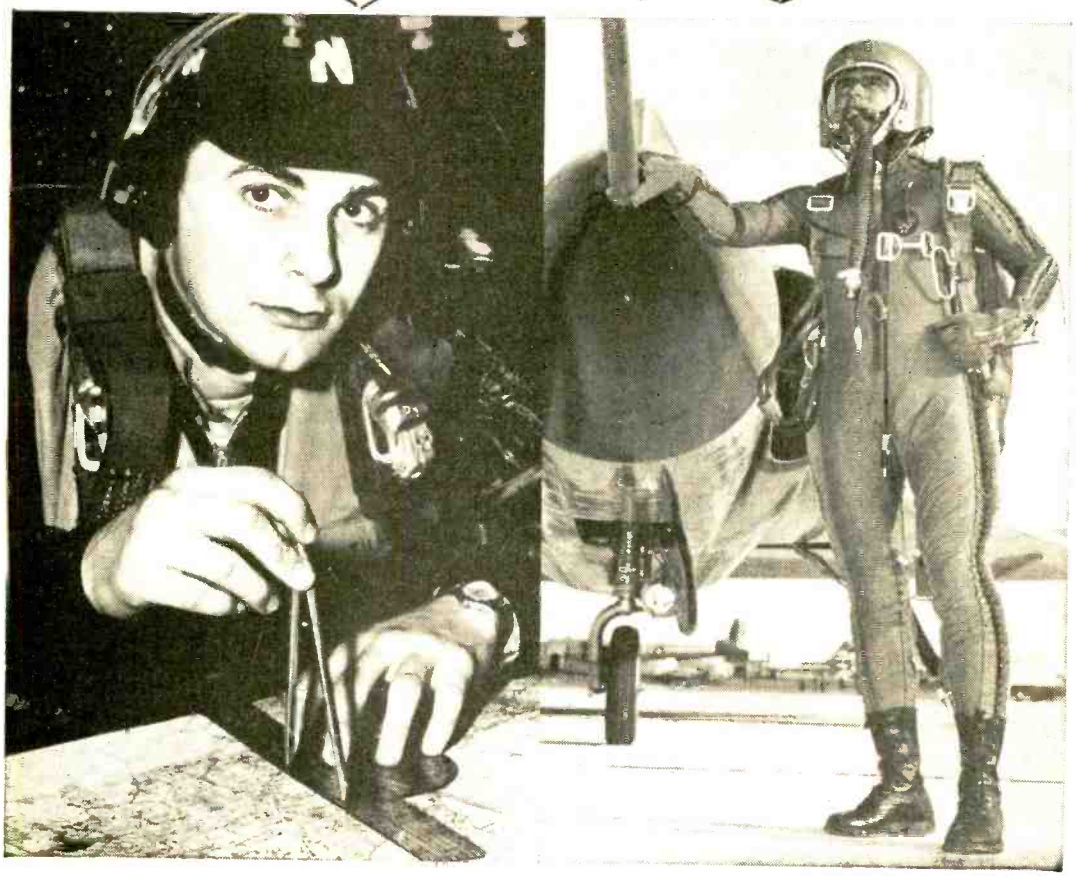

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THE WEATHER was more like late June than early April, and even energy-conserving Jerry was under the exciting spell of the rising sap. He and the dog, Bosco, were romping gaily about the back yard; but he stopped in surprise as his friend, Carl, came slowly around the corner of the house. When bouncy, athletic Carl moved slowly, something was wrong.

"What's bugging you, Mopey?" Jerry demanded.

"Aw, I've just come from Grubers next door, and I'm worried about Mr. Gruber."

"What's wrong?" Jerry asked quickly. The elderly man with the youthful outlook was a great favorite of both boys.

"It's hard to believe, but he's lost interest in things. Mrs. Gruber tells me it all started last summer when that rocket launching stage went into orbit and was visible here for a few nights. Mr. Gruber tried to spot it but couldn't. Actually that's no wonder, for it was darned hard to see. As you remember, it turned end over end so that reflected light from it brightened and dimmed, leaving it visible only part of the time; and it took only about twenty minutes to go from horizon to horizon. You had to be looking at precisely the right point in the sky at the right time to see it at all. But Mr. Gruber is convinced that his failure to see it means his eyesight is failing and that he won't be able to follow the other thrilling events in the launching of the Age of Space Travel which interests him so deeply."

"You mean he's quit reading his science-fiction magazines, collecting stories about flying saucers, and writing peppery letters to Cape Canaveral?"

"Yep. Doesn't sound much like the lively old gentleman who told us that there are only two ways to live: either as though you're going to die tomorrow or live forever; and he chose the latter. Does it?"

"No," declared Jerry, "and this is serious.

(*Continued on page* 130)

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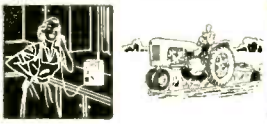

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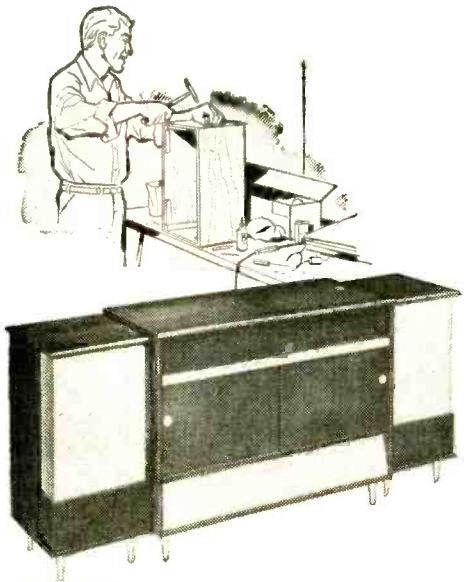

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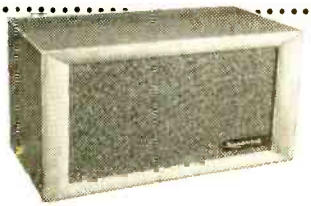

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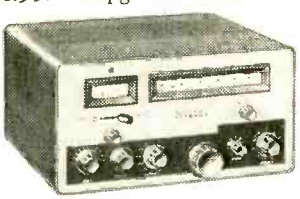

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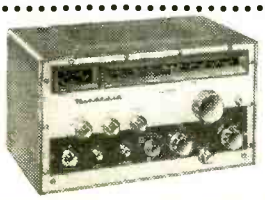

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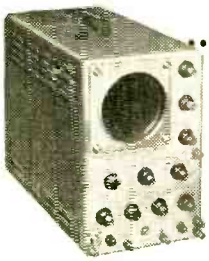

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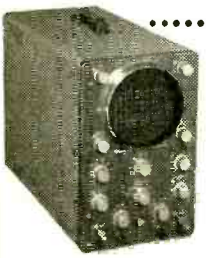

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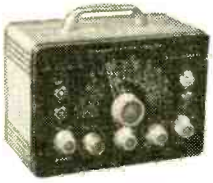

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This high quality auxiliary speaker offers many possibilities in audio, radio and TV work and will handle up to 12 watts with a frequency response from 50 to 9,000 CPS ±5 db. Speaker impedance is 8 ohms and employs a 6.8 ounce magnet. Shpg. Wt. 7 lbs.

HEATHKIT BR-2
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(less cabinet)

BROADCAST BAND RADIO KIT

Fun to build, and a fine receiver for your home. Covers complete broadcast band from 550 to 1600 kc. Built-in 5½" PM speaker and rod-type antenna. Transformer operated power supply. Excellent sensitivity and selectivity. Shpg. Wt. 10 lbs.

Cabinet optional extra: No. 91-9A. Shpg. Wt. 5 lbs. $4.95.

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MICROPHONE ACCESSORY KIT

Useful in countless applications, this kit consists of a rugged high fidelity crystal mike and three holders; a mike stand adapter, a lavalier neckband and desk stand. An 8' cable with phone plug is included. Shpg. Wt. 1 lb.

check engine RPM

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Easy-to-build and simple to install. Operates directly from the spark impulse of any 2 or 4 cycle engine with any number of cylinders. Operates on 6, 8, 12, 24 or 32 volt DC systems and is completely transistorized. The easy-to-read indicator shows RPM from 500 to 6,000. A calibration control is also provided. Shpg. Wt. 4 lbs.

Fun for the whole family

HEATHKIT XR-1P
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6 TRANSISTOR PORTABLE RADIO KIT

This easy-to-build portable radio offers fun and enjoyment for the whole family. Features 6 transistors, large 4" x 6" PM speaker for "big-set" tone quality, and built-in rod-type antenna. Uses standard size "D" flashlight cells for extremely long battery life (between 500 and 1,000 hours). The modern molded plastic case with pull-out carrying handle is two-tone blue with gold inlay and measures 9" L. x 7" H. x 3¾" D. Shpg. Wt. 6 lbs.

Tune-up your own Engine

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HEATHKIT IA-1 **$59.95**

Let your boy learn radio

HEATHKIT CR-1 **$7.95**

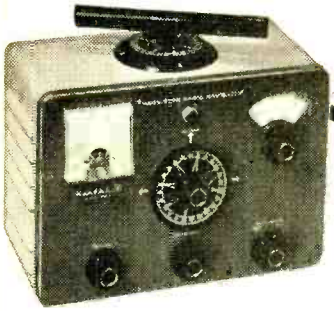
CRYSTAL RADIO KIT

Any youngster interested in radio or electronics will enjoy building and using this fine little crystal receiver. Frequency coverage is from 540 to 1600 kc. A sealed germanium diode is used for detection —no critical "cats whisker" adjustment. Headphones included. Measures 6" L. x 3" W. x 2⅛" D. Shpg. Wt. 3 lbs.

HEATHKIT TK-1
$9.95

COMPLETE TOOL SET

This handy tool kit provides all the basic tools required for building any Heathkit. Includes pliers, diagonal sidecutters, screwdrivers, and soldering iron with holder. Pliers and sidecutters are equipped with insulated rubber handles that provide protection from electrical shock. All of the tools are of top quality case hardened steel for rugged duty and long life. Shpg. Wt. 3 lbs.



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Economically powered by 6 standard flashlight cells, the DF-2 provides you with a completely portable 6-transistor standard and beacon band receiver of unusual quality and performance. Covers the beacon band from 200 to 400 kc and broadcast band from 540 to 1620 kc. A tuning dial light is provided for night operation. Large 4" x 6" speaker provides superb tone reproduction. Shpg. Wt. 9 lbs.

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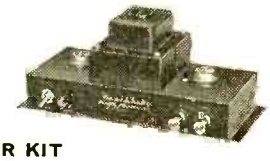

12 VOLT POWER CONVERTER KIT

Household electricity right on your boat or in your automobile is yours with this 12-volt power converter kit. Operate your TV set, radio, electric razor, lights, etc., directly from your 12-volt boat or car battery. Power rating is 125 watts continuously and 175 to 200 watts intermittently. Note: not recommended for record players, tape decks, power tools or radio transmitters. Shpg. Wt. 8 lbs.

HEATHKIT MC-1
$39.95

MARINE CONVERTER KIT

Charge your 6 or 12 volt batteries at dockside even while your boat's electrical system is in use. Provides up to 20 amperes continuously for charging 6-volt batteries or 10 amperes continuously for charging 12-volt batteries, regardless of type. Charging current is continuously monitored by a 25 ampere meter. Shpg. Wt. 16 lbs.

