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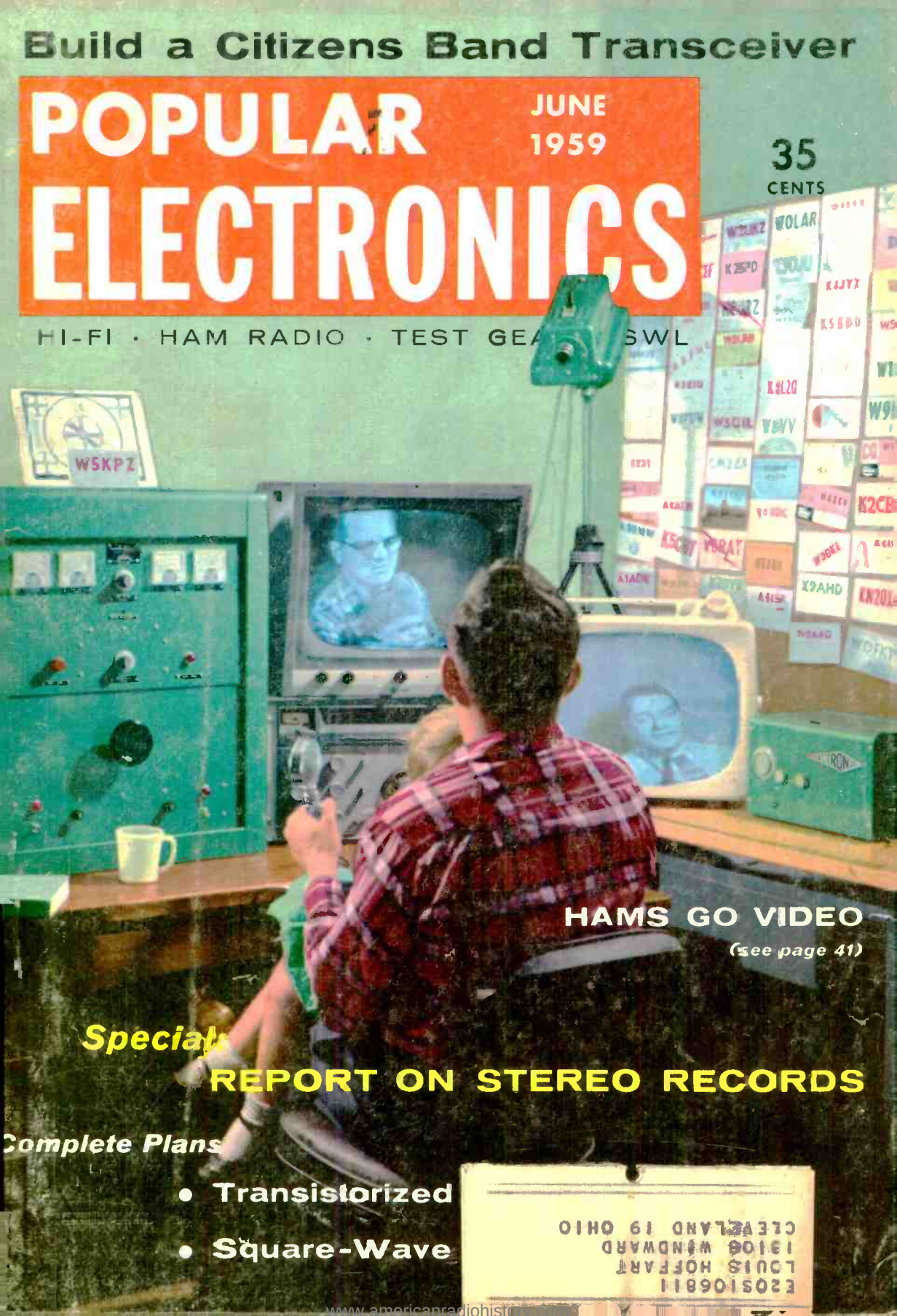

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(see page 41)

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POPULAR ELECTRONICS

JUNE 1959

VOLUME 10 NUMBER 6

ZIFF-DAVIS PUBLISHING COMPANY

"Bonus" Feature

Special Feature

Electronic Construction Projects

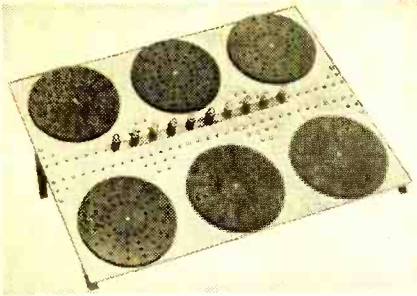
Audio and High Fidelity

Electronic Features and New Developments

Amateur and SWL

Departments

Can you think faster than this Machine?



Control Panel of GENIAC set up to do a problem in space ship engineering

Be careful before you answer. GENIAC ® the first electrical brain construction kit is equipped to play tic-tac-toe, cipher and encipher codes, convert from binary to decimal, reason in syllogisms, as well as add, subtract, multiply and divide. Specific problems in a variety of fields—actuarial, policy claim settlement, physics, etc., can be set up and solved with the components. Connections are solderless and are completely explained with templates in the manual. This covers 125 circuits and shows how new ones can be designed.

You will find building and using GENIACS ® a wonderful experience; one kit user wrote us: "this kit has opened up a new world of thinking to me." You actually see how computing, problem solving, and game play (Tic-tac-toe, nim, etc.) can be analyzed with Boolean Algebra and the algebraic solutions transformed directly into circuit diagrams. You create from over 400 specially designed and manufactured components a machine that solves problems faster than you can express them.

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Other machines you can build with your 1959 Model GENIAC ® Computer Kit.

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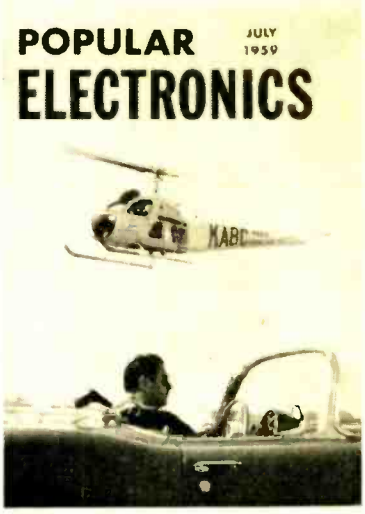
COMING NEXT MONTH



(ON SALE JUNE 23)

Our July cover will picture a radio-equipped helicopter hovering over the jam-packed traffic on the Los Angeles Freeway. This helicopter keeps the motorists below abreast of the latest traffic information. A feature article describes how the "radiocopter" helps the harassed drivers.

In July many a young man's fancy turns to boats. So POPULAR ELECTRONICS will feature a special 32-page section devoted to marine electronics. If you're a small boat owner, you'll find this section chock full of helpful information. (See pages 122 and 123 of this issue for more data.)

For those who like to listen to Police and Fire Department calls on the short waves, complete construction plans for a "Police Special" 30-50 mc. receiver will be given.

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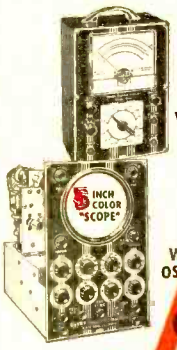

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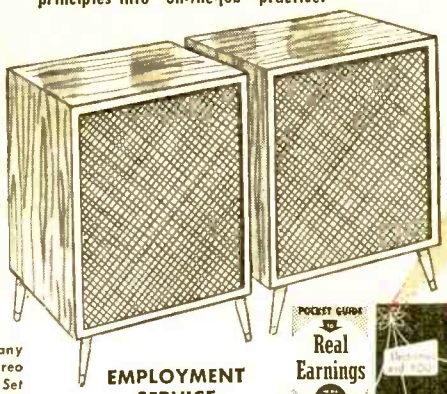

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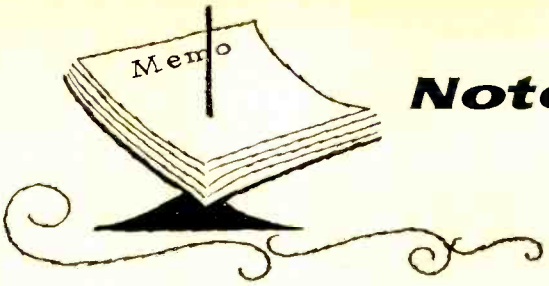


Notes from the Editor

"BONUS FEATURE." As you probably noticed when you opened this copy of POPULAR ELECTRONICS, we have a 16-page "extra added attraction" this month. "Stereo Records: Fad or Fulfillment," beginning on page 67, is a comprehensive evaluation of stereo in general and of stereo records in particular. The author, Sidney Norinsky, is a rare combination of musician, audiophile, and writer. He's been interested in audio matters since the early days of hi-fi, and has worked in the electronics and hi-fi fields for the last five years. In addition to contributing to most of the electronics and mechanics magazines, he has also written a book on home movie making. We expect Sid's article to shed new light on the confusion surrounding stereo discs.

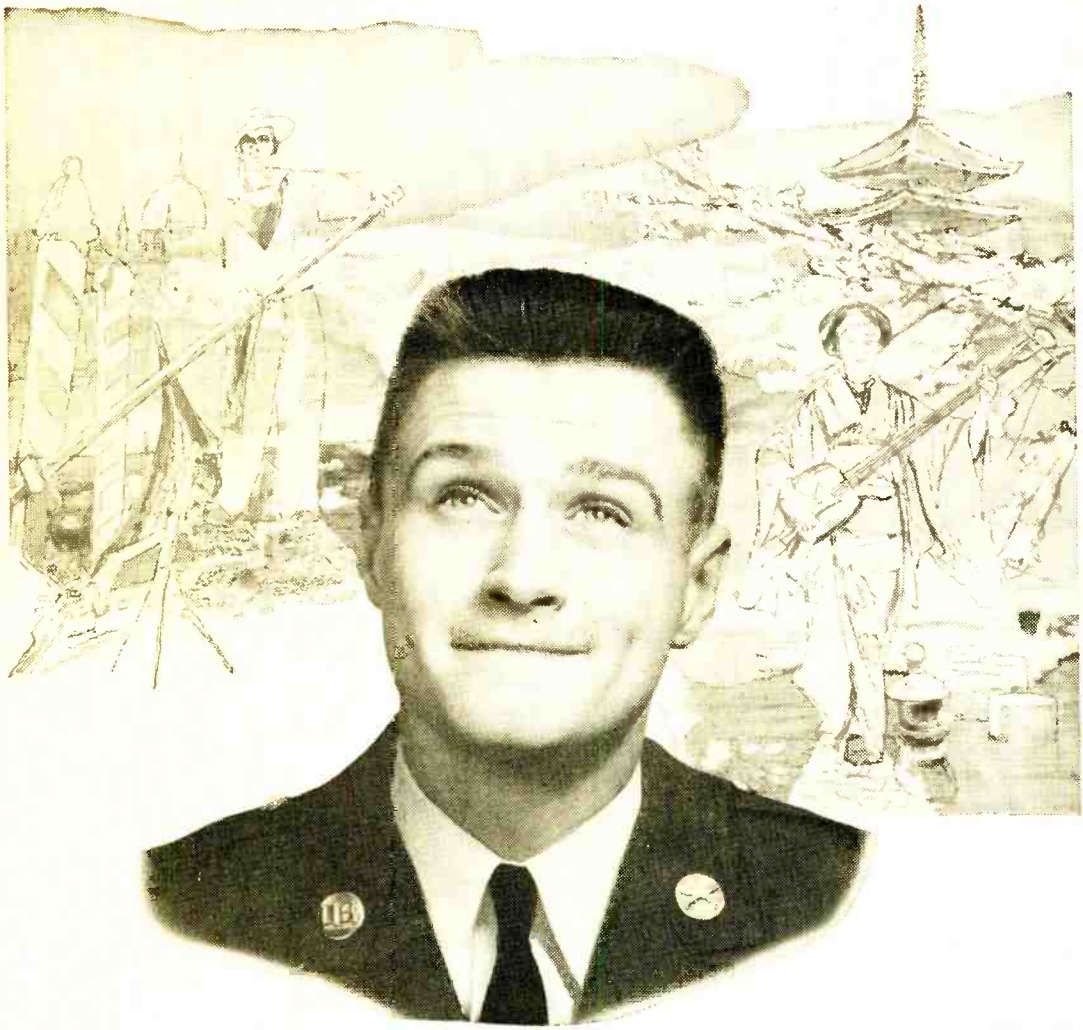
DISASTERS AT SEA. Collisions between large ocean-going vessels used to be a rare occurrence, but the several serious collisions in the past two years point up the need for some radical changes in maritime navigational practice. Despite thousands of dollars worth of electronic equipment installed on ships, the crashes continue. The blame appears to lie not in the electronic devices themselves, but in the attitude of ship captains toward them. Many times, when a nearby ship is picked up on a radar scope, the captain simply tries to steer around it. This practice doesn't allow for the other ship's changing course, nor does the captain know if the other ship has even sighted him. Another real danger to navigation comes from the fact that wooden boats don't make very good radar targets. They cause no ''pip'' on the scope, or a very weak pip which can often be masked by noise. The solution is simple —an inexpensive radar reflector, either metal-painted balloon or aluminum sheeting which folds into a compact package when not in use. In times of poor visibility, it is unfolded or inflated, and hoisted up to the masthead. It will give a solid pip on any radar scope. Every wooden sailboat or cruiser which navigates crowded sea lanes should carry one.

In line with the public interest in marine electronics, next month's issue of POPULAR ELECTRONICS will include a 32-page section devoted to electronics afloat. Of interest primarily to the small boat owner, this section will cover such nautical topics as direction finders, depth meters, autopilots, communications systems, etc.

TEST INSTRUMENT AND HI-FI SERIES. Due mainly to limitations of space, neither of our two series of articles on test equipment and hi-fi circuitry appear in this issue, but followers of Messrs. Marshall and Klein will be reassured to know that both will be back with us next month.

Oliver Read

EUROPE...OR THE FAR EAST?



choose your travel before you enlist

Ever had the itch to travel? To explore Paris at night? To hunt wild boar in the forests of Japan? To try surfboarding at Waikiki? Skiing in the Swiss Alps? Swimming on the Italian Riviera?

Every year, thousands of American soldiers experience the thrill of foreign adventure. Roaming far-away corners of the world that most folks at home can never hope to see. Storing up exciting memories that'll last a lifetime.

Many of these Army men *chose* their own travel. And they made their choice *before* enlistment.

Sound interesting? Your Army recruiter can tell you all about Army travel opportunities. This week, drop in and talk it over.

P.S. You may enlist in the Army for only three years.

CHOICE, NOT CHANCE **U.S. ARMY**

Letters from our readers

Short-Wave Certificates

■ I have recently seen the March issue of POPULAR ELECTRONICS and the Editor's note (*Notes from the Editor*) about short-wave monitoring certificates. I consider this one of the best ideas for SWL's that I have seen and am submitting my application for call letters.

I have been an SWL for three years and have logged 69 countries, all continents, all states, and

all call areas. Besides the S-53 and the AR-3, I use two transistor receivers for 90-145 mc. and 20-meter reception. I also hold POP'tronics s.w. department monitor card #559 (*Short-Wave Report*).

PAUL KATSUKI
Media, Pa.

■ The idea of a certificate for short-wave listeners is excellent. Short-wave listening helps all of us to get a better understanding of this mixed-up world of ours, and anything people can do to encourage it is a step in the right direction.

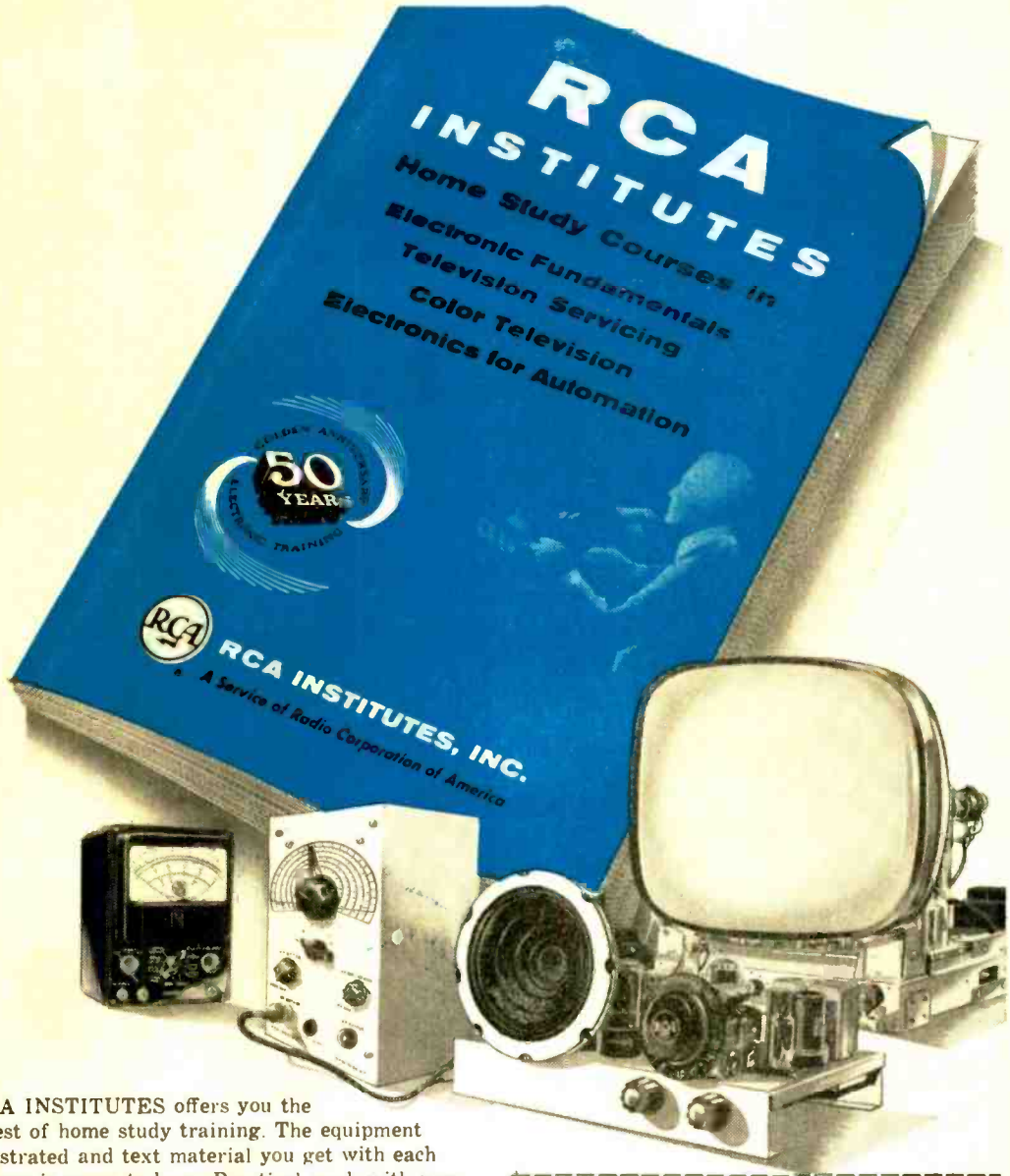
D. P. ROBERTSON
Poughkeepsie, N. Y.

For more details on how to get your certificate, see page 87.

More on TV DX'ing

■ I just finished reading in your March issue the letter from David Parrish in Quebec with regard to TV-DX. Enclosed is a photo of a 1500-mile DX from Wichita, Kansas.

I am Western DX Editor for the AIPA, the World-Wide TV-DX Club, and have been an active DX'er for over three years now. I have logged 127 different TV stations, of which about 110 are verified either by letters from the TV stations or by photos. Some of my loggings, *all* verified, are: CKCW-2 in Moncton, New Brunswick, Canada, 2900 miles; KONA-2 in Honolulu, Hawaii, 2750 miles; WORA-5 in Mayaguez,



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To save time, paste coupon on postcard.

Letters

(*Continued from page* 10)

Puerto Rico, 3650 miles; and CMAB-2 in Havana, Cuba, 2750 miles.

My farthest and most recent loggings are: the BBC-TV in London, England, over 6000 miles,

both sound and picture, verified by the BBC; also Channel 1, sound only, from France, and sound only from Germany's TV station.

MRS. DORIS JOHNSON
Western DX Editor of AIPA
Longview, Wash.

He Knows What He Wants

■ I would like to make two major comments about POPULAR ELECTRONICS.

It is very helpful and stimulating in keeping up with some of the newer developments in the field of electronics. However, I would appreciate more technical detail, if possible, in discussions of computers, tape recording, etc. (as in "Tape Recording and Industry," p. 41, Nov. POPULAR ELECTRONICS).

I found "Breaking the Language Barrier," p. 58, Nov. POPULAR ELECTRONICS, very interesting, although more details would be helpful. The machine that can do the work described in the article must be a tremendous accomplishment which should bring many more documents within the reach of not only American scientists, but also of many of us who would like to be able to use more non-English resources.

REV. M. P. WATSON
Sherburne, N. Y.

POP'tronics will strive to continue to provide interesting features in every issue. However, we find it difficult to include all technical details in any one feature without taking space away from another. Scope and length of feature stories present a tough editorial headache.

Hi-Fi by the Pound

■ Congratulations on getting Joseph Marshall to do your hi-fi series. I am greatly indebted to Mr. Marshall for having developed his "Golden Ear" circuit and for going out of his way to assist me with suggestions that helped me put together what is probably the largest and most powerful home-constructed amplifier in the world.

The photo shows the amplifier only, one of the

PUZZLE: FIND AL

Al's got himself lost in his job.

He does his work. He draws his pay. He gripes, and hopes, and waits. But the big breaks never seem to come.

You have to hunt hard for Al. He's in a rut!

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The others began to say, "Ask Tom, he knows." The supervisor began to take notice. The boss began to receive reports on Tom's progress. *And Tom began to move!*

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P.S.—You'll find men like Al everywhere—griping, hoping, waiting—reading this and skipping on. But forward-looking fellows like Tom will take time to investigate, will mark and mail the coupon and get the three valuable career books free. They're men of action. And a few short months from now, you'll see them start to move!

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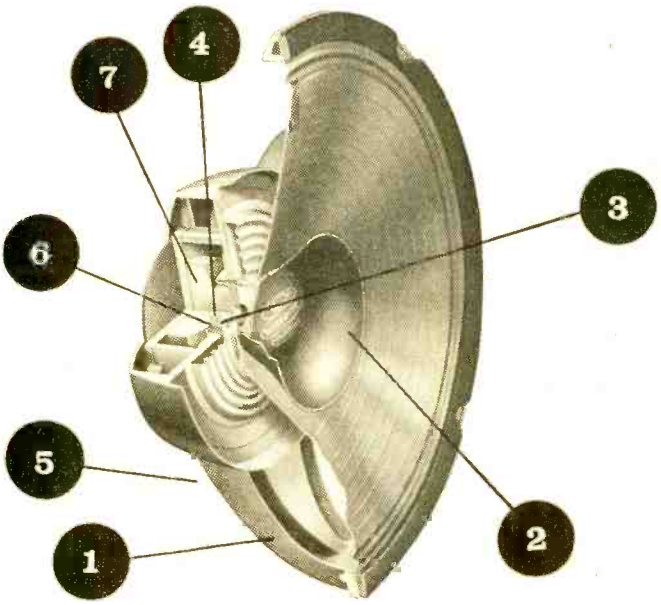
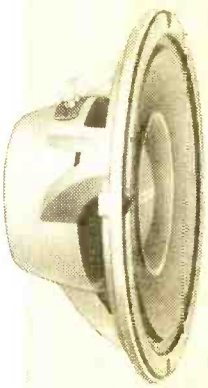


		WOLVERINE LS-12 and LS-8	SPEAKER A	SPEAKER B	SPEAKER C	SPEAKER D
1	Die Cast Frame	Yes	No	No	No	Yes
2	Radox Cone	Yes	No	No	Yes	No
3	Edgewise Wound Voice Coil	Yes	No	No	No	Yes
4	Glass Coil Form	Yes	No	No	No	No
5	Low Silhouette Frame	Yes	No	No	No	Yes
6	Long Throw Voice Coil	Yes	Yes	Yes	Yes	No
7	Slug Type Magnet	Yes	Yes	Yes	No	Yes
	NET PRICE	LS-12 $19.50 LS-8 $18.00	$23.75	$19.50	$33.00	$59.40

SELECT SPEAKER

LS-12 12" Full-Range Loudspeaker **$19.50**

LS-8 8" Full-Range Loudspeaker **$18.00**



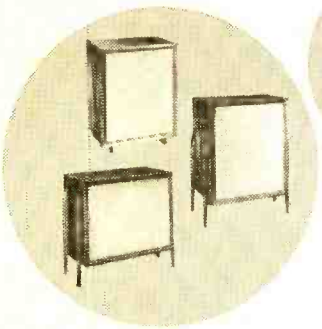
Visit your Electro-Voice dealer. Compare the Wolverine system. Whether you're starting from scratch or converting to stereo, Wolverine components will suit your taste . . . meet your budget. Write for complete Wolverine brochure.

popular-priced components for true high fidelity and superb stereo! Look at the Wolverine feature chart.

Compare the Wolverine Series' quality features with *any* high fidelity speaker or enclosure. And, compare the PRICE! You can actually get a complete stereo system at the price of a single monaural system.

Only Electro-Voice with its corps of 60 engineering personnel and vast precision manufacturing facilities can give you so much more value.

CHOOSE FROM THREE MAGNIFICENT AUDIO-ENGINEERED ENCLOSURES



LORAINE

Direct radiator, folded-horn corner enclosure for 12-inch speakers plus Step-Up Kits. Overall size: 27" high x 20" wide x 14" deep. **$48.00**

LANCASTER

Direct radiator, along-the-wall, *controlled baffle*, for 12-inch speakers plus Step-Up Kits . . . note flexibility for horizontal or vertical use. Overall size: 25" high x 20" wide x 14" deep. **$48.00**

Model LK1 Accessory Legs **$8.00**

The Lancaster, Loraine, and Lindon are finished in Blonde, Mahogany, or Walnut.

LINDON

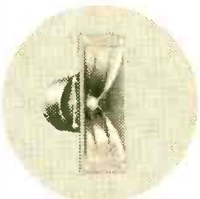
Direct radiator, shelf-type enclosure for 8-inch speakers and 2-way separate speaker systems. Overall size: 11" high x 23½" wide x 10" deep.

$34.50

Lindon also available ready-to-finish. **$29.00**

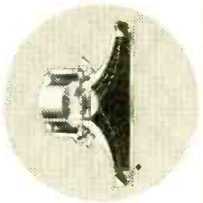
Step up your system with Wolverine treble or high frequency kits.

THEN ADD HF-1 STEP-UP KIT



Extends high frequency performance beyond limits of audibility, for silky precise definition of all string and woodwind instruments. Use with Lancaster, Loraine or Lindon. Includes TW-35 VHF driver and CR-35 crossover network.

$20.00



LATER ADD MF-1 STEP-UP KIT

Gives you complete 3-way speaker system with increased output in vital "presence" range and smooth, peak-free response. Use with Lancaster and Loraine. Includes MR-10 treble driver and CR-10 crossover network.

$25.00

Write to Dept. 69-P

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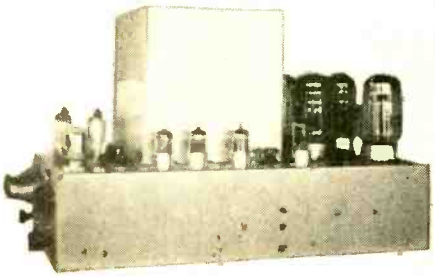
ELECTRO-VOICE, INC., BUCHANAN, MICHIGAN

Letters

(*Continued from page* 12)

few amplifiers in the world with four KT-88's. It weighs 55 pounds. The separate power supply



weighs in at an additional 80 pounds. Results obtained with this equipment have exceeded all my expectations.

C. F. Kirsch
Radio Station Bocas Del Toro
Republica de Panama

After Class Enthusiast

■ This is just to let you know that you have a new fan. I think you have one of the most interesting and informative electronics magazines in its class. Your article on the Wheatstone Bridge in *After Class* was just great, and it cleared up many misconceptions I had about this test instrument in the past. I hope to see more articles on antennas such as "The Vertical Makes a Comeback." And how about more of those short tests such as the "Frequency Quiz?" I had to really think on some of them.

Charles V. Briese
A2C, USAF

Ham Getting Started

■ Regarding the SSS transistor transmitter, August 1958, p. 61, I would like to know if it would be suitable for a first transmitter. If so, I would like to hear some reports on its performance.

Fred R. Welter
Maysville, Mo.

The biggest step a ham can make is getting on the air. Any transmitter is a good "first" transmitter. POP'tronics believes the SSS transmitter is ideal for a beginner.

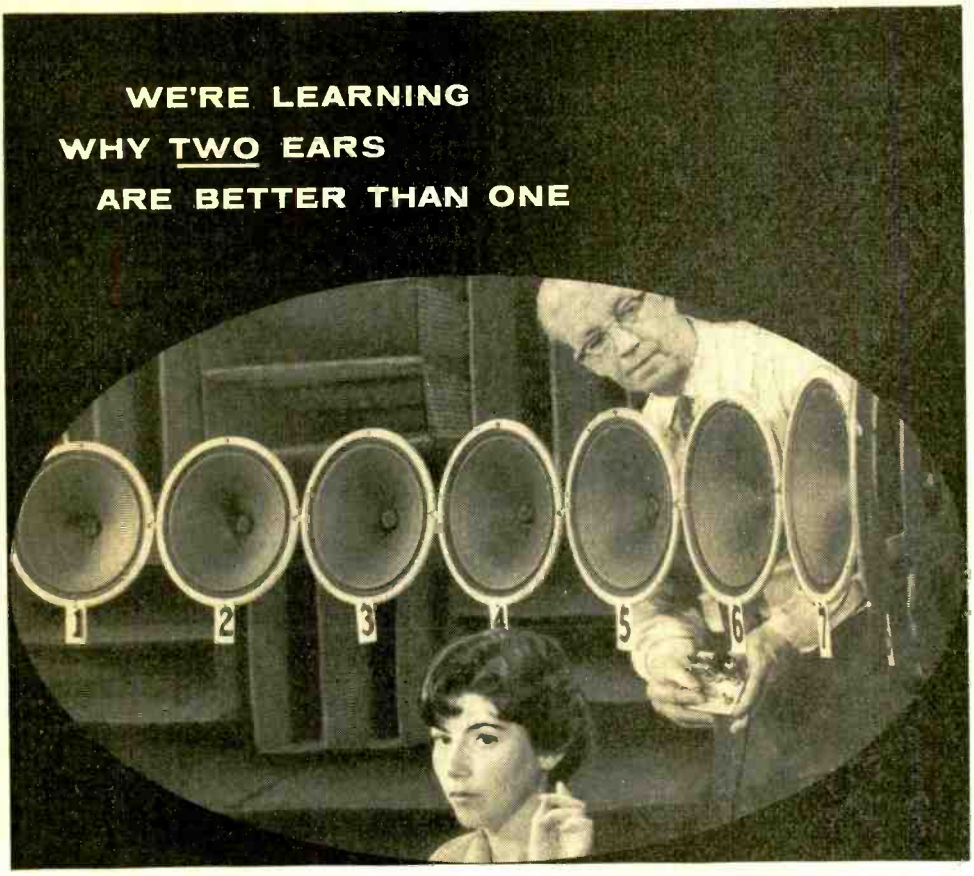
Better Paper

■ I have been reading Popular Electronics for about three years, since I first became interested in electronics, and I think the new glossy pages make a great improvement in its appearance. The photographs are clearer and the drawings are easier to understand.

Wm. W. Gellatly
Portland, Ore.

Will's letter was the first of many letters received commenting on our new paper. The improved paper stock is only one of the planned improvements for POP'tronics. We hope to make each issue bigger and better than ever. —30—

WE'RE LEARNING WHY TWO EARS ARE BETTER THAN ONE



Which speaker is making the sound? In echoless chamber at Bell Labs, Robert Hanson measures test subject's ability to localize sounds — observes how two ears operate in partnership. This and other tests may point the way to better telephone instruments.

In listening to stereophonic music, how is it that our ears and brain construct a picture of the entire orchestra with but two samples (the sounds from two speakers) to work with?

How is it that our ears and brain are able to pinpoint *one* voice in a roomful of talkers—to listen to it alone and ignore the rest?

What makes *two* ears better than one?

Bell Telephone Laboratories scientists are searching for the answers. For, in finding them, better telephone instruments and better ways of transmitting sound will surely result.

Our hearing performs feats that no electronic system can yet duplicate. How? Laboratories scientists believe the secret lies in the way our two ears function in partnership and in the way our neural network connects them with our brain. *The problem:* to discover what functions the network performs and to see whether electronic duplication might enhance understanding.

The work is under way. Electronic circuits that simulate the operation of nerve cells have already been created — and conceptual models of the neural network are being constructed.

Alexander Graham Bell's interest in deafness and hearing led to the invention of the telephone. Bell Laboratories' current explorations in binaural sound may well lead to important new advances in the transmission of speech and music.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

POP'tronics Bookshelf

"FUNDAMENTALS OF NUCLEAR ENERGY AND POWER REACTORS" by Henry Jacobowitz. Published by John F. Rider, Inc., 116 West 14th St., New York 11, N. Y. 144 pages. Soft cover. $2.95.

This is a very clear, non-mathematical explanation of nuclear energy written for the interested layman. Fundamentals of atomic and nuclear physics necessary to an understanding of nuclear reactors are covered, and the theory and construction of power-producing reactors are then examined. The many clear diagrams and photographs accompanying the text add a great deal of interest to this important and exciting subject. If you want a basic understanding of the atom and reactor principles, this is the book for you.

"101 WAYS TO USE YOUR SWEEP GENERATOR" by Robert G. Middleton. Published by Howard W. Sams and Co., Inc., Indianapolis 6, Ind. 138 pages. $2.00.

The first of a new series on how to use test equipment, this book admirably covers the uses of the sweep generator. Although written primarily from a practical standpoint, some theory is included.

As the title implies, 101 uses of the sweep generator are described, with block diagrams showing the required hookups for each. Applications include checking other test equipment, making antenna tests, r.f. and i.f. tests, video, sound, and color-TV tests. This book is recommended to owners of sweep generators who want to get the most out of them.

"WORKING WITH THE OSCILLOSCOPE" by Albert Saunders. Published by Electronic Technical Publishing Co., Inc., Boston, Mass. 93 pages. Soft cover. $4.50.

Most books on the oscilloscope are aimed at the professional or semi-professional in

Learn Electronics

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F.C.C. LICENSE—THE KEY TO BETTER JOBS

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

WHICH LICENSE FOR WHICH JOB?

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

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

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

GRANTHAM TRAINING PREPARES YOU

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

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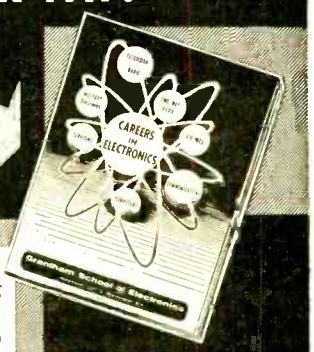
Grantham training is available by correspondence or in resident classes. Either way (residence or correspondence), we train you quickly and well—no previous training required. Even a beginner may qualify for his first class license in a relatively short time.

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

This booklet **FREE!**



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

Upgrade Your Income with a First Class

F. C. C. LICENSE

HERE'S PROOF...

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

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

GRANTHAM SCHOOL OF ELECTRONICS

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

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(Mail in envelope or paste on postal card)

To: GRANTHAM SCHOOL OF ELECTRONICS

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

Gentlemen:

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

Name_____ Age_____

Address_____

City_____ State_____

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

Bookshelf

(*Continued from page* 18)

electronics, and provide information for setting up the oscilloscope in various esoteric circuits to determine phase shift angle, waveform distortion, etc. However, for the beginner, there has been precious little information available on basic functioning: how to turn the scope on and off, focus it, and adjust the trace to observe the desired waveform.

This book, therefore, fills a long-felt need. A perusal of its chapters, and their step-by-step profusely illustrated treatment of the oscilloscope, its functions and operation, cannot fail to clarify the intricacies of this most useful electronic tool for the newcomer. This book deserves a prominent place in the library of every POPULAR ELECTRONICS reader.

"FIFTEEN MINUTES TO STEREO," published by General Electric Co., Auburn, New York. 26 pages. Soft cover. 25 cents.

In non-technical language, this booklet—which is available from your hi-fi dealer—covers the "why" and "how" of stereo hi-fi, stereo components, and typical component system arrangements for varied home settings. It also contains a glossary of stereo hi-fi terms and a basic stereo record guide. Illustrations include simplified diagrams showing recording and reproduction of stereo records, explanatory pictures of components, and diagrams showing speaker placement for best stereo perspective.

"DESIGNING AND BUILDING HI-FI FURNITURE" by Jeff Markell. Published by Gernsback Library, Inc., 154 West 14th St., New York 11, N. Y. 224 pages. Paper cover. $2.90.

In this book, Jeff Markell (a frequent contributor to POPULAR ELECTRONICS) guides the hi-fi fan through such fundamentals of hi-fi furniture construction as what woods to choose and what tools to use, to the highly developed skills of professional finishing, polishing, and retouching. On the way he expounds helpfully on furniture styles, good design, placement, and repair. Although no construction plans are included, this book fills a long empty niche in hi-fi woodworking bibliography. —30—

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TAKE A MINUTE TO MAIL THIS COUPON FOR FREE BOOKLET!

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- ☐ Electronic Engineering Technology
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- ☐ Television Engineering Technology
- ☐ Aeronautical Electronic Engineering Technology
- ☐ Automation and Industrial Electronics Engineering Technology

H1

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Street .....

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

CHECK: ☐ Home Study ☐ Residence School ☐ Korean Veteran

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Employed by .....

Type of Present Work .....

Education:

Yrs. High School .....

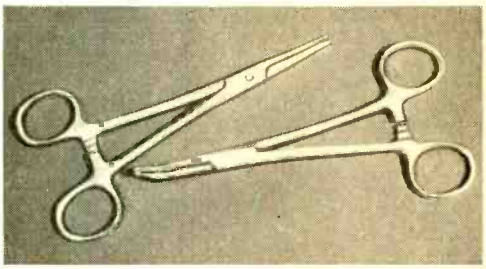
Other .....

Electronics Experience .....