MARINE BATTERY CHARGE INDICATOR KIT

See at a glance the exact percentage of charge in your boat batteries. Checks from 1 to 8 storage batteries instantly. Operates on 6, 8, 12 or 32 volt systems. Note: for mounting on non-ferrous metals or wood only. Shpg. Wt. 3 lbs.

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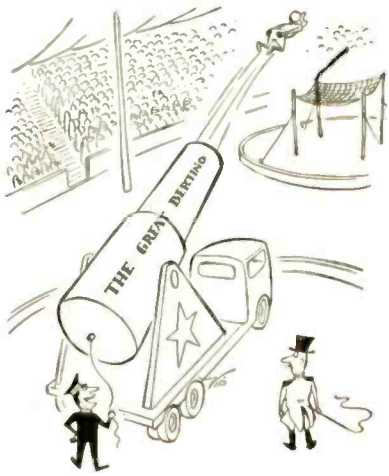

"Of *course* there's no smoke . . . I fired him off with a *JENSEN NEEDLE!*"

Carl & Jerry

(*Continued from page* 122)

Mr. Gruber has always had such a wonderful outlook on life. At his age many people turn away from the world about them and live in the past—and then complain that the world is neglecting *them;* but Mr. Gruber is better informed about the present and the future than nine people out of ten of any age. We've got to help our friend."

"Any ideas?" Carl wanted to know.

"Well, since failing to see the rocket threw him into this mental tailspin, maybe seeing one will bring him out of it."

"You mean—"

"Right. Let's fix up one he *can see.*"

"Okay, but it's got to look pretty authentic. He's a sharp old character and not easy to fool. I suggest we make it look as nearly like that thing he missed seeing as we possibly can."

"Check. Let's see now. If we string a wire from the peak of my house across to that big elm tree, it would just about follow the northwest-to-southeast path of the rocket stage as seen from Grubers' back yard, wouldn't it?"

"Right, but what are we going to use for a rocket?" Carl asked.

"All we need is a little light that waxes and wanes at the rate of the light from the orbiting stage. As I recall, that was about six complete cycles a minute, which happens to be the revolutions per minute we get when we power one of our tiny fractional horsepower motors with a couple of flashlight cells and run it through the speed-reducing gear train. We'll drive a low-ohmage, rotating, variable resistor with the gear train and insert this resistor in series with the two flashlight cells and a six-volt radio pilot lamp.

"We'll probably have to put some fixed resistance in series, besides," Jerry continued, "so that the maximum brilliance of the pilot lamp at the distance Mr. Gruber will be seeing it will be that of a fairly bright star. The rotating variable resistor will keep the lamp brightening and dimming. We'll put this stuff in a plastic bottle; and you, from a position up in the tree, can pull it along the wire at the proper slow rate by means of an endless loop of string running over a pulley up on my roof."

"What will you be doing?"

"I'll get Mr. Gruber out in his back yard and have him looking in the right direction

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1B3GT	3BC5	5Y2GT	6BH8	6SC7	7J7	12SK7	35C5
1C5GT	3BE6	5Y4G	6BJ6	6SF5	7K7	12SN7GT	35L6GT
1C6	3BN6	5Z3	6BK5	6SF7&5GT	7L7	12SQ7	35W4
1C7	3BU8	5Z4	6BK7	6SH7	7N7	12SR7	35Y4
1H4G	3BY6	6A8	6BL7GT	6SJ7	7Q7	12V6GT	35Z4GT
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1LC6	3Q4	6AH6	6BZ6	6T8	7Y4	14F7	#45
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1Q5GT	48Q7A	6AM8	6CB6	6V6GT	12AQ5	14S7	50C6G
1R5	4B58	6AN8	6CD6G	6W4GT	12AT6	17AX4GT	50L6GT
1S5	4BU8	6AQ5	6CF6	6W6GT	12AT7	17DQ6	50Y6
1T4	4BZ7	6AQ6	6CG7	6X4	12AU6	19AU4	50Y7
1T5GT	4CB6	6AQ7GT	6CG8	6X5GT	12AU7	19BG6G	#57
1U4	5AM8	6AR5	6CH8	6X8	12AV6	19C8	#58
1U5	5AN8	6AS5	6CL6	6Y6G	12AV7	19J6	#80
1V	5AQ5	6AS8	6CM6	7A4	12AX4GT	19T8	#81
1V2	5AS8	6AT6	6CM7	7A5	12AX7	19X8	117L7GT
1X2	5AT8	6AU4GT	6CN7	7A6	12AZ7	25AC5	117N7GT
2A3	5AV8	6AU5GT	6CU6	7A7	12B4	25AV5GT	117P7GT
2A5	5AW4	6AU6	6DG6	7A8	12BA6	25AX4GT	117Z3
2A7	5AZ4	6AU8	6DQ6	7B4	12BE6	25B5	117Z4GT
2AF4A	5BK7	6AV5GT	6DT6	7B5	12BF6	25B6	117Z6GT
2B7	5BR8	6AV6	6E5	7B6	12BH7	25CD6G	807
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2D21	5BZ7	6AX4GT	6J4	7B8	12BQ6	25L6GT	9003
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2X2A	5J6	6AZ8	6J6	7C5	12CA5	25Z5	
3A2	5T8	6BA6	6K6GT	7C6	12CU6	25Z6	
3A3	5U8	6BC5	6K7	7C7	12DQ6	#27	
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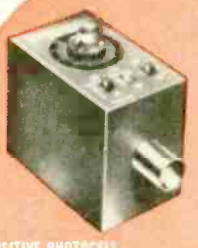

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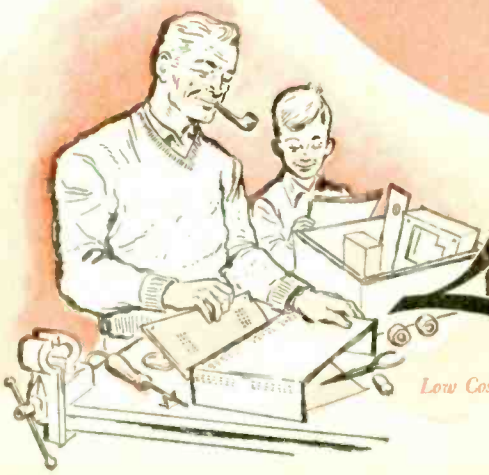

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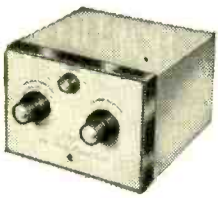

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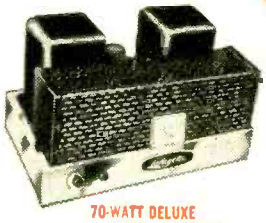

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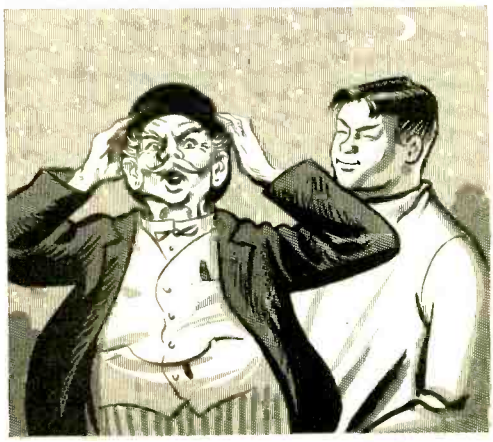
on the pretext of asking him something about the stars."

"Well, let's get going. I can't stand thinking about Mr. Gruber just sitting over there brooding."

RIGGING UP the "rocket" didn't take the boys long. Neither did stringing the thin copper-clad steel wire to serve as a trolley for the rocket. Since Carl and Jerry were constantly putting up and taking down all sorts of experimental transmitting and receiving antennas, stretching the wire



. . . "It must have just gone into orbit" . . .

and the accompanying loop of string attracted no neighborhood attention.

The unseasonal warmth of the April day carried over into the evening; so when the boys finally decided it was dark enough for their rocket launching and stepped outside, the night was warm and thousands of stars were twinkling overhead.

"You go shinny up that tree and get all set," Jerry said to Carl. "When I see the little light start to blink, I'll know you're ready and I'll get Mr. Gruber."

"Aye, aye, sir; you can start the countdown now, sir," Carl answered.

It was only a few minutes until Jerry saw a slow pulsing of the tiny light high up in the branches of the tree, and he started for the back door of the Gruber house. Just as he reached it, the door opened and Mr. Gruber came out.

"Well, hi there, Mr. Gruber," Jerry said. "You're just the man I wanted to see."

"Is that right, Jerry?" Mr. Gruber replied as he sat down heavily on the back step. "What was on your mind?"

"I've become interested in the stars lately, and I wondered if you would help me spot some of the constellations I've been reading about. I get confused when I try to pick anything out of that twinkling mess."

"I don't know, Jerry; I don't know," Mr. Gruber said sadly, shaking his head. "I'd like to help you, but I'm afraid you asked me too late. My eyes are failing mighty fast."

"I'm sorry to hear that," Jerry said with brusque cheerfulness; "but maybe you can help me a little. For example, where is Ursus Major, or the Great Bear?"

"Blind as I am I can see that one," Mr. Gruber declared in a tone that sounded a bit more like his old self. "That's it right up there. Most people call it the Big Dipper because it looks like a dipper. Can you make it out?"

"Yeah!" Jerry said, "I sure can. My book says the two stars forming the side of the dipper farthest from the handle are pointer

. . . "All at once I saw the biggest owl" . . .

stars to help locate the North Star. Is that right?"

"Look for yourself. Sight right along a line passing through those two stars. See; the North Star is almost exactly in line. It's not too bright, but you can't miss it because no other bright star is near it. But here's something else about the Great Bear that you may not have read in your books. Take a sharp look at the star in the handle, right where the handle bends. The name of that star is Mizar.

"Now if you'll look closely and if your eyesight is good," Mr. Gruber went on, "you'll see another faint star very near

Mizar. That's Alcor. Some say the Arabs used Alcor as a test of eyesight. If you could see it, your eyesight was good enough to permit you to be in the Bedouin cavalry. Hm-m-m—" Mr. Gruber's voice trailed off.

"What's the matter?" Jerry asked innocently.

"Don't you think it's a mite early for lightning bugs?" Mr. Gruber asked.

"Much too early," Jerry agreed. "We don't see them until June."

"Well," Mr. Gruber said, trying to keep a note of rising happy excitement out of his voice, "take a look right up there by Mizar and tell me if you see anything funny."

Jerry squinted his eyes obediently and stared up at the Big Dipper. "No, I don't see a thing—hey, wait a minute. I *do* see something. It looks like a moving star that keeps brightening up and fading out. It can't be a plane. They don't blink that slowly. Sure looks funny. I never saw anything like that before."

"Are you *sure?*" Mr. Gruber said, gripping Jerry's shoulder in his excitement. "Think hard. You saw that rocket launching stage in orbit last summer. Did it look like that?"

"It sure did!" Jerry exclaimed. "That's exactly how it looked."