NEW products

"SEIZERS"—A NEW TOOL

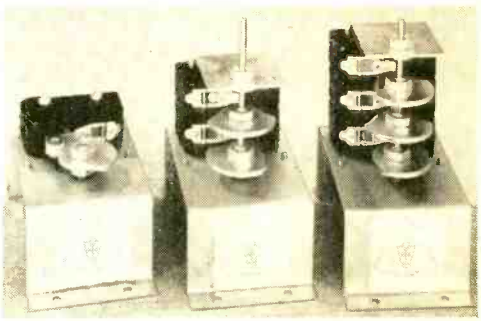
A new type of tool especially designed for working with miniaturized components has recently been announced by *Xcelite, Inc.*, Orchard Park, N. Y. Called a "seizer," it is



similar to a surgical hemostat. It will hold small parts and wires while soldering, and it makes an ideal heat sink. Both long-nose and bent-nose models are available.

TIMER KITS

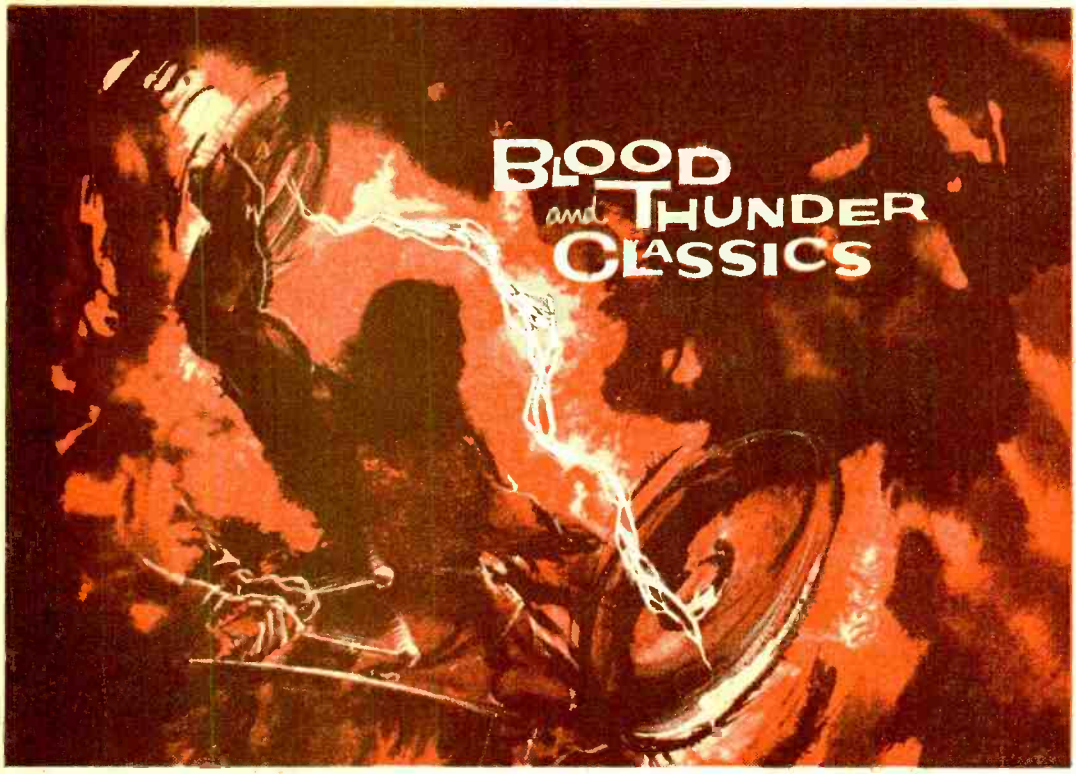
Herbach & Rademan, Inc., 1204-A Arch St., Philadelphia 7, Pa., has added a new series of Harco timer kits to its line. They are available in cycle lengths from 60 seconds up to one revolution per hour for use in process control, life testing, pulsing and flashing. The timers, which can also be supplied completely assembled, use a heavy-



duty, 115-volt, 60-cycle synchronous motor. For complete information and specifications, write to the manufacturer requesting Catalog R.

STEREO ADAPTER

A unique device for converting to stereo has recently been developed by *Bard Rec-*



Audiotape "speaks for itself" in a spectacular recording —available in a money-saving offer you can't afford to miss!

DETAILS OF THE PROGRAM

The stirring "Blood and Thunder Classics" program includes:

Tschaikowski	Russian Dance
Sibelius	from Finlandia
de Falla	Dance of Terror, Ritual Fire Dance (El Amor Brujo)
Brahms	from Symphony No. 4 in E Minor
Khatchaturian	Saber Dance
Stravinski	Infernal Dance of King Kastchei, Finale (Firebird Suite)
Beethoven	Ode to Joy (Symphony No. 9 in D Minor)

DETAILS OF THE OFFER

This exciting recording is available in a special bonus package at all Audiotape dealers. The package contains one 7-inch reel of Audiotape (Type 1251, on 1½-mil acetate base) and the valuable "Blood and Thunder Classics" program (professionally recorded on standard Audiotape). For the entire package, you pay only the price of two boxes of Type 1251 Audiotape, plus $1.

HERE'S a reel of musical excitement that belongs on *every* tape recorder. "Blood and Thunder Classics" is a program of great passages of fine music, specially selected for their emotional impact.

The makers of Audiotape have not gone into the music business. They are simply using this method to allow Audiotape to "speak for itself." This unusual program shows you how vibrant and colorful music can be when it is recorded on *Audiotape*.

"Blood and Thunder Classics" is available RIGHT NOW from Audiotape dealers everywhere. (And *only* from Audiotape dealers.) Ask to hear a portion of the program, if you like. Then, take your choice of a half-hour of rich stereo or a full hour of dual-track monaural sound—both at 7½ ips. Don't pass up this unusual opportunity.

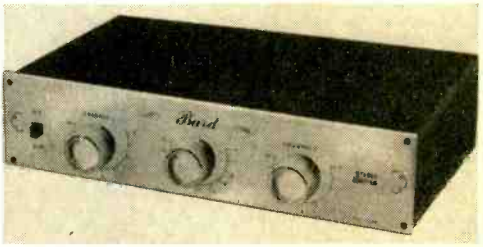
audiotape "it speaks for itself" TRADE MARK

AUDIO DEVICES, INC., 444 Madison Ave., N. Y. 22, N. Y.
In Hollywood: 840 N. Fairfax Ave. • In Chicago: 5428 N. Milwaukee Ave.

products

(*Continued from page* 22)

ord Company, Inc., 66 Mechanic St., New Rochelle, N. Y. The Bard system consists of a preamplifier control unit with a built-in phono oscillator. One of the stereo channels is played on your mono hi-fi system



and the other can be picked up on any broadcast radio. No interconnecting wires to the radio are necessary. The control unit is self-powered and provides channel balance facilities. Price, $29.95, including a ceramic stereo cartridge.

FLYBACK AND YOKE CHECKER

Manco Mfg. Co., 380-A Union St., Manchester, N. H., has a transistorized flyback and yoke checker for TV technicians. A positive check with a measured impedance can be made to determine whether the trouble is with the damper circuit, horizontal oscillator, flyback or yoke. A booklet entitled "Trouble Shooting High Voltage Networks" accompanies the unit. Price, $17.95.

TAPE SPEED CHECKER

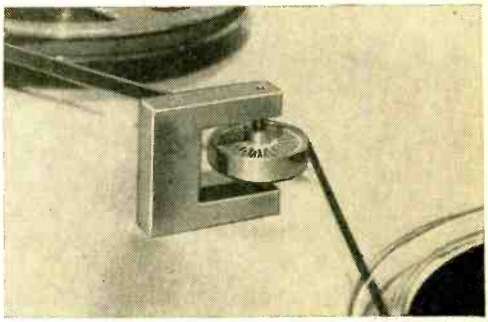
Quick and accurate checking of tape speeds is possible with a stroboscopic device developed by *Scott Instrument Labs, Inc.,* 17 E. 48th St., New York 17, N. Y. Under 60-cycle light sources, markings on

"Yeowie! *Here's* a whole chest full of *Jensen Cartridges!*"

products

(*Continued from page* 24)

the wheel disc of the "Tape Strobe" appear to stand still if the tape is moving past the capstan at correct speeds: 7½ ips, 15 ips,



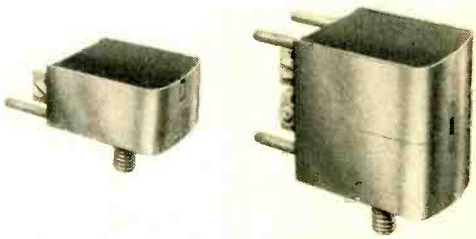
and 30 ips. If the pattern seems to be turning forward or backward, the tape is off speed. Complete with case, $22.50.

RECHARGEABLE FLASHLIGHT

Gulton Industries, Inc., Alkaline Battery Division, Metuchen, N. J., announces the development of a new rechargeable flashlight. The "Life-Lite" never needs battery replacement since it can be recharged by inserting it into an ordinary outlet. Nickel cadmium batteries are used. Price, $5.95.

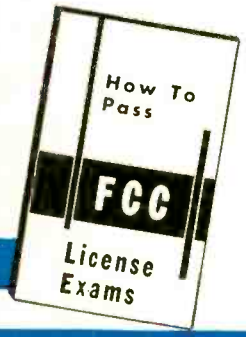
TAPE RECORDER ERASE HEADS

Erase heads designed for use with monaural and stereo two-track and four-track tape systems are being offered by Nortronics. They feature an all-metal face which produces 56 db erasure. Model ME-100, a two-track erase head, is priced at $7.50;



Accredited by the National Home Study Council

How To Pass FCC COMMERCIAL License Exams



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We Guarantee to train you until you receive Your FCC License

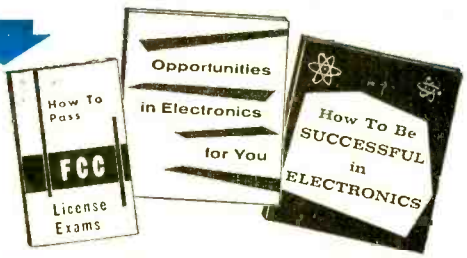
Get all 3 FREE

We guarantee

to train you until you receive

Your FCC license

—or your money back



The Master Course in Electronics will provide you with the mental tools of the electronics technician and prepare you for a First Class FCC License (Commercial) with a radar endorsement. When you successfully complete the Master Course, if you fail to pass the FCC examination, you will receive a full refund of all tuition payments.

Cleveland Institute of Radio Electronics
Desk PE-52, 4900 Euclid Ave., Cleveland 3, Ohio

Cleveland Institute training results in job offers like these:

Radio Operators & Technicians

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.

Service Technician

Man needed in Cleveland, Ohio, to service and maintain electronic medical instruments and equipment. Must have a solid knowledge of electronic fundamentals. A car is required. Company benefits include retirement plan.

And our trainees get good jobs

"Investment in training really pays off"

"Thought you would like to know that in almost two years since I completed your course and obtained my first phone license, my pay has increased $5 per week every six months. I don't believe any other investment could pay off as well as this one did."

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

Cleveland Institute of Radio Electronics
4900 Euclid Ave. Desk PE-52, Cleveland 3, Ohio

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

In what kind of work are you now engaged?

In what branch of Electronics are you interested?

Name Age

Address

City Zone State

PE-52

products

(*Continued from page* 26)

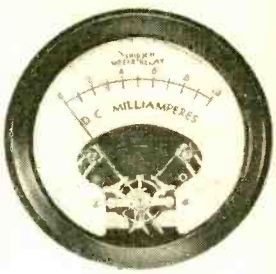
Model SE-100, a stacked stereo two-track erase head, and Model SE-50, for four-track tape systems, are each $12.50, audiophile net. (*The Nortronics Company, Inc.,* 1015 South Sixth St., Minneapolis 4, Minn.)

PRINTED-CIRCUIT REPAIR COMPOUNDS

Technicians and experimenters will be interested in two new Walsco products that facilitate repairs of printed circuits. "Silver Print" and "Copper Print" are liquid compounds that can be used to touch up printed circuits around eyelets, parts, etc. More detailed information is available from distributors or from *Walsco Electronic Manufacturing Co.,* 100 West Green St., Rockford, Ill.

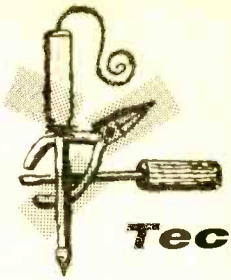
METER RELAYS

Two new panel meter relays—Model 195 (2½") and Model 95 (3½")—are available with microamp, milliamp and millivolt sensitivities, a.c. and d.c. They have varied uses in all types of equipment. For information on specific applications you can write to the manufacturer: *Simpson Electric Company,* 5200 W. Kinzie St., Chicago 44, Ill.



TAPE CLEANER KIT

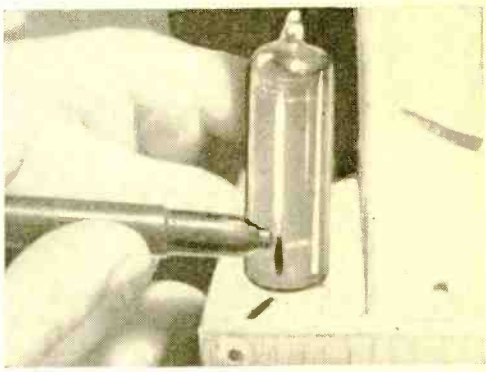
It's much easier to keep your tapes and tape recorder head clean if you use a "Tape-Kare Kit TK-2," offered by *Robins Industries Corp.,* Flushing 54, N. Y. This little kit consists of a specially formulated cleaner for removing dirt, grime, and oxides from recording heads and a tape cloth which rids the tape of foreign particles and lubricates it with a microscopic layer of silicone at the same time. List price, $2.00. —30—



Tips and Techniques

EASY TUBE REPLACEMENT

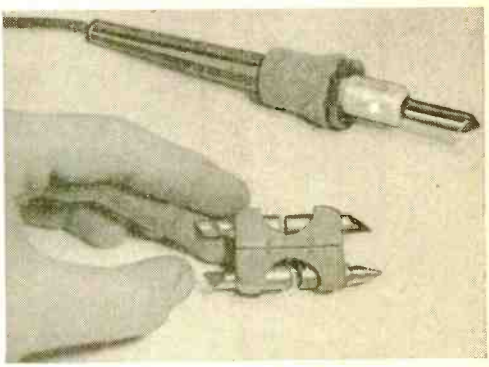
Ever have trouble replacing those multi-prong tubes in TV or radio sets? This worrisome task can be simplified if you mark the tube and the base of its socket



with crayon or lipstick before you remove it. When you replace the tube, simply match the two marks.—*Glen F. Stillwell, Manhattan Beach, Calif.*

HOLDER FOR PENCIL-IRON TIPS

If you have an interchangeable-tip pencil-type soldering iron, digging through your tools to find a particular tip soon becomes a familiar task. It seems as if that



particular tip you need for the job at hand is always hiding from you. Well, try this. Round up all your spare tips and snap them into a snap-on fuse holder. This will keep

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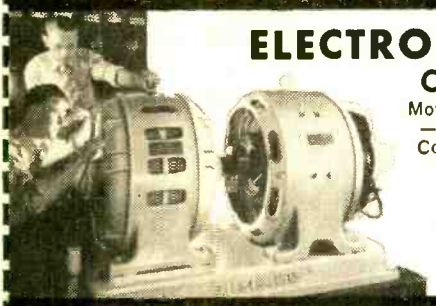

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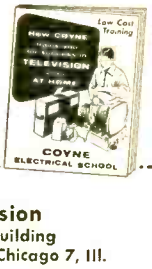

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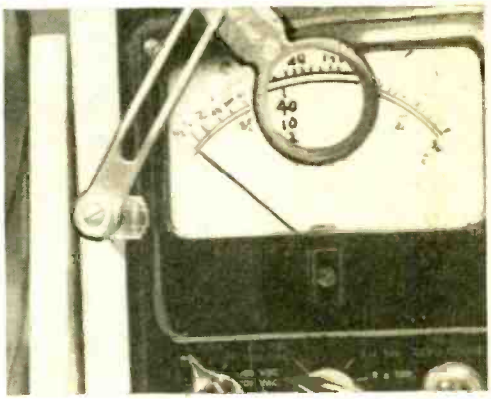
Tips

(*Continued from page* 30)

all your tips together, make selection easier and, most important of all, keep them from getting lost.—*John A. Comstock, Wellsboro, Pa.*

METER MAGNIFIER

An inexpensive plastic magnifier which can be picked up at the dime store makes a wonderful eye-saver when fitted to a



bracket which permits it to be moved over the scales of your meter. The lens shown was one end of a plastic letter opener. The attachment is freely adjustable to cover the entire scale. Although the bracket in the illustration is attached to an external wooden case which holds the meter, you can easily adapt the same idea to your particular type of meter.—*Miles M. Avery, Pharr, Texas.*

GROMMETS IN A JIFFY

If you have a tube of plastic rubber handy, keeping a stock of rubber grommets

is no problem. When you need a grommet, put the wire through the hole in the chassis and apply a bead of plastic rubber around

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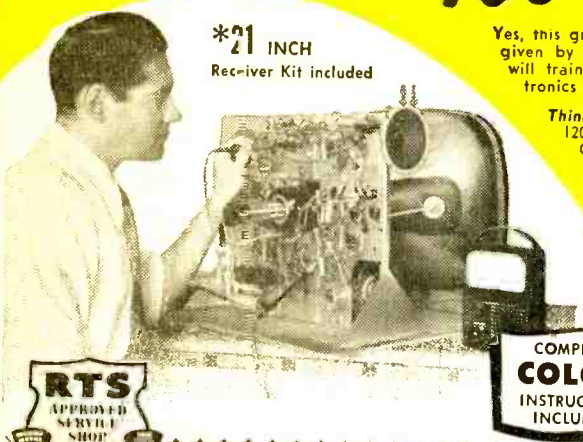

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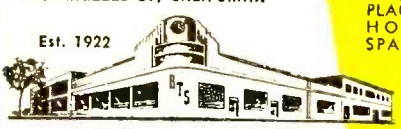

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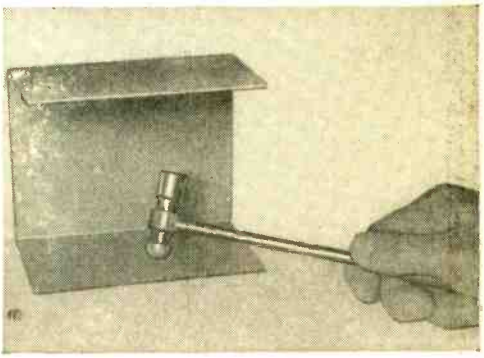
Tips

(*Continued from page 32*)

either side of the hole. The rubber will rapidly dry into a "grommet" that's about as good as a "real" one. Where appearance is of importance, trim the grommet to shape with a razor after it dries.—*John A. Comstock, Wellsboro, Pa.*

CHASSIS BOX REPAIR

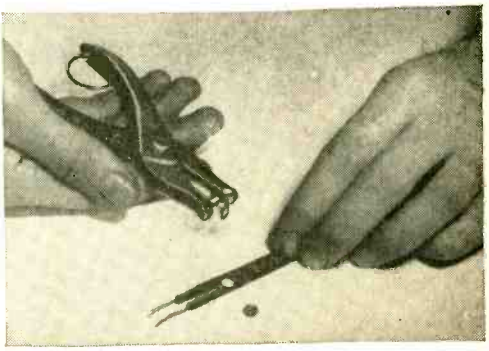
Frequent removal and over-tightening of self-tapping screws in a metal chassis box will ruin the threaded hole for further



use. To repair this damage, simply tap lightly around the edges of the damaged hole with a small ball peen hammer until the hole size has been reduced to about the original diameter. Now the screw can be carefully rethreaded in the hole. Where possible, hammer both sides of the chassis, but try to avoid marring any external surface.—*J. E. Pugh, Jr., Menominee, Mich.*

PREVENT TWIN-LEAD TEAR

To prevent television twin-lead insulation from tearing at the point where the cut terminates, make a hole with a paper



punch as shown. This is especially useful at the antenna end of the line because the insulation is exposed to cold weather, continuous flexing, and is thus more likely to

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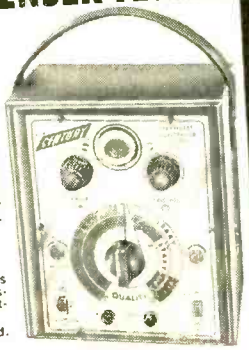
IN-CIRCUIT CONDENSER TESTER

Model CT-1



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Here is 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. . . .

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- 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

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

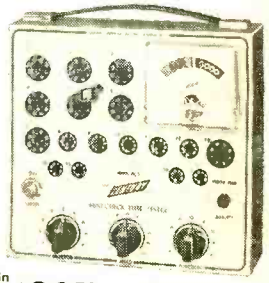
SIZE: W-6" H-7" D-3¼"

SPECIFICATIONS

• 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

MINI-CHECK TUBE TESTER

Model MC-1



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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.

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SIZE: W-9" H-8½" D-2¾"

SPECIFICATIONS

• Checks emission, inter-element shorts and leakage of over 600 tube types. This covers 024s, 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 principles • 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 tubes are introduced.

IN-CIRCUIT RECTIFIER TESTER

Model SRT-1

Checks all power rectifiers in-circuit whether SELENIUM, GERMANIUM, SILICON, etc.

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.

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

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

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

SIZE: W-6" H-7" D-3¼"

SPECIFICATIONS

- 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. . . .

TRANSISTOR TESTER Model TT-2

AN INEXPENSIVE QUALITY INSTRUMENT DESIGNED FOR ACCURATE AND DEPENDABLE TESTS OF ALL TRANSISTORS AND DIODES QUICKLY AND ACCURATELY

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 can develop excessive leakage, poor gain, shorts or opens, the need for TRANSISTOR TESTER is great.

SPECIFICATIONS

• 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 **$24.50** Net

SIZE: W-6" H-7" D-3¼"

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 periodically at no cost.

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No extra probes to buy! The versatile MULTI-PROBE does the work of 4 probes

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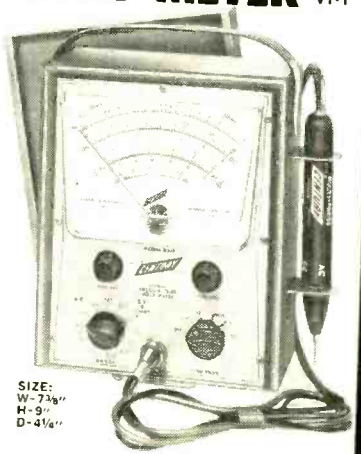
The VT-1 is a tremendous achievement in test equipment. With its unique MULTI-PROBE it will do all the jobs a V.T.V.M. should do without the expense of buying; additional probes. No longer do you have to cart around a maize of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE tip you can set it to do any one of many time-saving jobs. A special holder on side of case keeps MULTI-PROBE firmly in place ready for use.



SIZE: W-7¾" H-9" D-4⅛"

FUNCTIONS

DC VOLTMETER . . . Will measure D.C. down to 1.5 volts full scale with minimum circuit loading, and give accurate readings of scale divisions as low as .035 volts . . . Will measure low AGC and oscillator bias voltages from 1 volts or less up to 1500 volts with consistent laboratory accuracy on all ranges . . . Zero center provided for all balancing measurements such as discriminator, ratio detector alignment and hi-fi amplifier balancing.

AC VOLTMETER . . . True Peak-to-Peak measurements of any wave form including TV sync, deflection voltages, video pulses, audio in hi-fi amplifiers, AGC and color TV gating pulses . . . Scale divisions are easily read down to 1 volts . . . Measures RMS at 1/20th the circuit loading of a V.O.M. . . . Unlike most other V.T.V.M.'s there is no loss in accuracy on the lowest AC range.

ELECTRONIC OHMETER . . . Measures from 0 to 1000 megohms . . . Scale divisions are easily read down to .2 ohms to one billion ohms . . . Will measure high resistance leakage in electrolytic and by-pass condensers.

RF and LO-CAP MEASUREMENTS . . . With these extra VT-1 functions you can measure voltages in extremely high-impedance circuits such as sync and AGC pulses, driving saw tooth voltages, color TV gating pulses, mixer output levels, I.F. stage-by-stage gain and detector inputs.

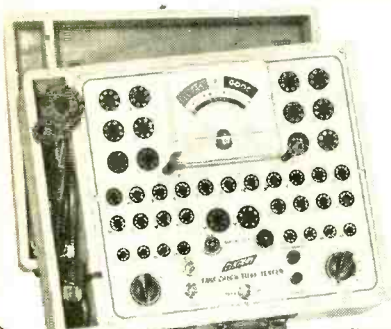
OUTSTANDING FEATURES

● Completely portable — self powered with long life batteries — permits use everywhere ● New advanced pentode amplifier circuit assures amazingly low battery drain ● Large 6" 100-microampere meter, many times more sensitive than meters used in most V.T.V.M.'s ● Laboratory accuracy performance — 2% of full scale on DC, 5% of full scale on AC ● Simplified multi-color easy-to-read 4-scale meter ● No heat operation assures rigid stability and accuracy ● Immune to power line fluctuations ● Amplifier rectifier circuit with frequency compensated attenator — a feature found only in costly laboratory instruments ● Meter completely isolated — practically burn-out proof ● Hand-crafted circuitry eliminates the service headaches of printed circuitry ● 1% resistors used for permanent accuracy ● Separate RF ground return for low-loss RF measurement ● Micro-phone type co-axial connector ● Matching cover protects instrument face — snaps on and off instantly.

SPECIFICATIONS

- DC Volts — 0 to 1.5/6/30/150/300/600/1500 volts
- AC Volts (RMS and Peak-to-Peak) — 0 to 3/12/60/300/1200 volts
- Ohms — 0 to a billion ohms, 10 ohms center scale — Rx1/10/100/1K/10K/100K/1M
- RF — Peak reading demodulator supplied for use on all DC ranges
- Zero Center — available on all DC volt ranges with zero at mid-scale
- Decibels — from —10 Db to +10/22/36/50/62 based on the Dbm unit: 0Db-1MW in 600 ohms
- Impedance — 11 megohms DC, 1 megohm AC, 10 megohms Lo-Cap
- Input Capacity — 130 mmfd. RMS, 250 mmfd. Peak-to-Peak, 25 mmfd. Lo-Cap

Model VT-1 — fully wired and calibrated, housed in handsome hammertone finish steel case, complete with MULTI-PROBE and thorough instruction manual covering all the applications in detail. **$58.50 Net**



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- ✔ Checks for inter-element shorts and leakage.
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City ..... State .....

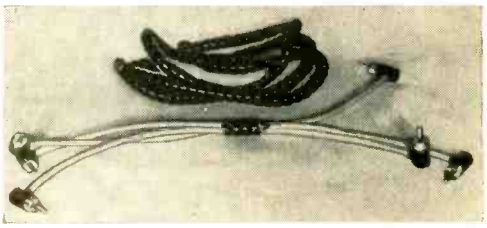
Tips

(*Continued from page 34*)

become brittle and tear after it's been in use for a while.—*James A. Clifford, Detroit, Mich.*

TELEPHONE WRAP HOLDS CABLES

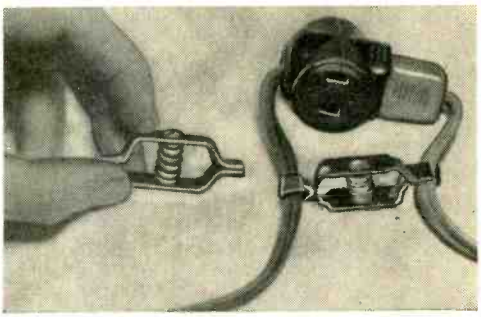
Standard telephone cable wrap can be used to bundle interconnecting cables and other wires that should be kept together



neatly. Simply cut off 1" sections and wrap them around the cables at strategic points. This technique will work well even with underchassis wiring in power supplies, etc. —*Dave Muirhead, New York, N. Y.*

CLIP SOLVES PLUG FALL-OUT

A dual clip (Muller #22) can be used to prevent an a.c. plug from accidentally pulling out of the cube tap of an extension cord. Slight tugs on the cord tend to pull



the plug out of the socket while you are working. This can't happen if you attach a dual clip onto the two cords as shown in the photo.—*Joseph A. Carroll, Brooklyn, N. Y.*

KNOBS FROM LAMP SWITCHES

It is often difficult to find a knob that will go on the shaft of a Vari-Loopstick antenna coil. Suitable knobs can be found on old switches from floor or desk lamps. To use one, just screw it on the shaft. It probably won't fit exactly, but this is to advantage as it prevents the knob from slipping.—*Bob Culter, Oswego, Ore.* —30—

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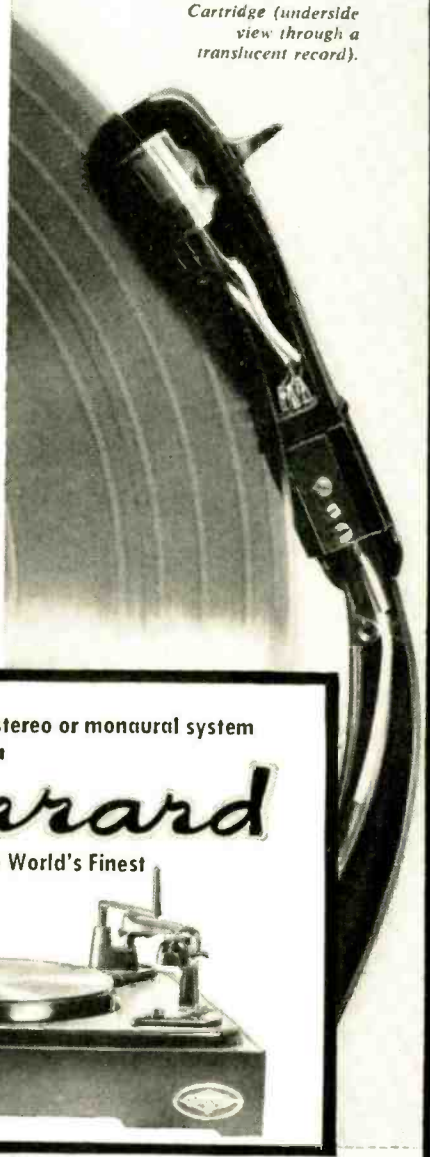
When considering the claims of changers "specifically designed for stereo" or turntables "to play stereo properly", it is well to remember that for years Garrard changers have had *all* the qualities necessary for this type of sensitive reproduction.



Standard Garrard Tone arm with Stereo Cartridge (underside view through a translucent record).

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Mono Integrated Amplifiers: (50, 30, 20, 12-Watt; use 2 for Stereo)
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◀ See Page 38 for EICO'S BEST BUYS in "HAM" GEAR.

By ART ZUCKERMAN

Hams Go Video

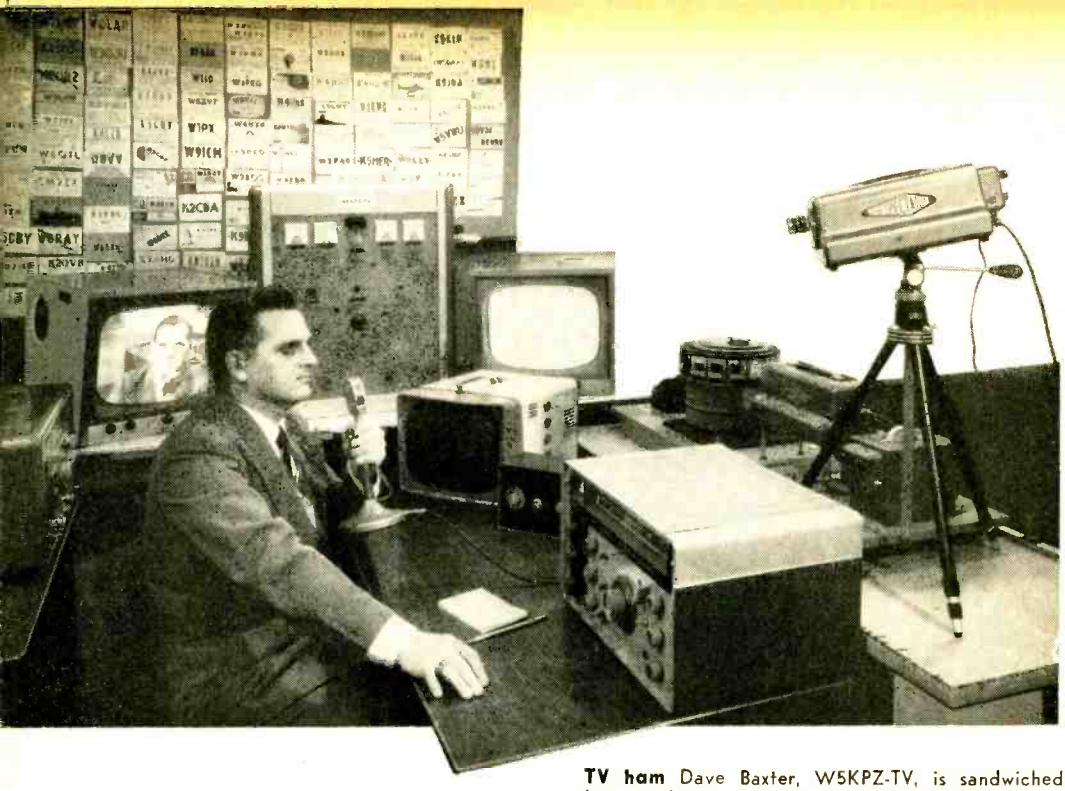
AMATEUR TV—an exciting new hobby

ONE DAY, in the not-too-distant future, the average ham may mean it literally when he asks a distant buddy, "How do you read me?" He will mean *not* "How well do you hear me?" but rather "How clearly can you read my test pattern?"

Ham TV today is admittedly a limited pastime, indulged in by a handful of dedicated adventurers using makeshift equipment. But at least one electronics manufacturer, the Electron Corporation of Dallas, Texas, is determined that things will not always be thus. Mort Zimmerman, the company's president, reasoned that when the Federal Communications Commission set aside the 420-450 mc. band for amateur television back in 1957, it meant for the band to be used. So he is marketing a complete ham video station.

Dave Baxter of Dallas, known in amateur circles as W5KPZ, is using the new equipment to telecast to several other Dallas amateurs whose TV sets are equipped with special u.h.f. converters to receive him. And in Denver, two ham clubs are buying the Electron Corp. gear on time, paying for it with a $6 monthly membership assessment. The cost of the complete package at present is $2895.

Ham TV Pioneers. Though such commercial gear should do much to popularize ham TV, amateur television has been with us longer than you might think. Its roots can be traced to the earliest days of video experimentation. And just before World War II, the Radio Corporation of America actively encouraged amateurs to jump on the television bandwagon it was then striving to get on the road. With the war, television went into mothballs for five years. But when it ended, the Armed Forces unloaded tons of surplus radar and other electronic gear.



TV ham Dave Baxter, W5KPZ-TV, is sandwiched between his gear. Dave works out of Dallas, Texas.

Some of the Armed Forces' surplus gear was snapped up quickly by a few of the more enterprising radio amateurs. Many of these hams were operating on the West Coast, where probably the greatest concentration of video hobbyists can be found today. On clear, bright days, small groups of these intrepid pioneers can be seen climbing up neighboring mountains, loaded down with equipment with which to exchange test patterns and live images.

For transmitters these hardy hams generally use modified radar gear, though some build their own. The pickup equipment is likely to be a primitive iconoscope camera originally built for wartime guided bombs, a Buck Rogers type weapon tried by the Army Air Forces toward the close of World War II.

Unfortunately, these surplus iconoscope cameras provide considerably less than good picture quality, and they gobble up light much too greedily. So the average member of the tiny TV ham fraternity is more likely to content himself with transmitting slide shows. For this he uses a setup known as a flying spot scanner.

Flying Spot Scanner. This interesting device is actually made up of two separate items: an ordinary TV receiver and a photoelectric multiplier tube, such as the 931A. Together with a video amplifier and a video transmitter, the flying spot scanner makes a dandy gadget for televising still transparencies. Here's how it operates.

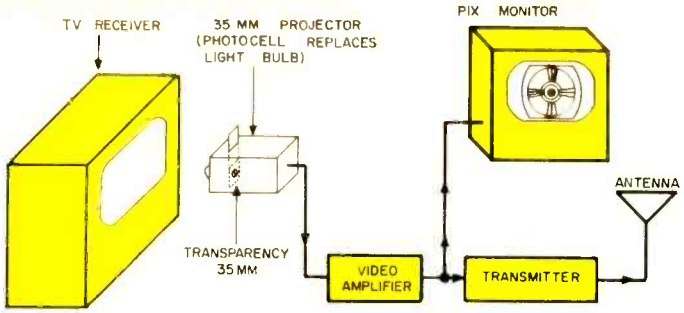
The TV set is tuned to an unused channel, so that its screen is lit up with the swept trace lines but shows no picture. Its brightness control is turned up as far as possible. Next, a slide or other transparency is placed against the face of the picture tube, and the set is adjusted until the trace lines just fill the part of the tube covered by the slide.

Now the photoelectric multiplier is placed right in front of the slide. The light hitting the photocell, after going through the transparency, is not just a blob of illumination; it is actually the scanning action of the picture tube's electron gun. As this light hits the photoelectric tube, it generates a signal that is fed to the video amplifier. The video amplifier, in turn, feeds either a monitor set, a video transmitter, or both.

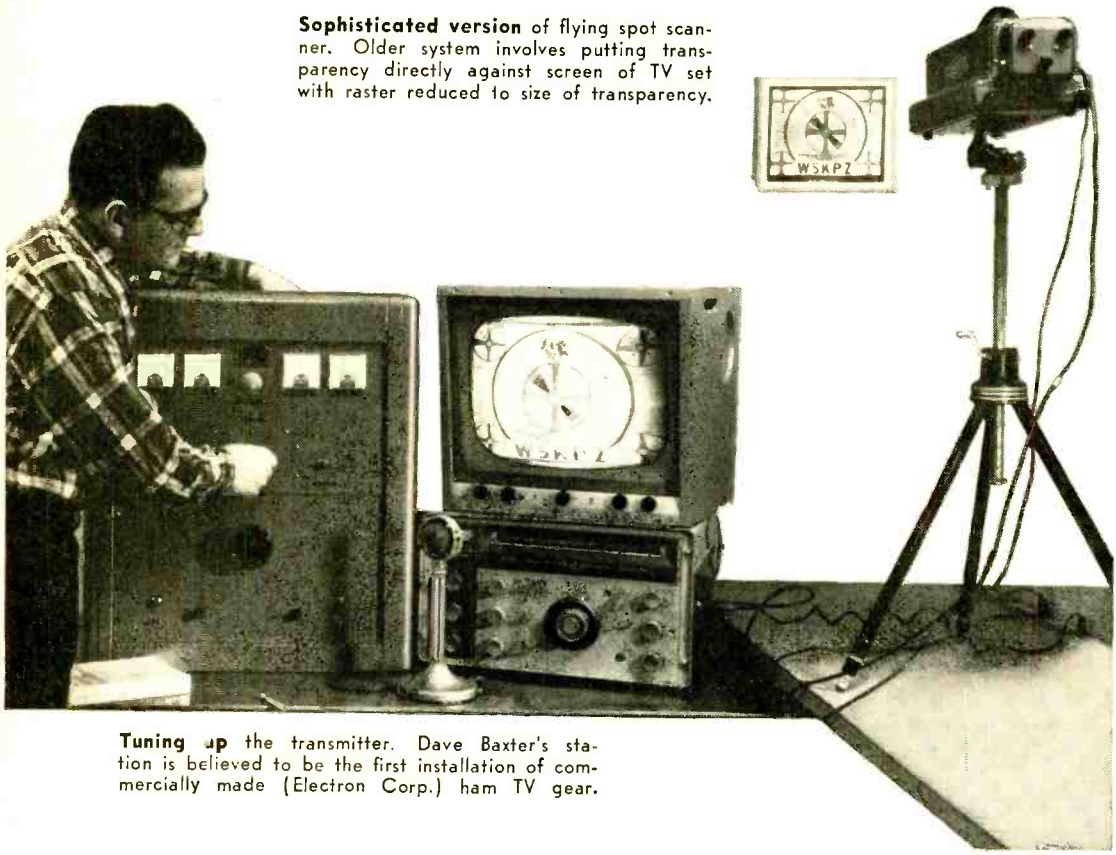
Result: a neat reproduction of the transparency on the monitor and on the receiving set of another ham.

This technique can also be used to produce positive images with photographic negatives if their phase is reversed in the video amplifier.

Two Typical TV Hams. Many of today's television amateurs, as might be expected, are actually professional electronics



Sophisticated version of flying spot scanner. Older system involves putting transparency directly against screen of TV set with raster reduced to size of transparency.



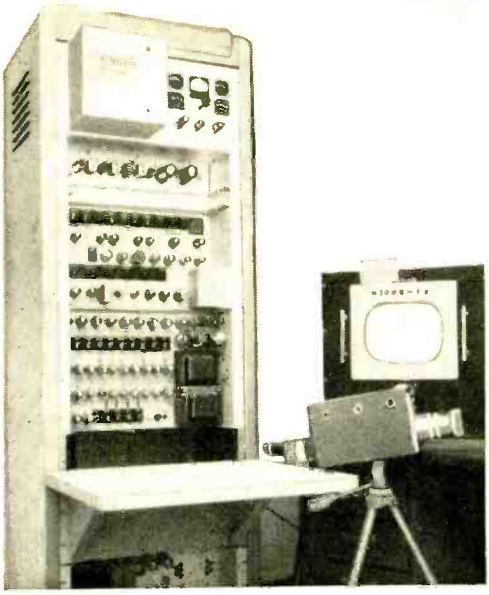
Tuning up the transmitter. Dave Baxter's station is believed to be the first installation of commercially made (Electron Corp.) ham TV gear.

engineers who like to tinker with video in their spare time. In New York, for example, two TV hams are Arnold Proner, W2OMU, a television broadcast engineer with the National Broadcasting Company, and Bill Ziner, W2MMY, an engineer in the research department of the Lewyt Corporation.

Working together, Arnie and Bill actually built their own vidicon cameras and amplifier-transmitter gear from the ground up, copying standard circuits in commercial use. The cameras are patterned after an old RCA vidicon design used for televising motion picture films.

For optics, Arnie Proner uses an *f*/1.9 50-mm. lens from a Leica camera. "It gives a slightly telephoto effect on the vidicon," he will tell you, "but it does a pretty good job."

Before Bill Ziner graduated to the vidicon, he had worked out a really sweet version of the flying spot scanner. "I took an old 35-mm. projector and rewired it, replacing the lamp with a photoelectric multiplier tube," he relates. "So I had a perfect slide changer setup for my transparencies. Then I simply filled my entire TV picture tube with scanning lines and focused the slide projector on its face. I worked out the



Home-built rig of Arnold Proner, broadcast engineer for NBC, includes rack-mounted amplifier-transmitter, vidicon camera, and monitor. Most of the equipment is similar to early commercial circuitry.

focus by the focal length of the projector's lens and checked it on the monitor. Airing slides with this rig was just like putting on a regular slide projection show, only the process was reversed."

Vidicon Simplifies Matters. The vidicon cameras turned the flying spot scanner into a child's toy for Bill and Arnie. They still sent each other test patterns and other slides in transparency form, but now they were also sending live pickups with ease. And transmitting slides was a much easier project.

They did it in two ways. Either they projected the slide on a wall and turned the vidicon camera on the projection or they aimed a slide projector right into the vidicon camera's lens. This would give a reverse image which was then corrected by electronic flopping in the amplifier.

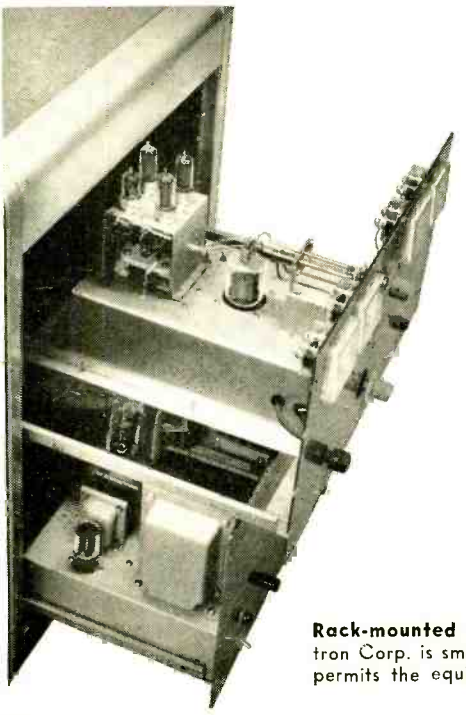
Arnie also succeeded in transmitting movies. He did this by beaming an 8-mm. projector on a screen made of translucent material and spotting the vidicon behind the screen. The vidicon picked up a reverse image from the rear of the screen, and the image was electronically flopped.

Because their gear was not fully refined, Arnie and Bill found that they had to take turns transmitting to one another on video. Their transmitters completely blanked out their own receivers. But this was normal radio practice and presented no problem.

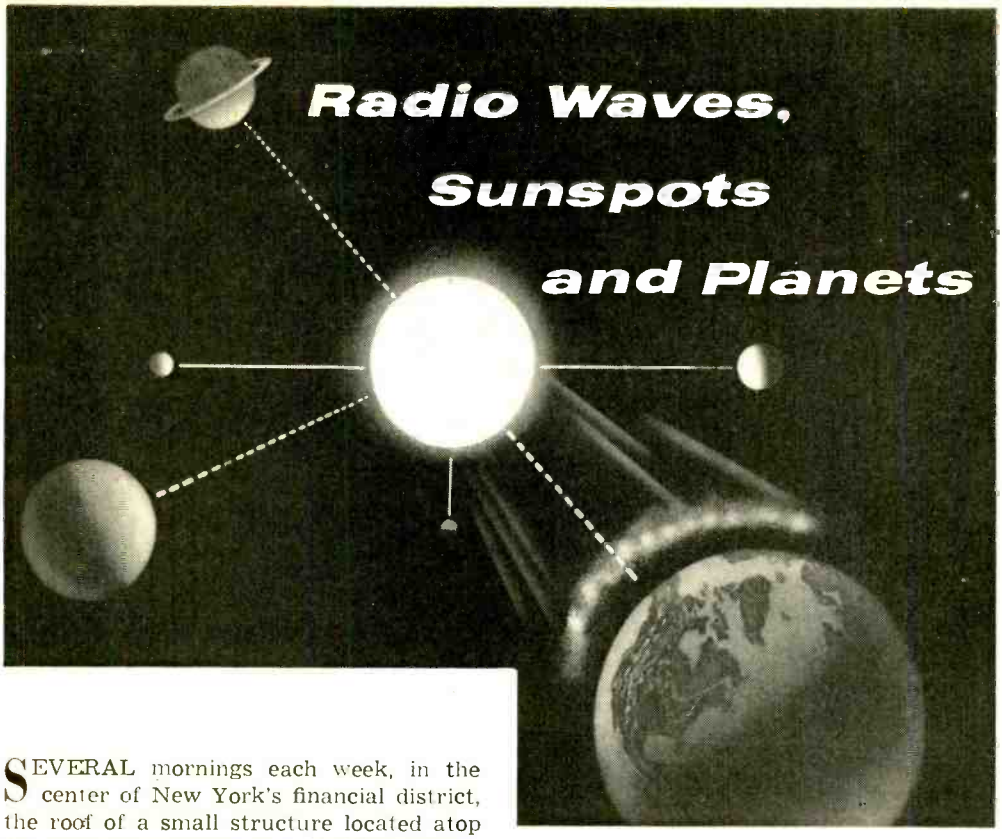
Arnie's gear once was put to a very practical use when he and his wife couldn't corral a baby-sitter while they made a short visit next door. Arnie trained the vidicon on his sleeping infant and Bill did the baby-sitting electronically at a distance of ten miles.

Commercial Equipment. Ham television is characteristically a strictly video proposition; because hams have radio transmitters and receivers anyway, there is no need for TV audio circuitry. And amateur TV, as practiced by these pioneers, is primarily a builder's hobby. There are few other video hams within reach of their short-range equipment, and the challenge is mainly one of seeing if they can put together workable rigs.

(*Continued on page* 128)



Rack-mounted ham TV transmitter manufactured by Electron Corp. is small enough to sit atop a desk. Use of slides permits the equipment to be adjusted and serviced easily.



New techniques aid in predicting radio weather

By SAUNDER HARRIS
W1NXL

SEVERAL mornings each week, in the center of New York's financial district, the roof of a small structure located atop the RCA Communications building swings open. A hovering helicopter could then see Mr. John H. Nelson, a serious-looking man with thinning hair, assume his place behind a six-inch refracting telescope. Mr. Nelson, an expert in electronics and astronomy, has one of the most specialized and unusual jobs in the world; he is a propagation analyst.

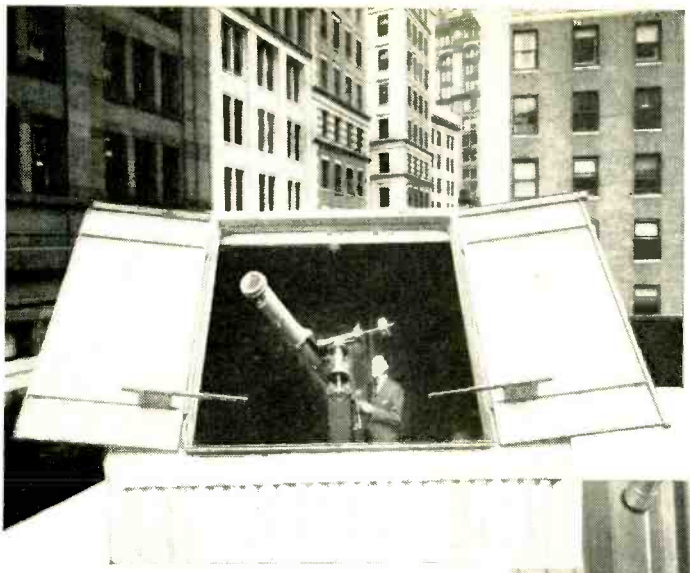
What, exactly, does a propagation analyst do? Well, Mr. Nelson forecasts the radio weather, or, in more scientific terms, he predicts the magnetic condition of the ionosphere, a major factor in the propagation of radio waves over long distances. To demonstrate the practical value of knowing what the radio weather will be, let's take a typical example.

Transatlantic Message. Suppose we want to send a message from New York to London. Normally, this message would be transmitted from the RCA station at Rocky Point, N. Y., directly to London. But today, let's say, Mr Nelson has predicted that conditions will be bad over the direct New York - London route.

So, after consulting one of Mr. Nelson's charts, we decide to reroute the message over an alternate path which is free of ionospheric disturbances. Instead of taking the direct route, we send the message through traffic relay points at Paramaribo on the northern coast of South America, or at Tangier in North Africa. From these points the message is relayed to its destination in London.

This rerouting takes advantage of normally ideal north and south transmitting conditions. Thus, rather than being chopped up and garbled because of unfavorable ionospheric conditions, thanks to Mr. Nelson's advance warning, our message gets to London clearly, accurately, and on time.

Radio Propagation. To appreciate the importance of knowing the condition of the ionosphere in predicting radio weather, it



Propagation analyst John H. Nelson is shown at his observatory (above) in the heart of New York City's financial district. In photo at right, Mr. Nelson uses solar map to study sunspot activity.

Illustrations courtesy of RCA Communications

is necessary to understand how a radio wave is propagated through space and what part the ionosphere plays in this process. The ionosphere extends from about 40 to 200 miles above the Earth and is composed of a fantastic number of "free" electrons which have been knocked loose from their atoms by ultraviolet rays, cosmic rays, and solar radiation. This gigantic electron sea floats high in our atmosphere, and, like its watery counterparts on Earth, it has tides, storms, and currents.

If conditions within the ionosphere are right, when a radio wave from a transmitter strikes it, the wave will be bounced back in much the same manner that light rays are reflected by a mirror. Thus, the radio wave can be returned to the Earth at a considerable distance from its point of origin (see Fig. 1). Long-distance radio communication would be impossible without this reflecting action of the ionosphere.

The next question is: how does a propagation analyst know when the ionosphere is going to reflect the radio wave properly?

Charting the Planets. Amazing as it may seem, Mr. Nelson predicts the condition of the ionosphere, and thus, the radio weather, by charting the positions of the planets. He first began to study radio wave propagation in 1946, at which time he was able to achieve 80% accuracy on 24-hour forecasts by basing predictions on sunspot observation. In spite of the apparent success of the sunspot prediction method, however, he felt that the condition of the ionosphere was determined *not only* by sunspots, but also by the relative positions of the planets as they circle around the sun.

Later investigation proved this theory to be correct. As a result of studying planetary positions in addition to sunspot activity, Mr. Nelson's forecasts are now 90% accurate for 30-hour periods. His long-range forecasts, covering periods of 36 days, are 80% accurate.

Pluto's angular relationship with the other planets is exceptionally significant in its effect on the radio weather, according to Mr. Nelson. During the International Geophysical Year, which began on July 1, 1957,

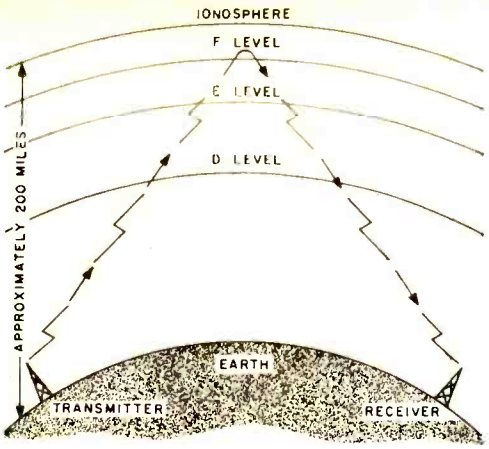


Fig. 1. Radio waves are reflected back to Earth by the action of the ionosphere, thus making possible long-distance radio communications.

and ran through December 31, 1958, there were six very severe magnetic storms and radio disturbances. Analyzing his data, Mr. Nelson found that the positioning of Pluto at a critical zero angle—three times with Venus and once with Mercury—showed up on four of the six disturbances. Since Pluto's mean distance from the sun is 3,671,000,000 miles, its influence would seem to be far-reaching indeed.

Important Relationships. The results of Mr. Nelson's plottings of the planetary positions over more than ten years of research have brought to light six important facts about the relationships of the planets and radio conditions on Earth. These are the significant relationships which he uses in making forecasts, and may be summed up as follows:

(1) Best radio reception periods occur when Saturn and Jupiter are 120° apart.

(2) The most severe disturbances occur when Mars, Venus, Mercury and the Earth are in critical relationship near points of the Saturn-Jupiter configuration.

(3) When two or more planets are at right angles to each other, or in line on the same side of the Sun, or in line with the Sun between them, magnetic disturbances occur more frequently on the Earth's surface. (See Fig. 2.)

(4) When the planets have moved away from their critical relationship, there is a corresponding decline in the severity of the magnetic weather.

(5) Three planets equally spaced at 15°, 30°, 60°, or 120° have a tendency to produce disturbed radio signals if two of the planets are fast-moving and one is a slow-moving planet, or if all three are fast-moving planets.

(6) Three planets equally spaced at 60° and four planets equally spaced at 60° will disturb radio signals if at least two or more of the planets are fast-moving. If three or more of the planets in this arrangement are slow planets, no disturbance will occur.

Successful Predictions. Mr. Nelson does not attempt to explain *why* these things happen as they do. What he has learned from his study is that they *do* happen. Proof? His predictions are successful!

In making a forecast, Mr. Nelson starts by calculating the positions of the planets with respect to each other. When a significant combination of angles is indicated, he then calculates the positions to plus or minus 6 minutes of arc for each hour of the day. It is this data which allows him to make the forecast.

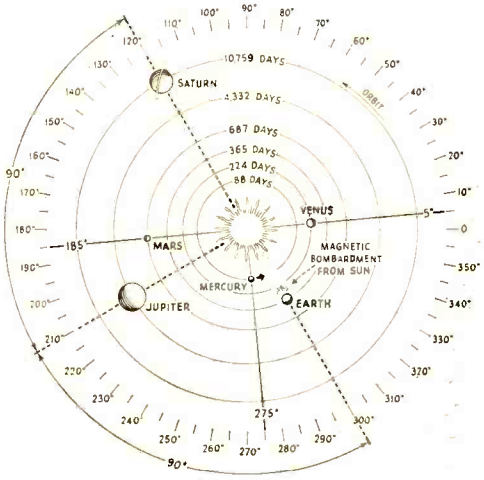


Fig. 2. When Saturn, Jupiter, and the Earth are at 90° to each other, magnetic storms appear on Earth and radio reception is poor. Drawing on page 45 is artist's conception of this relationship.

The implications of John Nelson's work with the planets and radio waves leaves one with the impression that planetary positions might be important in other phases of our lives. Perhaps the ancients' superstitious study of the heavens deserves re-evaluation by those of us interested in modern science. —30—

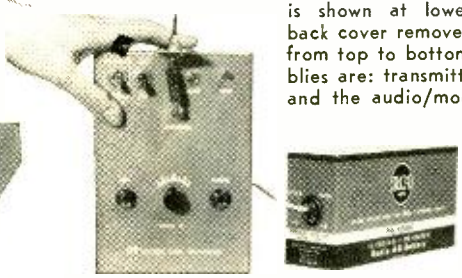
Build a Citizens Band Transceiver

A "walkie-talkie" with simplified semi-kit construction puts you on the air—person to person

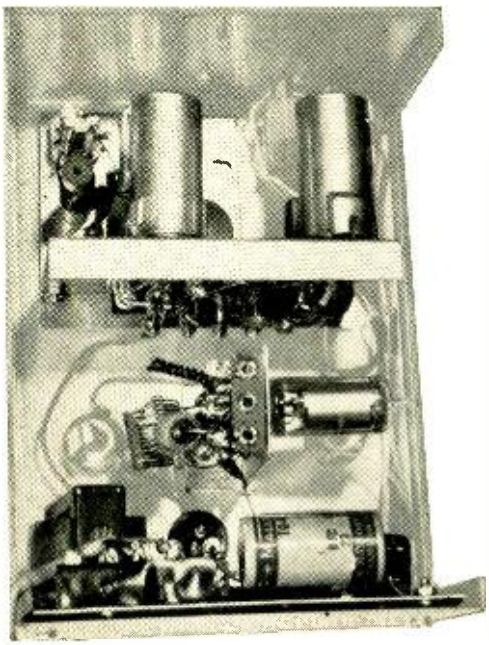
By **DONALD L. STONER,** W6TNS

REMEMBER the "Walkie-Talkie" of World War II fame? How would you like to have your own compact transmitter/receiver that will let you "keep in touch" wherever you go? You say you don't have an amateur license? Don't let that bother you, because the recent opening of the 27-mc. Citizens Band by the FCC makes it possible for *anyone* (except minors and aliens) to own and operate a transmitter without a ham ticket. So here's the P.E. "Citizens Talkie" transceiver—designed for battery operation in your car, boat, or at any fixed location where line power is unavailable.

The Citizens Talkie has a range of 2-5 miles when communicating with a fixed station using an *outside* antenna. The distance you can cover with a pair of these units using a whip antenna will be something more than one mile. On a high spot (such as on a hill top), the range is unpredictably good.



Completely assembled unit is shown at lower left with back cover removed. Reading from top to bottom, subassemblies are: transmitter, receiver, and the audio/modulator unit.



Ordinarily, the construction of a transceiver would be quite an undertaking. However, several innovations make this job as painless as possible. The transceiver is divided into three sections and the connections between the sections are "coded" for easy identification. Thus, you can build a section at a time and ease the wear and tear on both brain and budget.

The major portion of the transceiver, the transmitter section, can be purchased wired and tested, or as a kit which includes all

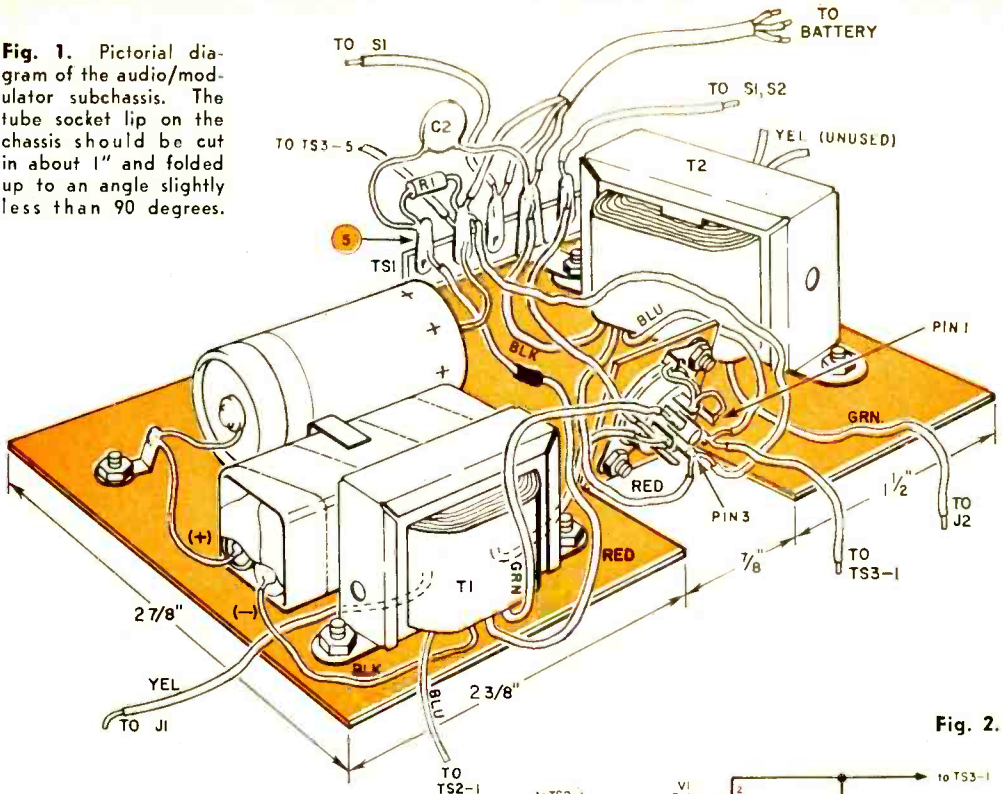
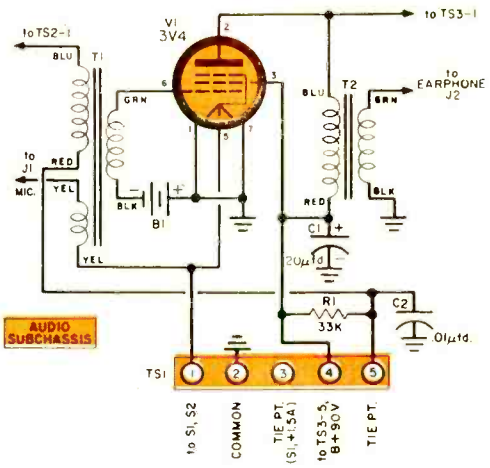


Fig. 1. Pictorial diagram of the audio/modulator subchassis. The tube socket lip on the chassis should be cut in about 1" and folded up to an angle slightly less than 90 degrees.

Fig. 2.



the parts listed alongside the transmitter schematic. This subassembly (available from International Crystal Mfg. Co., Inc., 18 N. Lee, Oklahoma City, Okla.) is a new development intended for Citizens Band or radio control applications.

CONSTRUCTION

Start by cutting the audio and receiver subchassis from a piece of Reynolds "do-it-yourself" aluminum as in Figs. 1 and 3. Punch all tube socket and other holes first. Then cut a slot in the audio chassis on each side of the tube socket hole and bend this "lip" up to an angle of 15° from the vertical. File the edges and steel-wool the aluminum for a neat appearance.

Terminal strips *TS1* and *TS2* are made from a standard 8-lug Cinch-Jones strip. Hold it with the two mounting feet toward you and cut it squarely between the third and fourth lugs from the left. The left section will have three lugs and the right section will have five lugs.

Prepare the bias battery (*B1*) by taping four miniature penlight cells together and connecting them in series. Solder a lead from the positive terminal of one battery to the negative terminal of the adjacent bat-

AUDIO SUBCHASSIS PARTS

B1—6-volt bias battery (four RCA VS074 cells wired in series)
C1—20-μfd., 150-volt electrolytic capacitor
C2—.01-μfd. disc ceramic capacitor
J1, J2—Open-circuit phone jack
R1—33,000-ohm, ½-watt resistor
T1—Transceiver transformer with plate, grid and microphone winding (Triad A-21X)
T2—Plate-to-phones or line transformer (Triad A-23X)
TS1—Terminal strip (Cinch-Jones 56C) (see text)
V1—3V4 tube
1—7-pin miniature tube socket
1—Headphone set (2000 ohms)
1—Carbon microphone

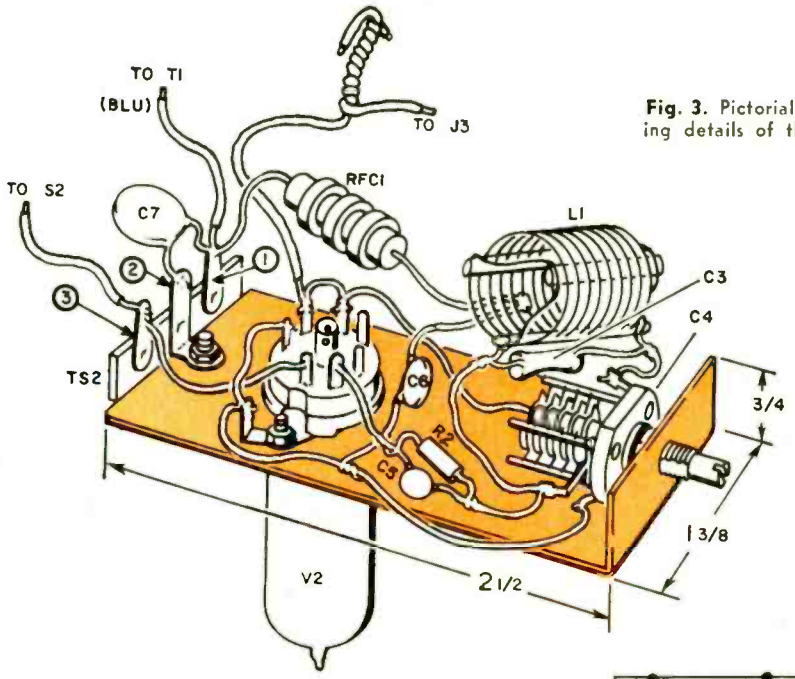
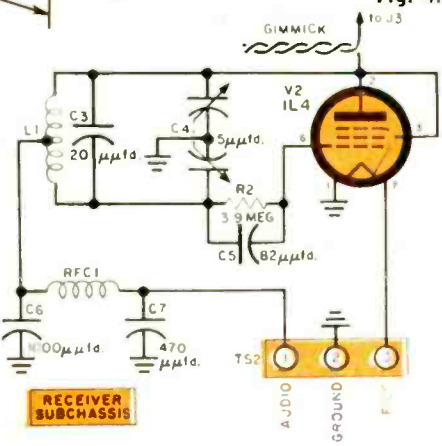


Fig. 3. Pictorial diagram showing wiring details of the receiver assembly.

RECEIVER SUBCHASSIS PARTS

C3—20 μμfd.
C4—5-μμfd. butterfly variable capacitor (E. F. Johnson Co. 5MB11)
C5—82 μμfd. *All capacitors disc ceramic,*
C6—.001 μfd. *200-volt rating or higher*
C7—470 μμfd. *unless otherwise indicated*
L1—11 turns of #24 wire 5/8" diameter, 16-turns per inch (Air Dux #516)
R2—3.9-megohm, 1/2-watt resistor
RFC1—2.5-mh. iron core choke (Miller #6302)
TS2—Terminal strip (Cinch-Jones 56C) (see text)
V2—1L4 tube
1—7-pin miniature tube socket

Fig. 4.



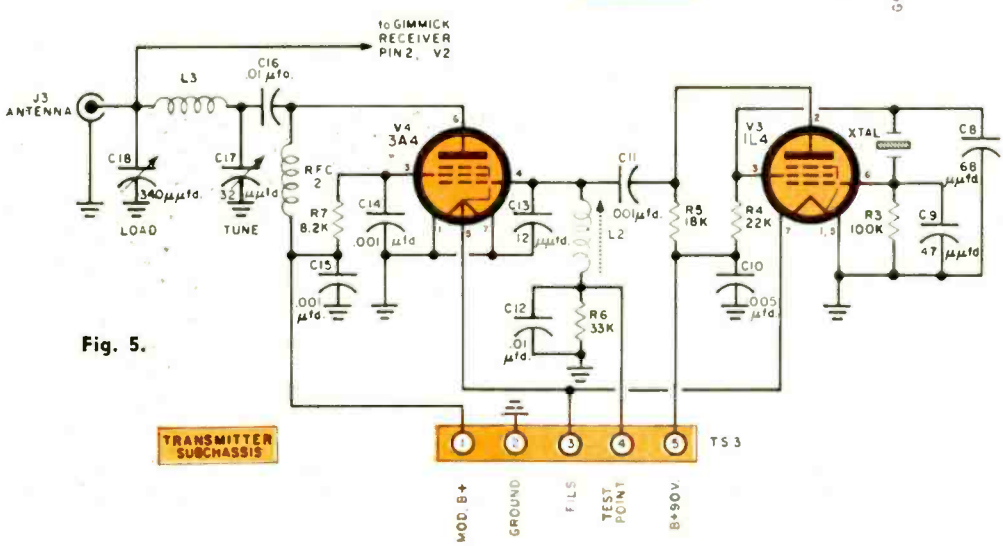


Fig. 5.

tery until you have two remaining terminals, a positive and a negative. Check the voltage between the terminals—it should read about six volts.

The audio section is constructed first. Mount transformers *T1* and *T2* with 4/40 hardware with the 5-lug terminal strip (*TS1*) installed under the front mounting bolt of *T2*, as shown in Fig. 1. Secure the batteries next to *T1* with a bracket made from a ½" aluminum strip. (The remaining holes are used later for fixing the chassis to the cabinet.)

Now wire the audio circuit as in Figs. 1 and 2. Lead length is not critical but the parts placement shown should be most convenient.

Make sure to connect the color-coded leads of *T1* correctly: black to negative terminal of penlight cells, green to pin 6 of *V1*, red to *TS1-5*, and one of the yellow wires to pin 5 of *V1*. The remaining yellow and blue wires are connected later.

Connect the color-coded leads of *T2* in a similar manner: red to pin 3 of *V1*, blue to pin 2 of *V1*, black to ground. The green lead is later connected to *J2*. Clip the unused yellow wires short.

Complete the audio unit by connecting the battery three-wire cable. Connect one wire to *TS1-2* and label it *Common*. Connect the second cable wire to *TS1-3* and label it +1.5*A*. Connect the remaining wire to *TS1-4* and label it +90*B*.

The receiver section, which is shown in Figs. 3 and 4 is simple and can be constructed very quickly. The circuit consisting of *L1*, *R2*, *C3*, *C4* and *C5* is wired separately, before being mounted on the receiver chassis.

Prepare the Air Dux coil (*L1*) so that you have 11 turns with 1" leads on each end. Solder the 20-μμfd. capacitor (*C3*) tight across the coil with short leads. Locate the exact center of the coil (5½ turns) and depress the adjacent turns slightly. Tin this center-tap so that *RFC1* and *C6* may be easily connected later. Solder the coil leads to the two stator terminals of capacitor *C4* and connect a 2" length of bare wire to the single rotor terminal.

Mount the tuned circuit assembly by *C4*'s mounting nut; this nut should be only finger-tight as it will be removed later and used to mount the entire receiver subchassis to the cabinet panel.

The transmitter (Fig. 5) should be wired at this time, unless you purchased the unit prewired. Instructions are included with the kit and you should have no trouble if you follow them carefully. When the transmitter is completed, connect an 8" wire to the terminal designated *Filament* (*TS3-3*) and label it as such. The *B*+ (*TS3-5*) and *Modulated B*+ (*TS3-1*) terminals will be connected later.

The cabinet should be prepared next. Check the placement shown against your subassemblies (particularly the transmitter) for they fit quite closely.

Drill all holes, except the three (*Load*, *Tune*, and *Antenna*) associated with the transmitter. Then install *J1* and *J2* in ½" rubber gommets; you may have to push a bit, but the nuts will go on. Mount *S1* and *S2* with *S1* nearest the center of the chassis and wire as shown in Fig. 6.

Install the audio chassis in place with sheet metal screws through the bottom of the chassis box and wire this unit into the complete unit, following Fig. 7.

INSTALLATION

Now, let's head down the home stretch by installing the receiver subchassis. Remove *C4*'s mounting nut and mount the

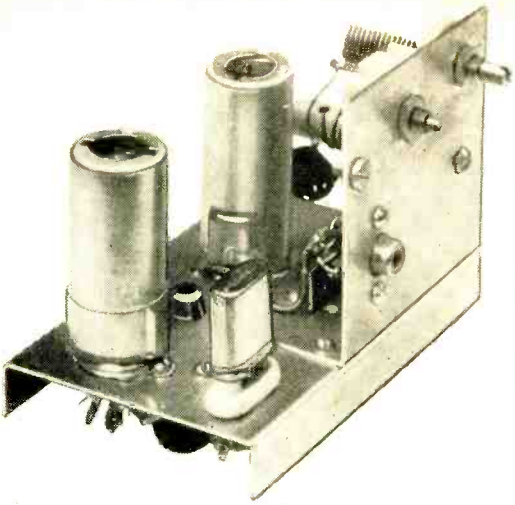
TRANSMITTER SUBCHASSIS PARTS*

C8—68 μμfd.
C9—47 μμfd.
C10—.005 μfd.
C11, C14, C15—.001 μfd.
C12, C16—.01 μfd.
C13—12 μμfd.
C17—32-μμfd. variable capacitor (E. F. Johnson Co. 30M8)
C18—340-μμfd. (average) compression padder capacitor (Arco #303)
J3—RCA-type phone jack (Ant.)
L2—14 turns of #26 wire close-wound on ¼" slug-tuned form
L3—17 turns of #26 close-wound on 5/16" form
R3—100,000 ohms
R4—22,000 ohms
R5—18,000 ohms
R6—33,000 ohms
R7—8200 ohms
RFC2—10-meter choke, 50 turns of #30 enameled wire close-wound on 1-watt resistor
TS3—5-lug terminal strip (part of transmitter)
V3—1L4 tube
V4—3A4 tube
Xtal.—Crystal for desired channel in Citizens Band (not part of kit)

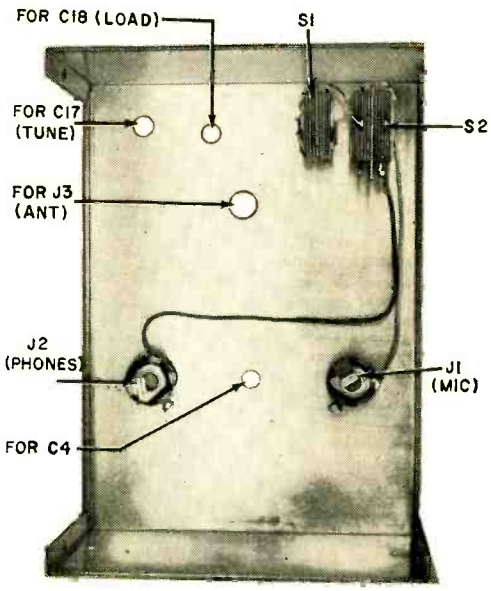
All capacitors disc ceramic, 200-volt rating or higher unless otherwise indicated

All resistors ½-watt composition

* Supplied with International Crystal FO-150 kit, $14.95, less crystal; Model FO-200, wired and tested, including crystal, $34.95.



Transmitter subassembly at left is available prewired or as a kit. Construction from scratch is not recommended because of critical wiring and parts mounting.



Front panel holes and parts mounting are shown at right. Three upper holes are drilled to fit the jack and slotted capacitor shafts of the transmitter. Before assembling the transmitter, use its front panel as a drilling template.

receiver subassembly over the ¼" front panel hole. The unit should be positioned so that tube *V2* extends over microphone jack *J1*. Now wire in the subassembly and connect a four-prong plug on the end of the battery cable as shown in Fig. 7. Install the knob on *C4*. Note that with this type of capacitor only 90° of rotation is required to cover the entire band. Make sure to cut a notch in the cabinet cover so it will not crimp the cable.