"Yippee!" Mr. Gruber shouted as he pulled his derby hat far down on his head and capered wildly about the yard. "It must have just gone into orbit, and we're the first to spot it. Get on the phone, boy! Call Washington! Call Cape Canaveral! I'll stay here and track it."

"Now wait a minute," Jerry started to say; but he was interrupted by a screeching scream of terror and pain from the direction of the elm tree. At the same moment the "rocket," now directly overhead, plummeted down and hit Mr. Gruber's derby with a resounding thump.

Before Jerry could find out if the old gentleman was injured, he saw a shadow half climb and half fall out of the tree; and Carl came running toward them.

"What on earth happened?" Jerry asked.

"*That's* what happened," Carl said dramatically as he directed the beam of a flashlight at a couple of deep scratches in his forearm. "I was sitting up there minding my own business when all at once I saw the biggest owl in the world flying straight at me. I threw up my arm just in time to keep him from sinking his claws directly into my face. He must have seen my eyes

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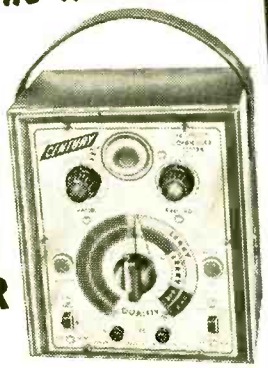
an IN-CIRCUIT CONDENSER TESTER *THAT DOES THE WHOLE JOB!*

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



IN-CIRCUIT CONDENSER TESTER Model CT-1

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

in-circuit checks:

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

out-of-circuit checks:

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

OUTSTANDING FEATURES

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

Check all power rectifiers in-circuit whether SELENIUM, GERMANIUM, SILICON, etc. with the

IN-CIRCUIT RECTIFIER TESTER Model SRT-1

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

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

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

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

OUTSTANDING FEATURES

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

SIMPLE TO OPERATE

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

ALL CENTURY INSTRUMENTS ARE GUARANTEED FOR ONE FULL YEAR

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

TRANSISTOR TESTER Model TT-2

Every day more and more manufacturers are using transistors in home portable and car radios . . . in hearing aids, intercoms, amplifiers, industrial devices, etc. Since transistors go bad the need for TRANSISTOR TESTER is great. They can develop excessive leakage, poor gain, shorts or opens.

The TT-2 is an inexpensive quality instrument designed for accurate and dependable tests of all transistors and diodes — quickly and accurately.

OUTSTANDING FEATURES

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

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

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

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see order form on facing page

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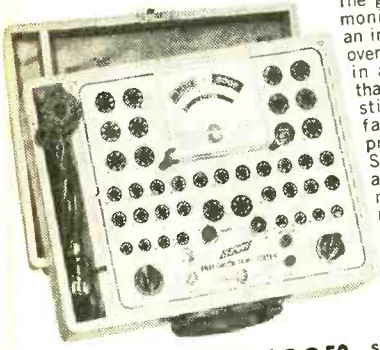
FAST-CHECK TUBE TESTER

Model FC-2



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

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

SIZE: W: 14⅝" H: 11¼" D: 4⅜"

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

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

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

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

RANGE OF OPERATION

- ✓ Checks quality of over 700 tube types, employing the time proven dynamic cathode emission test. This covers more than 98% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes. 0Z4s, magic eye tubes, gas regulators, special purpose hi-fi tubes and even foreign tubes.
- ✓ Checks for inter-element shorts and leakage.
- ✓ Checks for gas content.
- ✓ Checks for life-expectancy.

IMPORTANT FEATURES

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

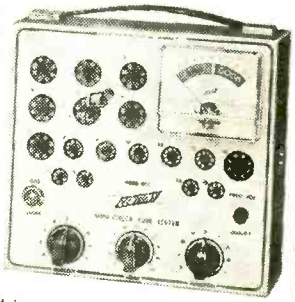
NOTE: The Fast-Check positively cannot become obsolete . . . circuitry is engineered to accommodate all future tube types as they come out. New tube listings are furnished periodically at no cost.

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

MINI-CHECK TUBE TESTER

Model MC-1

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



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

SIZE: W: 9" H: 8½" D: 2¾"

OUTSTANDING FEATURES

• Checks emission, inter-element shorts and leakage of over 600 tube types. This covers 0Z4s, series-string TV tubes, gas regulators, auto 12 plate volt, hi-fi and foreign tubes • 3 settings enable a test of any tube in less than 10 seconds • Employs dynamic cathode emission test principle • 3½" D'Arsonval type meter — most accurate type available . . . its greater sensitivity means more accuracy . . . its jewel bearing means longer life • 17 long lasting phosphor bronze tube sockets • Combination gas and short jewel indicator • 9 filament positions • Handy tube chart contained in special back compartment • New tube listings furnished periodically at no cost • Detachable line cord

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

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

CONVENIENT TIME PAYMENT PLAN — NO INTEREST OR FINANCING CHARGES

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CHECK INSTRUMENTS DESIRED

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

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

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

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shining and thought I was some sort of goody. I don't know who was scared the most, but while I was threshing around up there trying to turn him loose, I must have unfastened the wire from around the trunk of the tree."

"Aha! So you young rascals were trying to fool a poor blind old man, were you?" Mr. Gruber said with a chuckle as he looked down at the still-blinking little bulb in the plastic bottle he held in his hand. "You ought to be ashamed of yourselves."

"Yeah, I guess we should," Jerry agreed; "but honestly, Mr. Gruber, we weren't just trying to fool you for the fun of it. We hoped that if you saw what you thought was a rocket you'd quit worrying about your eyesight and be the same cheerful, helpful pal to us you've always been. It seemed like a good idea at the time, but it seems a lot different right now. Will you forgive us?"

"Forgive you!" Mr. Gruber exclaimed. "I think that's the nicest thing anyone ever tried to do for me. I'm the one who should be ashamed, and I am. I've been a thoughtless old fool, wallowing in self-pity and bringing worry and concern to my friends."

"Then you'll quit worrying about your eyesight?" Carl asked hopefully.

"I sure will and for good reason. Jerry, do you remember when I was telling you how Alcor was a test of eyesight?"

"Yes."

"Well, all at once I realized I was seeing it! I didn't see it as well as I did when I was a boy, mind you; but I could still make it out. I made the happy discovery just before I spotted this orbiting rocket. Would either of you boys like to shake the hand of the first human being ever struck by a rocket that had been in orbit and who still lived to tell the tale?"

AS THE BOYS shook his hand in mock deference, Mr. Gruber came up with a final suggestion:

"Hey, guys, what say we raid the refrigerator for some cokes and fried chicken Martha has stashed away in there? Then I wish you'd look over some plans for assembling a space station I've worked out. I've got to get busy and make up the time I've lost these last few months!"

"Just lead the way!" Carl and Jerry chorused happily. —30—

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SAVINGS FROM $3 TO $35 AND MORE! 88¢ EACH!

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

40-RECORD CADDY
Wrought iron. Holds 40 records & albums. 2 lbs. Reg. $2.95. **88¢**

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Mica-filled. For transistors, too. **88¢**

40 SUB-MINI C'ND'S'RS
For transistor, printed circuit work. 1 lb. Reg. $7. **88¢**

8-SCREWDRIVER SET
8 asstd. drivers with wall rack. Plastic handles. 1 lb. List $3.50. **88¢**

60 PLUGnRECEPT'CLES
Audio, power, line, battery, spkr. 3 lbs. Reg. $7. **88¢**

$2S SURPRISE PACK
Large, varied assortment radio, TV parts. 3 lbs. **88¢**

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

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

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

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

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

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

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

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

8 GERMANIUM DIODES
Glass sealed, w/long leads. For all hobby projects. **88¢**

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Wafer-thin; to .01 mf. Reg. $5. **88¢**

40 PRECISION RESISTORS
1%, ½ & 1 W; carbolov & WW. 100 ohms to 1 meg. Reg. $17. **88¢**

10 POLY BOXES
Clear plastic, hinged, w/snap locks. Asstd. sizes. 1 lb. **88¢**

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4 to 9-pin; ceramic, mica, shield-based incl. 2 lbs. Reg. $10. **88¢**

100 CERAMIC CONDENSERS
Hi-Q discs, tubulars; to .01 mf. 2 lbs. Reg. $12. **88¢**

"1-POUNDER" HAMMER
Claw; 16-oz. steel, w/14" formed handle. Reg. $2.50. **88¢**

16-END WRENCH SET
For home and auto. Box and open; 15/64 thru 7/16" 16 sizes. Reg. $2.50. **88¢**

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Pop. flashlite size; miniature bay. type. Reg. $9. 1 lb. **88¢**

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

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

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Wide variety resistors, condensers, pots, forms. 3 lbs. **88¢**

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10 x 12" stainless steel. 2 lbs. Reg. $4. **88¢**

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

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Carbon, IRC. Ohmite; 1%, too! ½ & 1 W, 10 ohms to 10 megs. 2 lbs. Reg. $13. **88¢**

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Crystal, w/cord set & plug. Reg. $5. **88¢**

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Crystal. 100 to 8,000 cps. 1 lb. Reg. $7. **88¢**

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

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Hi-Q steel. ⅜, ½, ¾, 1" 5" long. Reg. $3. **88¢**

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100% pure bristle; sizes 1-6. Reg. $2.50. **88¢**

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1/16" thru ¼" by 64ths. w/calibrated case. Reg. $3. **88¢**

7S RESISTOR SPECIAL!
WW, precision, carbon, variable, minitypes. 3 lbs Worth $15. **88¢**

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

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Nuts, screws, washers, etc. 1½ lbs. Reg. $6. **88¢**

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Six assorted blades. 1 lb. **88¢**

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

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IF, RF, ant., slug-tuned, too. 3 lbs. Reg. $15. **88¢**

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

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

30 MOLDED COND'S'RS
Asstd. Finest made! Wt. 2 lbs. **88¢**

1S ROTARY SWITCHES
Asstd. gangs. 3 lbs. Reg. $12. **88¢**

S-IN-1 DRILL BIT
Reams, saws, copes, shapes, drills. Hand or power drill. **88¢**

1S INSTR. KNOBS
Knurled black bakelite, w/pointer; brass inserts, set-screws. Reg. $5. **88¢**

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¼" long. 20 values; 1/5W to 10 megs. Reg. $6. **88¢**

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For radios, code osc., intercoms. 2 lbs. Reg. $5. **88¢**

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Mechanisms; precision geared. 2 lbs. Reg. $30. **88¢**

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Used in many pop. make radios. Worth $5. **88¢**

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Popular make! Dozens of hobby uses. $5 value. **88¢**

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Adj. 540-1500 kcs. Transistor radios, etc. 1 lb. **88¢**

RADIATION DETECTOR
World's smallest. 100's of Atomic and Radiation uses. Reg. $21.00. **88¢**

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Hundreds of uses! Only 1¾" diameter. 1 lb. Reg. $3.50. **88¢**

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Paper, molded, oil, porc., to .5mf to 1000V. 2 lbs. Reg. $14. **88¢**

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

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

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

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

GET MORE ENJOYMENT OUT OF YOUR HI-FI FOR ONLY $1.00!

photo courtesy Electro-Voice, Inc.