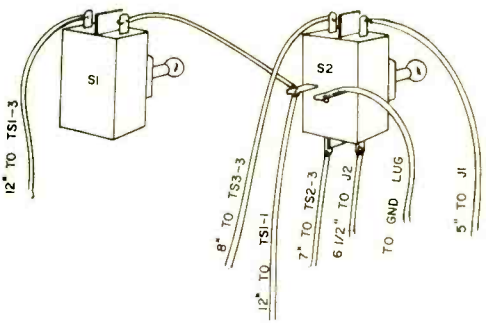


Fig. 6. Wiring details of toggle switches S1 (on-off) and S2 (transmit-receive). Leads to J1 and J2 should connect to the normally grounded lugs (J1 and J2 are insulated from the metal chassis by ½" rubber grommets).

Install the transmitter next. Visually check the chassis alignment and drill the holes to fit the shafts. Mount the transmitter using extra nuts on the *Tune* and *Load* capacitors. Now connect a 2" piece of insulated hookup wire to pin 2 of *V2* and a 6" piece of wire to the antenna jack. Run the longer wire through a convenient hole in the transmitter chassis and twist tightly around the shorter wire soldered to *V2*. This forms a "gimmick" capacitor a little less than 1" long and completes the wiring of the transceiver.

TESTING AND TUNING

Check and double-check your wiring. Then, assuming everything looks okay, check the power circuits—an error here could ruin the tubes or batteries.

Place both *S1* and *S2* in the down position (*Receive* and *Off*), and connect an ohmmeter between -A/-B and +1.5A of the plug on the end of the battery cable. (See Fig. 7.) The meter should read "open circuit." Now, flick the power switch to the *On* position. The meter should read very few ohms. Switch back to *Receive*, and remove tubes *V1* and *V2*. The meter should indicate an open circuit. Replace the tubes

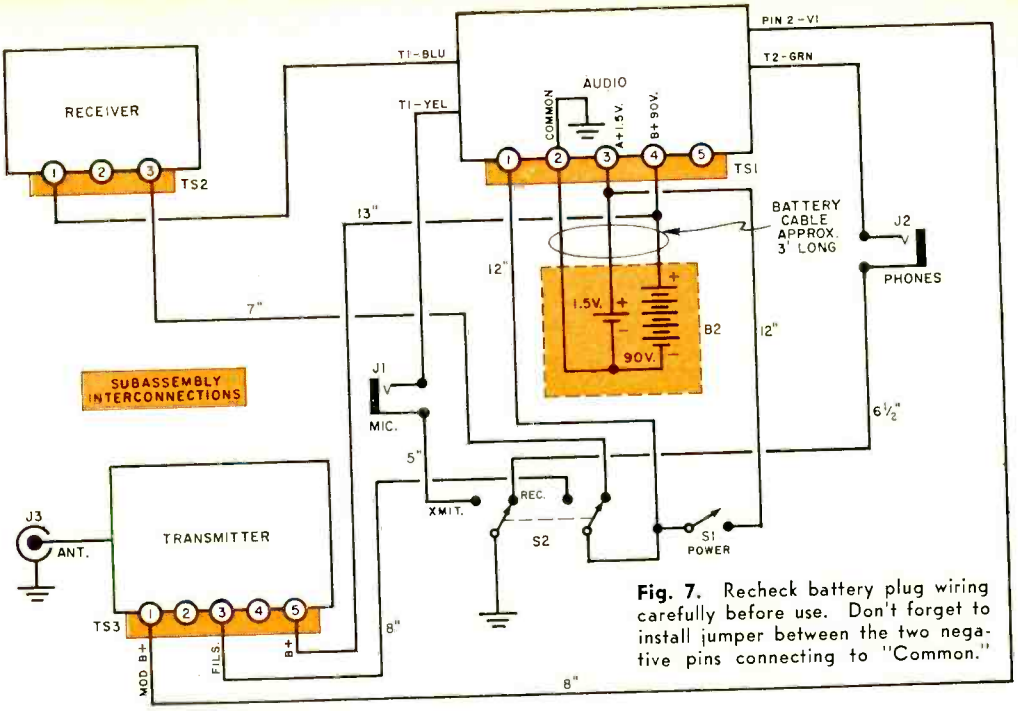


Fig. 7. Recheck battery plug wiring carefully before use. Don't forget to install jumper between the two negative pins connecting to "Common."

ADDITIONAL PARTS

B2—Battery pack, 1.5-volt "A," 90-volt "B" (RCA VS064)
S1—S.p.s.t. toggle switch
S2—D.p.d.t. toggle switch
1—3' length of flexible 3-wire cable
1—4-prong battery plug for VS064 battery
2—½" rubber grommets
1—3" x 5" x 7" cabinet (Bud Minibox CU-2108)

and move the ohmmeter lead from the +1.5A terminal over to the +90B wire. The ohmmeter needle will kick and then drift back to more than 100,000 ohms after the filter capacitor charges.

If these tests come out as described, you can safely energize the receiver. You should hear a very loud hissing noise, which indicates that the receiver is working. Connect an antenna to the transceiver as described below. If you are lucky, you may hear stations in the Citizens Band, but more than likely you will have to "trim" the receiver frequency.

The coil has been constructed so that you will come out slightly lower than 27 mc. By bending in the turns of *L1*, you can put it "on the nose." It might be worth your time to have the unit aligned at a service shop with an accurate TV marker generator. At the low end you should hear the generator on 26.9 mc., and at the high end on 27.3 mc.

The transmitter tune-up procedure is described in the information accompanying the International Crystal unit. You can make a dummy testing antenna with a #49 pilot lamp and a plug that will fit the antenna jack. With this inserted and the transmitter energized, adjust coil *L2* and the *Tune/Load* capacitors for maximum brilliancy. The bulb should light very brightly. Connect the microphone and whistle into it. The bulb should get noticeably brighter.

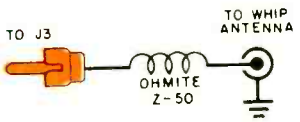


Fig. 8.

GETTING ON THE AIR

The Citizens Talkie can be used with a dipole antenna (measuring 9' 6" tip-to-tip) fed by 25' of RG-58/U coaxial cable. You can also use a "whip" antenna so that it becomes a true "walkie-talkie."

(*Continued on page* 125)

Patio Hi-Fi Extension Speaker

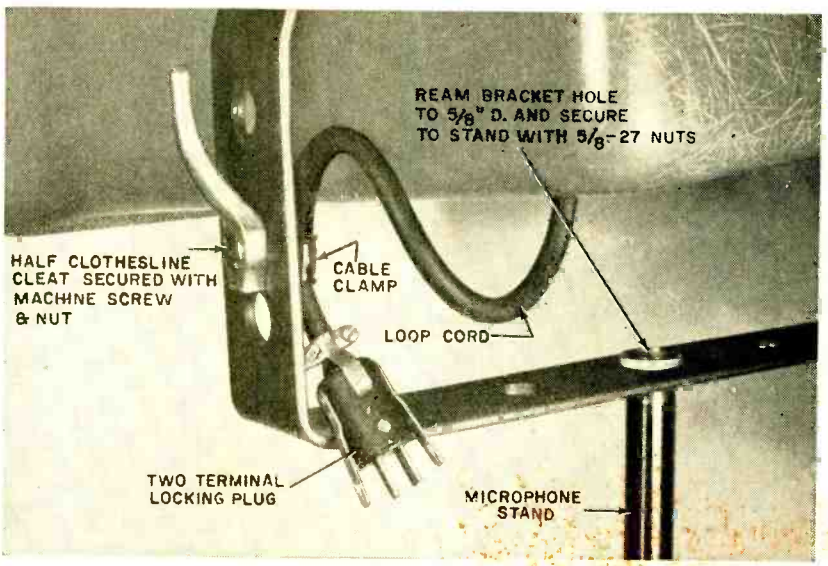
. . . for outdoor listening pleasure

FOR A relatively small investment, any audiophile can both have his music and beat the heat. All he needs is a moderately priced, good-quality, weatherproof loudspeaker, a portable stand, extension cord, a handful of connectors, spade lugs and small hardware, and an hour or so of spare time.

The "Patio Hi-Fi" consists of a University Type MLC weatherproof loudspeaker, a standard microphone stand and a 50′ extension cord. The entire assembly is an inexpensive, compact, and easily portable extension loudspeaker which permits you to "put music where you want it." It can be shifted from the front porch to the patio, to the yard, or wherever you wish—but you needn't dash like crazy to move the assembly inside during a sudden summer shower.

The loudspeaker is equipped with a mounting bracket pre-punched with ½"-diameter mounting holes. Ream out the center mounting hole to ⅝"-diameter to fit a standard ⅝" mike stand, and secure the loudspeaker in place using knurled ⅝"-27 ring nuts. Almost any type of microphone stand can be used, although a broad-base stand will provide better stability.

Details for mounting the loudspeaker are shown at right, extension cord details on the next page. The length of the extension cord will depend on where you want to use the speaker.

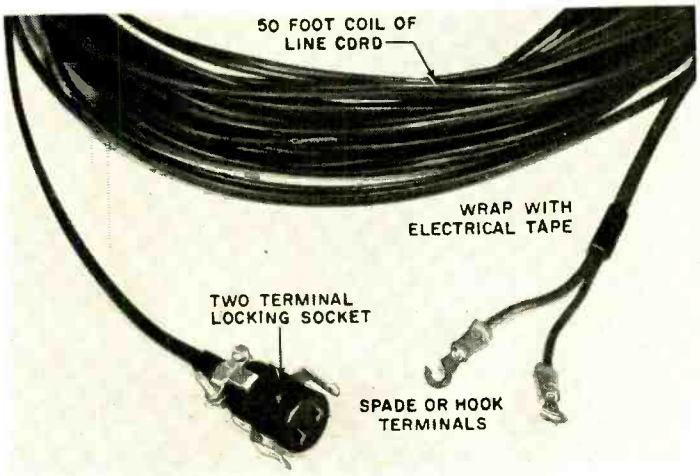


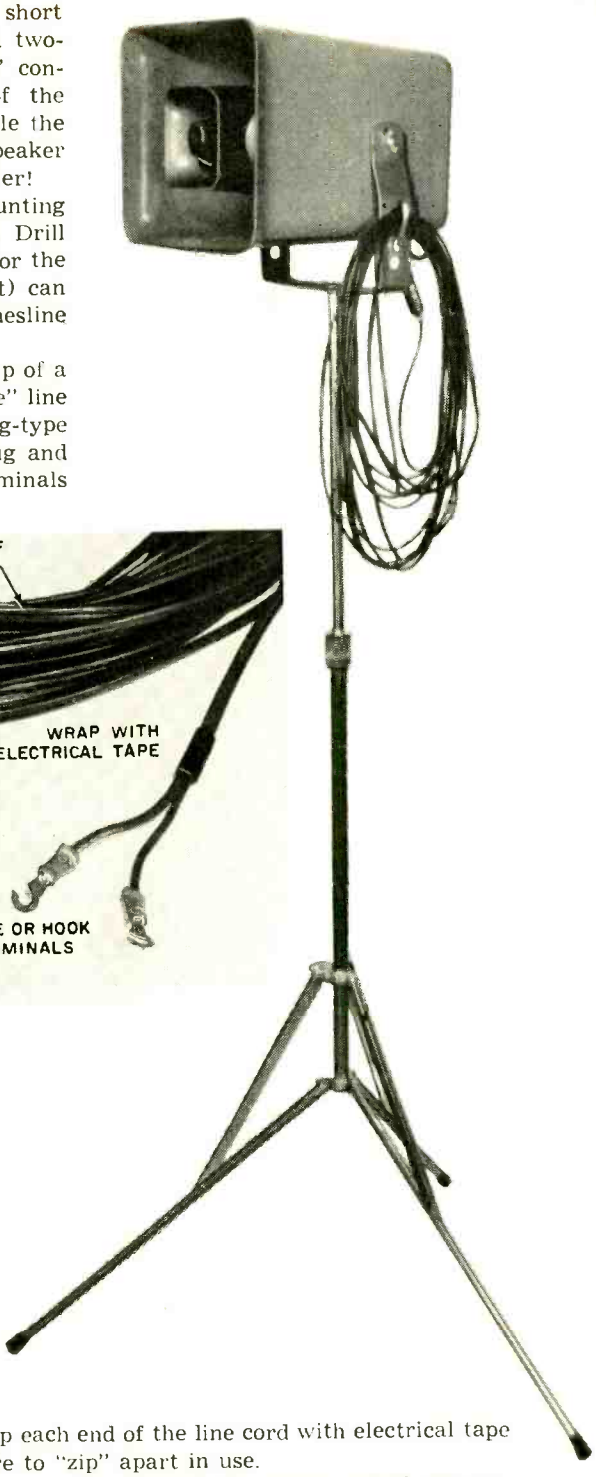
By LOU GARNER

Attached to the loudspeaker is a short two-conductor cable terminated in a two-terminal plug. Use a "locking-type" connector to minimize the chances of the speaker connection being broken while the audio system is in use. An open speaker connection could damage your amplifier!

Secure the speaker cable to the mounting bracket with a standard cable clamp. Drill a small hole in the speaker bracket for the mounting screw. This screw (and nut) can also be used to mount a half clothesline cleat to store the extension cord.

The extension cable can be made up of a 25′ to 75′ length of standard "zip-type" line cord. Terminate one end in a locking-type socket to match the loudspeaker plug and the other end in a pair of spade terminals





PARTS LIST

1—Weatherproof high-fidelity loudspeaker (University Type MCL)
1—Microphone stand (Atlas CS-1 or equivalent)
1—Clothesline cleat (see text)
2—⅝"-27 knurled machine nuts
1—Cable clamp
1—½" 8-32 flat-head brass machine screw
1—8-32 brass hex nut
2—Spade or hook terminals
1—50′ two-conductor "zip" line cord
1—Two-terminal locking type plug (Cinch-Jones No. P-302-CCT-L)
1—Two-terminal locking type socket (Cinch-Jones No. S-302-CCT-L)
Misc. electrical tape, solder, etc.

for connection to the amplifier. Wrap each end of the line cord with electrical tape to prevent any tendency for the wire to "zip" apart in use.

Set up the loudspeaker wherever you wish. Connect the proper end of your extension cord to the loudspeaker plug, uncoil the extension cord, and connect the other end to the proper output terminals of your power amplifier. Switch on your amplifier, tuner or record player, and enjoy some real cool hi-fi. —30—

Nuvistors and Micro-Modules:

New developments in miniaturization

Three Nuvistors are shown beside their larger glass-tube counterparts. Left to right are developmental samples of a triode, tetrode, and beam power tube. Nuvistors outperform conventional types and make possible smaller, more efficient electronic instruments.

TWO developments which could shape the future of the electronics industry were recently announced by the Radio Corporation of America. One, a new type of vacuum tube called the "Nuvistor," comes from the laboratories of the RCA Electron Tube Division. The second, a new technique of integrating electronic circuits into "micro-modules," was engineered by RCA under a contract with the U. S. Army Signal Corps.

The Nuvistor. A new concept in tube design, the Nuvistor is notable for several reasons. Roughly one-third the size of conventional tubes which perform similar functions, it employs a unique cylindrical type of construction which is ideally suited for mass production techniques. Materials used are ceramics, steel, molybdenum, and tungsten. The Nuvistor uses no glass or mica in its construction.

Tiny military radio has been made smaller than an average lump of sugar through the use of micro-module techniques.

Electrodes are supported from one end in a cantilever fashion. This feature eliminates the need for mica support discs or spacers. Because of the low mass and shape of the electrodes, Nuvistors can withstand a high degree of shock and vibration.

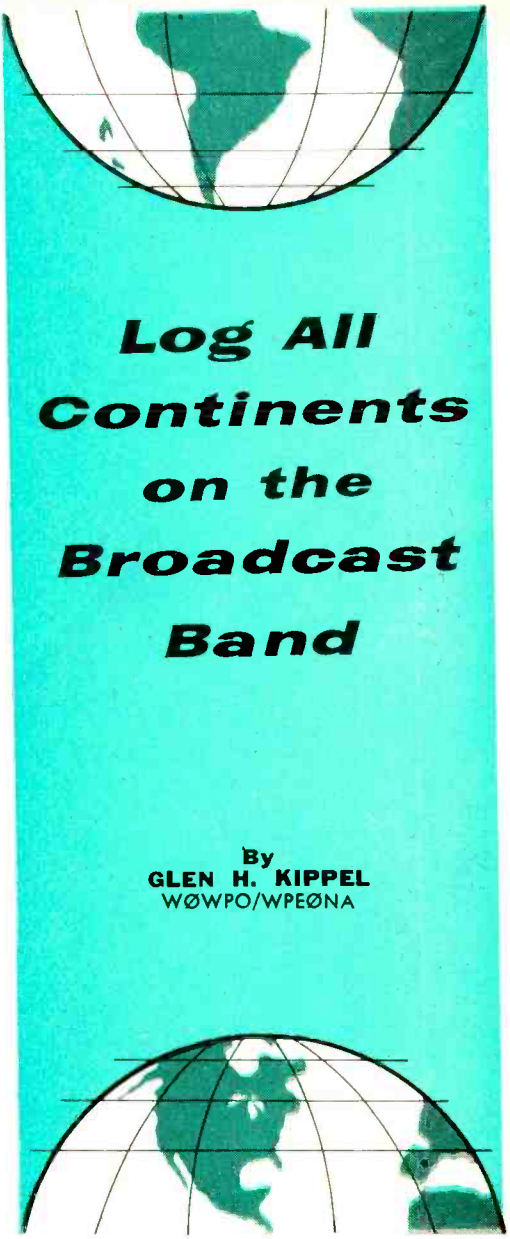
Advantages claimed are miniaturization, improved ruggedness, reliability, efficiency, and lower power drain. Nuvistors operate satisfactorily at temperatures in excess of those possible with conventional tubes. Another interesting feature is the inclusion of indexing lugs to simplify insertion into tube sockets.

It is expected that Nuvistors will be useful in industrial, military, and entertainment applications. Limited production will start next year. Future refinements include the possibility of incorporating the cold cathode design now under development by Tung Sol and the Signal Corps (see POPULAR ELECTRONICS, May, 1959).

Micro-Modules. Developed primarily for military applications, micro-modules are nevertheless expected to find their way into industrial and entertainment equipment. Seemingly the end step in the trend toward miniaturization, they are composed of tiny wafers one-hundredth of an inch thick and a third of an inch square. These wafers, each of which is an electronic circuit component such as a resistor, capacitor, transistor, etc., are stacked, interconnected, and encased in a protective coating.

The use of micro-modules makes possible no less than a tenfold reduction in size and weight of electronic devices. Tests indicate that the tiny cubes should be highly dependable, require little power, and provide high performance. It is expected that mass production techniques will lower their cost sufficiently to justify a "take-out-and-throw-away" repair philosophy.

Micro-modules developed to date have all employed transistors. There is no reason, however, say RCA spokesmen, why they could not be combined with vacuum tubes, or Nuvistors, to offer functions not provided by transistorized circuits. —30—



Log All Continents on the Broadcast Band

By
GLEN H. KIPPEL
WØWPO/WPEØNA

Medium waves provide real DX'ing challenge

IT COULD BE that you, like so many others, feel that world-wide reception can be had only on the short waves. But with a good receiver and antenna, it is possible to *log all continents* on the medium-wave broadcast band.

You may say to yourself, "That's all well and good, but I can't afford a professional receiver, and I don't have the room for a 500' long-wire." Well, while such equipment is certainly desirable, less expensive receivers can be utilized successfully. Very inexpensive D/F (Direction-Finder) receivers, such as the 12-tube MN-26C and the 17-tube BC-433F, can be purchased at many surplus stores and made to work as well as most communications receivers. This is not so surprising when you consider that the BC-433 has three r.f. stages.

The "Q-5'er." Older console models usually contain sensitive chassis, and can be adapted for DX work by the addition of a Q-multiplier, sideband slicer or "Q-5'er" to increase selectivity. Of course, the accessory must match the receiver's i.f. frequency.

The surplus BC-453 receiver, long known as the "Lazy Man's Q-5'er," contains an 85-kc. i.f. which is very sharp. It can be employed with any i.f. frequency commonly used in broadcast receivers (175, 262, 455 and 456 kc. being the most common) by breaking the i.f. signal lead in a convenient place, connecting to it a small capacitor and, from that, a length of coaxial cable to the antenna post on the "Q-5'er."

Audio from the "Q-5'er" can then be taken from a large capacitor connected to its output stage and fed into the receiver's phono input, if it has one. If it does not, the lead from the detector to the volume control in the receiver can be cut and a shielded cable run from the volume control to the "Q-5'er." It may be necessary to connect a variable resistance in series with this lead to avoid overloading the receiver audio section.

If desired, the sensitivity and signal-to-noise ratio can be boosted considerably by connecting a simple preselector (r.f. amplifier) between the antenna and receiver antenna posts.

Antennas. The higher and longer antennas are much to be preferred, whether they are of the long-wire or the dipole type. If it is impossible to erect an antenna more than ten feet high or so, just remember that any antenna is better than no antenna

at all, and concentrate on making the receiver more sensitive.

Since few antennas can be long enough to resonate effectively at broadcast frequencies, the alternative is to scoop in as much signal as possible. If you can, use stranded antenna wire, as it has lower signal resistance than solid wire, and use double insulators to reduce losses in wet weather.

Join a Club. If you have the equipment, you need to know where and when to listen. To find out what other DX'ers are hearing, the best thing to do is to join a radio club.

The Newark News Radio Club, 215 Market St., Newark 1, N. J., dedicates a section of its monthly bulletin to the broadcast band. Another club is the National Radio Club, c/o Harold F. Wagner, R. D. #1, Lake City, Pa.

The DX'ers' Radio Club, which was formed solely for the purpose of BCB DX'ing, also issues a monthly bulletin. Information can be had by writing to the DX'ers' Radio Club, c/o Jim Ernst, 563 Park Ave., Scotch Plains, N. J.

Using the Station List. Stations which are heard well in the United States, plus some of the better DX stations which are heard regularly, are listed at right.

As a rule, the European and African stations can be heard from sunset, local time, until they begin to fade out around sunrise in Europe. You can bring in the Central and South American stations until they sign off around 0100 EST. The Pacific Area and the Far East are heard best from around 0300 EST until American stations sign on and drown out the weaker DX. Stations listed as being in the Caribbean Area can be heard from about 0410 EST, when they begin signing on. And listeners in western states will find that some stations in Central America will come in better in the early morning hours because there will be less local interference.

Winter is the best season for DX, although the early spring is almost as good. The reason is that the sun's rays strike the ionosphere at more of an angle and cause less ionization of the atmosphere, resulting in less ionospheric absorption.

The years of low sunspot activity will provide better DX for the same reason. The next sunspot low will be 1964 to 1966, but there is no reason to wait until then because solar activity varies considerably even over very short periods. —30—

DX BROADCAST

FREQ. (kc.)	CALL LETTERS	STATION NAME (Location)
		EUROPE AND NORTH AFRICA
665		Emisora Nacional (Lisbon, Portugal)
701		Radio Moghreb (Sebaa Ayoun, Morocco)
764		Radio Lausanne (Sottens, Switzerland)
845		Radio Italiana, Roma II (Rome, Italy)
890		Radio Algiers II (Algiers, Algeria)
935		Radio Africa-Moghreb (Tangier, Tangiers)
980		Radio Algiers I (Algier, Algeria)
1142	RV129	(Kaliningrad, R.S.F.S.R.)
1205		(Alexandria, Egypt, U.A.R.)
1205		Radiodiffusion Francaise (Bordeaux, France)
1286		Radio Prague (Prague, Czechoslovakia)
1295		B.B.C. (Daventry, Great Britain)
1439		Radio Luxembourg (Villa Louvigny, Luxembourg)
1466		Radio Monte Carlo (Monte Carlo, Monaco)
1500		Radio Renasenca (Lisbon, Portugal)
		CENTRAL AND SOUTH AMERICA
540	XEWA	La Voz de America Latina (San Luis Potosi, Mexico)
640	TGW	Radio Nacional (Guatemala City, Guatemala)
650	TIBAS	Radio Monumental (San José, Costa Rica)
655		Radio Nacional del Salvador (San Salvador, El Salvador)
660	CMCU	Radio Garcia Serra (Havana, Cuba)
660	XEBZ	(Mexico City, Mexico)
675	YNDS	Union Radio (Managua, Nicaragua)
730	CMHU	Radio Mambi (Havana, Cuba)
730	XEX	XEQ, Radio Panamericana (Leon, Mexico)
755V		Radio Sisí (San José, Costa Rica)
760	XEWB	La Voz de Amèrica Latina (Mexico City, Mexico)

STATIONS HEARD IN THE UNITED STATES

FREQ. (kc.)	CALL LETTERS	STATION NAME (Location)
790	CMCH	(Havana, Cuba)
820	HJED	Radio Lenti (Cali, Colombia)
830	CMBZ	Radio Salas (Havana, Cuba)
840	HJKC	Radio Nuevo Mundo (Bogotá, Colombia)
845	HROW	Radio Montserrat (Tegucigalpa, Honduras)
854	OAX4A	Radio Nacional del Peru (Lima, Peru)
860	CMBL	Radio Aeropuerto (Havana, Cuba)
880	TILS	Para Ti (San José, Costa Rica)
880	TGJ	Radio Nuevo Mundo (Guatemala City, Guatemala)
890	HJCI	La Voz de la Victor (Bogotá, Colombia)
900	TILC	Radio Hispaña (Cartago, Costa Rica)
900	XEW	La Voz de Amèrica Latina (Mexico City, Mexico)
910	CMCF	Union Radio (Havana, Cuba)
935	YNW	Radio Mundial (Managua, Nicaragua)
950	CMBF	(Havana, Cuba)
980	PRE8	Radio Nacional (Rio de Janeiro, Brazil)
995	TIFC	Faro del Caribe (San José, Costa Rica)
1060	CMCX	(Havana, Cuba)
1075	YSEB	La Voz de Latino Amèrica (San Salvador, El Salvador)
1150	CMCA	Radio Popular (Havana, Cuba)
1235	ZBM1	(Hamilton, Bermuda)
1340	ZBM2	(Hamilton, Bermuda)
1540	ZNS	(Nassau, Bahamas)

OCEANIA, FAR EAST

550	KMVI	(Wailuku, Hawaii)
590	KGMB	(Honolulu, Hawaii)
630	KPOA	(Honolulu, Hawaii)
660	2YC	(Wellington, New Zealand)
670	JOBK	Nippon Hoso Kyokai (Osaka, Japan)
690	KULA	(Honolulu, Hawaii)
730	KFQD	(Anchorage, Alaska)
770	3LO	(Melbourne, Australia)
785		Radio Pyongyang (Pyongyang, North Korea)
790	4QG	(Brisbane, Australia)
800	1YZ	(Rotorua, New Zealand)
830	JOBB	Nippon Hoso Kyokai (Osaka, Japan)
840	4RK	(Rockhampton, Australia)
850	KILA	(Hilo, Hawaii)
870	KAIM	(Kaimuki, Hawaii)
870	2GB	(Sydney, Australia)
880	JOLB	Nippon Hoso Kyokai (Fukuoka, Japan)
900	KFRB	(Fairbanks, Alaska)
900	4YC	(Dunedin, New Zealand)
920	KAHU	(Waipahu, Hawaii)
930	VRH	Radio Suva (Suva, Fiji Islands)
950	JOKR	Radio Tokyo (Tokyo, Japan)
1010	JONR	Asahi Broadcasting Company (Osaka, Japan)
1040	4ZB	(Dunedin, New Zealand)
1180		Voice of America (Naha, Okinawa, Ryukyu Islands)
1220	4AK	(Oakey, Australia)
1370	JOJB	Nippon Hoso Kyokai (Kanazawa, Japan)
1380	KHON	(Honolulu, Hawaii)

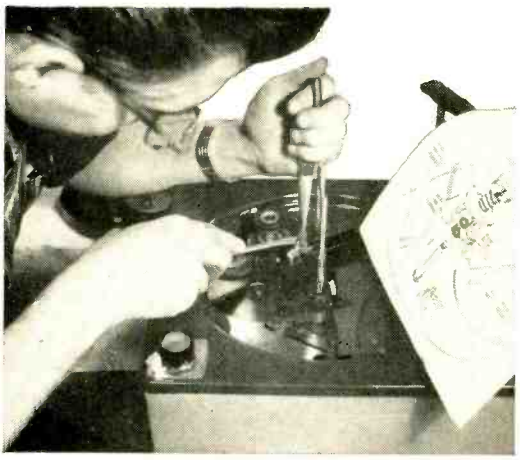
CARIBBEAN AREA

630	CMQ	Radio Centro (Havana, Cuba)
640	CMHQ	Radio Centro (Santa Clara, Cuba)
655	PJA-10	The Voice of Aruba (Aruba, Netherlands West Indies)
660	ZFY	Radio Demerara (Georgetown, British Guiana)
670		Radio Progreso (Havana, Cuba)
675	YNDS	Union Radio (Managua, Nicaragua)
690	CMBC	Radio Progreso (Havana, Cuba)
730	VP4RD	Radio Trinidad (Port of Spain, Trinidad)
810	WKVM	(San Juan, Puerto Rico)
810	CMW	Radio Reporter de Cuba (Havana, Cuba)
880	TGJ	Radio Nuevo Mundo (Guatemala City, Guatemala)
1200	CMA	Radio Musical de Cuba (Havana, Cuba)
1435	PJA-5	Radio Keklboom (Aruba, Netherlands West Indies)

POPULAR
ELECTRONICS
Builds a

Record Changer Kit

TESTED By POPULAR ELECTRONICS



Heath's RP-3 kit can be put together with ordinary hand tools. Clear instructions allow even a rank amateur to tackle the assembly with confidence.

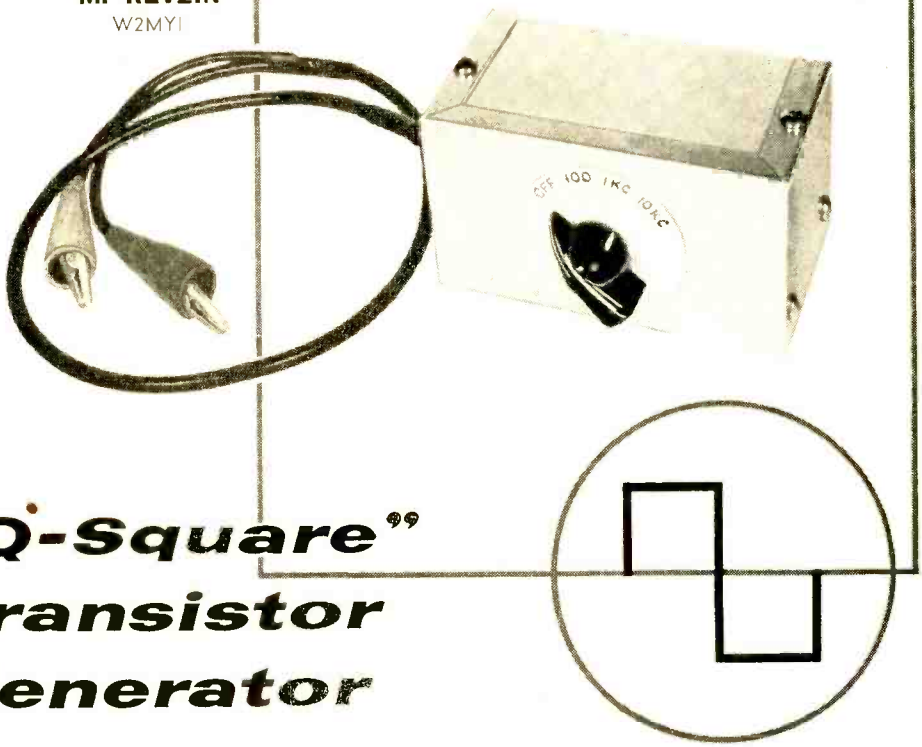
INTRODUCED on the market late last year by the Heath Company, Benton Harbor, Mich., the RP-3 is the world's first and only record changer in kit form. It is a complete record-playing unit; in addition to the changer itself, the "package" also includes an unassembled mounting base, pickup, stylus pressure gauge, and 45-rpm spindle.

A rather unusual feature of the RP-3 is its changing mechanism. Unlike most record changers, it has separate drive systems for rotating the platter and powering the changing mechanism. This enables the platter to "pause" during the change cycle, with the result that records fall on a stationary surface and cannot be "ground" together.

Assembly is not difficult. The 40-page instruction book, like most Heath instruction books, is a model of clarity and includes numerous exploded and detailed diagrams. The whole job, including putting the base together and mounting the pickup, can be completed in from three to six hours.

Thanks in part to the basic simplicity of the design, the RP-3 unit which we assembled worked well after only a few minor adjustments were made. No problems of rumble, wow, or flutter became evident, and the changing mechanism performed faultlessly. If you're in the market for a reliable changer at a reasonable price, the RP-3 kit merits your consideration. —30—

By
M. REVZIN
W2MYI



"Q-Square" Transistor Generator

Check your hi-fi audio amplifier with a multi-square-wave generator

WE HAVE ALL READ of the advantages of using square waves to test our hi-fi equipment, only to be scared off by the cost and complexity of the generator. The rise-time requirements are strict, or interpretation of the results is very difficult. However, low-cost transistors are available which make possible a simple unit with rise-times as good as 2.5 *micro*seconds.

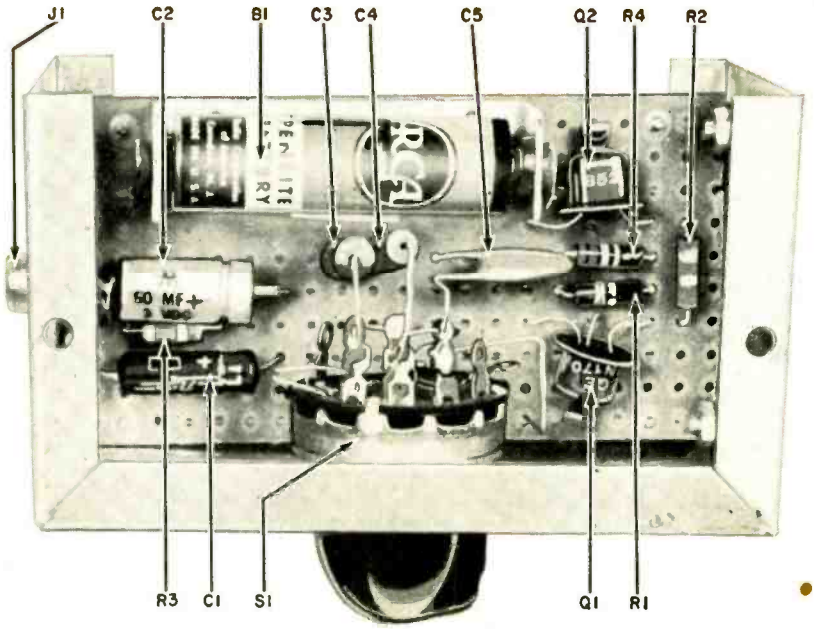
The cost of the complete transistor square-wave generator is less than $10. Single-knob control is used, for selecting 100-cycle, 1-kc. or 10-kc. output, and for turning the generator on automatically. An *Off* position is provided to save the battery when it is not in use, although the operating current is about the same as normal leakage for a penlight battery.

Mounting and Wiring. Components of the "Q-Square" are mounted by their own leads to a perforated Bakelite board. Cut to fit the Bud CU-3003 box, the board is held by four small brackets. Note the neat placement of the parts. Wiring is done by laying the component leads next to each other and soldering.

Be careful to heat-sink the transistors when soldering. And where connecting wires are required, use solid tinned hookup wire with the insulation removed. The result looks like a printed circuit, without its headaches. The battery holder is fastened to the board with #2 sheet-metal screws.

Wire in all components except R_4. Temporarily connect a 1-megohm potentiometer as a variable resistor in its place. After all wiring has been carefully checked, insert the battery with the positive end toward Q_2. Plug in the output lead and connect to the vertical input terminals of your oscilloscope. Turn S_1 to the 1-kc. position.

It will take several seconds for C_2 to



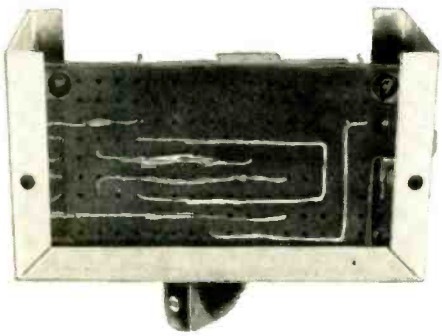
charge and allow the generator to operate. Vary the potentiometer resistance until the square waves are symmetrical. Shut off the generator, disconnect the potentiometer without disturbing its setting, and measure its resistance. Then select a resistor of the same value and wire it in place.

Substitutions. If the generator does not give a stable pattern with any value of *R4*, or a symmetrical pattern cannot be obtained, interchange the transistors. Performance may be improved somewhat by the use of more expensive transistors such as the 2N168A.

Don't be surprised if the 100-cycle and 10-kc. square waves do not look square on your scope—its response may be much worse than you thought. Remember that a response to at least 100 kc. is necessary to get a square waveform.

It may also be necessary to try several different capacitors for *C3*, to set the operating frequency far enough away from a multiple of the a.c. line frequency. If this is not done, the interaction (in the scope) will cause the pattern to exhibit "crawl" or be difficult to lock.

Using the Generator. Square waves are very rich in harmonics. When they are used for testing, a great deal of information about the frequency response, phase shift and transient response of your amplifier



Phenolic subchassis is prewired, then installed in the cabinet with small brackets.

HOW IT WORKS

The circuit consists of a common-base amplifier feeding a common-collector stage through a frequency-determining capacitor (e.g., *C4*). Feedback is provided through the common emitter resistor (*R3*). When power is applied the base bypass capacitor (*C2*) charges through *R1*, applying a reverse bias to *Q1*, turning it *off*, and thus allowing *C4* to charge through *Q2*, turning it *on*. This state continues until *C2* is fully charged. Thereafter, *C2* serves merely as a low-impedance a.c. path to ground.

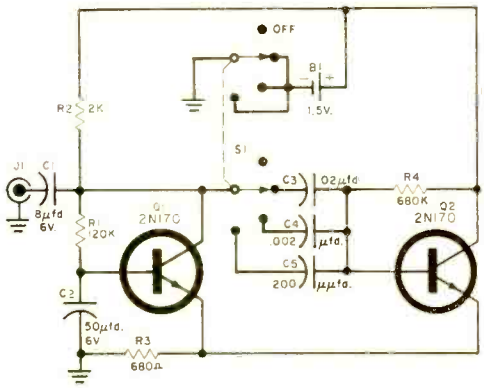
With the inhibiting effect of *C2* removed, *C4* discharges through the *Q1* collector load resistor (*R2*). *Q1* is kept *off* by the current drawn through *R3* by *Q2*. The voltage applied to the base of *Q2* is reduced, lowering the bias current through *R3*, turning *Q1 on*. The drop in collector voltage through *R2* is transmitted as a pulse to cut *Q2 off*. At this time *C4* begins to charge through the base-emitter path of *Q2*. When its charge is great enough, it will turn *Q2 on*, initiating a new cycle.

can be seen at a glance. The "Q-Square" was designed to operate into at least a 20,000-ohm load, making it suitable for most hi-fi amplifiers.

Connect the output lead to the amplifier input, disconnect the speaker and replace it with a resistor, and connect your scope across the resistor. Be sure that your load resistor is rated to carry the power output of your amplifier. Now turn the amplifier gain control to minimum, set your tone controls for flat response, and turn on the generator.

Bring up the gain control until you see a clear pattern on your scope. Then compare the pattern to those shown here. You can also rotate the tone controls to see just how much cut and boost they allow.

With your speaker connected, the "Q-Square" will enable you to check for speaker "hangover," transient response, and cabinet rattles and resonances. —30—



Frequency-determining capacitors C3, C4 and C5 will provide 100-, 1000-, and 10,000-kc square waves. Other frequencies can be obtained by using other capacitor values.

PARTS LIST

B1—1.5-volt penlight cell
C1—8-μfd., 6-volt electrolytic capacitor
C2—50-μfd., 6-volt electrolytic capacitor
C3—.02-μfd. capacitor (100 cps)
C4—.002-μfd. capacitor (1000 cps)
C5—200-μμfd. capacitor (10,000 cps)
J1—RCA-type phono jack
Q1, Q2—2N170 transistor
R1—120,000 ohms (All resistors ½-watt composition)
R2—2000 ohms
R3—680 ohms
R4—680,000 ohms (see text)
S1—3-pole, 4-pos. switch (Mallory 3134J)
1—Chassis box (Bud CU-3003)
1—Battery holder (Acme #5)

TEST FREQUENCY = 100 CYCLES


Excessive low-frequency response (bass boost)


Insufficient low-frequency response (bass cut)


Leading phase shift


Lagging phase shift

TEST FREQUENCY = 1 KC. or 10 KC.

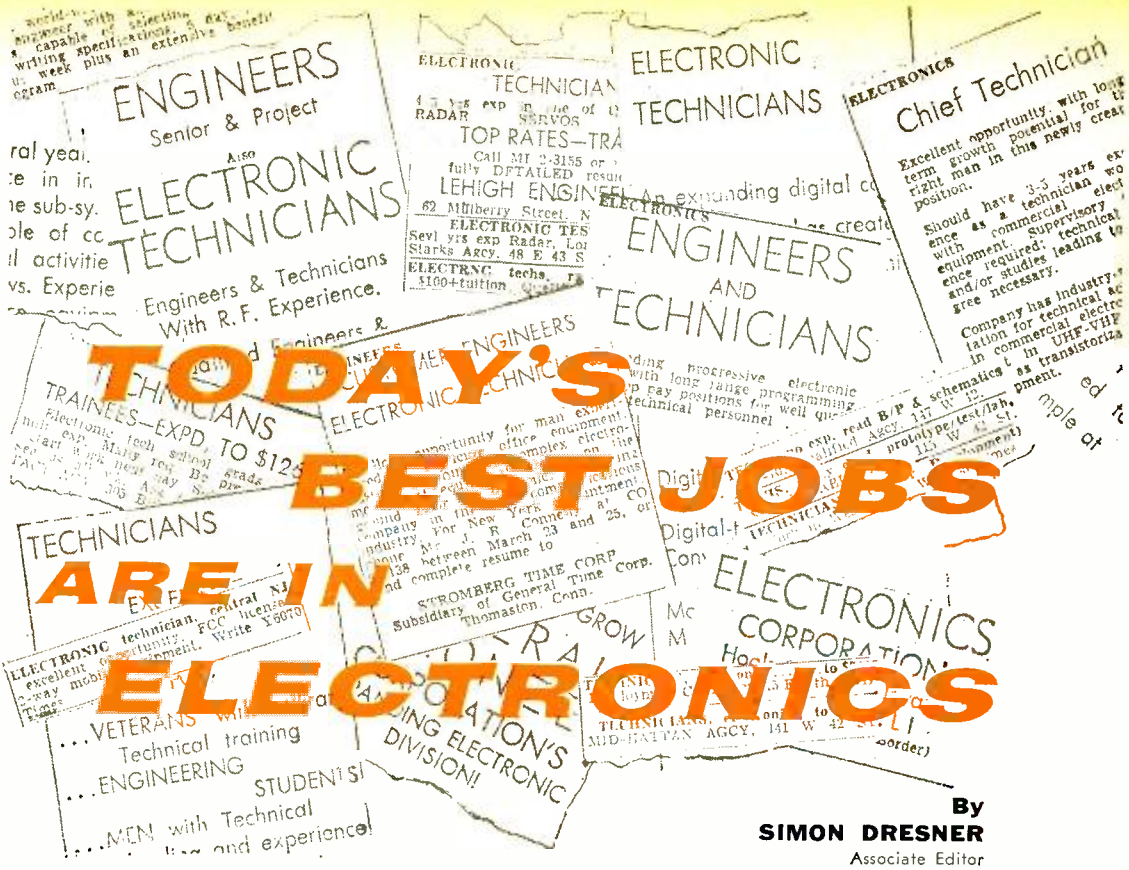

Peaked high-frequency response (treble boost)


Slight high-frequency loss


Severe high-frequency loss (treble cut)


Damped oscillation (ringing)

Typical square-wave distortions which are encountered in hi-fi amplifier testing.



TODAY'S BEST JOBS ARE IN ELECTRONICS

By
SIMON DRESNER
Associate Editor

You can take advantage of the best job opportunities in the world if you know how to:

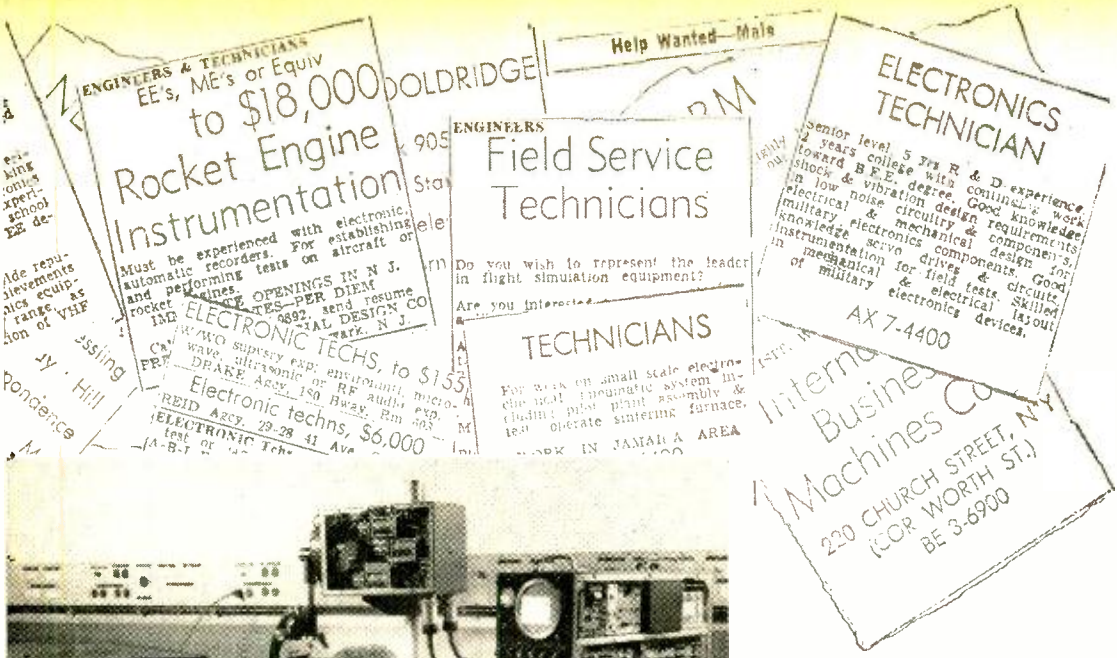
- **Measure your education and experience**
- **Look for and land a job**
- **Save money on an overseas job**
- **Make your electronics education pay for itself**

THE BEST job opportunities in America today are in the field of electronics, and anyone with enough interest, initiative or knowledge can carve out an exciting and profitable career for himself in America's fourth largest industry. The electronics industry has grown and is continuing to grow so rapidly that the demand for trained technical personnel is outstripping the supply and will continue to do so. This situation is a headache for companies that are desperately seeking men to fill the empty technical positions, but it's a bonanza to anyone with a technical bent who wants to insure his future in this well-paying field.

It doesn't take an extensive education or a college degree to break into the electronics industry—all you need is a genuine interest in the field, and a willingness to take the first step. Once a foothold has been gained, you can advance farther and faster than in any other industry.

How Much Do You Know? Chances are that you know something about electronics, and the first thing to do is to take stock of this knowledge and figure out your value to a potential employer. To help you find out where your present education, background, and experience fits into the electronic industry, the table at right gives a description of several of the most common job categories under the engineering level. It shows you how much education and experience is usually required, as well as the probable pay scale.

Most research and development jobs deal with one specific aspect of electronics, such as radar, or computers, or missile control equipment, and specialized knowledge of a subject pays off handsomely. A short cut to high salaries can be made by taking some of the home-study courses on special subjects now being offered by many correspondence schools. Course credits in automation, servomechanisms, instrumentation,



TV and radio broadcasting offers many well-paying jobs, especially in the larger cities. Once a start is made in this field, job security is excellent. An FCC First Class Radiotelephone license is the minimum requirement.

RESEARCH AND DEVELOPMENT JOBS AVAILABLE FOR ELECTRONIC TECHNICIANS*

Class A Technician: Construction of complicated experimental breadboard circuits, working from basic engineering schematics or drawings along with sketches or oral instructions under minimum supervision of an electronics engineer; originating details of circuitry, control mechanisms, components, and subassemblies; exercising one's own judgment in modification of design or substitution of parts or materials; conducting tests and compiling data on experiments; frequently making suggestions for improvement of equipment; occasionally directing work of lower level electronic technicians.

Education and Experience: *High school plus a minimum of two years of correspondence school or resident technical school. Two years or more of practical experience in similar-type job. Advanced knowledge of electronic theory and mechanical aptitude and judgment.*

Pay Scale: *$96 to $150 a week or more. Average, about $125 a week.*

Class B Technician: Generally the same functions as Class A, but usually working under moderate supervision of a Class A technician; frequently directing the work of lower level technicians or assisting higher level electronic technicians; occasionally operating machine tools to make or alter mechanical parts.

Education and Experience: *High school plus a minimum of one year of correspondence or resident technical school, and two years of experience or two years of technical school and one year of experience.*

Pay Scale: *$85 to $120 a week or more. Average, about $105 a week.*

Class C Technician: Same general functions as Class B but more detail wiring and less over-all design.

Education and Experience: *One year of correspondence or resident technical school and one year of experience, or two years of schooling alone, or two years of experience alone.*

Pay Scale: *$65 to $110 a week. Average, $90 a week.*

* Based on information published by the U.S. Department of Labor, Bureau of Labor Statistics.

transistor circuits, computer mathematics, etc., are much appreciated by employers.

Radio/TV Broadcasting. About 20,000 electronic technicians were employed in radio and television broadcasting stations last year. The largest stations in the metropolitan areas have as many as 500 technical employees. The highest-paying and most responsible jobs are in New York and Los Angeles, originating centers for most of the network programs. Average weekly earnings are about $130 in the larger stations, while top salaries may run as high as $200 weekly if you have several years of experience.

Anyone who intends to become a broadcasting technician should plan on getting a First Class Radiotelephone license from the Federal Communications Commission. Federal law requires that anyone who operates or maintains a broadcast transmitter must have a license. Applicants for licenses must pass a written examination covering construction and operation of transmitting and receiving equipment, radio theory, and the federal and international regulations and practices covering broadcasting. Information on how to apply for these examinations, and guides to studying for them, can be obtained from the Federal Communications Commission, Washington 25, D. C.

Perhaps the easiest way to acquire the knowledge for passing the FCC test is to take an electronics course in a good technical institute or from a home-study school. Some of the better schools provide courses especially designed to prepare the student for the FCC test and to qualify him for a beginning job in a broadcasting station. Many research companies also look on an FCC license as proof of achievement in electronics, and are glad to hire people with this "government diploma."

Jobs Overseas. If you have the urge to travel and see distant places, you will find thousands of overseas jobs in the electronics industry. Tremendous salaries will sometimes be paid to technicians working in uncomfortable climates and isolated places; one company has offered over $20,000 for 18 months duty at military arctic radar bases. Other jobs under less extreme working conditions can be found wherever the U. S. Government is building or maintaining military bases, in Greenland, Spain, North Africa, etc.

Many of the electronic construction or maintenance contracts are given to private companies, and these companies often advertise for trained technical personnel. Oil companies need electronic technicians to work with equipment in their foreign oil fields. Construction companies and manufacturers of commercial equipment who sell overseas usually keep a technical staff in foreign countries.

As a quick way of earning a considerable amount of money, a job overseas can't be beat. Salaries are usually 25-50% higher than equivalent jobs in the United States. Passage money is generally paid both ways, but a two-year contract usually must be signed. If the contract is broken, return passage is not paid. Partial or complete payment of passage for the technician's family is often paid by the company.

But the biggest financial advantages come from the facts that living expenses in a foreign country are commonly one-half or less than in the United States, and that if you stay overseas for 18 months or more you do not pay U. S. income taxes. The companies usually make special payment arrangements to maximize tax savings. With all these advantages, an overseas job can yield a salary double or more than that of an equivalent American job.

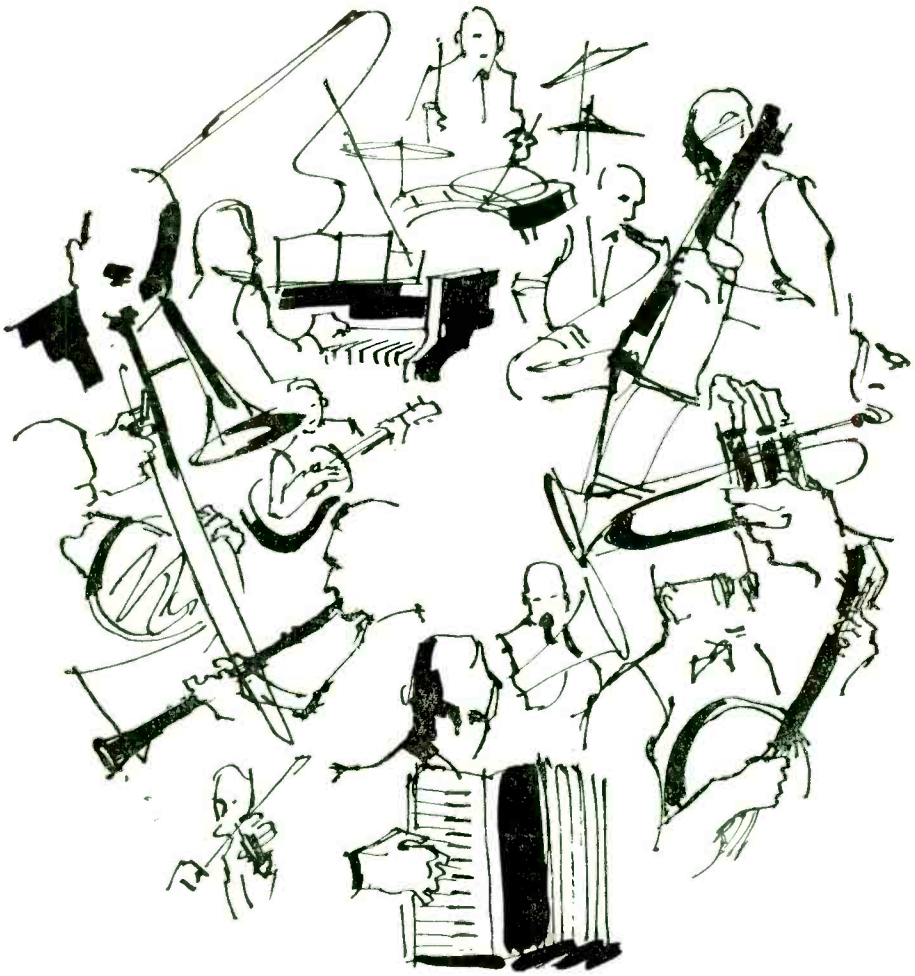
Which Companies Are Hiring? To find out which companies are actively recruiting technical personnel, the best place to look is in the classified advertisement section of the Sunday edition of the *New York Times*, or the *Los Angeles Times*. You'll find several pages of ads for engineers in every category and in every location in the country, although most electronics companies are located in the North Atlantic States and California.

The ads will usually mention only engineering positions, but keep in mind that for every engineer hired they've got to hire one or more technicians. You'll also find many ads which ask specifically for technicians. Between the two, chances are you'll come across about a dozen job opportunities every week.

Education Pays for Itself. Once you're hired by a company, at either the technician or engineering level, you need no longer worry about the expense of furthering your education. The company will often foot most of the bill for a professional-level home-study course. Also, the company appreciates the fact that if you're enrolled

(*Continued on page* 128)

A POPULAR ELECTRONICS "BONUS" FEATURE



STEREO RECORDS: Fad or Fulfillment?

By Sidney Norinsky

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Illustrations by ART SUSSMAN

TASTE AND TECHNOLOGY

When, in 1926, acoustical recording gave way to the new electrical technique, everyone marveled at the expanded frequency and dynamic range, lower distortion, and far lower surface noise of the new discs.

And when LP microgroove records made their debut in June of 1948, it was evident to all that here was an undeniably real advance in the art of sound reproduction. Any rumblings of discontent arising from those unfortunates overloaded with vast 78-rpm record collections were drowned out by the hurrahs of the audiophiles savoring the high highs and the low lows engraved in the vinylite LP grooves.

But has stereo drawn the same unanimous applause? Is *everyone* convinced that 45-45 discs and dual-channel sound systems actually bring us nearer the "ideal" of putting symphony orchestras into our living rooms? Are stereo discs really significantly better than monophonic records? And what about the factors of distortion, wear, and frequency response?

After almost two years of living with stereo, we can legitimately attempt answers to these and other questions. The stereo situation is still in flux, so there are no "final" answers yet. But the opinions

and data presented in this article, developed from interviews with leading figures in the record industry and from critical listening and consideration, represent a good cross section of thinking about the stereophonic disc in this, its second year of existence.

Surprisingly, opinions in the recording industry about stereo run to two extremes: from downright disapproval to enthusiastic evangelism for stereo as *the* answer. The diversity of opinions is as broad as the range of tastes of the people expressing them. For it is as much a matter of taste as of technology.

Electrical recordings were unquestionably better than the older acoustical discs, and LP's are better than 78's for obvious and hardly debatable reasons. But does a violin and piano sonata sound better with one instrument coming from the left and the other from the right?

Stereo directionality is fascinating to experience. But, after you've recovered from your astonishment at the audio fireworks built into stereo samplers—choo-choo train records, on-the-spot recordings of Lockheed Constellations zooming across your living-room ceiling, etc.—you have to answer the question: does stereo enhance *music?*

So you listen to hours of music. And once the

novelty of having the orchestral violins on the left and cellos on the right wears off (as it inevitably will), there is the question: does the sound of stereo justify its higher expense and greater complexity as far as *enjoyment* is concerned?

With these questions in mind, the author decided to query several people actively engaged in the business of recording and producing stereo discs.

THE PROFESSIONALS SPEAK UP

SOLOMON—
Vanguard Records

Seymour Solomon of Vanguard Records stands up to be counted as an enthusiastic stereo supporter—for music that's meant to be really listened to, that is. If you want to hear Lawrence Welk's champagne music bubbling from your speakers, forget it, he says, you don't need stereo.

But Solomon is convinced, on the basis of his long association with classical music (he and his brother Maynard founded the Bach Guild, later expanded their operation with the highly successful Vanguard label) that stereo adds very substantial elements of realism to recorded music beyond the sheer novelty of pinpoint instrument localization. It contributes solidity and breadth to an orchestra, color and fire to all kinds of music.

The Vanguard contingent is so convinced of stereo's value that they are using it for records of unaccompanied solo instruments—piano, harpsichord, violin. Solomon asserts that a piano recorded and reproduced through two channels sounds more live, "placed-in-space," as it were. He admits, of course, that stereo records run the gamut in sound quality; some are "abominably" bad. But he's willing to run a straight comparison of his own stereo recordings against mono records any time.

Possibly because he knows at first hand the painstaking care that goes into the production of a stereo record, Solomon advises that a listener will do well to search his playback system for faults before condemning the record. For example, the first stereo cartridges available left much to be desired, he says. In addition, many systems have the speakers hooked up out of phase; that is, when one cone moves forward, the other moves back, with a resulting "hole-in-the-middle" that destroys the

stereo effect. And there are other common faults such as stylus misalignment, wrong stylus pressure, speaker imbalance, and improper speaker placement—all of which detract from full enjoyment of stereo.

BACHMANN—Columbia Records

William Bachmann, chief engineer at Columbia Records, and one of the pioneers of high fidelity, has somewhat different views. To Bachmann, the directionality of stereo is of questionable value to anyone but a fanatical audiophile. Pings and pongs are an intriguing sonic phenomenon, but they have little to do with music.

Classical music, he asserts, was written to be performed and heard as a musical whole. It therefore does not need the special microphone placements and intense directionality of present-day stereo reproduction, an approach which to him is tiresome. And solo performances—voice, piano, etc.—are just as well recorded monaurally, says Bachmann (and Columbia and Epic policy follows his thinking on this point).

In the realm of symphony and chamber music, Bachmann believes that today's stereo is primitive. He feels that experience and maturity will bring many changes for the better, changes that will create stereo techniques devoted to the nature of music itself, rather than to novelty or special effects.

However, the world of jazz, swing, pops, and rock-n-roll has a powerful new tool in stereo, says Bachmann. He points out that stereo's ping-pong and sound-image properties have become the latest in a growing sequence of synthetic effects, such as close-miking and echo-chamber sounds, effects which have transformed recorded jazz and pops into what he calls a "new art form."

Bachmann also points to another benefit as a by-product of the surge to stereo; the use of two speakers. Stereo or monophonic, the use of two speakers eliminates the narrow "extruded-through-a-hole" point source effect.

PULLEY—RCA Victor

RCA Victor engineer Albert Pulley has been active on the recording scene for more years than he cares to remember. He is an unreserved champion of stereo. In fact, he notes that he first began recording dual-channel tapes as long as five years ago, well before the advent of stereo records, in the expectation that stereo would achieve popularity.

Pulley believes strongly that most of the people who deride stereo simply have not heard it properly, and cites a recent experience with a well-known RCA recording star who at first vehemently dismissed stereo as a mere sales "gimmick." Only after Pulley had demonstrated one of the better stereo discs on a professional playback system did this concert artist change his mind.

The moral that Pulley draws from this example is the same one now being voiced by many other figures in the industry: if you cut corners, and thereby cut quality, either in producing or reproducing a stereo record, the public will become disillusioned with stereo altogether and will turn back to the lower cost and comparative simplicity of monophonic phonographs.

Pulley also warns that some records sold as stereo are faked from mono sources by devices such as frequency range separation. "But when you hear real stereo played back on adequate equipment," he adds, "it's very, very good."

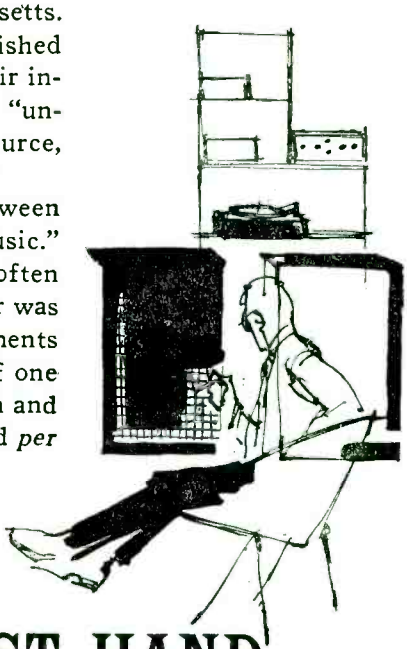
ANONYMOUS—Major Record Company

Yet, another industry figure, who insisted on anonymity (but who is, rest assured, quite real), believes that stereo has no significant merit. "I'm happy to listen to a good musical performance and I don't care if the trumpet issues from one speaker or the other" was the comment.

In support of this anti-stereo stand, this individual recalled a dramatic experiment performed about eight years ago. RCA had placed its "Berkshire" model radio-phonograph combination console behind the Boston Symphony Orchestra on

the stage of the enormous Tanglewood Music Shed at the Berkshire Music Festival in Massachusetts. At one point in the performance, the astonished audience watched the musicians put down their instruments and heard the music continue "unchanged." With such reality from a mono source, was the conclusion, why bother with stereo?

This person made a strong distinction between "listening for sound" and "listening for music." Whether these twain shall ever meet has often been debated, but the answer for this dissenter was a most definite "No." Other anti-stereo arguments reflected the thoughtful but adamant stand of one to whom musical values such as interpretation and instrumental techniques come first, with sound *per se* a poor second consideration.



LISTENING AT FIRST HAND

So much for the opinions of others.

Before and after hearing all the foregoing opinions, the author engaged in many hours of critical listening to stereo and monophonic records. The system used for the "auditions" included a Shure M3D stereo cartridge, an Eico HF85 stereo preamp, a pair of HF35 (watt) basic amplifiers, and two Tannoy Belvedere speaker systems consisting of 12″ dual-concentric extended-range speakers in ducted-port reflex enclosures. A variety of records from a number of recording companies was heard: records of soloists, orchestras, Broadway shows, jazz, concertos, pop tunes, cantatas, and even a drum ensemble.

STEREO-MONO JUDGING METHODS

For some of these records, the monophonic counterpart releases were also heard (practically all stereo records are available in mono versions as well). At first, the audition of a record began with a stereo hearing (using the Shure cartridge), then a performance of the monophonic release (using

an ESL C-60 mono pickup). This practice was soon abandoned in favor of paralleling the two outputs of the Shure to produce a mono signal from the stereo record.

This was judged to be a fair method because, when both outputs of a stereo cartridge are paralleled, the vertical components of the stereo signals, being in opposite phase, cancel each other, as shown in Fig. 1. Only the lateral components of the signals remain to be amplified. The combined lateral contents of the two stereo channels add up to provide an essentially monophonic version of the stereo record.

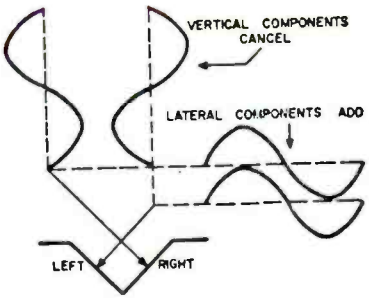


Fig. 1. When outputs of stereo cartridge are paralleled, vertical components cancel, lateral components add.

After many comparisons between the sound of a monophonic record itself and the stereo record played monophonically, the difference was judged slight or non-existent. Consequently, it was decided to use stereo records as the basis for listening tests and comparisons between stereo and mono reproduction. Instant comparison between stereo and mono was possible merely by a turn of the mode control on the preamp. This method also served to reveal a curious phenomenon which will be discussed later.

RECORD EVALUATION

Music for the Harpsichord. Many of the debates over stereo have centered around its questionable value in recording solo instruments, and so some reactions to "Music for the Harpsichord," played by Sylvia Marlowe (Decca DL710001), are worth mentioning. The harpsichord is a difficult instrument to reproduce accurately because of its sharp transients and intricate overtone structure.

In stereo this record came very close to conveying the sound of a harpsichord in the concert hall. It was delicate and soft, with none of the hard "clanginess" heard on many older records. Moreover, it was, as Seymour Solomon put it, "placed in space." While no sharp directionality was obvious, the instrument itself seemed to have real dimensions.

Flipping the mode switch to mono made a difference, but not a shocking difference. The delicate harpsichord quality was well retained. Yet several such back-and-forth comparisons revealed that only the stereo version offered the illusion of an actual harpsichord just beyond the wall of the room. In the monophonic version, the harpsichord seemed to be definitely a product of the two speakers.

Of course, it took a direct comparison to tell—but the difference was there. And while other differences in sound quality such as distortion and frequency range were not discernible, the stereo version added a touch of reality just barely lacking in the mono version.

Themes for African Drums. A fascinating record is RCA Victor's "Themes for African Drums" played by Guy Warren and his group (LSP-1864).

Here, stereo added directionality—a priceless ingredient in listening to the back-and-forth responses from performers who are normally spaced across a stage. The interplay of bongo drums with the larger "talking drum" is also dramatized by directionality. Switching to mono narrowed the sound source intolerably and eliminated the effect of the action's taking place across an imaginary stage.

Beethoven's First Piano Concerto. Glenn Gould's stereo recording of Beethoven's *First Piano Concerto* with the Columbia Symphony under Vladimir Golschman (Columbia MS 6017) demonstrates a rather different approach to stereo. It does not send the piano out of one speaker and a big chunk of orchestra out of the other, as one might suppose. Instead, the piano is heard between the speakers with the orchestra surrounding it. Moreover, directionality is not stressed; you don't hear instruments in distinct locations as with many other orchestral records.

It was with the Gould record that the practice of stereo-mono switching with the preamp mode control revealed a striking effect. Each time the preamp was switched from stereo to mono, the "sound-front" from the two speakers seemed to collapse to a narrow line between them, somewhat as turning a TV set's width control causes the picture to be squeezed into a central vertical line.

This "TV squeeze" phenomenon was most obvious on recordings of full symphony orchestras, but was apparent even in the harpsichord record, as already described. Of course, the reason for

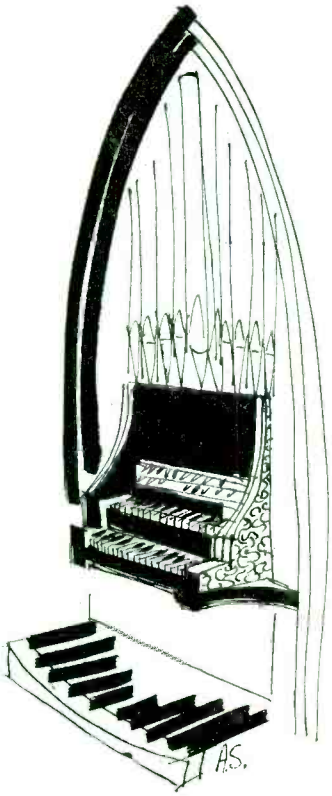
the squeeze is that the monophonic sound is "imaged" directly between the two speakers.

Sound Ideas. The glossy, golden-brassy style of Les and Larry Elgart and their orchestra is projected on a dance record called "Sound Ideas" (Columbia CS 8002), in which Bachmann's "new art form" thesis is well illustrated. This record is a stereophile's dream of directionality.

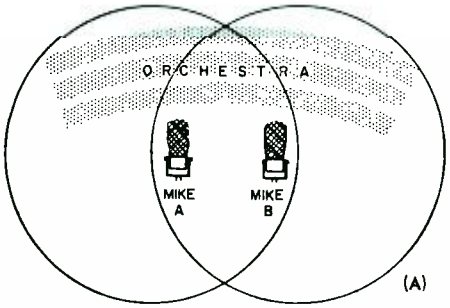
Yet the sound of saxes from the left, percussion from center, and the trumpets from the right is more than an audio gimmick. It's a spectacular display of harmonies and textures among soloists and sectors of the Elgart band, and as such, a highly interesting picture of a bright, polished ensemble. This is fine if you're listening intently. But this is dance music designed for *casual* listening. Turn the mode switch to mono and the bandstand contracts in the "TV squeeze"; but if you're dancing, who cares?

Magnificat in D. Different entirely is the Vanguard record of J. S. Bach's *Magnificat in D,* a cantata for chorus and orchestra (Stereolab BGS-5005). This is music for serious listening, if you like to get this serious, and the stereo version allows you to hear the sopranos from the left, altos from the right, etc. Not only is the sweep and grandeur of the massed chorus and orchestra lost by switching the mode switch to mono, but some of the clarity of the enunciation of the Latin text is also lost. A student of religious music is bound to appreciate the greater clarity of the stereo version, but even a newcomer to the Bach fan club is likely to warm to the intensely personal qualities of this music by being able to hear the localized voices of the chorus.

West Side Story. The stereo "West Side Story" (Columbia OS 2001) is something of a disappointment. The sound is good and directionality is clearly evident. Yet the expectation of hearing a virtual Broadway performance is never fulfilled. Voices and instruments come from left and right and middle, but the listener's reaction is, "So what?" They could just as well have come from the middle, for their dramatic significance. The probability is that the recorded performance was not really acted out like the regularly staged performance. If this was the case, then the potential of stereo for drama was not properly utilized.



HOW SHOULD STEREO SOUND?



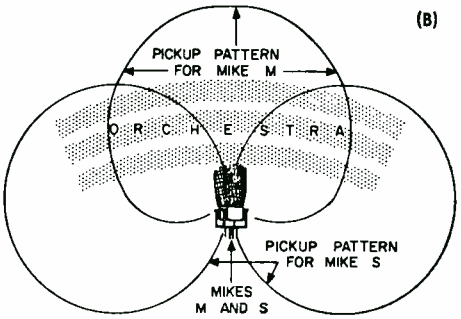


Fig. 2. Highly directional stereo is produced by recording setup diagrammed in (A); most American recording companies use this method. The M-S recording system shown in (B) is favored in Europe; the characteristics of this technique are depth and spatial quality.

Hearing these and other stereo discs confirmed the impression gained from the interviews that there is no single, universal conception of how stereo *should* sound. There are, in fact, two basic opposing schools of thought, each favoring its own system of microphone technique, and each lined up on either side of the Atlantic Ocean.

Most American companies use two main microphones spaced left and right as in Fig. 2 (A). Usually a central mike feeds a third recording channel, and special mikes are dotted around as needed for close pickups. Spacing between main left and right mikes depends on the size of the performing ensemble, studio, acoustics, the engineer's own ideas, and experimentation. This approach results in highly directional stereo.

Europeans favor the so-called M-S system, shown in Fig. 2(B), a method which emphasizes depth and over-all spatial quality. Occasionally the Europeans supplement the M-S placement with additional left and right mikes, justifying this compromise of their principle by explaining that it merely "adds accent" to the sound.

Which system is better? That's largely a matter of personal preference. If you must have directionality, records made with the "American-style" miking technique will be your cup of tea. If you want a feeling of musical integration with an added measure of depth and spaciousness, then try a few of the European M-S discs. Most Angel and Capitol EMI stereo recordings are made with M-S miking.

HOW DOES STEREO SOUND?

No recording technique can enable even the finest equipment to produce an *absolute* replica of a musical performance or aural experience in your

living room. At the risk of being held up to scorn twenty years from now, one would venture to say that such a goal will never be achieved.

Stereo reproduction, however, sounds more "real" than does monophonic reproduction. Unseen performers play from definite locations. The acoustics of recording halls or studios are "built into" the sound, and they keep the music from sounding disembodied. Solo instruments stand out more clearly in stereo.

There is no contradiction in saying that the very "reality" of stereo is the product of an elaborate illusion which was conjured up in the recording studio and then consummated in your living room.

In listening, it's as if you say to yourself, "I'll just suppose for the time being that there is an actual symphony orchestra arranged along the wall." Then, when horns blare from the center, fiddles from left and right, and basses from the rear, you can grin with the satisfaction that your "suppose" paid off! Sound funny? There's a big grain of truth in it.

In hard fact, a symphony orchestra could never squeeze into a living room, and if one ever did negotiate the feat, the sound would probably be unbearable. But a jazz combo or a string quartet or a soloist are all ideally suited to the dimensions of the average living room, and in stereo they become startlingly lifelike.

TECHNICAL PROBLEMS

DISTORTION: Stereo vs. Mono

Having taken into consideration various professional opinions and the impressions gained from first-hand listening, now let's talk about distortion levels and record wear.

In percentages, distortion is inherently higher on 45-45 stereo discs than on the latest and best monophonic LP records. Whereas harmonic distortion on a good monophonic LP record can be held to less than 2%, the distortion on a 45-45 disc reaches 10%. Taken by itself, this figure of 10% will sound shocking to audio fans who habitually mumble "1/10 of 1% at 50 watts" in their sleep. A knowledge of two major factors helps to relieve the shock.

First, the harmonic distortion consists largely of second harmonics and higher even-order harmonics. Though it is not widely known, second harmonics are not objectionable even in amounts as high as 10%. William

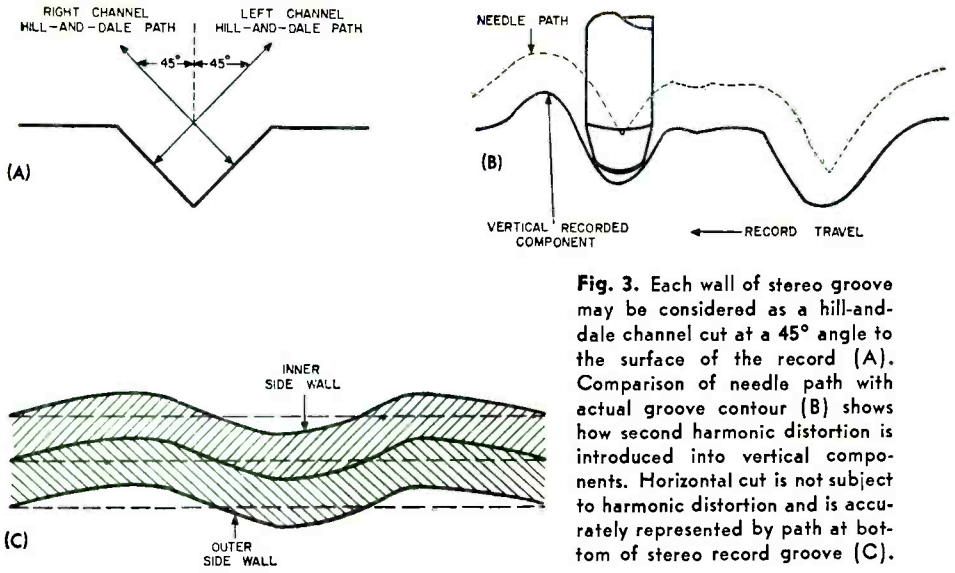


Fig. 3. Each wall of stereo groove may be considered as a hill-and-dale channel cut at a 45° angle to the surface of the record (A). Comparison of needle path with actual groove contour (B) shows how second harmonic distortion is introduced into vertical components. Horizontal cut is not subject to harmonic distortion and is accurately represented by path at bottom of stereo record groove (C).