Now—just $1 can show you how to get more listening pleasure from your hi-fi set! That's the cost of the new 1959 edition of the HI-FI GUIDE & YEARBOOK—the authoritative Ziff-Davis Annual that covers every facet of high fidelity enjoyment. Besides telling you how to use your equipment for the best possible reproduction, the 1959 HI-FI GUIDE & YEARBOOK presents a round-up of the trends in the hi-fi field ... tells you how to save on repairs ... guides you in the selection of records ... gives you tips on tapes.

You'll find this Annual a wonderfully practical source of information on improving the sound output of your system. Articles are presented in easy-to-understand, non-technical language. No wonder the HI-FI GUIDE & YEARBOOK has been a virtual sellout in other years! Be sure to pick up your copy of the 1959 edition now. It's like getting two big books for the price of one:

GUIDE

Section 1: IMPROVING YOUR HI-FI—Strange Allergies of hi-fi. Square Waves Check Tone Controls. Give Your Pickup a Chance. Getting the Most from Your Tweeters. MX means Multiplex. Your Stereo Listening Area.

Section 2: INSTALLING YOUR HI-FI SYSTEM—Hi-ing the Fi to the Suburbs. Index Your Music. Ceiling Mounted Speaker.

Section 3: TAPE RECORDING—Getting the Most From Your Tape Records. Tips and Techniques. Don't Let Your Tapes Hiss at You. Make Your Own Stereo Tape Recordings.

YEARBOOK SECTION

TRENDS IN HI-FI: developments in 1958 and what the future holds.

CRITICS' CHOICE OF RECORDINGS: a conductor, a music critic, and a sound engineer tell what records (classical and jazz) they would select—and why.

THE ULTIMATE IN FM STATIONS: Here's how an FM station in Chicago really caters to its hi-fi listeners—in what could be a nationwide trend in programming! Also gives you a listing of FM stations throughout the country.

STEREO: the latest report on what is happening in this big, exciting field. Plus a photo story showing what can be done to fit more equipment into less space.

All told, the HI-FI GUIDE & YEARBOOK brings you a wealth of information to help you get the most out of your hi-fi listening hours. Only $1.00 ($1.25 outside U.S.A.), it's a fabulous buy! Make sure you pick up your copy at your newsstand.

Now on sale.

ZIFF-DAVIS PUBLISHING COMPANY

434 South Wabash Avenue, Chicago 5, Illinois

Inside the Preamplifier

(*Continued from page 60*)

provides us with bass boost. The amount of boost will increase as the slider is moved downward. Thus, we will have a curve which compensates for the loudness effect at the bass end fairly adequately. We can boost the highs by installing a capacitor or capacitive network between the top of the volume control and the volume control tap, and so achieve a boost at both ends. This type of circuit is shown in Fig. 4(B) and is being used with success in the Dynakit preamplifier.

Figure 4(C) is a more elaborate configuration which is used in the Centralab "Compentrol." Here, two taps on the control give two different curves. Although this is a complicated network, it occupies little space since it is contained in a small printed circuit.

Variable Loudness Controls. A little reflection will indicate that no single fixed loudness compensation could serve all needs. First, not everybody has the same ear response. Second, almost everybody plays his hi-fi set at a different loudness level. Third, the loudness delivered by a hi-fi system depends on the amplifiers, loudspeakers and pickups used in the system.

An efficient speaker system will deliver a higher volume level with a given input signal than will an inefficient speaker system. Clearly, the same loudness control would deliver an over-boosted effect with the most efficient speakers and an under-compensated effect with the less efficient speakers. A high-level pickup would produce over-compensation and a low-level pickup would produce under-compensation. Room acoustics differ and so do personal tastes. For these reasons, a single unadjustable loudness curve will obviously not be equally satisfying for all people, all installations, and all circumstances.

The easiest means of providing a wide range of loudness control action is to add a simple volume or gain control ahead or after the loudness control. This two-control method will yield results which will suit the majority of needs.

A word of caution concerning the use of loudness controls would not seem to be out of place. The person whose set incorporates a loudness control must not forget that these controls were designed first and foremost for use at low volume levels. If the

set is played at normal, or slightly higher than normal levels, and the loudness control is left in the circuit, the resulting sound will usually have a mushy character. As a consequence of this common misuse of loudness controls, many critical listeners have formed unfavorable opinions of them and decline to use them at any volume level. This is unfortunate because loudness controls, when properly used, can provide a semi-automatic tone control action which is very effective and easy to control.

Next month we'll go on to the consideration of the special problems of *stereo preamplifiers* and discuss the means that various manufacturers have devised to solve these problems. —30—

Transistor Topics

(*Continued from page* 117)

its maximum ratings) or if subjected to excessive temperatures or mechanical strain. This may pose a real problem to the serviceman called on to check the equipment. Unsoldering and removing components for test is not an easy task.

To help the serviceman, the Philco Corporation (Philadelphia, Pa.) is now producing the first transistor tester capable of checking the performance of a transistor *while it is wired in the circuit*. At present, Philco is assembling these units to fill a Bureau of Ships contract, but a commercial model of the tester will be introduced in the near future.

Price Cuts. As a famous radio news analyst might say . . . *"There's good news tonight."* Two major mail order distributors have announced special low prices on transistors having wide application in experimental circuits.

Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) is now offering *p-n-p* general-purpose audio transistor with characteristics similar to the famous CK722 for *only* 49c each, plus postage. Even lower prices apply to quantity sales. The catalog number is SP-146.

Olson Radio Warehouse (260 S. Forge St., Akron 8, Ohio) is offering Bendix high-power *p-n-p* transistors with characteristics similar to the Motorola 2N554, Sylvania 2N307, and CBS-Hytron 2N255 for *only* 99c each, plus postage. Again, even lower prices apply to quantity sales—three for $2.50, ten for $8.00, and so on. Olson's stock num-

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ber is X-771. (Incidentally, this bears out one of our predictions made in January—that a power transistor selling for under one dollar would be offered this year.)

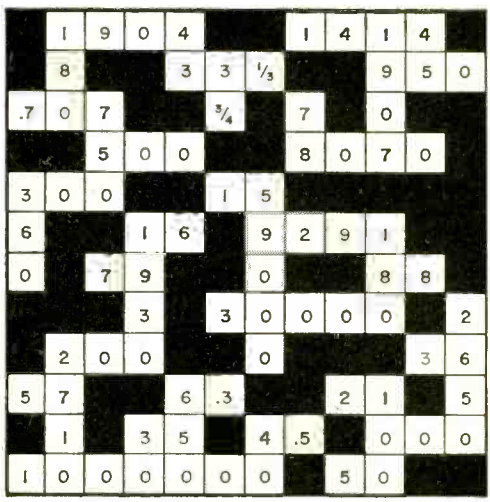
Product News. Want stereo at minimum cost? Then you'll be interested in a new device called the "Stereo-Bug." This little unit is basically a transistorized wireless phono oscillator and, in operation, it "broadcasts" the second channel of a stereo record through a nearby AM radio receiver. The "first" channel is played through the phonograph in conventional fashion. The "Stereo-Bug" nets for only about $13.00.

Allied Radio Corporation (100 N. Western Ave., Chicago 80, Ill.) has a fully transistorized three-channel audio *mixer* in its latest catalog. Useful in p.a. and general audio work, this unit serves to combine the signals from three microphones into a single output, while maintaining individual control over each channel. It nets for $14.95, plus postage.

RCA (Somerville, N. J.) has announced a number of new transistors: Types 2N647, 2N1010, 2N331, 2N561 and 2N1014. The 2N331, 2N561 and 2N1014 are *p-n-p* germanium units. The 2N647 and 2N1010 are *n-p-n* germanium alloy types. All except the 2N561 and 2N1014 are designed for a.f. amplifier applications; the latter are primarily for use in high-voltage, high-current industrial and military applications.

That's the transistor story for now, fellows. I'll be back with more news and circuits next month . . .

Lou



Solution to crossnumber puzzle on page 108.

Transformer Substitutions

(*Continued from page 75*)

When choosing a substitute, make sure that its secondary voltage specifications are the same and that its current ratings equal *or exceed* those of the original.

For example, a transformer with a 250-0-250 volt, 60-ma. secondary may be used as a satisfactory replacement for a unit rated at 250-0-250 volts, 40 ma. Similarly, a filament transformer rated at 6.3 volts, 3 amperes, is a satisfactory substitute, electrically, for a unit rated at 6.3 volts, 1.5 amperes.

A 5% difference in secondary voltage ratings will usually not affect circuit operation. Thus, if a project calls for a transformer rated at, say, 360-0-360 volts, substitutes with ratings of either 375-0-375 or 350-0-350 generally will be satisfactory.

Where a special transformer having several secondary windings is required, and an exact duplicate is unobtainable, separate transformers can be used in place of the single multi-winding unit, provided that adequate mounting space is available. The transformer's 117-volt primary windings are connected in parallel.

If special filament or bias voltages are required, two (or more) windings can be connected in series to supply the necessary voltages, as shown in Fig. 4 (A). Connect adjacent winding leads together temporarily and check the output voltage obtained between the "free" leads, using your a.c. voltmeter. If the output voltage is *less* than expected, the windings may be "bucking." In this case, interchange the connections to one winding.

It may be necessary to reduce the circuit's B+ voltage after installing a substitute transformer. There are several ways of doing this. A small resistor (5 to 25 ohms, 10 watts) can be connected in series with one of the primary leads, or the effective turns ratio of the transformers can be reduced by connecting one of the filament windings in *series* with the primary, as shown in Fig. 4(B). The preferred methods would be to substitute a rectifier tube with a larger internal voltage drop or lower the value of the input filter capacitor (*C1* in Fig. 1). If the hum level in the d.c. output goes up, raise *C2*'s value.

Often, a center-tapped filament winding may be needed, but may not be available on the substitute transformer. In such a

case, an electrical "center-tap" can be obtained by connecting a 50-to-100-ohm adjustable wire-wound resistor across the filament winding, as shown in Fig. 5. The adjustable tap is centered on the resistor.

It is not necessary to use all the windings available on a multi-winding power transformer. For example, suppose you need a general-purpose power transformer, and find one with secondary specifications which match those of the needed unit but with an "extra" 6.3-volt filament winding. Simply ignore the extra winding, taping its leads to one side (taking care that they do not short together).

Mechanical specifications are important only when the substitute unit is used as a servicing replacement or in the construction of equipment where the component's physical size and shape are important. These specifications include over-all dimensions, weight, and type of construction or mounting. —30—

Answers to Electronic Sticklers

on page 106

1. Two ohms. Redraw the network schematic in the form of a bridge circuit. You will find that the resistance values of the bridge legs result in a balanced bridge. Hence the 3-ohm resistor is an inactive component and can be omitted from the circuit. All that remains are two series resistance circuits in parallel.

2. A short circuit. The current remains the same since the two dry cells provide not only twice the voltage but also twice the internal resistance.

3. Since there is no surge resistor, the charging current of the capacitor would pull too much current through the rectifier. Without the surge resistor (20 cents), there's a good chance the rectifier ($1.00) would burn out.

4. About 282 volts! How come? On one half-cycle, when the diode's plate is positive, the capacitor charges to *peak* line voltage . . . or about 141 volts (1.41 multiplied by line voltage). On the next half cycle, the capacitor's voltage is *in series* with the peak line voltage and thus adds to it . . . and 141 plus 141 equals 282! This arrangement, incidentally, is basic to voltage-doubler power supply design.