Bachmann of Columbia Records tells of an experiment in which an audio oscillator first produced a pure note before an audience. Successive amounts of even-order harmonics were then injected and the audience was asked if the tone sounded different. Not until the even-order harmonic content was increased to well over 10% did the audience reply affirmatively.

Audio expert Stephen Temmer, of Gotham Audio Development Corp., notes that the diapason in an organ is deliberately provided to introduce various second harmonics and higher even-order harmonics because they add a pleasing brilliance to the sound. He also notes that even-order harmonics are not even measured in high-grade German systems.

Secondly, most of the distortion on a 45-45 stereo record appears in the vertical component of the signals, the component which carries only the stereo information, or difference signal. The lateral component, which carries the main body of the sound, is not appreciably subject to second harmonic distortion.

Figure 3 shows how even-order harmonics are introduced into the vertical component. Each wall of the groove is actually a single-channel vertical, or hill-and-dale path, as in Fig. 3(A), with the hills and dales at a 45° incline to the horizontal. Figure 3(B) is a cross section of one wall. The stylus, riding over the crests of the hills and down into the dales, follows a path slightly different—pointed at the bottom and flattened at the top—from the actual wall contour. This introduces the second harmonics—but only into the vertical component. As in Fig. 3(C), the *horizontal* component for both channels is traced along both walls. The tracking axis follows the bottom of the groove relatively accurately.

In other words, the lateral signal components are created by a push-pull "generator" which cancels out even-order harmonics in much the same way a push-pull output stage in an amplifier cancels out even-order harmonics. The vertical component for each channel is created by a single-ended hill-and-dale "generator" and is therefore subject to harmonic distortion.

RECORD WEAR: Stereo vs. Mono

A frequently asked question by professionals and amateurs alike is: how will stereo discs wear?

The plain answer is: not as well as their monophonic predecessors. Whether or not the difference is significant, however, remains to be seen. Anyway, the following are the technical facts of life for the stereo disc:

(1) Most stereo stylus tips are .7 mil in diameter (a mil is 1/1000 of an inch), and at least one stereo cartridge uses a .5-mil stylus. When compared with the standard 1-mil stylus tip used for monophonic LP records, it can readily be seen that a .7-mil or .5-mil stylus exerts greater pressure per unit area. Even the nomal reduction in stylus pressure to two or three grams does not entirely offset the rise in pressure which results from the reduced

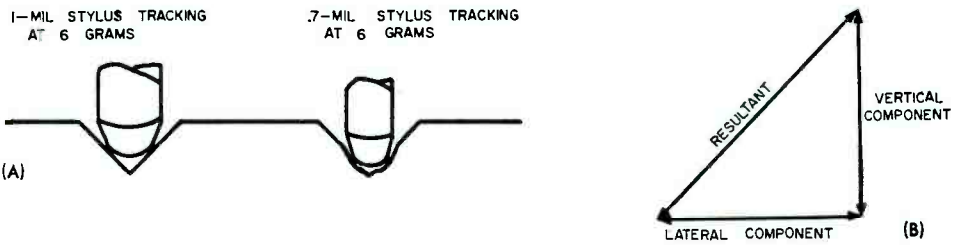


Fig. 4. Effect of a .7-mil stylus tracking at same pressure as a 1-mil stylus (A), and representation of stylus velocity in tracking stereo record grooves (B).

diameter. End result: the soft plastic of the record is gouged more deeply by the stereo stylus. See Fig. 4(A).

(2) In tracking the stereo disc, the stylus travels farther in each 45° direction than it would on a mono version of the same record. See Fig. 4(B). The travel path of the stylus in a stereo groove is the diagonal of a rectangle formed by the lateral component and the vertical component. This diagonal resultant is always greater than either the lateral or the vertical component; consequently, the stylus must move at a greater velocity when following the undulations of a stereo groove than it would in tracking a monophonic record. The added velocity means that the stylus slams up harder against each side of the groove wall of a stereo record than it would on a mono record. Hence, a tendency toward more wear of both stylus and groove.

SUMMING UP

After hearing the views of some of the best informed people in the record business, and piecing together some of the technical facts into a picture of what—and what not—to expect from stereo discs, the author developed the following conclusions:

Without question, stereo sound is better than monophonic sound. Perhaps the most striking demonstration of this is the sudden collapse of the sound-front—the "TV squeeze"—which occurs if you switch from stereo to mono

when playing a stereo record. Whether it is sharply directional stereo or the more sonorous but generalized stereo of M-S, switching to mono inevitably dispels any doubts of stereo's superiority.

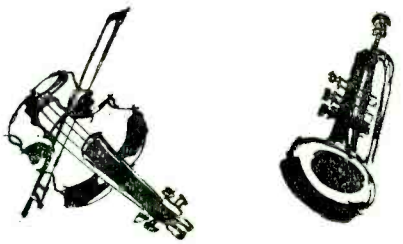
Also, stereo provides more effective separation of instruments and even melodic lines within the same frequency range. The two speakers "share" the job; each handles a more easily managed waveform with subsequent greater clarity. For example, channeling a trumpet through one speaker and a simultaneous violin passage through the other permits each to reproduce a far less complex waveform than if one speaker were called upon to reproduce both. So, despite any theoretical rise in distortion, this division of labor results in greater clarity and increased listening pleasure.

Yet, with all the advantages attributed to stereo on these pages and elsewhere, there is one which merits more consideration than it has received: stereo *demands attention*. In the main, listening to a good stereo record cannot be a casual experience. The listener is practically commanded to concentrate. Not disembodied sound, but the performance of unseen yet almost real musicians emanates from the speaker wall.

For many of us, weaned and later calloused by years of droning table-radio music, such concentration is often tough to muster. As a matter of fact, it is much the same concentration that we quite naturally employ at a live concert. This is not to equate stereo sound with a live concert; nor is stereo a substitute for live music. But the stereo qualities are aural substitutes for the visual centers of attention which help us concentrate in the concert hall.

We can't really locate individual sounds in a concert hall (close your eyes and try sometime), but we do *see* the horns, the oboe, the tympani. In stereo, the pinpointing of instruments serves the same purpose by increasing our attention to the music and thereby enabling us to derive greater enjoyment from it. Stereo directionality may be "artificial," but it does serve this very useful purpose.

Finally, just to settle an old argument, a monophonic phonograph may produce lifelike sound when played in the tremendous Tanglewood Music Shed, possibly because the Shed doesn't "care" whether the sound source on its stage is a real orchestra or a recording and just goes ahead adding its reverberation and hall-like character to the sound reaching the listener in his seat. But to those millions of people who seldom, if ever, sit in a concert hall, and who must enjoy their musical heritage through electronic means, stereo offers a compelling experience.



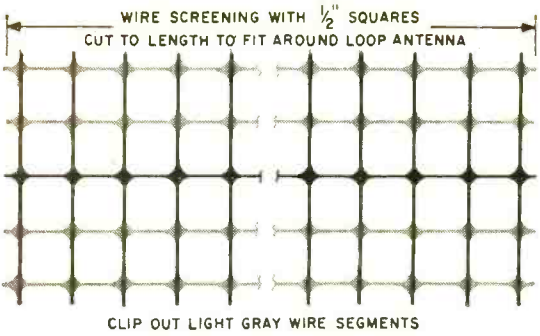
Transistorized Metal Detector

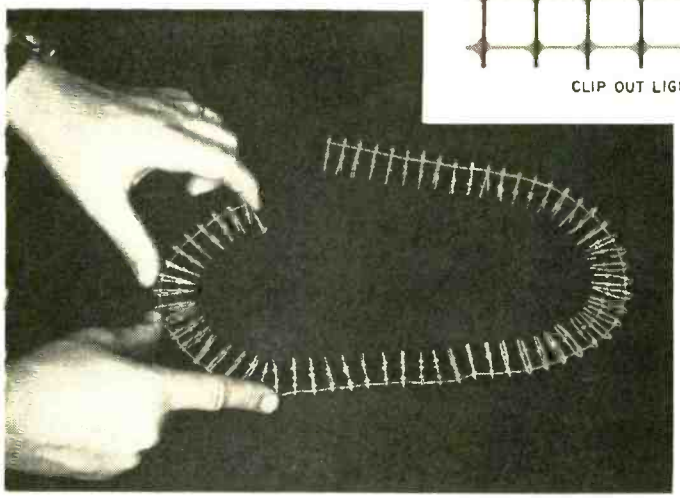
Simple detector tracks down hidden pipes, conduits and other metal objects

By
RUDOLF F. GRAF

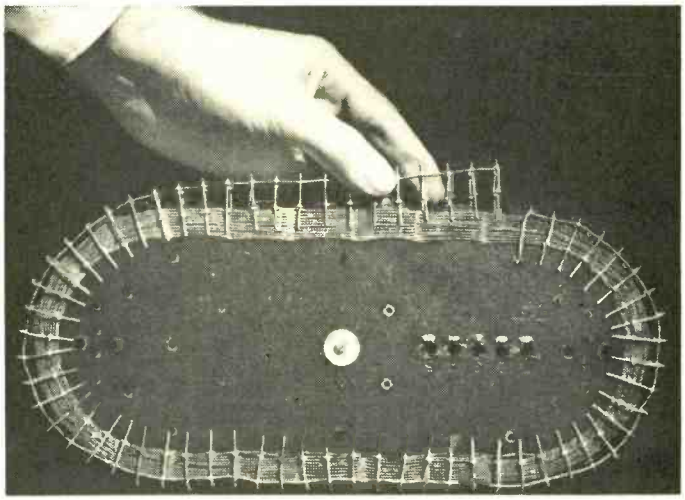
HAVING TROUBLE tracking down those plastered-over conduits, plumbing and terminal boxes? Then this transistorized, lightweight metal detector is for you. Simple construction and low cost make it an ideal project for the home mechanic and experimenter. As an extra bonus, it will also detect underground pipes, cables, fuel oil tanks, and other metal objects—*if* they are not buried too deeply.

Construction. Except for the search coil, the entire detector is built into a 2¾" x 4" x 2" aluminum box. The search coil (*L2*), which is actually a standard AM loop an-





Cut out Faraday shield as shown above and bend it to shape as in photo at left for installation on the loop antenna.



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tenna, is mounted at one end of an 8"-long ¾" wooden or plastic dowel. The larger *L2* is, the more sensitive the unit will be. Ordinary magnetic headphones of 1000-2000 ohms impedance are used.

You can make the chassis from a small piece of perforated phenolic board. Cut the transistor socket slots slightly undersize, and press and glue the socket in place. This

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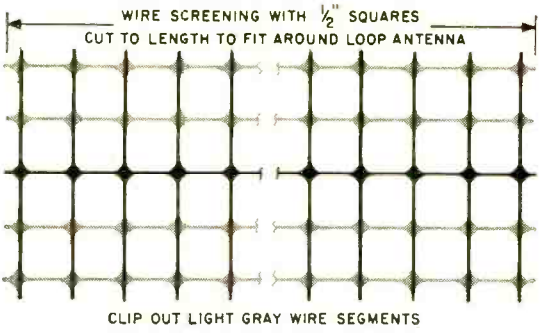

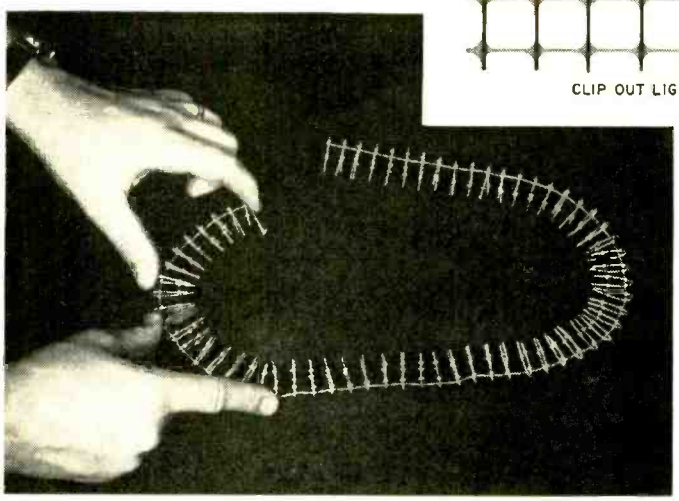

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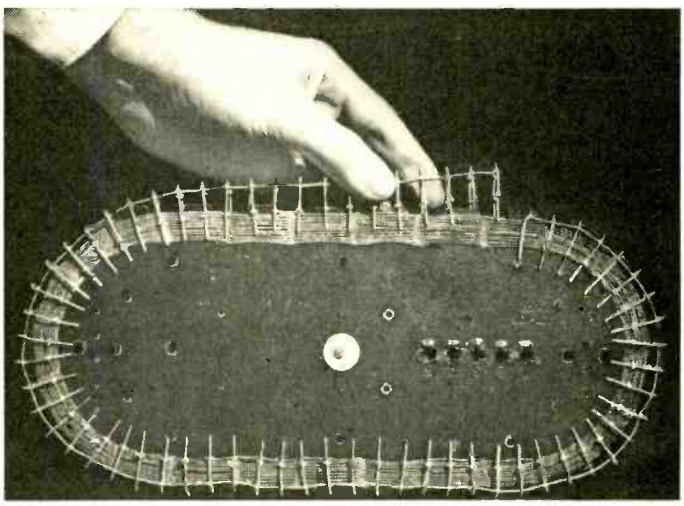

Install the shield on the loop as shown. Make sure that the ends do not touch each other.

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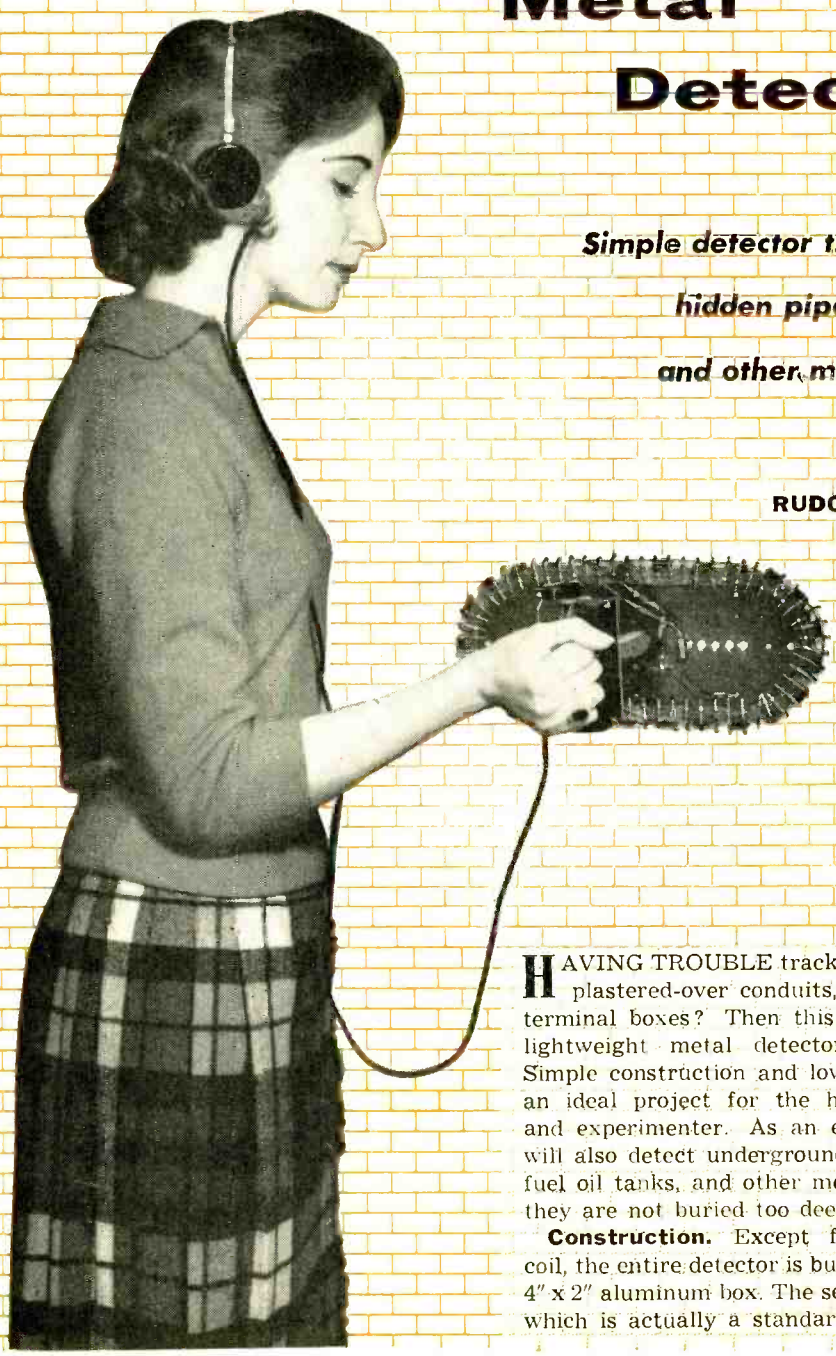
You can make the chassis from a small piece of perforated phenolic board. Cut the transistor socket slots slightly undersize, and press and glue the socket in place. This chassis is made self-supporting by using busbar for the connections to *S1, L1,* and phone jack *J1*. Note that *J1* is insulated from the cabinet with shoulder washers.

The electrostatic Faraday shield used to eliminate the effect of external capacitance is made from ½"-square wire screen. Be careful *not* to form a closed circle or short any two wires, or the shorted turn will stop

Transistorized Metal Detector

Simple detector tracks down hidden pipes, conduits and other metal objects

By
RUDOLF F. GRAF



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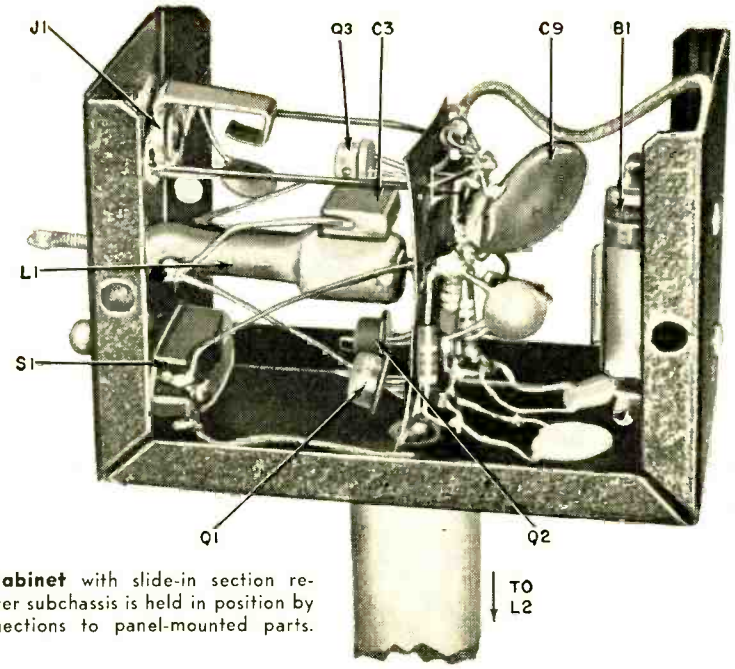
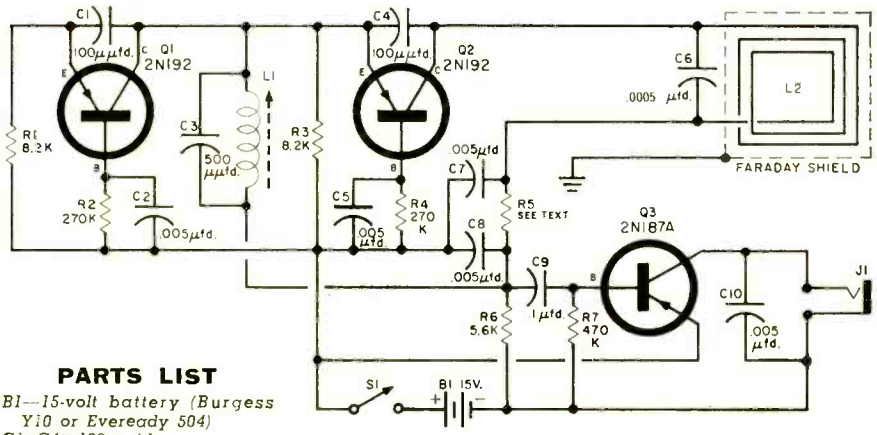


Detector cabinet with slide-in section removed. Center subchassis is held in position by busbar connections to panel-mounted parts.



PARTS LIST

B1—15-volt battery (Burgess Y10 or Eveready 504)
C1, C4—100 μμfd.
C2, C5, C7, C8, C10—.005 μfd.
C3—500 μμfd. — *all capacitors*
C6—500 μμfd. (see text) — *low-voltage*
C9—0.1 μfd. — *disc ceramic*
J1—Insulated phone jack
L1—Loopstick antenna (Lafayette MS-11 or equivalent)
L2—Standard AM broadcast receiver loop antenna
R1, R3—8200 ohms
R2, R4—270,000 ohms — *all resistors*
R5—47 to 1000 ohms (see text) — *½-watt*
R6—5600 ohms — *composition*
R7—470,000 ohms
S1—S.p.s.t. toggle switch
Q1, Q2—2N192 transistor
Q3—2N187A transistor
3—Transistor sockets
1—8" length of ¾" rod
1—2¾" x 4" x 2" chassis box (Bud HB-1622)
1—Battery bracket (Acme #31)
1—½" wire screen for Faraday shield

circuit oscillation. Leave about ½" to 1" space between the start and the end of the Faraday shield to be sure. Connect the shield to the cabinet at one point with a wire which should run along the dowel supporting the loop.

Adjustment. Before turning the unit on, check the wiring carefully. Be sure the battery is connected with the proper polarity, as an error may ruin the transistors. If everything looks okay, turn on the switch. A slight background hiss will indicate operation of the audio stage.

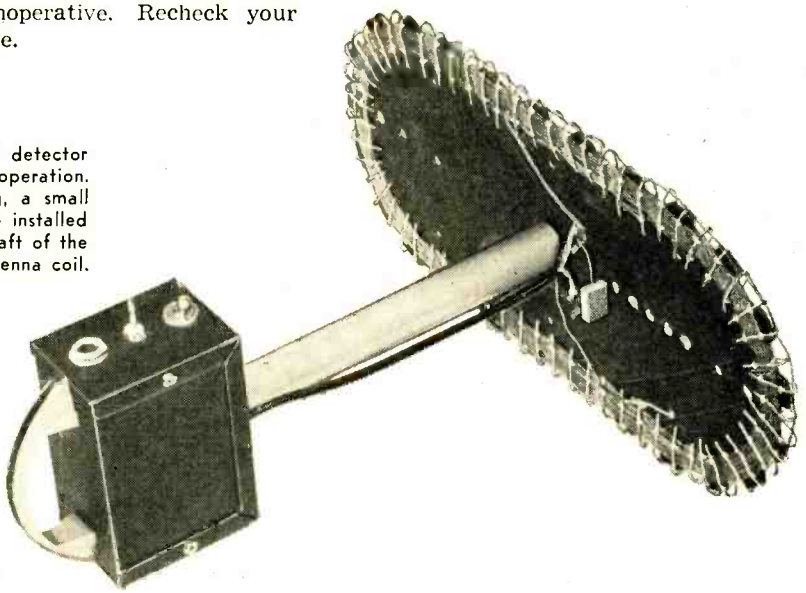
Now adjust the frequency of the variable oscillator with the tuning slug of *L1*. If it

is not possible to adjust for a beat note anywhere in the tuning range of the variable oscillator, one or both oscillators may not be working, *or* the variable oscillator frequency may not be close enough to the frequency of the fixed oscillator to beat with it. Try changing the value of the fixed capacitor (*C6*) across the loop antenna from about 300 $\mu\mu$fd. to 700 $\mu\mu$fd. to shift the frequency within the range of the variable oscillator.

If the fixed (search) oscillator is inoperative, try removing the Faraday shield. It may be shorted or have reduced the *Q* of the circuit to the point where oscillation stopped. The audio amplifier stage (*Q3*) may also be inoperative. Recheck your wiring to be sure.

One way to check oscillator functioning is to bring the unit near a broadcast receiver tuned to a station near the high end of the band. Adjusting the tunable oscillator should produce "birdies" as a result of its harmonics beating with the station signal.

"Pulling" may occur as adjustment for zero beat is made. If the audio frequency heard goes from a high to a lower pitch whistle and then "plops" out *before* the low "growl" is heard, then *R5* requires a change in value—possibly up to about 2000 ohms. At the proper resistance, the "plop" does not occur until *after* a very low frequency note or buzz is heard.



Completed metal detector ready to be put in operation. For ease of tuning, a small tuning knob can be installed on the threaded shaft of the adjustable loop antenna coil.

HOW IT WORKS

Two separate r.f. oscillators are employed in the beat-frequency type of metal detector. One of these (*Q1*) is tunable and shielded within the metal box. The second oscillator (*Q2*) uses non-tunable loop antenna *L2* (the search coil of the detector) as its oscillator tank coil. The output of both oscillators is coupled to a third transistor (*Q3*) which mixes and amplifies the resulting beat signal.

Frequency of the tunable oscillator is so adjusted that normally a low-frequency beat note or "growl" is heard in the phones. (If the fixed oscillator frequency is 500,000 cps and the variable oscillator frequency is adjusted to 499,900 cps, then a beat-frequency signal of 500,000 minus 499,900 or 100 cps is heard.)

The metal detector functions by inducing eddy currents in any metal in the radiated r.f. field of the exploring loop. These currents are reflected back and cause a shift in the fixed oscillator frequency which affects the frequency of the beat note heard in the phones. The tone of the note heard indicates the direction and location of the metal.

Using the Detector. When you are ready to use the detector, adjust the variable oscillator slug until a low-frequency beat note is heard in the phones. The search coil should *not* be near metal.

Now bring the loop close to a metal object. The frequency of the beat note should *increase*. If it decreases, retune the variable oscillator through zero beat to the "other side," and adjust again for a low-frequency beat note.

With the detector set for the lowest audible "growl," you're all set to go. All you have to do is listen for the whistle when the detector finds anything metallically interesting. —30—

Short-Wave Monitor Registration Receives International Acclaim

LETTERS from short-wave listeners all over the world have been pouring into the editorial offices of POPULAR ELECTRONICS, acclaiming the Short-Wave Monitor Registration Program. Listeners from Afghanistan to Zanzibar are sending in their registration applications in order to receive their attractively printed 8½" x 11" certificates with individual station letters. Both American and international station letters are assigned in accordance with established amateur radio call zones.

The registration program has been recommended over *Radio Australia, Voice of America, Radio Sweden, Voice of Denmark, Deutsche Welle,* and *La Voix Evangelique* (Haiti). Some of the 40 countries where monitoring stations have been registered include Cyprus, Honduras, Brazil, Canada, Scotland, Belgium, Netherlands, Germany, India, U.S.S.R., and Korea.

The world's largest and best DX clubs, such as the Newark News Radio Club, Universal Radio DX Club, National Radio Club, DXplorers Radio Association (U.S.A.), and Teknikens Världs Radioklubb (Sweden) have urged their members to register.

Best response has been from American DX'ers—some 5000 call letters have been assigned, in every one of the 49 states. In several call areas we have exhausted all the two-letters calls (through "ZZ") and are now issuing three-letter calls, such as WPE2ACJ, WPE8AEX, etc. To make this project a real success, every DX'er should have his station registered.

If you have not yet obtained your certificate, fill out the form below and mail to: Monitor Registration, POPULAR ELECTRONICS, One Park Ave., New York 16, N. Y. Please include ten cents to help cover cost of mailing and processing your certificate.

SHORT-WAVE MONITOR REGISTRATION

(Please Print)

Name .....

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

Receiver — Make ..... Model .....

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

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

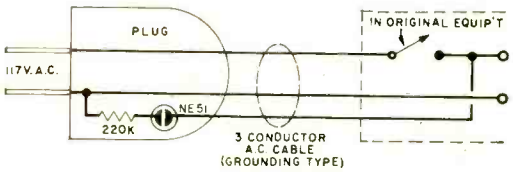
Type of Antenna Used .....

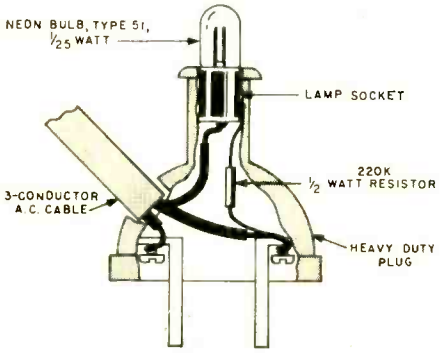
Signature ..... Date .....

Foolproof Pilot Light

Soldering irons and other appliances without pilot lights would obviously benefit by having an "on" warning device. A suitable indicator can be simply installed by using a small neon lamp force-fitted into the normal opening of a heavy-duty a.c. line plug.

The side of the plug is then drilled to accept a three-conductor a.c. line cord, and the circuit is wired as shown in the diagram at right if the instrument or appliance has an on-off switch. With items such as a soldering iron, two-wire cable is used, wired to the prongs of the plug in normal





fashion, and the neon lamp and resistor are connected across the plug terminals. The hookup to the device with which the pilot is to be employed is indicated in the schematic at the left.

If the NE-51 neon bulb is properly installed, it will light only when the instrument is on, thus providing a positive indication of current flow.

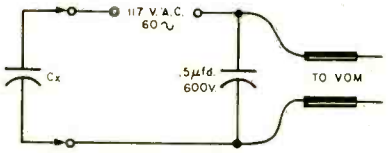
—Brian Desind, K3GBT

Finding Capacitor Values

Most of us know that capacitors will "conduct" a.c., but have you ever thought that this property could be used to provide a rough measurement of the value of a capacitor? Employing the circuit at right, a chart of proper voltages for the standard capacitor values was determined experimentally. The device can be built into any small chassis or plastic case.

When testing a capacitor, always start with your highest a.c. scale. Leaky capacitors will pass excessive voltage, and no voltage indication shows an open capacitor. This technique will work reliably *only* for low-leakage paper capacitors of the values indicated.

—Ronald Wilensky



STANDARD CAPACITOR VALUES

μfd.	A.C. Volts	μfd.	A.C. Volts
.002	.45	.08	14.50
.004	.83	.1	17.45
.006	1.25	.2	30.00
.008	1.65	.4	45.00
.01	2.10	.6	57.00
.02	4.30	.8	65.00
.04	7.70	1.0	75.00
.05	9.70	2.0	85.00

TESTED By POPULAR ELECTRONICS

Build a 90-Watt Transmitter

Eico's Model 720 is suitable for both the Novice and the seasoned General

THE FIRST PURCHASE a ham radio operator will make is a transmitter. This he considers as his reward for the hours of study and code practice required to pass the FCC amateur license test. One of the top quality transmitter kits for amateurs on the market is the new Eico Model 720 (Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long-Island City 1, N. Y.).

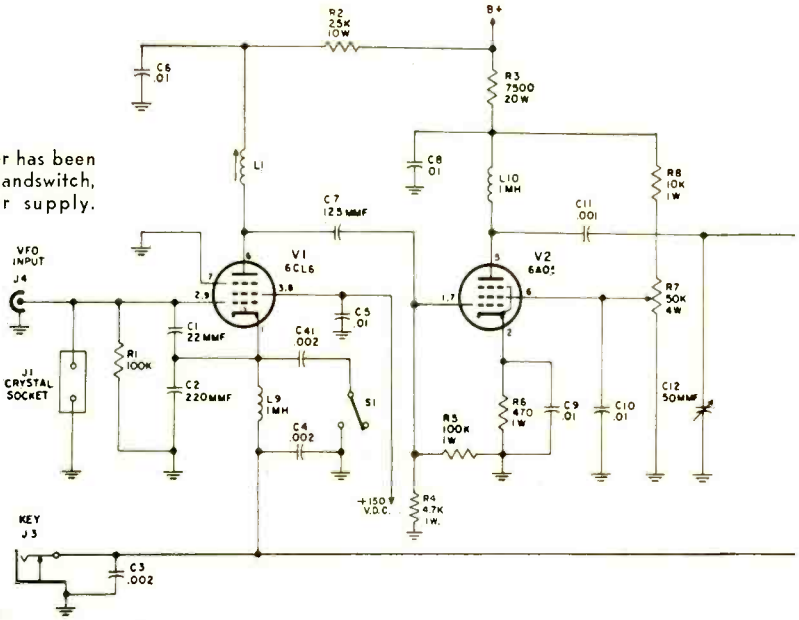
A very "clean" 90-watt c.w. bandswitching amateur transmitter, the Model 720 covers 80 through 10 meters. Important design features include: a one-knob *Stand-by, Tune* and *X'mit* switch; final amplifier grid drive control without detuning oscillator; oscillator keying for break-in operation; and provision for matching antennas from 50- to 1000-ohm impedance. The completely sealed cabinet, and careful bypassing and choking of all inputs and outputs, effectively suppresses TVI.

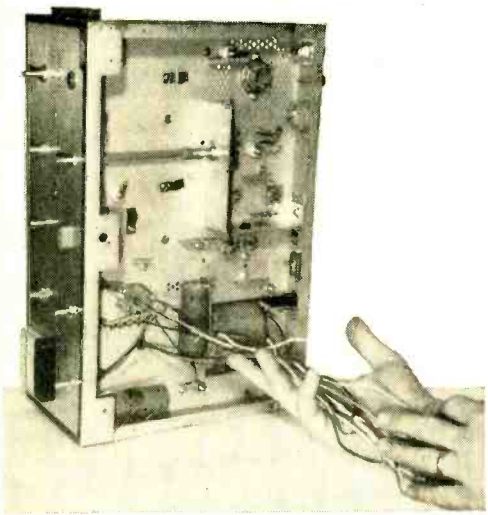
Circuit Description. A high transconductance 6CL6 pentode is employed as an electron-coupled Colpitts crystal oscillator. This circuit is noted for its high harmonic output and low crystal heating. Since the oscillatory part of the circuit is isolated from the load side by the screen grid, frequency shift due to plate loading is minimized.

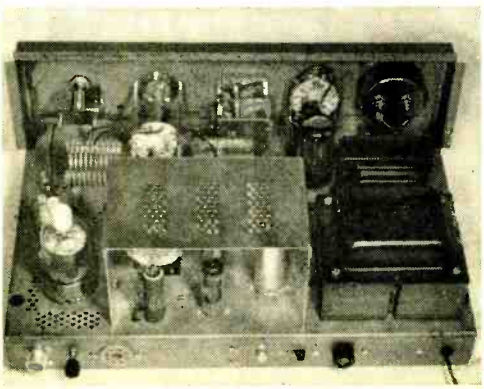
The plate tank circuit consists of a broadly tuned slug coil. It resonates at 40 meters for all bands of operation. The coil acts as a r.f. choke for 80-meter operation. Eighty-meter crystals are used for 80 and 40 meters, and 40-meter crystals for 20, 15, and

MANUFACTURER'S SPECIFICATIONS	
Power Input:	90 watts c.w. (Novice limit calibration on meter); 65 watts AM-phone with EXT plate modulation
Output Load Impedance:	500-1000 ohms
Tubes:	6146 final amplifier, 6CL6 oscillator, 6AQ5 clamper, 6AQ5 buffer-multiplier, GZ34 rectifier
Power Requirements:	117 volts, 60 cycles a.c., 175 watts
Cabinet Size:	15" wide x 6" high x 9" deep

Schematic of Eico transmitter has been simplified by omission of bandswitch, modulator jack and power supply.







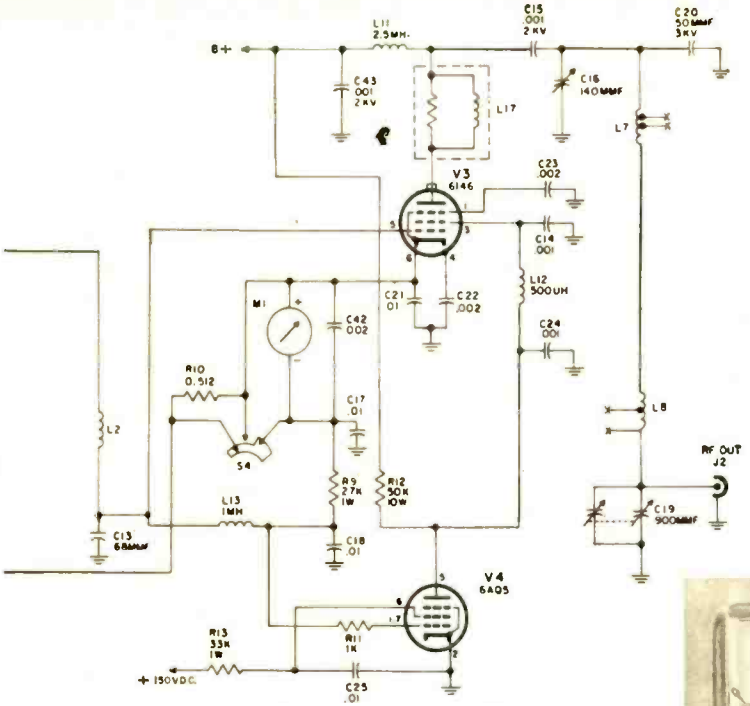
10 meters. An external VFO jack is provided which is connected to the grid of the 6CL6 and selected by a slide switch.