If you know of a tricky Electronic Stickler, send it with the solution to the editors of POPULAR ELECTRONICS. If it is accepted, we will send you a $5 check. Write each Stickler you would like to submit on the *back of a postcard*. Submit as many postcards as you like but, please, just one Stickler per postcard. Send to: POPULAR ELECTRONICS STICKLERS, One Park Ave., New York 16, N. Y. Sorry, but we will not be able to return unused Sticklers.

. . . Before Buying Stereo

(*Continued from page 62*)

stereo power amplifiers. Remember, the more separate units you have in your system, the more flexibility you will have in adjusting for new developments.

Dissimilar speaker systems pose a more difficult problem. Speaker systems of different manufacturers may be entirely different in coloration or "texture." Some make the listener feel as if he were in a fifth-row-center seat; others are known as "12th-row-balcony" speakers. Where you want to sit is your own business. But if one ear is "in the balcony" and the other is "in the orchestra," the result may be disquieting.

Don't be stampeded while purchasing a speaker. Take your time, listen, and compare. And never forget that human memory for sensory perceptions is short. You can't reliably compare a loudspeaker you hear today with one you heard yesterday any more than you can match a color today with one you saw yesterday.

Buying Tips. In general, you should be suspicious whenever someone says "Look here—stereo *really* isn't expensive." It *is*. Poor components are never a good buy for the person genuinely interested in high-fidelity music reproduction. If $300 is what it costs to buy a monophonic high-fidelity outfit which you find satisfactory, you cannot expect to get a satisfactory stereo outfit for the same money.

One solution from a thoroughly practical standpoint is to build the best-quality monophonic system your budget and critical ear can agree upon. Then, at a later date, when you and your bank account have recovered from the initial investment, you can add stereo by duplicating your amplifier and speaker.

The following points should be of help in planning your stereo system:

- Stereo is not magic. It will tend to mask some imperfections in reproduction, but the ear of the critical audiophile is a quickly educated organ. Good reproduction depends, as always, upon good components.
- Monophonic reproduction has reached a high level of fidelity and standardization, and the wise buyer will take advantage of this whenever possible.
- Stereo is wonderful! Listen to it and consider buying it. But *don't* settle for low fidelity just to get stereo. —30—

Soldering Without Tears

(*Continued from page 92*)

solders are much better for printed circuits. Their better wetting power means you need to apply heat for a shorter time, and are less likely to blister the foil or copper loose from the board.

JIM picked up the iron again and looked at it. The tip had discolored slightly and he again brushed it with the cloth and applied more solder. Then he placed it against the connection Danny had been soldering and touched solder to the connection. The solder softened and flowed onto the connection.

"Just a little solder is needed, but don't remove the heat until it becomes liquid and flows. And don't attempt to cool the connection in any way. Any artificial cooling method may cause the solder to crystallize, which may give you a cold solder joint. A good connection will appear somewhat bright and very smooth, a bad one dull, lusterless and gobby.

"Notice that I applied a little solder to the iron first. That gives the tip a chance to come in intimate contact with the terminal, delivering its heat much better. A physicist might say, 'Why, it's only a heat transfer problem' . . . which would be exactly right. The better heat conduction you achieve, the better the soldering job.

"Always heat the connection or wire till it will melt solder, and never carry solder to the work on the iron.

"We haven't said much about tinning. To tin an item means to put a thin coat of solder on it. Sufficient heat must be used to assure that the solder actually *bonds* to the metal. Just as glue should usually be applied to *both* surfaces of anything to be joined, so solder ideally should first be applied to both items to be joined even though it is only a very thin covering. The leads of most electronic components are pretinned by one technique or another.

"Once the connection is made physically secure, all that remains is to melt on a little extra solder to bond the two surfaces. Then let it cool naturally.

"Any questions?"

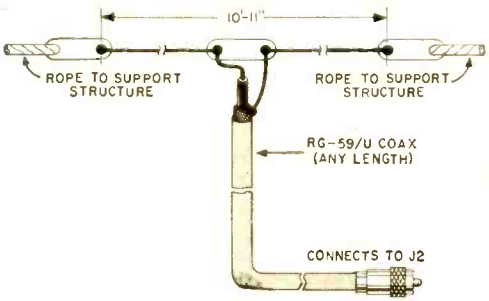
"Yes, one," Danny replied. "How about my borrowing some of your rosin core solder?"

Jim grinned, took a spare roll from his tool box, and tossed it on the bench. —30—

"Nifty Novice" Transmitter

(*Continued from page* 70)

A suitable dipole for 15 meters is shown below. The dimensions should be followed closely, with lengths cut to the nearest inch. Get the antenna up in the air, the higher the better. Face the broadside of the antenna in the direction you want to work (north-south-east-west, or in-between); for DX contacts, a north-east south-west direction would prove quite satisfactory. This antenna is simple enough so that you can erect two of them, 90° apart.



If you want to put up a real "performer," try the "Demi-Quad," described by William I. Orr in POPULAR ELECTRONICS (January, 1958). The DX stations will come rolling in so fast that you may need a secretary to keep the station log in order! —30—

HOW IT WORKS

The 15-meter transmitter uses a three-tube circuit, employing a 6AU8 oscillator/clamp (*V1*), 6L6 power amplifier (*V2*), and a 5Y3 rectifier (*V3*). Power input, when fully loaded, runs about 25 watts.

The oscillator circuit uses the pentode section (*A*) of *V1* in a modified Pierce connection. Feedback occurs between the screen and control grid, at the fundamental crystal frequency (7035-7080 kc.). The plate circuit of this stage is tuned to the third harmonic of the crystal (21.1- 21.25 mc.). This r.f. energy is applied to *V2* for power amplification.

V1's triode section (*B*) is used as a "clamp" tube and is connected between the screen grid of *V2* and ground. The control grid of *V1(B)* is connected to the control grid of *V2* through *R6*, causing *V1(B)* to act as a very low resistance from *V2*'s screen to ground, hence limiting the amount of current drawn.

When the oscillator is keyed and r.f. energy applied to *V2*, a negative voltage will develop across *R5* due to *V2's* grid current. Since this negative voltage is also applied to *V1(B)*, it acts as a bias to cut the tube off. The effect is much the same as removing the low resistance between *V2*'s screen and ground. The screen voltage goes up and allows *V2* to amplify to full power.

The tank circuit is composed of *C10*, *C11*, and *L2*. Pilot lamp *PL1* is connected in series with *L2* and the antenna jack (*J1*) so that the antenna current flows through the bulb. Thus, the brilliancy of the bulb will indicate relatively how much power is being delivered to (and radiated by) the antenna. Coil *L3*, shunting the bulb, prevents burn out.

Among the Novice Hams

(Continued from page 112)

is very severe. Contributing to it are several foreign broadcast stations that operate (legally) in the 40-meter Novice band and often are very strong in the U. S.

As a result of these factors, many Novices who do well on 40 meters in the daytime find it difficult to make contacts at night, unless they shift to the 80-meter band.

Fifteen Meters. Fifteen meters is far more erratic than either 80 or 40 meters, but it is the Novice DX band. Normally, because of the skip effect, you can't work stations closer than 1000 miles. On very good days, you can make an occasional DX contact with almost any kind of antenna; but a good antenna, preferably a rotary beam, is essential for consistent results on 15 meters—much more so than on 80 or 40. Fifteen meters is normally a daytime band.

The average two- or three-tube Novice transmitter works well here. However, many low- and medium-priced receivers, which are reasonably satisfactory on the lower frequency bands, lose most of their sensitivity and stability on 15 meters. If your receiver is satisfactory on other bands, you can probably improve its 15-meter operation greatly with a 15-meter converter. (See POPULAR ELECTRONICS, July, 1958, page 61, or the *Radio Amateur's Handbook.*)

No matter which band you select, your receiver and antenna will be more important in determining your results than your transmitter power. And put operating skill ahead of power, too.

Cathode Modulator

The cathode modulator shown on page 112 offers an easy method of putting a c.w. transmitter on phone when you get your General Class license. To use it, tune the transmitter for maximum c.w. output and plug *PL1* into the transmitter key jack. Talk into the microphone, and adjust the volume control for best modulation. Ask a local amateur to check you.

The modulator may be built on an aluminum chassis about 4" x 5" x 2". No special precautions are required, except to keep the input and output terminals reasonably well separated and the leads short. Choke *CH1* may be almost any replacement type filter choke with an inductance of seven henrys or more and a current rating of at least 10 milliamperes. You can obtain

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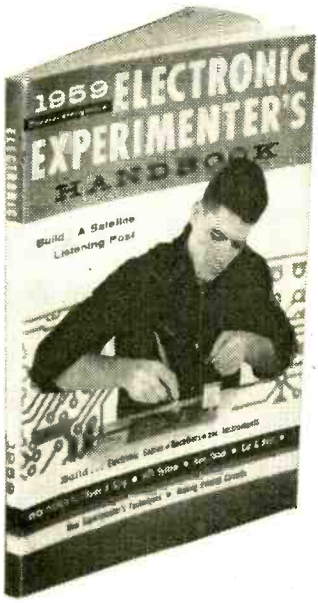

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Martin Lonfat, Ballater, Alberta, Canada. (Code, theory and selection of equipment)

Francis C. Wedge, 235 Union St., Bathurst, N. B., Canada. Phone: LI 6-3141. (Code and theory)

Hughie Coulthard, Flin Flon, Manitoba, Canada. (Code, theory and selection of equipment)

Richard Finnie, Kamsack, Sask., Canada. (Code, theory, and regulations)

Don Boucher, 671 Stella Ave., Winnipeg 4, Manitoba, Canada. Phone: JU 2-2104. (Code and theory)

the 6.3 volts for the filaments from the "accessory" socket of the transmitter. No external plate power is required.

Use a 6W6G as the modulator tube if your normal transmitter output tube plate current is no more than 125 ma. Use a 6Y6G for currents up to 200 ma. The current will drop 30% to 50% when the modulator is plugged in. A crystal, ceramic, or other high-impedance microphone will be satisfactory.

To work properly, the modulator output circuit must be connected in the cathode circuit of the transmitter output tube(s). If both the oscillator and amplifier tube cathodes are keyed in your transmitter (as they usually are in small transmitters), disconnect the lead from the oscillator cathode circuit to the key jack, and connect it to the transmitter chassis (B−) instead.

Also, if the transmitter does not have a "standby" switch, install one between the center-tap of the high-voltage winding of the power transformer and ground, to shut off the transmitter while you are listening.

News and Views

"Al" Johnson, KN1IIK, 55 Pinnacle Rd., Newport, N. H., works 80, 40, and 15 meters, running 75 watts to a Heathkit DX-40 transmitter. He receives with a Hallicrafters SX-99 receiver and uses dipole antennas. But he may have a 15-meter beam up by the time you read this. Al's record is 25 states, Poland, and Puerto Rico. . . . . **Jim Lisson, WV2CEP,** 47 Dean Rd., Depew, N. Y., stayed home from school to take his General exam—he passed, he thinks. In two months as a Novice, Jim's Heathkit DX-20, Hallicrafters SX-99 with Q-multiplier, and "all-band" Novice antenna (December, 1955, column) have accounted for 60 contacts. Jim's dad is sweating out his Novice license. . . . . Incidentally, we would like to modify the statement made in the February *Among the Novice Hams* regarding the privileges granted by a *Technician* Class license. Such a license grants all amateur privileges on the frequencies *above* 50 mc., *excluding* the 144 to 148 mc. amateur band.