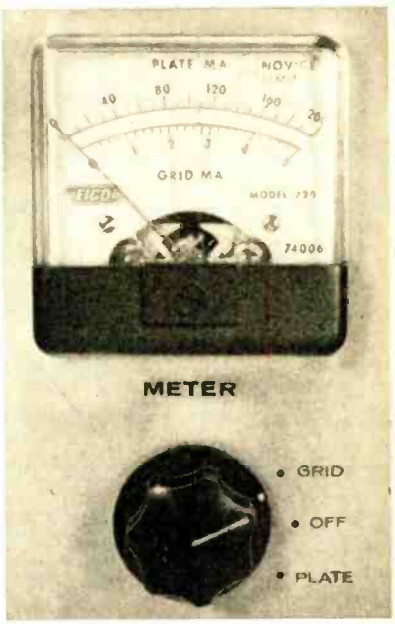
On 80 and 40 meters, a 6AQ5 buffer multiplier tube functions as a class A buffer; on all other bands, it functions as a class C multiplier. Second, third and fourth harmonics are obtained for operation on the 20- 15-, and 10-meter bands. A pi-network is employed in the plate circuit of the 6AQ5 to provide a stable load for the final amplifier, and screen voltage of the 6AQ5 is variable by a wire-wound potentiometer to provide drive control of the final stage. By this means, efficient and stable operation of the buffer and final is obtained.

A 6146 high-perveance power pentode final amplifier tube is used as a straight-through Class C power amplifier. The grid circuit is driven by the pi-network of the buffer stage, which helps prevent parasitics and self-oscillation in the final and also attenuates any high-order harmonics that may be present in the grid circuit.

To match the final amplifier to various loads between approximately 50 and 100 ohms, a variable pitch, bandswitching, pi-network tank circuit is used. A variable

Before starting underchassis wiring, twist protruding leads together to clear your view (above, left). Directly at left is the chassis after wiring has been completed and tubes installed.





The meter is used to tune the input grid and plate circuit of the transmitter's final r.f. amplification stage. It clearly indicates the Novice power limit.

900-$\mu\mu$fd. capacitor is connected across the output of the pi-network for controlling the degree of loading of the antenna and tuning the 80-, 40-, 20-, 15- and 10-meter bands.

A 6AQ5 clamper tube is employed to prevent excessive plate current flow if grid drive of the final should fail. It operates by dropping the 6146 screen grid voltage to a low value in the event of such failure. This tube also is part of the keying circuit and acts as a screen grid regulator when the transmitter is keyed. The transmitter is basically keyed in the oscillator and final cathode circuits, which results in a clean crisp note.

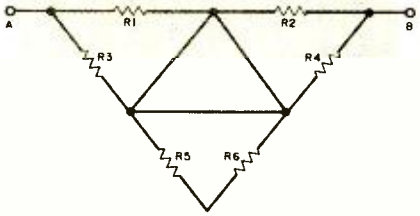
Putting It Together. Eico has prepared an excellent manual for the kit builder. Eleven two-color page-size pictorials illustrate the 13-page step-by-step assembly and wiring procedure. Do not be tempted to disregard the instructions and follow the pictorials only—you might leave out one wire which would only mean hours of trouble-shooting later.

Here are a few hints on assembly and wiring.

• Before starting the instructions given on page 13C, install the top shield as directed in step 19 on page 23C. This will permit you to turn the chassis upside down, avoiding possible damage to the bandswitch on top of the chassis. Remove the top shield whenever it interferes with chassis-top wiring.

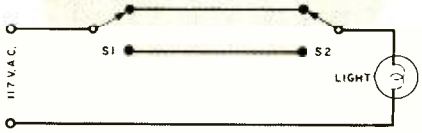
• A standard soldering iron is suitable for most connections. However, there are a few connections for which a standard iron will be too large. A good-quality pencil iron or soldering gun can reach these con-

(*Continued on page* 130)



1 Ned Work's homework assignment was to determine the resistance between points A and B in the circuit above. All resistors in this circuit are one-ohm units. Ned managed to do his homework in 30 seconds. Can you?

—William Plummer



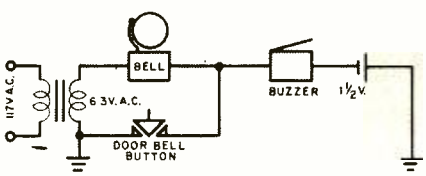
2 Joe Toggle wired up his porch light so he could turn it on or off with either of two switches. Now Joe wants to add a third switch in his upstairs bedroom so it too can control the light. What kind of a switch would it have to be?

—Donald Rimmer

Electronic Sticklers

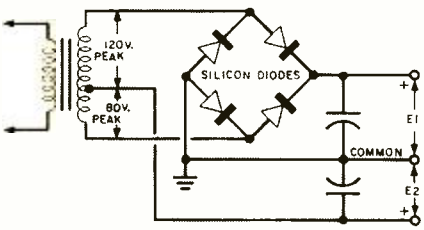
These four thought-twisters are arranged in order of increasing difficulty

(Answers on page 131)



3 Another problem Joe Toggle had to cope with was connecting an upstairs buzzer to the front door. Alas, he had only a d.c. buzzer to work with. So, using the hookup shown here, Joe reasoned that the doorbell button would ring his bell and buzzer. Where did he goof?

—Peter Denning

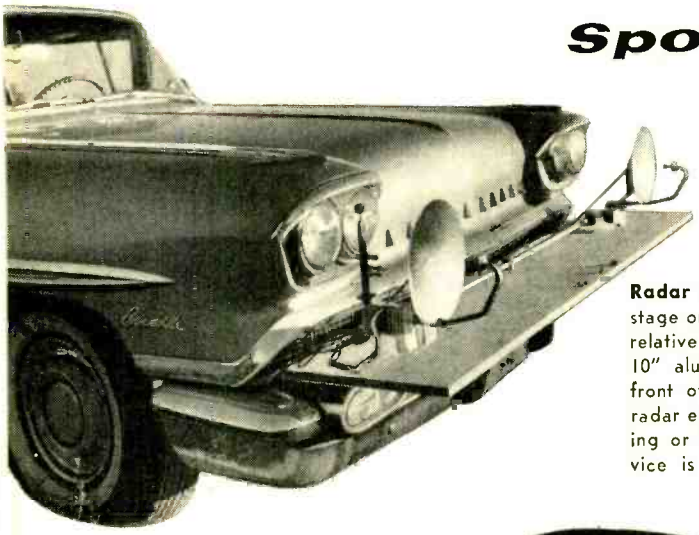


4 Harry Odball wired up a rectifier circuit using a surplus transformer. Since the tap on the secondary winding is not centered, peak voltages on either side of the tap are 120 and 80 volts. With no load on the circuit, what d.c. voltages does Harry's VTVM show for E1 and E2?

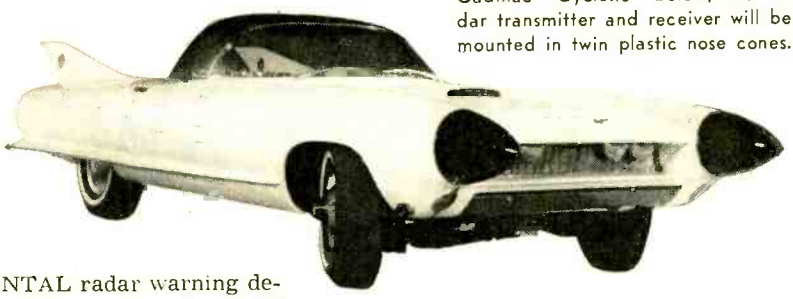
—Robert Weber

AUTO RADAR

Spots Highway Dangers



Radar warning device, shown in "breadboard" stage on car at left, uses Doppler principle to judge relative speed of approaching objects. One of the 10" aluminum reflectors focuses a radar beam in front of the car, the other reflector picks up the radar echo, and a transistor amplifier sounds a warning or flashes a light in case of danger. The device is especially useful in fog or low visibility. In cars of the future, such as the Cadillac "Cyclone" below, the radar transmitter and receiver will be mounted in twin plastic nose cones.

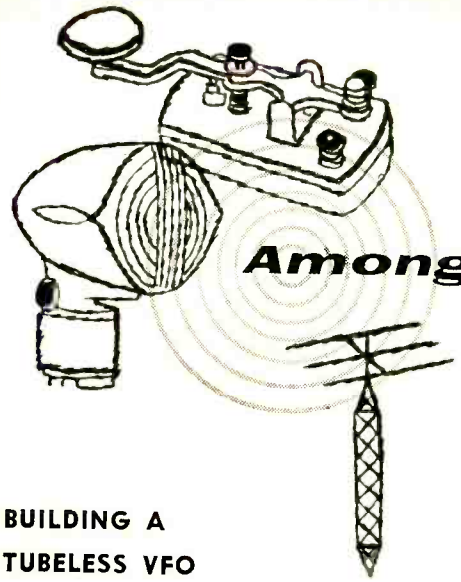


AN EXPERIMENTAL radar warning device for automobiles has been developed to warn motorists of highway dangers. When a car approaches too close to a car ahead, or when there is an obstruction or a slow-moving vehicle ahead, the unit provides a sound warning signal or warning light.

Microwave power is piped by the radar unit to one of the reflectors on the front of the car, and beamed ahead like the light from a headlamp. These microwaves bounce back when they strike an object, are collected by the other reflector and piped to a detector where the frequencies of the outgoing and incoming signals are compared in the manner of Doppler radar. Any relative motion between the radar device and the object ahead shows up as a frequency difference between the transmitted and received signal. This difference (called the Doppler frequency) is detected and amplified and made to operate the warning signal.

Developed by Delco Radio Division of General Motors, the radar unit can spot objects up to 1000 feet away, and it increases the intensity of the warning with the increasing rate of approach to an object. If a car traveling at 55 miles per hour approaches one going 50 miles an hour—rate of closure only 5 mph—the warning will not be strong. However, if the same car approaches a stalled car—55-mph rate of closure—the warning will be much stronger.

On a speaker in the car, these tones can be identified by the average driver after a little practice. An extra transistor circuit can be added which causes a green light to be switched off and a red light to appear under danger conditions. With this device, danger ahead can be recognized by the driver before he would otherwise be aware of it. —30—



Among the Novice Hams

By
HERB S. BRIER
W9EGQ

BUILDING A TUBELESS VFO

ONCE the Novice gets over the hump to his General Class, the megacycles open up, the ether is his home, and the variable frequency oscillator (VFO) is his next project. No longer rock-(xtal)-bound by FCC edict, the General can skip blithely from kilocycle to kilocycle with a VFO, evading QRM and collecting (he hopes) enough QSL's to wallpaper his living room.

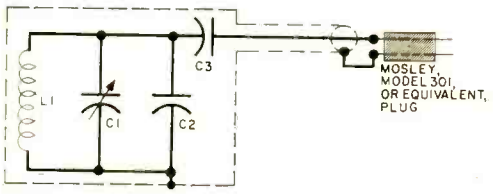
A good way to learn about VFO's is to build one, so here are some construction details on a tubeless VFO for 80 or 40 meters for use with a DX-20.

First mount the variable capacitor *C1* on one side of the 3" x 4" x 5" aluminum box, and solder *C2* and *L1* from its stator to its rotor terminals. Leave a couple of extra turns on *L1* for later adjustment.

Next, prepare an 18" length of RG-59/U or similar coaxial cable. Connect a two-terminal plug, such as the Mosley #301, or one made from an old FT-243 crystal holder, to one end of the cable. Solder the shield connection on the other end to the frame of *C1* and its center conductor to *C3*. The other end of *C3* is connected to the stator of *C1*.

Place the VFO beside the transmitter, and place the VFO output plug in the xtal socket with the shield of the cable to the

(*Continued on page* 132)



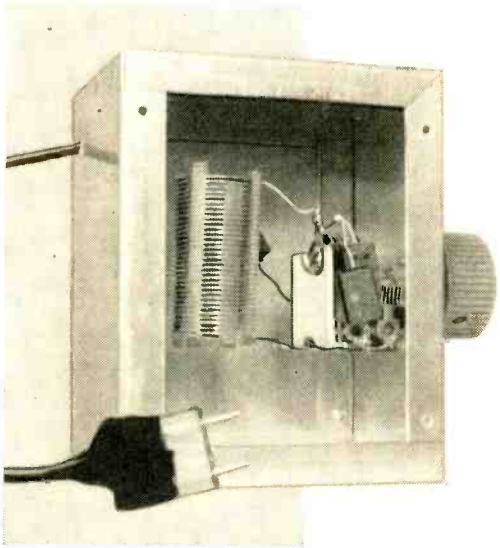
PARTS LIST

Eighty Meters

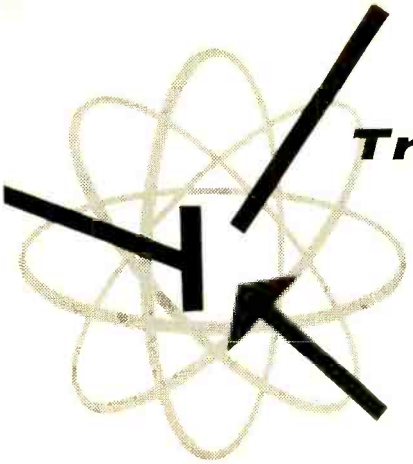
C1—365-μμfd. "broadcast" variable capacitor (see text)
C2—500-μμfd. silver mica fixed capacitor
C3—.002-μfd. mica capacitor
L1—32 turns of #20 wire, 1" diameter, 2" long (B & W #3015 Miniductor)
PL1—Two-terminal male plug (Mosley #301 or equivalent)
1—3" x 4" x 5" aluminum box

Forty Meters

C1—100-μμfd. "midget" variable capacitor (see text)
C2—300-μμfd. silver mica fixed capacitor
L1—19 turns of #20 wire (as above)
All other parts same as for 80 meters



Simple tubeless VFO for use on 80 or 40 meters. The photo shows a 3500-4000 kc. unit.



Transistor Topics

By LOU GARNER

TO A LARGE EXTENT, the high-frequency capability of a transistor depends on its internal geometry, and hence on the manufacturing technique used to produce it. High-wattage "power" transistors are physically large and, in general, have relatively poor high-frequency response. Many of them cannot be used as amplifiers beyond the audio frequencies.

A transistor's response to high frequencies may be expressed in one of several ways: as *alpha cutoff frequency, beta cutoff frequency,* or *figure of merit.* The first two specifications are similar in that they refer to the frequency at which the transistor's gain is 0.707 of its gain at low (audio) frequencies in either the common-base (*alpha*) or common-emitter (*beta*) circuit arrangements. The *figure of merit* is the frequency at which the transistor's gain is unity (1.0) and, for practical purposes, is the highest frequency at which the transistor can be used as an oscillator.

The first transistors manufactured commercially were point-contact units. They consisted of two closely spaced contact wires resting on a small wafer or cube of semiconductor material, and had fairly good high-frequency characteristics. One manufacturer, for example, introduced a type that was especially selected to serve as an r.f. oscillator at 50 megacycles.

The young lady is examining Philco Corporation's all-transistor satellite transmitter. See text.

But point-contact transistors were noisy, difficult and expensive to manufacture, and notoriously unstable. As a result, with the invention and production of junction transistors, the point-contact unit was soon placed in the "Hall of Fame" as an obsolete and outmoded type.

The junction transistor, consisting of a three-layered "sandwich" of *n*-type and *p*-type semiconductor materials, while far superior to the earlier point-contact unit in most characteristics, had (and still has) relatively poor high-frequency response. Only very carefully made units could be employed as amplifiers at much above broadcast-band frequencies. The "best" units had a cutoff frequency on the order of 30 mc.

One of the first technical breakthroughs was the development of the *junction tetrode* transistor. Some of these units can be employed as oscillators at frequencies up to 250 mc. Another breakthrough occurred

with the development of the now-famous *Surface-Barrier* (SB) transistor. Refinements and modifications of the production techniques used to manufacture SB units led, eventually, to the development of the *Micro-Alloy Diffused Type* (MADT) transistor; some of these units can be employed as oscillators at frequencies close to 1000 mc.

But tetrodes, SB types, and MADT transistors suffered from one common failing: they could handle relatively little power. When used as r.f. oscillators, their output power was generally measured in *microwatts* or, at the most, in terms of a few milliwatts.

Today, improved manufacturing techniques permit the production of u.h.f. transistors with power-handling capabilities comparable to those of small vacuum tubes. For example, TI's Type 2N1141 is a diffused-base "mesa" transistor with a collector dissipation rating of ¾ *watt* (or 750 milliwatts) and an alpha cutoff frequency of 750 mc.

As manufacturing techniques continue to improve, we may expect both upper frequency limits and power-handling capabilities to improve. In fact, within the next year or two, at least one manufacturer should announce transistors capable of delivering well *over a watt* at frequencies in excess of 1000 mc.

Reader's Circuit. Warren Boehling (26 Tioga Ave., Lake Hiawatha, N. J.) submitted the diagram for a battery-operated transistorized phonograph given in Fig. 1. All the parts used for assembly are standard and readily available through local parts distributors and the larger mail order houses.

Referring to Fig. 1, *Q1* is a G.E. Type 2N107, *Q2* a Raytheon Type CK722, and *Q3* and *Q4* are CBS-Hytron Type 2N255. *T1* is an Argonne Type AR-147 input transformer, *T2* a Type AR-503 output transformer. Except for controls *R1* and *R6*, and decoupling resistor *R7*, all resistors are half-watt units. *C1, C2, C4, C7,* and *C8* may be either ceramic or paper capacitors (50 volts d.c., or higher); all other capacitors are 12- or 15-volt electrolytics.

Power switch *S1* can be a separate slide or toggle switch or may be ganged to volume control *R1*. The 7.5-volt power supply is made up of five size "D" flashlight cells connected in series. A standard battery-operated turntable is used.

Follow your own preferences in choosing a pickup arm and cartridge, but make sure

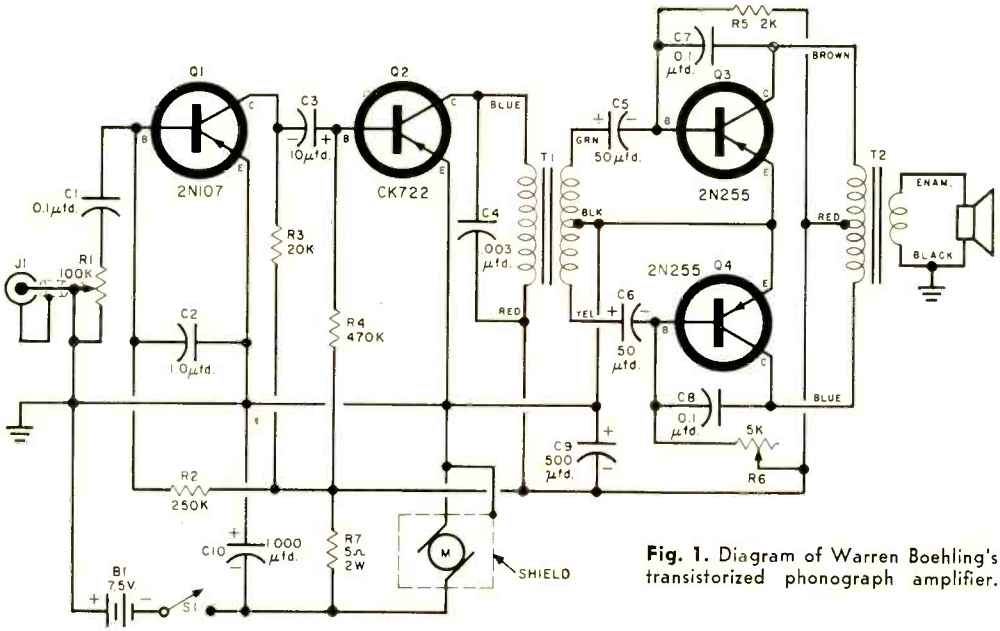


Fig. 1. Diagram of Warren Boehling's transistorized phonograph amplifier.

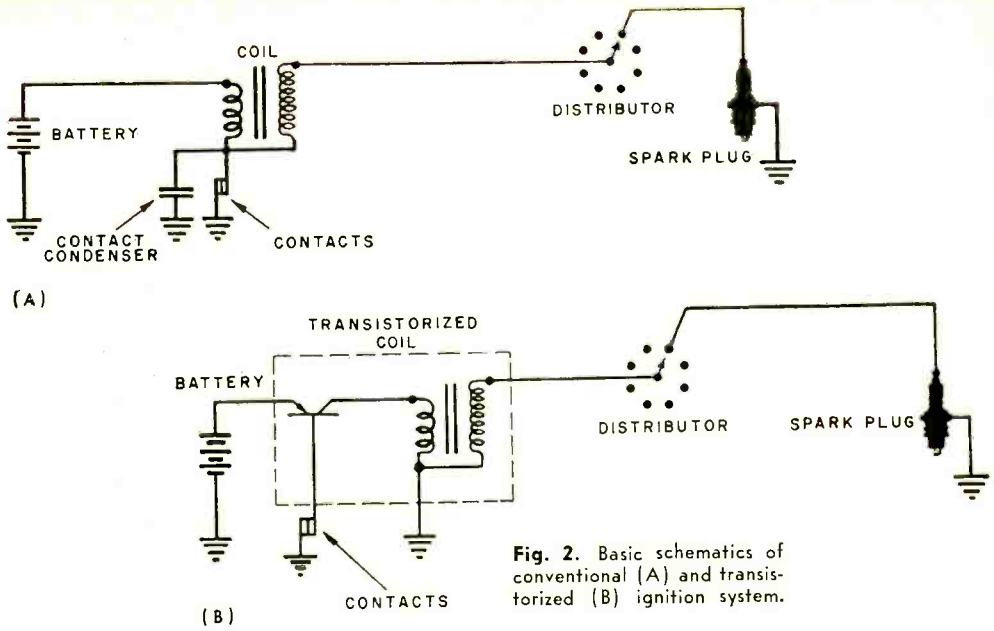


Fig. 2. Basic schematics of conventional (A) and transistorized (B) ignition system.

that the unit you purchase has high output and requires minimum tracking pressure. The latter is necessary to minimize loading and "drag" on the turntable. Chances are you'll use a ceramic or crystal cartridge.

The entire unit can be mounted in a standard portable phonograph case. Wiring is not especially critical, but you should follow good practice; keep the "input" and "output" sections well separated, and use short, direct connections for all signal leads. The turntable motor (*M*) and input leads should be shielded, and the amplifier chassis should be mounted as far away from the motor as space permits. For best quality reproduction, use as large a PM loudspeaker as you can fit into your case.

In operation, the unit is essentially a two-stage resistance-coupled amplifier, with the second stage transformer-coupled to a Class AB push-pull power amplifier. The transistors used throughout are *p-n-p* units in the common-emitter circuit arrangement. *C1* and *C2*, in *Q1*'s base circuit, form a capacitive voltage divider and impedance-matching network. You may want to experiment with *C2*'s value to obtain optimum performance.

Once the wiring has been completed and double-checked for errors and accidental shorts, connect a voltmeter between the

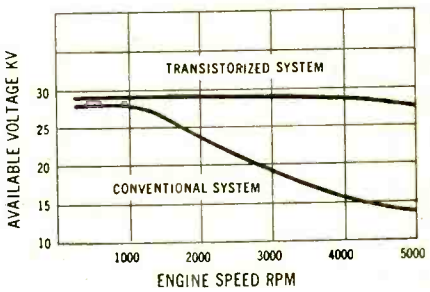


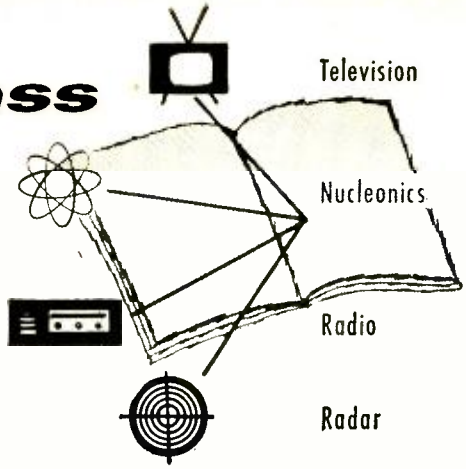
Fig. 3. Comparative performance of transistorized and conventional ignition systems.

collector electrodes of *Q3* and *Q4*. Turn the power *on* and adjust *R6* for a zero meter reading. This step adjusts the bias of the power amplifier stage for balanced operation.

Transistorized Ignition. One of the weakest links in the design of the modern gasoline engine is its ignition system. A fairly high voltage must be applied to the spark plug at just the right instant to ignite the compressed fuel mixture in the engine's cylinder. Since the only source of voltage in an automobile is its battery (and charging generator), the high voltage needed to operate the spark plug is ob-

(*Continued on page* 126)

After Class



THE A.C. SERVO AMPLIFIER

By HARVEY POLLACK

IN last month's *After Class*, we looked into the problems faced by that hard-working mechanism, the continuous-type servo. As you will remember, the servo designers are faced with a number of electrical and mechanical problems. In an antenna rotator, for example, the big question is: how can we control precisely the heavy current needed in the rotator's servo motor up on the roof with a 4-watt potentiometer in the basement?

Relays are fine, of course, but they have an on-off action which is not what the situation demands in most servo operations. What is needed is a device that will supply a *"continuous"* high-current correction signal and, in addition, leave a high input impedance (to keep the current requirements of the correction signal low). What do we have in our electronic workshop to fill the bill? Of course—a power amplifier—not a hi-fi job, but one designed specifically for a.c. servo amplification. (See Fig. 1.)

A.C. Error Signal. It is perfectly possible to design a servo amplifier that can respond to a d.c. error signal such as we encountered last month, but more reliable and effective response can be obtained when the error signal is a.c.

Consider the balanced potentiometer arrangement—or Wheatstone bridge—with a.c. applied across the input terminals, shown in Fig. 2. With the wipers of *R1* and *R2* in the equivalent positions (A_1A_2 dead center, B_1B_2 top, or C_1C_2 bottom), the oscilloscope will indicate zero voltage since the bridge is in balance.

Suppose we leave *R1* at position A_1 and move *R2* to position B_2. The unbalanced bridge will then develop an a.c. output voltage that will be displayed on the oscilloscope as either inphase or 180° out of phase with the input signal. (Actually, it doesn't matter which phase relationship we assume at this time.) For the sake of simplicity, we'll assume that the output voltage is *inphase* with the input voltage (as shown in Fig. 2).

It is also evident that the *amplitude* of the trace on the screen will depend upon how much the bridge has been unbalanced

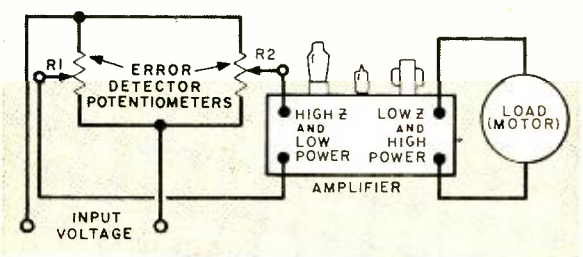


Fig. 1. The small signal from the error detector has to be amplified to operate a motor that requires power.

by shifting the *R2* wiper. If we now bring it back slowly toward A_2, the inphase condition will persist, but the amplitude of the output potential will gradually diminish, shrinking to zero at point A_2.

As the *R1* wiper continues to be advanced toward C_2, a trace again appears on the screen, growing in size, but this time the bridge, unbalanced in the opposite direction, causes a signal 180° out of phase with the input to appear.

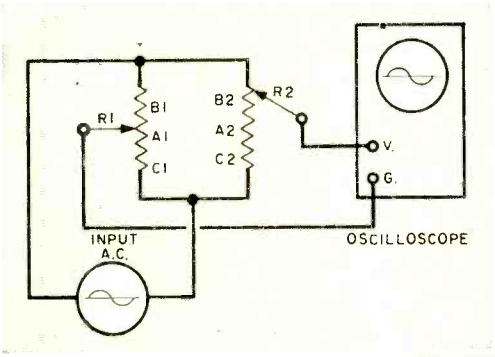


Fig. 2. Bridge unbalance causes an a.c. trace to appear on the screen. The phase of the input and the output voltage is the same.

One more set of conditions needs clarification before we proceed to the servo amplifier itself. Starting with both wipers at position A_1 and A_2 respectively (zero output voltage), if the *R2* wiper is now moved anywhere between A_2 and B_2, there are two ways by which the newly developed output potential can be brought back to zero. Either we can shift the *R2* wiper *back* to A_2 or we *reset R1* so that the position of its wiper corresponds to that of *R2*. Now we have an error detector which not only indicates the *extent* of the error by the *amplitude* of the a.c. voltage it develops, but also indicates the *direction* of the error by the *phase* of the voltage that appears across its output terminals—a decided advantage, as we shall see.

Typical Circuit. What we have just said implies that our servo amplifier must be *phase-* as well as *amplitude-sensitive.* For a given phase relation between error input and error output signals, the amplifier must be able to rotate the load motor in one direction. When the phase becomes inverted, it must change the motor's rotation direction. Likewise, it must apply more driving voltage to the motor for large error signals than for small ones. Let us analyze one standard servo amplifier circuit that possesses these characteristics.

Looking at Fig. 3, suppose the error detector is balanced and is, therefore, yielding zero signal output. The grids of power triodes *V1* and *V2* are connected in push-pull while the plates are both fed through resistors *from a common a.c. source* so that the voltages on them sweep up and down together in phase.

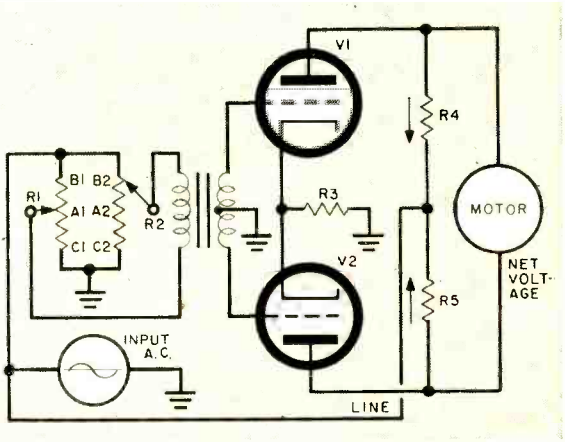


Fig. 3. When the error detector is unbalanced, one tube draws more plate current than the other, causing a net driving voltage to appear across the motor.

As the *Line* from the a.c. source goes positive with respect to ground, both tubes draw equal plate currents, developing equal voltage drops across the plate load resistors *R4* and *R5*. As shown by the arrows in the drawing, these voltage drops are in opposition, resulting in zero voltage applied to the load motor.

During the next half of the a.c. cycle, the *Line* becomes negative with respect to ground, both plates go negative, and the plate currents drop to zero. Again, the motor receives no power. Thus, with zero

error signal, the motor does not operate during any portion of the a.c. cycle.

Now assume that the *R2* wiper has been moved to B_2 while the wiper of *R1* remains at A_1, thereby giving rise to an error signal having the polarity shown. Thus we have "stopped the action" at a time when the a.c. generator has made the *Line* positive. The push-pull grid connection then produces voltages of opposite polarity on these elements.

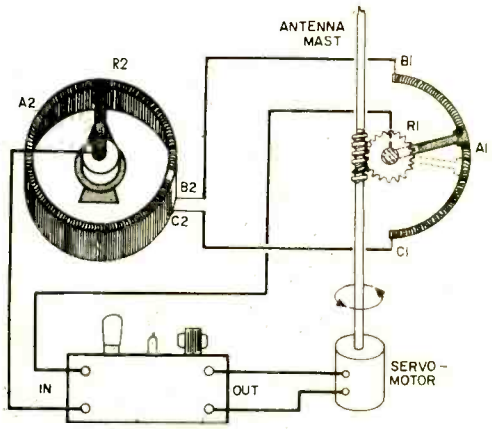


Fig. 4. Open-loop positional servo and servo amplifier used to rotate a beam antenna.

We have shown the grid of *V1* positive and that of *V2* negative, but this condition can be reversed if desired merely by interchanging the transformer secondary leads. Hence, it makes little difference which polarities we assume in our explanation. Obviously, *V1* with its positive grid will draw a heavier plate current than for the zero error signal condition, while the plate current of *V2* will diminish below its former value.

The voltage drops across *R4* and *R5* are now unbalanced and a net effective d.c. voltage appears across the load motor, negative at the top and positive at the bottom. Since *both* tubes cut off when the input a.c. cycle reverses (plates go negative), the potential across the motor is pulsating but unidirectional. The armature of the motor will therefore rotate in a given direction, say counterclockwise, for this polarity.

It requires little imagination to see that a voltage of the opposite polarity will appear across the motor when the wiper of *R2* is moved down to C_2. Under these conditions the lower grid goes positive when the line polarities make the plates positive. This produces a large plate current in *R5* and a small one in *R4*, reversing the net effective voltage across the motor terminals.

One additional bit of reasoning discloses that the amplitude of the voltage fed to the motor must depend upon the amplitude of the error signal because this, in turn, governs the grid voltages. For a large error signal, there will be a large grid voltage differential, and hence a correspondingly large difference in plate currents.

Mechanical Linkage. All that remains to be done is to establish some form of mechanical linkage between the driven element—the antenna mast in this case—and *R1*. Let us hook a positioning knob on the shaft of potentiometer *R2* (Fig. 4). As we have shown, if both wipers are in corresponding positions, no motor action will occur.

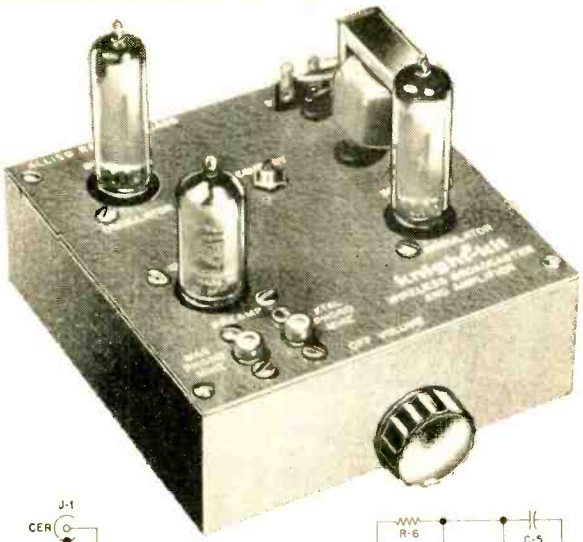
Now let's rotate the positioning knob to a new compass direction, say to B_2. Instantly the servo amplifier generates an output voltage that starts the motor and causes the mast to turn toward the desired position. As it moves, it carries the wiper of *R1* along with it toward position B_1 through the mechanical linkage. The latter might be a gear train or a direct connection between the mast and the wiper.

In the actual system, *R1* would be located adjacent to the mast, that is, remote from the positioning control. The position knob would, of course, be placed in a spot convenient for the operator.

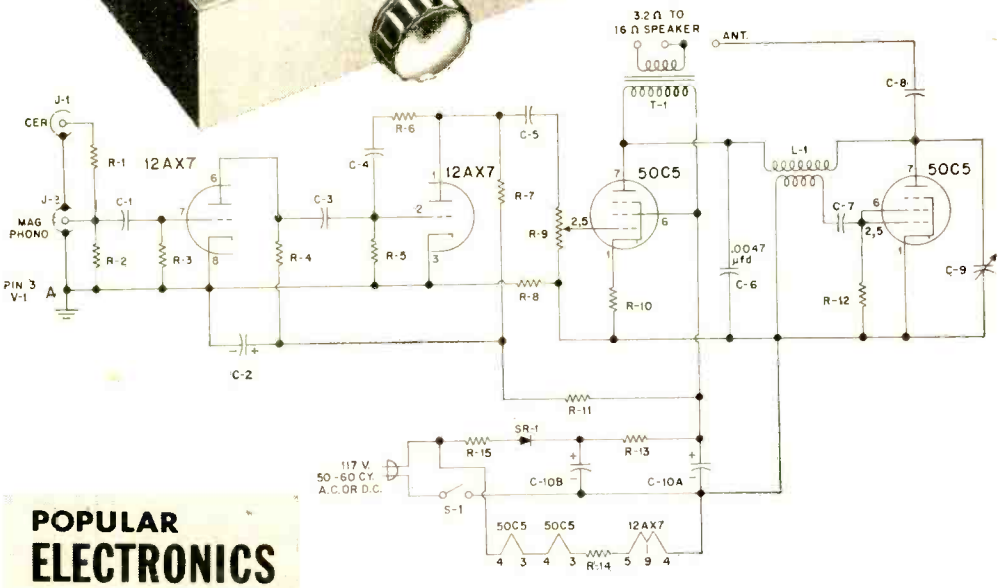
Although a description of a sequence of events like the foregoing gives the impression that there is a time lag between the setting of the positioning knob and the final reaction (rotation of the antenna), a moment's reflection will show that the actions are virtually instantaneous.

If the knob is rotated slowly, the antenna will begin to follow it almost instantaneously, since the error signal appears as soon as a difference in wiper position occurs. In a well-designed open-loop servomechanism, it is impossible to spot a time lag visually, so that action and reaction may be considered to occur together.

In continuing our discussion of servomechanisms next month, we'll talk about the place of thyratrons in control circuits —what they can and can't do, and where you're most apt to meet them. —30—



TESTED By POPULAR ELECTRONICS



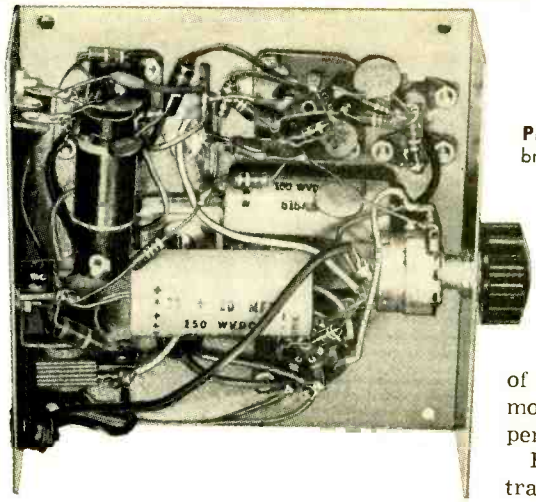
POPULAR ELECTRONICS Builds a

Wireless Broadcaster–Amplifier

Flexible Knight-Kit transmits music throughout the home

THE Knight Wireless Broadcaster-Amplifier (Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.), takes only a few hours to build, and has many home entertainment uses. It can be connected to a record player or microphone to send programs out to any number of standard radios in the house. Or it can be used as a complete preamplifier and amplifier with any phono cartridge. One input takes ceramic or crystal cartridges and microphones; the other takes magnetic cartridges and microphones.