Dave Givens, KN5RSI, 414 Mulberry St., Charleston, Miss., uses a vertical antenna that will operate between 80 and 6 meters, since K5EXW got it to "load" properly on 40 meters. Dave's Heathkit DX-20 and Hallicrafters S-85 haven't worked any DX, but he has worked 31 states. Check with him, if you need Mississippi. . . . . **Stanley Head, Jr., KN8MMZ,** 3942 Piedmont Rd., Huntington 4, W. Va., uses his father's Heathkit DX-100 transmitter running 75 watts. In nine weeks he has had 155 contacts, all on 80 meters. One contact lasted two hours and 15 minutes! Stan's antenna is a center-fed doublet, and he receives with a National NC-88, plus a Heathkit QF-1 Q-Multiplier. Stan will help anyone around Huntington obtain his Novice license. . . . . **Kenny**

Houtz, KN4VUZ, 300 W. Church St., Elizabeth City, N. C., goes away to school; so he doesn't get much time to be on the air. Nevertheless, he has made 40 contacts in six states on 40 and 15 meters, using a Heathkit DX-40 transmitter running 40 watts, and a Hammarlund HQ-100 receiver.

Tobe Carey, KN1GOP (16), 4 Woodford St., Worcester 4, Mass., claims he has a "bailing-wire antenna." Yet, he has worked 28 states and Germany, France, Finland, and Puerto Rico. All the DX and 20 of the states are confirmed. Tobe transmits with a DX-40 and receives on an SX-99 receiver. He is also a short-wave listener, with 171 countries heard and 95 verified. Tobe has recently been appointed SWL Bureau Manager for the W1 area; he gets all the SWL cards for the first and second call areas which are sent to the ARRL QSL Bureaus, as the ARRL QSL Bureaus distribute only amateur QSL cards. . . . . **Wayne Dunlap, K5MDZ,** 136 Pike Ave., Jacksonville, Ark., will sked anyone needing an Arkansas contact on 40 meters on weekends. He also offers help to prospective amateurs around Conway, Ark., where he goes to college. His address there is Box 63, A.S.T.C. . . . . **Nick Lash, K9KLR,** 4360 Massachusetts St., Gary, Ind., uses a WRL Globe Scout 66, running 65 watts, and a Hallicrafters S-85 receiver with a Q-multiplier. He has two antennas, a 40-meter dipole, and a rotary 15-meter dipole, both about 45′ high. Nick's record is 48 states worked, 47 confirmed, and 15 countries, 11 confirmed. He will be glad to help prospective amateurs get their licenses.

When **Dave Marks, KN8MRC,** (17), P. O. Box 124, 124 South High, Columbus Grove, Ohio, got his license, he expected his contacts and states total to be very low, because of his simple equipment—a Knight Space-Spanner receiver, a DX-20 transmitter, and a 17′-high antenna strung between two buildings. But in a couple of weeks on 40 meters he has worked around 20 states, including California five times. . . . . **Andy Metro, KN4BPU,** (16), 329 Euclid Ave., Daytona Beach, Fla., claims he operates on the QRM frequency of the year, "7162 kc." In two months of operation, he has ten states confirmed. He uses a Knight transmitter, running 50 watts and an S-85 receiver. His antenna is a doublet, 30′ high, fed with 75-ohm twin lead, via a set of balun coils. . . . . **John Gately,** a short-wave listener in New Jersey, wishes phone hams would enunciate their call letters distinctly, so that they can be copied more easily. . . . . **Stephen Momot, KN3HBP,** 1126 Highland St., Chester, Pa., wants to thank all the hams and SWL's who answered his plea for help in POPULAR ELECTRONICS. In two weeks on the air, he has worked seven states and Canada, using a WRL Globe Chief 90A transmitter at 75 watts, a 65′ antenna, and a Hallicrafters S-38E receiver.

We would like to have a report of *your* activities for the next column. And good, sharp pictures of hams at their stations are always welcome. Also, we can use short construction articles on equipment and gadgets useful around the ham shack. 73,

Herb, W9EGQ

Short-Wave Report

(*Continued from page* 110)

At time of compilation all reports are correct. Stations often change schedules and/or frequencies with little or no advance notice. All times shown are Eastern Standard and the 24-hour system is used.

Albania—Tirana is heard with Eng. news, music, and commentary at 1530-1600 on 6900 kc. The 7850-kc. parallel channel is rarely noted here. *(541)*

British Guiana—*R. Demerara* is scheduled Sundays at 0445-2145, Saturdays 0415-2245, weekdays at 0415-2145 on 5981 and 3255 kc. Listeners in southern states might also try for this station on 660 kc. in the medium-wave band. *(477)*

Cape Verde Islands—CR4AC, *R. Barlavento,* St. Vincente, 3960 kc., may be noted from 1825 to 1900/close with typical native music. The anthem "A Portuguesa" is played just before close-down. *(MS)*

Chile—CE1196, *R. Sociedad Nacional de Mineria,* Santiago, 11,960 kc., is often logged from about 2215 to 2230 with popular recordings. *(420)*

Dominican Republic—HI5B, Santiago de los Caballeros, is now noted on 4905 kc. at 1800-2000. Previously it was covered by YVKB, Venezuela, on assigned 4890 kc. *(100)*

Write Us Again!

We have received mail from a few readers who have neglected to include return addresses. If the following correspondents will write in again, we will be glad to acknowledge their letters and reports:

Jack Carr	George Neumann
William Dickerman	Richard Shavel
William Doppel	Bruce Skogen
David C. Heckendorn	Richard Sullivan

Ecuador—*R. Mundial,* Riobamba, has moved from 6295 kc. to 6218 kc. and can be noted at 1900-2300. *(100)*

French Guiana—Cayenne has moved back to 6195 kc. from 6215 kc. and is heard from 0515 s/on to 0600 when HJEZ, Colombia, blocks it out; also noted at 1730 in French, again badly cut up by HJEZ. *(4, 166, 378)*

Germany—*Deutsche Welle (Voice of Germany)* is currently scheduled as follows: to the Far East at 0200-0510 on 21,735, 21,650, and 11,795 kc.; to the Near East at 0930-1240 on 21,735, 21,490, and 17,875 kc.; to Africa at 1300-1610 on 17,815, 15,275, and 11,945 kc.; to South America at 1700-2010 on 15,375, 11,795, and 9735 kc.; and to N.A. at 2030-2340 on 15,405, 11,795, and 9640 kc. German-speaking listeners may receive the program schedule by airmail at no charge. *(GN, 378, 474)*

Haiti—The following list of active radio stations in Haiti was compiled with the help of PE reporter #4: 4VU, relay of 4VI, Cayes, on 3322 (or 3455) kc., 250 watts power; 4VGS, *R. Independence,* Gonaives, 5020 kc., 400 watts; 4VPM, *La Voix du Nord-Quest,* Port-de-Paix,

5040 kc., 225 watts; 4VRM, *La Voix des Gonaives,* Gonaives, 5060 kc., 400 watts; 4VBS, *La Voix du Sud,* Cayes, 5750 kc., 300 watts; 4VB, *R. Commerce,* Port-au-Prince, 5982 kc., 7500 watts; *La Voix de la Vie Marie,* Cap Haitien, 6100 kc., 540 watts; 4VE, *La Voix Evangelique,* Cap Haitien, 6138 kc., 50 watts; 4VWA, *R. Citadelle,* Cap Haitien, 6155 kc., 150 watts; 4VHW, *R. Haiti,* Port-au-Prince, 6200 kc., 1000 watts; 4VCP, *La Voix du Nord,* Cap Haitien, 6222 kc., 300 watts; 4VEH, *La Voix Evangelique,* Cap Haitien, 9770 kc., 4000 watts; 4VWI, *La Voix Evangelique,* Cap Haitien, 11,850 and 15,390 kc., 300 watts.

SHORT-WAVE ABBREVIATIONS

Anmt—Announcement	N.A.—North America(n)
B/C—Broadcasting	R.—Radio
Eng.—English	s/off—Sign-off
ID—Identification	s/on—Sign-on
kc.—Kilocycles	

Honduras—The call letters for *R. Tegucigalpa,* Tegucigalpa, 6035 kc., are HRTL and not HRCM as reported in other bulletins. The ID is plainly noted at 0100 s/off. *(149)*

Indonesia—The current Eng. schedule for *Voice of Indonesia,* Djakarta, reads: 0600-0700 (news at 0615) to Australia, New Zealand, and Pacific Islands on 9710 and 11,795 kc.; 0930-1030 (news at 0945) to S.E. Asia and Pakistan on 9710 and 11,795 kc.; 1400-1500 (news at 1415) to Western Europe and New Zealand on 9865 and 11,795 kc. The 1400 period is usually well heard in Eastern USA. Reports and suggestions about the programs are wanted and may be sent to P.O. Box 157, Djakarta. *(501)*

Ivory Coast—*R. Abidjan,* 4940 kc., is noted at 1700-1730 s/off and at 0200 in French. The "William Tell Overture" (a part) seems to be a trademark of this station for it is noted frequently. They verify promptly. *(DR, 348)*

Lebanon—Beirut has been found on exactly 8000 kc. at 0030 with Arabic chanting, French ID, news, but no English. *(166)*

Mexico—*La Voz de America* has replaced 15,160 kc. with 6165 kc. and is parallel to 9500 kc. at 0645-0100. *(378, 474)*

Monaco—Monte Carlo can be found on 6035 kc. at 1630-1730 with operatic music and at 0100-0105 with news in French, followed by a musical program. The 7140-kc. outlet carries Eng. and French at 2330-0000 with an excellent signal. *(BW, 348, 541)*

North Vietnam—Hanoi, 11,840 kc., has an Eng. ID at 0730, 0830, and 0930. English news is noted at 0930, with dictation-speed news at 0915. Parallel to 9840 kc. *(166, 377, 420)*

Pakistan—Karachi can be tuned in Eng. to Turkey at 1315-1400 (news at 1330) on 11,674 and 7010 kc.; to the United Kingdom on 11,674 and 9705 kc. at 1415-1500 (news at 1430); and with Eng. news at 2000 to S. E. Asia on 11,885 and 15,355 kc. Reports go to *R. Pakistan,* 71 Garden Road, Karachi. *(WF, 61, 378, 541)*

Peru — OAX1Z, *R. Nacional del Peru,* Tumbes, 9549 kc., is a new station and has been tuned at 0700 s/on; also at 1900-2300 when Prague is not too strong. *(100)*

Philippine Islands—The schedule for the new 50,000-watt Far East B/C Co. is: DZF2,

11,920 kc., at 0800-0900 in Hindi, 0900-0930 in Tamil, 0930-1000 in Telugu, 1000-1100 in Eng., 1100-1130 in Eng., 1130-1200 in Russian, 1600-1730 in Japanese, 1730-1830 in Mandarin; and DZF3, 15,385 kc., at 1830-1930 in English. All transmissions are beamed west except the 1100-1200 and 1600-1830 segments which are beamed north. *(92)*

Saudi Arabia—Tune for Djeddah on 11,950 kc. A tone signal is broadcast at 2230-2250, an interval signal to 2300 when Home Service in Arabic begins. Do not confuse this with London's Arabic service on 11,955 kc. *(378)*

South Africa—Johannesburg, 15,230 kc., has Eng. on Thursdays from 1200. News at 1200 is followed by old American recordings. *(61)*

Tanganyika—Dar-es-Salaam is scheduled in Eng. on 5050 kc. at 2315-0000 Sundays through Fridays, and at 1300-1430 (Saturdays to 1500). The 7167-kc. outlet carries Eng. at 0400-0615 Mondays through Saturdays, and Eng. and Swahili at 0300-0400. *(LP, 44)*

Thailand—The Thai National B/C Station, Bangkok, 11,670 kc., gives fair to good reception only at 0850-0900 with a brief Eng. anmt at 0900. This is a relay of the Home Service for overseas listeners. *(378)*

United Arab Republic—Cairo now carries Eng. dictation-speed news on 11,670 kc. at 0145-0205 closing. The 11,989-kc. outlet has Eng. to Europe and the United Kingdom at 1600-1700 with news and commentary at 1615. *(RM, EN, 61, 420)*

Windward Islands—Grenada's new 15.086-kc. outlet is heard well at 1600-2115 in beam to Jamaica, dual to 5010 kc. News relay from London is noted at 2100; home news at 1900. *(JB, JD, 44, 59, 166, 226, 383, 420, 466)*

Clandestine—*R. Liberacion*, Honduras, is heard irregularly at 1900-2300 on 5810 kc. (varies) with anti-government broadcasts. *(DS, 100, 121, 190, 420, 466)*

—30—

SHORT-WAVE CONTRIBUTORS

Jerry Badurski (*JB*), St. Petersburg, Fla.
Johnny Dyer (*JD*), Cisco, Texas
Werner Funkenhauser (*WF*), Kingsville, Ont.
Richard Martin (*RM*), Pittsfield, Mass.
Eddie Nance (*EN*), Elizabethton, Tenn.
George Neumann (*GN*), Culver City, Calif.
Larry Page (*LP*), Rochester, N. Y.
Denny Reeves (*DR*), Peoria, Ill.
Dick Schreiber (*DS*), Wheat Ridge, Colo.
Manuel A. Sousa (*MS*), Braga, Portugal
Bill Waltz (*BW*), Dayton, Ohio
Stewart West (*4*), Union, N. J.
Anson Boice (*44*), New Britain, Conn.
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J. Art Russell (*149*), San Diego, Calif.
George Cox (*166*), New Castle, Del.
Austin Frazee (*190*), Point Pleasant, N. J.
William Bing (*226*), New Orleans, La.
Glenn Cuthrell (*348*), Maxton, N. C.
Ken Boord (*377*), Morgantown, W. Va.
J. P. Arendt (*378*), Aurora, Ill.
L. E. Kuney (*383*), Detroit, Mich.
A. R. Niblack (*420*), Vincennes, Ind.
Robert Sabin (*466*), Wilmington, Ohio
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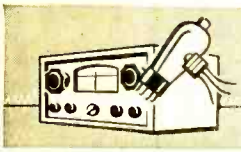

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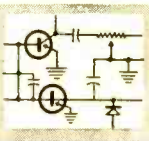

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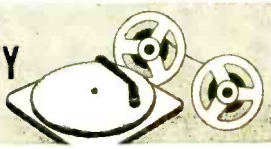
CODE courses to enable passing Radio Amateur examinations. Designed and tape recorded by former U.S.N. Operator and R.R. telegrapher. Both sides 7" 1200' reels. Learning to Six W.P.M. or Six to Sixteen W.P.M. Response enables reduction to $3.98 each. Postpaid in U.S.A. Elham Inc., P.O. Box 98, Hawthorne, California.

HAMS. Calculate as Experts calculate. 10" Slide Rule Plus Instruction Booklet. Perfect for Electronics. 1 set $1.50 Pal-Pak 2 sets $2.50 Science Recruits, Box 575, Walla Walla, Washington.

HIGH-FIDELITY



HI-FI Interest you? Write for Free 20 page H. H. Scott Component Catalog. H. H. Scott Inc., Dept. PE-4, 111 Powdermill Road, Maynard, Mass.

DISGUSTED with "Hi" Hi-Fi Prices? Unusual discounts on your High Fidelity Requirements. Write Key Electronics, 120 Liberty St., New York 6, N. Y. EVergreen 4-6071.

HI-FI Haven, New Jersey's newest and finest sound center. Write for information on unique mail order plan that offers professional advice and low prices. 28 Easton Avenue, New Brunswick, New Jersey.

HI-FI AM Tuner Kits $14.90. Grindon, 7820 Murdoch, St. Louis, Mo.

HI-FI Converter. Console sound from your radio, television set, or record player, with new speaker system kit. Write for Free Folder. Windhaven Radio, Box 13C-74, Baroda, Michigan.

TAPE & RECORDERS

RECORDERS, Hi-Fi. Free wholesale catalogue. Carston, 215-P, East 88 St., N.Y.C. 28.

HIGHEST Trade-In Allowances Toward Ampex, Concertone, Crown, Ferrograph, Presto, Pentron, Components. Accessories. Catalog. Boynton Studio, 10-PE Pennsylvania, Tuckahoe, N. Y.

RECORDERS, Tape Decks, Stereo Tapes, Accessories, Excellent Values, Catalogue. Efsco, 270E Concord, West Hempstead, N. Y.

TAPE Recorders, Hi-Fi Components, Sleep Learning Equipment, Tapes. Unusual Values. Free Catalog. Dressner, 69-02F, 174 St., Flushing 65, N. Y.

EXCHANGE Tapes—Send Commercially Recorded Stereo or Monaural Tape and $1.00 for Different Tape of Like Quality. Satisfaction Guaranteed, Our Choice. Selected Tape Exchange, Box 424, Hagerstown, Maryland.

EMPLOYMENT INFORMATION

JOBS—High Pay; USA, So. America, The Islands. All trades. Many companies pay fare. Write Dept. 71N, National Employment Information, 1020 Broad, Newark, N. J.

AMERICAN Overseas Jobs. High Pay. Men, Women. Transportation Paid. Free Information. Write: Transworld Information Service, Dept. AZ, 200 West 34th St., New York 1.

WANT A Better Job?? High Pay?? Overseas—U.S.A. All Occupations. Free Information. Employment Headquarters, 79 Wall Street. Dep't. 3-G, New York 5.

JOBS on Steamships and Yachts traveling Foreign Countries. Davenport's, GPO 1354, New York 1, New York.

JOBS Overseas! Janecek Development Co., 1093 Hub Station, New York 55, N. Y.

WANT a Good Job?? High Pay?? Overseas—U.S.A. All Occupations. Free Information. Employment Headquarters, 79 Wall Street, Dept. 4-0, New York 5.

FOREIGN Employment Information—$1. Parks, Box 1665A, Lake City, Seattle 55, Wash.

PLASTICS

NEW Liquid Casting Plastic clear, colors. Embed real flowers, minerals, biological specimens, delicate instruments, electronic parts. Also cold-setting resin and fiberglass for laminating, casting, molding, coating. Manual 25¢. Castolite, Dept. D-108, Woodstock, Illinois.

INVENTIONS WANTED

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

MISCELLANEOUS

LEARN While Asleep with amazing new Electronics Educator endless tape recorder. Details free. Research Association, Box 24-S, Olympia, Wash.

WORLD'S Largest Electronic Parts Catalog. 1,536 pages. New 1959 edition. Over 150,000 standard items sold through parts distributors at your fingertips. Complete product descriptions, specifications, prices: 11,500 illustrations. Used by hams, hobbyists, experimenters everywhere. Only $3.50 from local radio-TV parts distributors, or send check/money order direct. Radio-Electronic Master, 60 E. Madison Avenue, Hempstead, N. Y. Free 24-page Panel-Flashlight Lamp Chart with Direct Order.

CODE Remembered forever in minutes with amazing memory aid. $1. McKenzie Enterprises, Box 245, Palo Alto, California.

3 LINES 1.00 Rubber Stamps. Box 66, Mt. Holly Springs, Pa.

24" ROCKET—solid fuel, high altitude performance, will carry experimental transistor equipment, parachute return. Educational. Complete scale plans and instructions $1.00. Advance Engineering, P. O. Box 2274, Dallas 21, Texas.

HAVING trouble getting ahead? Read "Gems of Wisdom." $1.00. Frazier Enterprises, 201 Delaware Circle, North West, Huntsville, Ala.

POCKET-SIZE Ventilator, world's smallest. Own this amazing new gadget this summer. De-Luxe brass finish. Imported. Order now. Complete with standard batteries and leather bag. Only $12.95 postpaid. E. T. Schilling, P. O. Box 623, San Francisco 1, California.

LP Records. Stereodiscs, Stereotapes, 20% Discount Catalog 30¢. SWRS, 1108 Winbern, Houston, Texas.

SHOPPING GUIDE
Classified

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

PHOTOGRAPHY—FILM EQUIPMENT, SERVICES

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.

CODE remembered forever In minutes with amazing memory aid. $1. McKenzie Enterprises, Box 245, Palo Alto, California.

COLOR Economy! Anscohrome, Ektachrome film developing, 80¢ (20 exp. 35 mm rolls mounted). Color prints from transparencies—2½x3½ six for $1.00, 3½x5 six for $1.50, 5x7 each 75¢, 8x10—$1.50. Lee-Jan-Lab., Box 382, LaGrange, Illinois.

ABSOLUTELY highest quality professional double weight enlargements at dealers prices. 5x7, 32¢; 8x10 41¢; 11x14, 85¢. No extra charge for cropping or dodging. New negative from your photo 60¢; Minimum order $1.00. 25% discount on Kodacolor processing. 20% discount on Developing By Kodak. Foto Portrait Co., 1172-E Ogden Ave., New York City 52.

5,000 8mm.-16mm. Films, Equipment. Free catalogues. International, Greenvale, New York.

HOBBIES, Industries, Sports, Travel! Meston's 35mm Color Slides of over 16,000 subjects. Send $1.00 for Exciting Preview Package four slides hermetically sealed in plastic plus 80 page catalog. Meston's Travels, Dept. PE, 3801 N. Piedras, El Paso, Texas.

COLORFUL Autumn—New York State. Eight Colorslides $1.00. Eddings, Roberts Avenue, Corning, N. Y.

BUSINESS OPPORTUNITIES

$SAVE! $Save! $Save! Statistics prove television repaired without technical knowledge. Guaranteed, money back, method. Only $1.00. Electronic Research Foundation, Box 301, Orange, New Jersey.

MEN—Women Agents: sensational new money-makers—Beautifully hand-painted plastic personalized photo enlargements, compacts, rings, bracelets, lockets, etc. Simply take orders, pocket 40% commission—we deliver and collect. Sales outfit free. Novelco, 3341 North Ave., Chicago 47.

PHOTOGRAPHY for Pleasure or profit. Learn at home. Practical Basic training. Long established school. Free booklet. American School of Photography, 835 Diversey Parkway, Dept. 2254, Chicago 14, Illinois.

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

OPERATE Profitable mailorder business!! Write: Bond, 1637-X West Vernon, Phoenix, Arizona.

EXTRAORDINARY Opportunity! Retire Now! Lead leisurely Life. Remarkable Book Shows How. Free Details. Belmont, Wyckoff 177, New Jersey.

MAILMAN Brings us $150 Daily. Operate home Mail Order Business. Write Publicity, Box 727ZE, Kalamazoo, Michigan.

MAKE $25-$50 Week, clipping newspaper items for publishers. Some clippings worth $5.00 each. Particulars free. National, 81-DG, Knickerbocker Station, New York.

AMATEURS and Professionals—Extra Cash from your photos. Become a member of our world wide photo agency and enjoy innumerable benefits. Send your 8x10 photos for presentation to world markets and only $1.00 for membership number and informative letter. Limited offer. Photo-World, 538 North Federal, Fort Lauderdale, Florida.

VENDING Machines—No Selling. Operate a route of coin machines and earn amazing profits. 32-page catalog free. Parkway Machine Corporation, Dept. 12, 715 Ensor St., Baltimore 2, Md.

MAKE $25-$50 Week, clipping newspaper items for publishers. Some worth $5.00 each. Particulars free. National, 81-PE, Knickerbocker Station, New York City.

FREE Book "505 Odd Successful Businesses." Work home. Pacific-PPY, Oceanside, California.

YOUR Own Income Tax Business Tax Service. Licensed training. Union Institute, Hoboken 3V, N. J.

EARN extra cash! Prepare advertising postals. Langdon's, Box 41107Z, Los Angeles 41, California.

EARN Extra money selling advertising book matches. Free samples furnished. Matchcorp, Dept. MD-49, Chicago 32, Ill.

YOUR Own home-operated business! Take over your area as our Service Distributor keeping stores supplied Nationally advertised 29-year-old line pays you 66⅔% mark-up. Less than $100 for merchandise starts you. For samples, highly successful plan, write Novo, Inc., 1168-P Milwaukee, Chicago 22, Ill.

FREE-Lance Photographers register now. No obligation. For application write Accredited Press, Inc., Lawrence 6, New York.

$30-$60 WEEKLY Addressing Envelopes at home. Instructions $1. (refundable). Reiss, 210 Fifth Ave., Suite 1102-M, New York 10.

SELL Stereo Hi-Fi by home demonstration, full or part time, direct from factory. Al Cloutier, Dept. PE, 11143 Orville St., Culver City, California.

EARN Up to $10,000 yearly selling shelving—parts bins—shop equipment. Write, BFC Corporation, 2806E. Hedley, Phila. 37, Pa.

STAMPS & COINS

COIN Magazine. 200 pages. Sample 40¢. Scrapbook, 7328 Milwaukee, Chicago 48.

1000 DIFFERENT Worldwide Stamps $1.25. Valued over $20.00. Universal, Box 6, Kenosha 18, Wisconsin.

100 LARGE U.S. Commemoratives—only 25¢ with approvals. Wm. Rice, 87 Washington Ave., Kingston 41, N. Y.

UNITED Nations. Five different 10¢. Approvals. Anderson, 1112 Harrison, San Francisco 3, Calif.

77 DIFFERENT U.S., 100 Different China, 25 Different Czechoslavakia, all 60¢ Approvals. Leonards, 1143M, North Keeler, Chicago 51.

NEW! 1959 Bargain American Coin Catalogue! Revised Prices! Only 25¢. Write! Sullivan, 128EC East Fourth St., St. Paul 1, Minnesota.

508 DIFFERENT Worldwide from Madagascar, Macao, Guinea, etc., cataloging over $15.00 on 35¢. Approvals. Littleton Stamp Company, Littleton Q17, New Hampshire.

U.S. Stamps. Giant Bargain Catalog—15¢. Raymax, 35-VZD Maidenlane, NYC 38.

427 STAMPS 10¢, Catalogue Value $10.00. Mystery Mixture Including U. S., Ireland, Asia, Africa, Pictorials, Commemoratives, Air Mails. WorldOStamps, 8203 Grubb-PE, Silver Spring, Maryland.

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.

307 WORLDWIDE Different stamps only 35¢. Approvals. Niagastamp, St. Catherines 690, Ontario.

MISCELLANEOUS

WHY not be the person you wish to be, realizing the fulfillment of your desires? Good things are attracted to you when you know and apply the rules. Read: Man, God's Helpmate $1.25; Using The Magnetic Forces of Your Mind $3.00 postpaid. I.P. Society, Dept. Z, P.O. Box 42187, Los Angeles 42, California. (In Calif. add 4% sales tax.)

BARBELLS. Courses, Apparatus. Catalogue 10¢. Good Barbell Co., Dept. D, Siloam Springs, Arkansas.

THE Law of Life Revealed and How to Apply It, $1.00. The Open Way, Celina, Tennessee.

"WINEMAKING; Beer, Ale Brewing." Illustrated. $2.00. Many others. Eaton Books, Box 1242-C, Santa Rosa, California.

PRINTING Presses, Type, Supplies, Lists 4¢. Turnbaugh Service, Mechanicsburg, Pa.

FLYING Saucers Latest Reports, Articles. Subscribe for "The Saucerian" magazine. Six issues $2.00. Saucers, Dept. 5, Box 2228, Clarksburg, West Va.

ENGINES OHV V8's. All Popular Makes. 1956, 1959. Ledbetter Enterprises, 1015 West 17th, Texarkana, Texas.

HYPNOTIZE . . . One Word . . . One fingersnap, on stage. Satisfaction—or refund. $2. Hypnomaster, 846-S8 Sunnyside, Chicago 40.

COBRA. Self-Defense street-fighting tricks. Designed to help peaceful adults. $2. Gaucho, 846-S8 Sunnyside, Chicago 40.

SONGPOEMS And Lyrics Wanted! Mail to: Tin Pan Alley, Inc., 1650 Broadway, New York 19, N. Y.

PHONOGRAPH Records cheap, postpaid. Catalogue. Paramount, Box 242-R, Williamsport, Penna.

BINOCULAR specialists, all makes repaired. Authorized Bausch Lomb, Zeiss, Hensoldt, Bushnell dealer. Tele-Optics, 5514 Lawrence, Chicago 30, Illinois.

OPTICAL Bargains—Request Free Giant Catalog "CJ." 96 pages—Astronomical Telescopes, Microscopes, Lenses, Binoculars, Kits, Parts. Amazing war surplus bargains. Edmund Scientific Co., Barrington, New Jersey.

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NO MONEY WITH ORDER — NO C.O.D.

Superior's New Model 76

ALL PURPOSE BRIDGE

IT'S A CONDENSER BRIDGE
IT'S A RESISTANCE BRIDGE
IT'S A SIGNAL TRACER
IT'S A TV ANTENNA TESTER

Model 76 ALL PURPOSE BRIDGE
Total Price $26.95
Terms: $6.95 after 10 day trial, then $5.00 per month for 4 months if satisfactory. Otherwise return, no explanation necessary.

✓ CAPACITY BRIDGE SECTION
4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad, .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. Will also measure the power factor of all condensers from .1 to 1000 Microfarads.

✓ RESISTANCE BRIDGE SECTION
2 Ranges: 100 ohms to 50,000 ohms; 10,000 ohms to 5 megohms.

✓ SIGNAL TRACER SECTION
With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc.

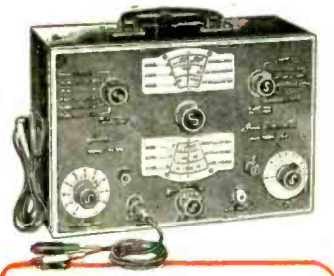
✓ TV ANTENNA TESTER SECTION
Loss of sync., snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? Locates a break in any TV antenna and measures the location of the break in feet from the set terminals.

Complete with R.F. and A.F. probes and test leads **$26.95 Net**

Superior's New Model TV-50A

GENOMETER

7 Signal Generators in One!



Model TV-50A 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
✓ Bar Generator
✓ Cross Hatch Generator
✓ Color Dot Pattern Generator
✓ Marker 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: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Patterns will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

CROSS HATCH GENERATOR: The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

DOT PATTERN GENERATOR (FOR COLOR TV) Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. 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).

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. Only **$47.50**

USE APPROVAL FORM ON NEXT PAGE ▶

We invite you to try before you buy any of the models described on this and the following pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send 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.

MOSS ELECTRONIC, INC. **Dept. D-585 3849 Tenth Avenue, New York 34, N. Y.**

TRY FOR 10 DAYS

before you buy! ***then*** if satisfactory pay in easy, interest free, monthly payments. See coupon below.

SUPERIOR'S NEW MODEL 82A

A truly do-it-yourself type

TUBE TESTER

Model 82A — TUBE TESTER . . . Total Price $36.50 — Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

TEST ANY TUBE IN 10 SECONDS FLAT!

1. Turn the filament selector switch to position specified.
2. Insert tube into a numbered socket as designated on our chart (over 600 types included).
3. Press down the quality button—

THAT'S ALL!

Read emission quality direct on "BAD-GOOD" meter scale.

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82A will outperform similar looking units which sell for much more—and as proof, we offer to ship it on our examine before you buy policy.

To test any tube, you simply insert it into a numbered socket as designated, turn the filament switch and press down the quality switch—THAT'S ALL! Read quality on meter. Inter-element leakage if any indicates automatically.

Specifications

- Tests over 600 tube types.
- Tests OZ4 and other gas-filled tubes.
- Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings
- Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence
- Dual Scale meter permits testing of low current tubes
- 7 and 9 pin straighteners mounted on panel.
- All sections of multi-element tubes tested simultaneously.
- Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Model 82A comes housed in handsome, portable Saddle-Stitched Texon case. Only $36.50

(Picture Tube Adapter available for $5.50 additional)

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.

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SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

MOSS ELECTRONIC, INC.
Dept. D-585 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 76.....Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
- ☐ Model TV-50A....Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.
- ☐ Model 77.....Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.
- ☐ Model 82A.....Total Price $36.50 $6.50 within 10 days. Balance $6.00 monthly for 5 months.
  - ☐ Include Model 82A Picture Tube Adapter at $5.50.
- ☐ Model 80.....Total Price $42.50 $12.50 within 10 days. Balance $6.00 monthly for 5 months.

Name .....

Address .....

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

All prices net, F.O.B., N. Y. C.

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Model 77—VACUUM TUBE VOLTMETER . . Total Price $42.50
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

Superior's New Model 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price

• Extra large meter scale enables us to print all calibrations in large easy-to-read type.

• Employs a 12AU7 as D. C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability. • Meter is virtually burn-out proof. The sensitive 400 micro-ampere meter is isolated from the measuring circuit by a balanced push-pull amplifier. • Uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, Intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

SPECIFICATIONS

• **DC VOLTS**—0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance • **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS** (Peak to Peak)—0 to 8/40/200/400/800/2,000 volts • **ELECTRONIC OHMMETER**—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 meg ohm/10 megohms/100 megohms/1,000 meg. ohms. • **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 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 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**

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

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.

SEE OTHER SIDE

CUT OUT AND MAIL TODAY!

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New York, N. Y.

BUSINESS REPLY CARD
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VIA AIR MAIL

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