Mounting of the major parts of the unit is the first assembly step. There is a good reason for this because all the parts mounted on the underside of the chassis have terminals that are used for point-to-point wiring. Sockets, input jacks, volume control and switch, selenium rectifier and terminal strips are involved here. Parts with wire leads are supported by those leads after they are soldered into the cir-



Precut color-coded wire supplied with the broadcaster-amplifier kit reduces wiring time.

cuit. There are 72 steps in all to be followed in completing the broadcaster-amplifier.

How It Operates. The phono amplifier section consists of two tubes; a 12AX7, and a 50C5. This circuit amplifies the input signals from the phono cartridge or microphone, making the signals strong enough to drive a speaker. Output is slightly more than 1 watt.

Ceramic, crystal or magnetic cartridges are correctly loaded by input resistors. The 12AX7 preamplifier tube supplies the high gain needed for magnetic cartridges, with equalization supplied by a feedback loop made up of R-6 and C-4 in the circuit.

Output from the preamplifier stage is fed into the 50C5 audio output tube which supplies ample power to drive a 3.2-16 ohm speaker. The output level is adjusted by a volume control at the grid of the output tube.

As a wireless broadcaster, this unit operates much like a regular broadcasting station. It sends out a modulated carrier signal between 600 and 1500 kc. which can be received by any standard radio within its range.

The carrier wave is produced by the 50C5 oscillator tube, and can be varied between 600 and 1500 kc. by adjusting a trimmer capacitor whose screw projects through the top of the chassis. The audio 50C5 doubles as an audio output and modulator tube, and amplifies the audio voltage to effect 75% modulation of the carrier wave.

Clean modulation is assured by the use of degenerative feedback. The amount of modulation can be varied by adjusting the percentage control.

Remember that the wireless broadcaster transmits a signal over the air and hence must meet FCC requirements to be operated without a license. If it is built according to the instruction manual, with not more than 10 feet of antenna connected, there will be no problems. The FCC requires that the certification listed on page 15 of the Allied instruction book be attached to the unit. Cut it out of the manual and paste it on the bottom cover.

Modifications. For more advanced experimenters, or beginners who have conquered the fundamentals, the Allied broadcaster circuits can be modified very simply to form other pieces of equipment. For example, you can change the oscillator circuits to cover a very low frequency to make a wired-wireless or carrier-current transmitter that will radiate over the local power lines to a considerable distance.

An audio signal tracer is another piece of equipment that can be made from the unit. Almost no modification is needed, but an isolation transformer should be added, since you may use it to test audio amplifiers or receivers that have an a.c./d.c. circuit. Only the 12AX7 and one of the 50C5 tubes are employed for signal tracing. The r.f. oscillator 50C5 is not needed but its filament is required in the circuit. A switch can be added to open the cathode circuit to make the oscillator inoperative.

All under-the-chassis wiring is completely enclosed and rubber feet are supplied so that the unit can sit on top of any piece of furniture. A.C. leakage from chassis to ground is said to be well within Underwriters Laboratories specifications. The finished unit can be proudly displayed, or—if concealed location is preferred—it's small enough to fit almost anywhere. —30—

Build the "Trans-Pack"

Convert battery voltage to 250 volts d. c.

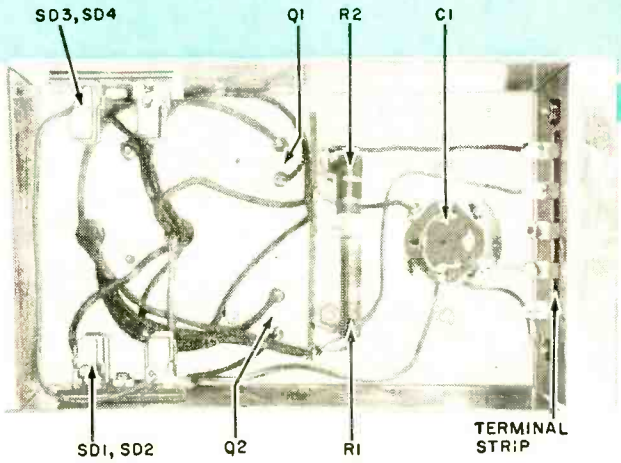
By
DON LEWIS

HERE IS an easy-to-build two-transistor power supply that will deliver a whopping 250 volts d.c. at 125 ma. from any 12-volt automobile battery. Although this project was specifically designed to provide power for the modular six-meter station described in the May 1959 issue of POPULAR ELECTRONICS, it can be used wherever high voltage d.c. is required and where there is only a storage battery available.

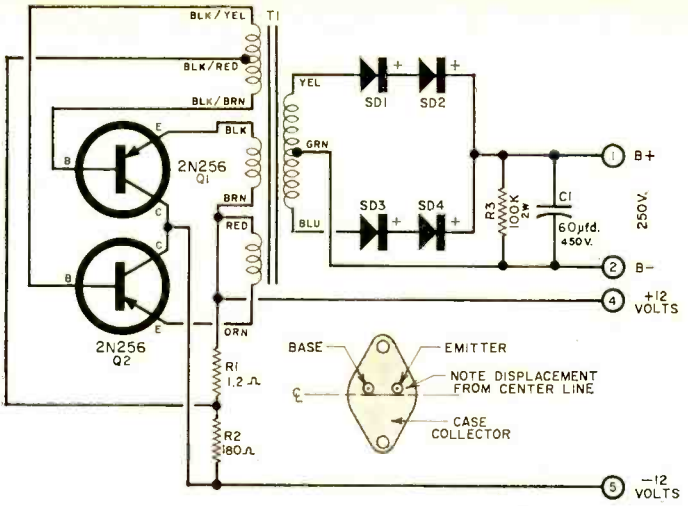
Construction. Components are mounted on a small aluminum chassis measuring 3⅝" x 6¼" x 2". The chassis shown is a cover that was left over from the six-meter station project. An LMB #138 chassis which has nearly the same dimensions will serve nicely also.

The power transformer, transistors and filter capacitor are mounted on top of the chassis. The rectifiers (and holders), terminal strip and the two resistors are mounted under the chassis. Keep the distance between the transistor mounting screws to 1⅞"; this allows the terminal strip to be mounted on the same screws that are used to secure the transistors. Anodized (insulated) aluminum washers insulate the transistors and fiber washers insulate the terminal strip from the chassis.

All common ground connections are made to the chassis at the metal filter capacitor



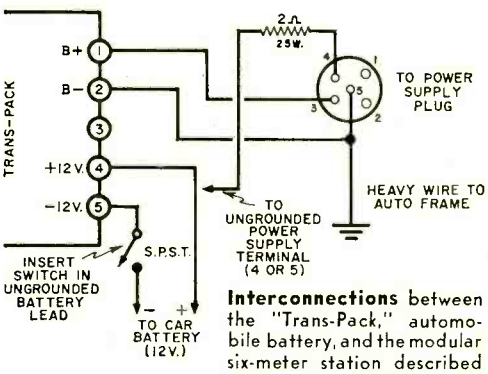
Parts arrangement beneath the chassis is non-critical. Holders for the silicon rectifiers may be fuse clips or special diode clips. Make sure that all components are properly insulated and polarized.



Special circuit of the "Trans-Pack" is made possible by transformer T1 which was developed for transistor oscillator power supply applications.

PARTS LIST

C1—60-μfd., 450-volt can-type electrolytic capacitor (single or multiple section unit wired in parallel)
Q1, Q2—2N256 transistor
R1—1.2-ohm, 2-watt resistor
R2—180-ohm, 4-watt resistor
R3—100,000-ohm, 2-watt resistor
SD1, SD2, SD3, SD4—500-ma. silicon diode rectifier (Sarkes-Tarzian M500 or Audio Devices A750)
T1—275-volt, 125-ma. transistor power transformer (Chicago Transformer Co. DCT-1)
1—Aluminum chassis (LMB #138—see text)
2—Dual silicon rectifier holders
2—Power transistor insulating kits (Lafayette M-20)
1—5-screw terminal strip
1—8-lug terminal strip
Misc. 4/40 nuts, bolts, washers, and 6/32 nuts, bolts and washers



Interconnections between the "Trans-Pack," automobile battery, and the modular six-meter station described in the May 1959 issue of POPULAR ELECTRONICS.

mounting plate. The 5-screw terminal strip is mounted on the *outside* of the chassis lip to minimize the possibility of shorts.

Testing. Before applying power to the "Trans-Pack," make a few ohmmeter checks. The resistance from the 12-volt terminals (either plus or minus) to the chassis should be higher than 100,000 ohms. If it is lower, check the insulation between transistors and chassis. There should be no metallic connection between *Q1-Q2* and the chassis.

Next, check the resistance between B-plus and B-minus. The ohmmeter should jump over to zero and then slowly drift back towards a high resistance reading, stopping at about 100,000 ohms.

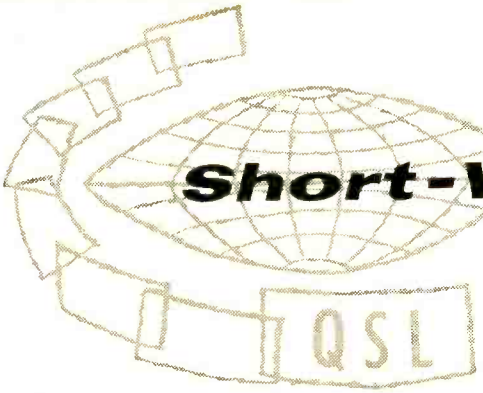
If everything checks okay, you can apply power to the supply. Warning: do not get the plus and minus 12-volt terminals reversed, or you will "wipe out" the power transistors faster than you can say "POPULAR ELECTRONICS."

A 20-watt load resistor, about 4000 ohms, should be connected between the plus and minus high-voltage terminals (it can be made up of several different size resistors in series or in parallel). This resistor will have high voltage across it and run very hot, so be careful.

As soon as the 12-volt battery is connected, the supply will "take off" and an audible whistle will be heard. Although the voltage across the load resistor should be between 250 and 275 volts, it may vary widely, depending on the condition of the transistors and the battery.

Using the "Trans-Pack." If your receiver has an accessory socket and requires about 250 volts B-plus, you can use the "Trans-Pack" to provide this power. The power transformer in the receiver must be

(*Continued on page* 129)



Short-Wave Report

By HANK BENNETT
W2PNA/WPE2FT

INSTEAD of our usual general discussion this month, we are going to give you some specific information on frequencies, times, and radio clubs which is based on questions that are frequently asked in letters received by your Short-Wave Editor. Before starting, however, we'd like to remind you that POP'tronics is conducting a Short-Wave Listeners' Registry.

This important project is designed to help DX'ers throughout the world. To qualify for a Short-Wave Monitor Certificate with individual station call letters, you need only have a sincere interest in DX'ing, whether it be on the short-wave bands, the medium waves, the amateur bands, or other bands of your choice. The only cost to you is ten cents to cover postage and handling.

Just fill out the registration form on page 87 and address it to: Monitoring Registration, POPULAR ELECTRONICS, One Park Avenue, New York 16, N. Y. It is our hope that this registration will soon include every DX'er, but in order to achieve that we must hear from you.

Starting this month, credits in the *Short-Wave Report* will show station call letters, except in cases where calls have not yet been assigned. Send for yours now!

Megacycles and Meters. Many readers write in asking for a clarification of the relationship between *kilocycles, megacycles,* and *meters.* Briefly, frequency is usually expressed in either kilocycles or megacycles while wavelength is expressed in meters. A *megacycle* (mc.) is one thousand *kilocycles* (kc.). A station operating on 11.71 mc. is operating on 11,710 kc. Stations operating on medium waves (540 to 1600 kc.) are usually listed in kilocycles rather than megacycles, al-

Stan Sosnowski, Detroit, Mich., a veteran DX'er, depends on his Hallicrafters SX-71 to bring in elusive catches.

Jim Monahan, of East Haven, Conn., doubles as a POP'tronics Monitor and the operator of amateur station K1BNQ.

FREQUENCY-WAVELENGTH CONVERSION

To convert 9.65 megacycles into the wavelength in meters, for example, divide the frequency in kilocycles into 300,000. Your answer will be the wavelength in meters.

9650/300,000 = 31.08 meters

To convert 25.3 meters into the frequency in kilocycles, divide the wavelength in meters into 300,000. Your answer will be the frequency in kilocycles.

25.30/300,000 = 11,857 kc. or 11.857 mc.

though 840 kc. can be expressed as 0.84 mc.

In working with wavelengths in *meters,* you should keep in mind that the higher the frequency, the shorter the wavelength. To convert kilocycles to meters, divide the frequency in kilocycles into 300,000. Your answer will be the wavelength in meters. Conversely, to find the frequency in kilocycles when you know the wavelength in meters, divide the wavelength into 300,000 and your answer will be in kilocycles. If you wish to be more exact in your calculations, use 299,820 in place of 300,000.

Time Conversion. Another often-asked question concerns conversion from Greenwich Mean Time (GMT) to Eastern Standard Time (EST) or Pacific Standard Time (PST). GMT is five hours ahead of EST and eight hours ahead of PST. Therefore, at noon in New York, it is 5 p.m. in London and 9 a.m. in Los Angeles.

TIME CONVERSION TABLE

GMT	EST	CST	MST	PST
0000	1900	1800	1700	1600
0100	2000	1900	1800	1700
0200	2100	2000	1900	1800
0300	2200	2100	2000	1900
0400	2300	2200	2100	2000
0500	0000	2300	2200	2100
0600	0100	0000	2300	2200
0700	0200	0100	0000	2300
0800	0300	0200	0100	0000
0900	0400	0300	0200	0100
1000	0500	0400	0300	0200
1100	0600	0500	0400	0300
1200	0700	0600	0500	0400
1300	0800	0700	0600	0500
1400	0900	0800	0700	0600
1500	1000	0900	0800	0700
1600	1100	1000	0900	0800
1700	1200	1100	1000	0900
1800	1300	1200	1100	1000
1900	1400	1300	1200	1100
2000	1500	1400	1300	1200
2100	1600	1500	1400	1300
2200	1700	1600	1500	1400
2300	1800	1700	1600	1500

In the *Short-Wave Report,* we show time in EST and use the 24-hour system. In this system, noon is expressed as 1200, 6 p.m. as 1800, and 9:45 p.m. as 2145. Midnight can be written either as 0000 or 2400, although the former is the most generally accepted. Hours between midnight (0000) and 10 a.m. (1000) are also written in four digits with the first digit being a zero; for example, 7 a.m. would be 0700.

Radio Clubs. Some of our readers are unaware of the fact that, while POP'tronics is the only newsstand magazine which regularly features short-wave information, other publications are also available. Most of them are issued by radio clubs and only to club members.

NEWARK NEWS RADIO CLUB (215 Market St., Newark 1, N. J.) has a monthly 56-page bulletin covering the short-wave broadcast band, short-wave (commercial) band, ham, broadcast, FM and TV bands, and an occasional listing of SWL card swappers. Dues are $4.00 yearly.

UNIVERSAL RADIO DX CLUB (21446 Birch St., Hayward, Calif.) publishes a bulletin 19 times a year which averages 8 to 16 pages and covers the short-wave broadcast and ham bands only. Dues are $4.00 yearly.

INTERNATIONAL SHORTWAVE CLUB (100, Adams Gardens Estates, London, SE 16, England) puts out a four-page monthly bulletin which covers the short-wave broadcast and ham bands. Membership requirements and dues information can be obtained from the club.

NATIONAL RADIO CLUB (% Harold Wagner, Lake City, Pa.) has a bulletin strictly for broadcast-band DX'ers. Complete details can be obtained from Mr. Wagner.

While the *World Radio Handbook* is not a club publication, it can be obtained only by mail, and lists all the short-wave stations in the world, both by country and frequency. Other information provided includes schedules, addresses, names of station officials, and tentative future plans. This once-a-year publication is available for $2.50 from Gilfer Associates, P. O. Box 239, Grand Central Station, New York 17, N. Y.

(*Continued on page* 135)

INTERNATIONAL'S NEW

TRANSCEIVER

at home...work...or play here is

2-WAY RADIO for everyone!

for the Class "D"

CHECK THESE ADDED FEATURES!

- ✓ Choice of tunable or crystal controlled receiver
- ✓ BUILT-IN Squelch
- ✓ Add a crystal & switch for second transmit channel
- ✓ Available on time payment terms

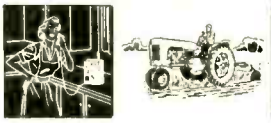
CUSTOM, 117V AC, all channel receiver **$94.95**
DELUXE, 117V AC or 6/12V DC **124.50**
COMMAND, 117V AC or 6/12V DC fixed channel receiver **149.50**

MEETS ALL FCC REQUIREMENTS

FOR BUSINESS

Ideal for office-to-field communication. Also for office to trucks operating within restricted area or for office and factory liaison.

FOR THE FARM



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

FOR SPORTS

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

FOR THE HOME

From the kitchen to the den, workshop or sickroom . . . the Transceiver will save you many steps.

SEND FOR FREE BROCHURE

INTERNATIONAL
CRYSTAL MFG. CO., INC.

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Oklahoma City, Okla.

Dept. PE, International Crystal Mfg. Co., Inc.
18 N. Lee,
Oklahoma City, Okla.

GENTLEMEN:

Please send me ☐ your free brochure on the Transceiver ☐ Your new 1959 Catalog.

NAME _____

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By
JOHN T. FRYE
W9EGV

Carl and Jerry

Dog Psychologists

"A FINE REWARD for a whole day spent climbing up and down hills, over fences, through bogs," Carl said ruefully as he held up an onion sack containing four scrawny, brown-tinged sponge mushrooms. He and Jerry were sitting on the latter's back steps resting after a not-too-successful morel-hunting expedition.

"Yeah, and the disgusting part is that tonight's paper is almost sure to have a picture of some simpering joker holding a dishpan full of king-size mushrooms that he just happened to stumble over as he was digging a posthole, burying the garbage, or doing anything else except actually looking for mushrooms," Jerry added gloomily.

"I suppose we walked right past a truckload of morels today if we only knew it," Carl reflected. "They certainly are hard to see snuggled down in the leaves and grass. What a guy needs is some device that will sniff them out."

He was interrupted by a gentle snore, and the eyes of both boys turned to where Bosco, Carl's dog, was stretched out flat on his back, asleep. His twitching hind legs

were spraddled out, and his front paws were curled limply. Bosco had had a hard day protecting his young masters from vicious rabbits, squirrels, field mice, turtle doves, and other similar dangers. Now, with them safe at home, he was taking a well-earned rest.

Carl answered the question in Jerry's eyes with a shake of his head. "No, not old No-Nose Bosco, who couldn't smell scorched hair if his tail were on fire," he said sadly. "Bosco doesn't know a dog is supposed to have a keen sense of smell. In fact, I don't think Bosco knows he's a dog at all. Who ever heard of a dog sleeping on his back and snoring?"

"Let's not give up so easy," Jerry demurred. "Remember we taught him to find an artificial bird quicker than a trained bird dog could do it. Maybe we can teach him to find mushrooms the same way."

"I doubt it. Raw mushrooms are one of the few things he won't eat, and it's difficult to interest Bosco in anything he can't eat or chase."

"Maybe we can give him a conditioned reflex," Jerry suggested.

"Like how?"

"Every time he finds a mushroom we'll give him some raw hamburger. In time he'll associate the finding of a mushroom with his favorite sport, eating."

"Well, it's worth a try. How do we start?"

"It's always easier to teach a new lesson that can be connected to one already learned. Bosco has been taught to find a hidden transmitter by the sound he hears in a receiver; so let's start there. We'll fasten on that special Sherlock Holmes cap we made for him and hide the transmitter under some leaves. We'll pull one of these mushrooms on top of the leaves. When the increased sound from the transmitter brings him to the mushroom, we'll grab him and give him some hamburger. You wake up Sleeping Beauty, and I'll get the stuff."

CARL awakened Bosco by unceremoniously grabbing him by the hind legs and

(*Continued on page* 116)

BUILD 16 RADIO CIRCUITS AT HOME

with the New 1959 PROGRESSIVE RADIO "EDU-KIT"®

Reg. U. S. Pat. Off.

A Practical Home Radio Course

ONLY $22.95

Now Includes

- ★ 12 RECEIVERS
- ★ TRANSMITTER
- ★ SIGNAL TRACER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

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

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

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

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

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester 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 worth-while investment. Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

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

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

Included in the "Edu-Kit" course are 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.

FREE EXTRAS

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

SERVICING LESSONS

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

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

FROM OUR MAIL BAG

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

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

PRINTED CIRCUITRY

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

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

☐ Send "Edu-Kit" postpaid. I enclose full payment of $22.95.
☐ Send "Edu-Kit" C.O.D. I will pay $22.95 plus postage.
☐ Rush me FREE descriptive literature concerning "Edu-Kit."

Name .....

Address .....

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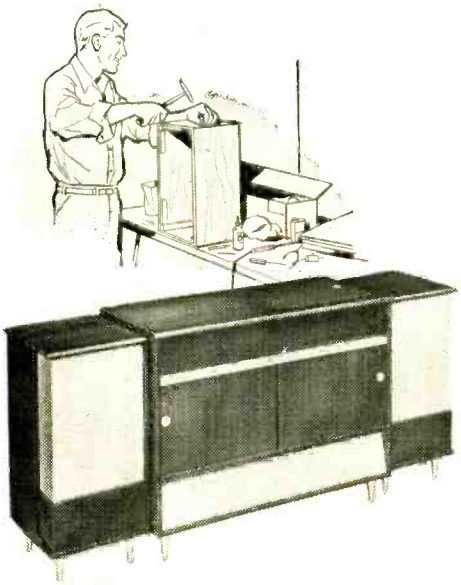
PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 557D, Hewlett, N. Y.

HEATHKIT

do-it-yourself kits put top quality within easy reach

With absolutely no previous experience or knowledge of electronics you can assemble your own HEATHKIT hi-fi system, Ham station, test equipment or marine gear. Easy to understand step-by-step instructions, along with large pictorial diagrams, guarantee your success—and you save ½ or more on the highest quality equipment available today at any price!



STEREO EQUIPMENT CABINET KIT

A thing of beauty as well as utility, this stereo equipment cabinet ensemble houses your complete stereo hi-fi system. It consists of a stereo equipment center flanked by two stereo speaker enclosures. The kit is supplied with mounting panels pre-cut to accommodate Heathkits and interchangeable blank panels are also furnished. The pre-cut panels accommodate the Heathkit AM-FM Tuner (PT-1), Stereo Preamplifier (SP-2), and Stereo Record Changer (RP-3-S). The changer slides out smoothly for easy record loading. Convenient record and tape storage space is provided. Ample room is provided in the rear of the center cabinet for a pair of matching Heathkit amplifiers from 12 to 70 watts. The stereo wing speaker enclosures are open-backed, cloth-grilled cabinets designed to hold the Heathkit SS-3 or similar speaker enclosures. The cabinets are available in beautifully grained ¾" solid core Phillipine mahogany or select birch plywood suitable for the finish of your choice. Entire top features a shaped edge. Hardware and trim are of brushed brass and gold finish.

$149.95 each (shpg. Wt. 162 lbs.)

STEREO EQUIPMENT CABINET KIT
Model SE-1B (birch)
Model SE-1M (mahogany)

$39.95 each (shpg. wt. 42 lbs.)

STEREO WING SPEAKER ENCLOSURE KIT
Model SC-1BR (birch—right end)
Model SC-1BL (birch—left end)
Model SC-1MR (mahogany—right end)
Model SC-1ML (mahogany—left end)

MODEL SF-1
$39.95

DIAMOND STYLUS STEREO PICKUP CARTRIDGE

Enjoy the latest stereo records now. Fits all standard tone arms and features a .6 mill diamond stylus. Designed to Heath specifications by Fairchild Recording Equipment Corporation. Shpg. Wt. 1 lb.

MODEL MF-1
$26.95

DIAMOND STYLUS HI-FI PICKUP CARTRIDGE

Get the most from your LP microgroove records. Designed to Heath specifications by Fairchild Recording Equipment Corporation, the MF-1 is one of the finest pickup cartridges on the market today. Shpg. Wt. 1 lb.

TRADITIONAL
Model CE-2T (mahogany)

CONTEMPORARY (not shown)
Model CE-2B (birch)
Model CE-2M (mahogany)

$43.95 each

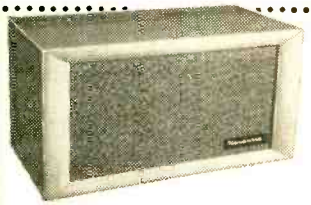
CHAIRSIDE ENCLOSURE KIT

Put your entire hi-fi system right at your fingertips with this handsome enclosure. Available in either traditional or contemporary models and constructed of beautiful veneer-surfaced plywood suitable for the finish of your choice. It is designed to house the Heathkit AM and FM Tuners (BC-1A and FM-3A), the WA-P2 Preamplifier, the RP-3 Record Changer, and adequate space is provided for any Heathkit amplifier designed to operate with the WA-P2. All parts precut and predrilled for easy assembly. Shpg. Wt. 46 lbs.

HEATHKIT EA-2
$28.95

"BOOKSHELF" HI-FI 12 WATT AMPLIFIER KIT

True hi-fi performance is yours with this handsomely styled amplifier-preamplifier combination. With more than enough power for the average home hi-fi system it features a frequency response of ±1 db from 20 to 20,000 CPS with less than 2% distortion at full output over the entire range. Inputs provided for tuner, xtal phono and mag phono. RIAA equalization, separate bass and treble tone controls, and a special hum control are provided. Shpg. Wt. 15 lbs.



Build it in one Evening

HEATHKIT SS-2
$39.95

"BASIC RANGE" HI-FI SPEAKER SYSTEM KIT

With performance comparable to speakers costing many times more, the SS-2 employs a Jensen 8" woofer and compression-type tweeter to provide total frequency response of 50 to 12,000 CPS. Shpg. Wt. 26 lbs.

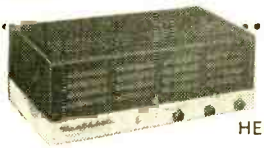
ATTRACTIVE BRASS TIP ACCESSORY LEGS: convert the SS-2 into handsome consolette. Shpg. Wt. 3 lbs. No. 91-26. $4.95.

BASIC FIR MODEL: same as SS-2 except constructed of non-premium plywood without trim or grille cloth. Shpg. Wt. 26 lbs. Model SS-3. $34.95.

HEATHKIT FM-3A $26.95

HIGH FIDELITY FM TUNER KIT

The thrills of FM entertainment are yours at budget cost with this handsomely styled tuner. Featuring broad-banded circuits for full fidelity and better than 10 microvolt sensitivity for 20 db of quieting, the FM-3A pulls in stations with clarity and full volume. Shpg. Wt. 8 lbs.



HEATHKIT W-7M $54.95

"EXTRA PERFORMANCE" HI-FI 55 WATT AMPLIFIER KIT

Offering full fidelity at less than a dollar per watt, the power output of this remarkable amplifier is conservatively rated at 55 watts from 20 CPS to 20 kc with less than 2% total harmonic distortion throughout this entire range. Shpg. Wt. 28 lbs.

HEATHKIT PT-1
$89.95

MONAURAL-STEREO AM-FM TUNER KIT

This professional quality 16-tube tuner offers you outstanding AM, FM or stereo AM/FM performance at minimum expense. Features include individual flywheel tuning and automatic frequency control. A multiplex jack is also provided. Shpg. Wt. 24 lbs.

HEATHKIT SP-2
$56.95

MONAURAL-STEREO (two channel mixer) PREAMPLIFIER KIT

Control your entire stereo system with this 2-channel preamplifier. A remote balance control with 20' of cable allows balancing the stereo system from listening position. Shpg. Wt. 15 lbs.

HEATHKIT TR-1A $99.95

Includes tape deck, tape recorder electronics, microphone and roll of blank tape.

HIGH FIDELITY TAPE RECORDER KIT

Whether making your own recordings or playing pre-recorded tapes you'll enjoy the many fine features of this tape recorder kit. Included are fast forward and rewind functions and choice of 7½ or 3¾ IPS tape speeds. Printed circuit boards simplify assembly. Shpg. Wt. 24 lbs.

HEATHKIT RP-3
$64.95

(stereo model RP-3S $74.95)

AUTOMATIC HI-FI RECORD CHANGER KIT

Combining the convenience of an automatic record changer with true turntable quality the RP-3 obtains full fidelity from your hi-fi and stereo records while treating them with the care they demand. A "turntable pause" feature prevents records from dropping on moving turntable or disk. Plays at 33⅓, 45, 78 and 16 RPM. Shpg. Wt. 19 lbs.

HEATH COMPANY
Benton Harbor, Mich.

A Subsidiary of Daystrom, Inc.

HEATHKIT

HEATHKIT TX-1
$234.95

"APACHE" HAM TRANSMITTER KIT

Features 150 watt phone input and 180 watt CW input. Provision for single-sideband transmission using the SB-10 External Adapter. Shpg. Wt. 110 lbs.

HEATHKIT RX-1
$274.95

"MOHAWK" HAM RECEIVER KIT

Covers from 160 through 10 meters on 7 bands with an extra band calibrated to cover 6 and 2 meters using a converter. Outstanding SSB reception. Shpg. Wt. 66 lbs.

HEATHKIT SB-10
$89.95

SINGLE SIDEBAND ADAPTER KIT

A compatible plug-in adapter unit for the "Apache" Transmitter, the SB-10 covers 80, 40, 20, 15 and 10 meter bands. Produces USB, LSB or DSB signals, with or without carrier insertion. Shpg. Wt. 12 lbs.

HEATHKIT DX-40
$64.95

PHONE AND CW TRANSMITTER KIT

Providing phone and CW operation on 80, 40, 20, 15, and 10 meters, the DX-40 features built-in modulator and power supplies. Shpg. Wt. 25 lbs.

HEATHKIT MP-1
$44.95

MOBILE POWER SUPPLY KIT

Furnishes all power required to operate both MT-1 Transmitter and MR-1 Receiver from 12-14 volt battery. Delivers full 120 watts continuously or 150 watts intermittently. Kit includes 12' battery cable, tap-in studs for battery posts, power plug and 15' connecting cable. Shpg. Wt. 8 lbs.

Mobile Fun! With all New Heathkit Mobile Ham Gear

HEATHKIT MR-1
$119.95

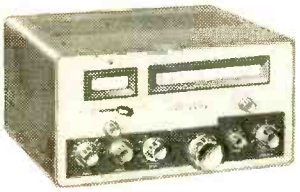
"COMANCHE" MOBILE HAM RECEIVER KIT

Handsome styling, rugged construction, top quality components and economy are all wrapped up in the "Comanche". It is an 8-tube superheterodyne receiver operating AM, CW and SSB on the 80, 40, 20, 15 and 10 meter amateur bands. Operates from 12 volt car battery through the MP-1 Mobile Power Supply. Can be converted in minutes to a fixed station unit by using an AC power supply. Shpg. Wt. 19 lbs.

MOBILE ACCESSORIES

Quality 5" PM speaker in rugged steel case with mounting brackets. Heathkit AK-7. $5.95. Shpg. Wt. 4 lbs.

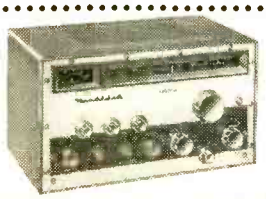
Mobile base mount holds both transmitter and receiver. Universal floor mounting bracket. Heathkit AK-6. $4.95. Shpg. Wt. 5 lbs.



HEATHKIT MT-1
$99.95

"CHEYENNE" MOBILE HAM TRANSMITTER KIT

The fun and convenience of mobile operation are yours with the compact and efficient "Cheyenne" Transmitter. Featuring high power with minimum battery drain, the unit provides up to 90 watts phone input and covers 80, 40, 20, 15 and 10 meters. Featured are a built-in VFO, modulator, 4 RF stages with a 6146 final amplifier pi network (coaxial) output coupling. The "Cheyenne" is designed as a companion to the "Comanche" receiver and is powered by the MP-1 Power Supply. Shpg. Wt. 19 lbs.



HEATHKIT VHF-1
$159.95

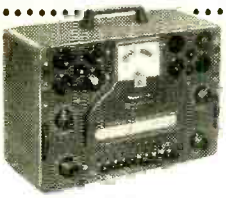
"SENECA" VHF HAM TRANSMITTER KIT

General, technician or novice class hams wishing to extend transmission into the VHF region will find the "Seneca" ideal. A completely self-contained 6 and 2 meter transmitter, the VHF-1 features up to 120 watts input on phone and 140 watts input on CW in the 6 meter band. Included are controlled carrier phone operation, built-in VFO for both 6 and 2 meters, and four switch-selected crystal positions. Shpg. Wt. 56 lbs.

HEATHKIT V7-A
$25.95

ETCHED CIRCUIT VTVM KIT

World's largest selling VTVM, the V7-A measures AC voltage (RMS), AC voltage (Peak-to-peak), DC voltage and resistance. Features 7 AC (RMS) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500 and 1500. In addition there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400 and 4000. Seven ohmmeter ranges are provided. Battery and test leads are included with kit. Shpg. Wt. 7 lbs.



HEATHKIT TC-3
$39.95

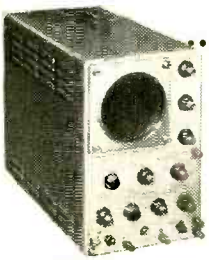
TUBE CHECKER KIT

An invaluable aid to servicemen, the TC-3 tests for open, short, leakage, heater continuity and quality of all tube types commonly encountered in radio and TV servicing. Checks 4, 5, 6 and 7-pin large, 7 and 9-pin miniature, 7-pin sub-miniature, octal and loctal tubes and pilot lamps. A blank socket provides for future tube types. Shpg. Wt. 12 lbs.

Model 355.

TV PICTURE TUBE TEST ADAPTER

For use with TC-3 or earlier model TC-2. Includes 12-pin TV tube socket, 4' cable. Octal connector and data. No. 355. Shpg. Wt. 1 lb. $4.50.



HEATHKIT OP-1
$179.95

"PROFESSIONAL" 5" DC OSCILLOSCOPE KIT

Offering complete versatility, the OP-1 features DC coupled amplifiers and also DC coupled CR tube unblanking. Triggered sweep circuit operates on internal or external signals and may be either AC or DC coupled. Transformer operated power supply has silicon diode rectifiers. Shpg. Wt. 34 lbs.

HEATHKIT OM-3
$39.95

"GENERAL PURPOSE" 5" OSCILLOSCOPE

Ideal in servicing as well as routine laboratory work, the OM-3 features wide vertical amplifier frequency response, extended sweep generator operation and improved stability. Vertical response is within ±3 db from 4 CPS to 1.2 mc. Sweep range covers 20 CPS to over 150 kc. Shpg. Wt. 22 lbs.

HEATHKIT T-4
$19.95

VISUAL-AURAL SIGNAL TRACER KIT

Doubling as a utility amplifier, test speaker, or substitution transformer, the T-4 represents an outstanding buy. Traces RF, IF and audio signals in AM, FM and transistor-type radios. Shpg. Wt. 5 lbs.

HEATHKIT SG-8
$19.50

RF SIGNAL GENERATOR KIT

Aligns RF, IF and tuned circuits of all kinds. Provides extended frequency coverage in five bands from 160 kc to 110 mc on fundamentals and up to 220 mc on calibrated harmonics of the fundamental frequencies. Shpg. Wt. 8 lbs.

HEATHKIT CT-1
$7.95

IN-CIRCUIT CAPACI-TESTER KIT

Check capacitors for "open" or "short" right in the circuit. Detects open capacitors from 50 mmf up and checks shorted capacitors up to 20 mfd. Checks all bypass, blocking and coupling capacitors of the paper, mica and ceramic types. Shpg. Wt. 5 lbs.

HEATHKIT TO-1
$16.95

TEST OSCILLATOR KIT

Provides fast and accurate selection of test frequencies most used by servicemen in repairing and aligning modern broadcast receivers. Five fixed-tuned frequencies are quickly selected for trouble-shooting. Shpg. Wt. 4 lbs.

HEATH COMPANY
Benton Harbor, Mich.

A Subsidiary of Daystrom, Inc.

add that "extra" speaker

HEATHKIT US-1
$7.50

12" UTILITY SPEAKER

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
$18.95
(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.

HEATHKIT AK-1
$9.95

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 neck-band and desk stand. An 8' cable with phone plug is included. Shpg. Wt. 1 lb.

check engine RPM

HEATHKIT TI-1 $25.95

ELECTRONIC TACHOMETER KIT

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
$29.95

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 3¼" D. Shpg. Wt. 6 lbs.

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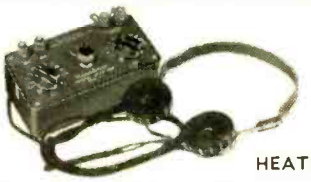
ELECTRONIC IGNITION ANALYZER KIT

An ideal tool for the mechanic, tune-up man or auto hobbyist. Locates ignition system faults quickly without removing any parts and with the engine in operation (400 to 5000 RPM). Shows complete engine cycle or just one cylinder at a time. Use on all types of internal combustion engines where breaker points are accessible. 10' test leads supplied with kit. Shpg. Wt. 20 lbs.

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

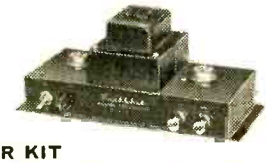
This handy tool kit provides all the basic tools required for building any Heathkit. Includes pliers, diagonal sidecutters, screwdrivers, and soldering iron with holder. Pliers and sidecutters are equipped with insulated rubber handles that provide protection from electrical shock. All of the tools are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

HEATHKIT DF-2
$69.95

2-BAND TRANSISTOR RADIO DIRECTION FINDER KIT

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.

HEATHKIT PC-1
$24.95



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MC-1
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QUANTITY	KIT NAME	MODEL NO.	PRICE

Carl and Jerry

(*Continued from page* 108)

turning him in a backwards somersault onto his feet. One thing in the boys' favor was Bosco's excellent memory. He demonstrated his memory by promptly bolting for the alley when he saw Jerry emerge from the basement laboratory with the weird-looking cap.

But Carl brought him down with a flying tackle, and soon the dog's head was encased in the headgear that looked like a Sherlock Holmes fore-and-aft hat worn sideways so the flaps could be tied firmly

beneath his chin. A small transistor receiver was in the crown of the cap, and earphones in the flaps carried the tone-modulated signal from the transmitter right to Bosco's sensitive ears.

While Carl was putting the cap on the dog, Jerry had been busy concealing the miniature transmitter under some leaves down by the garage. A lone mushroom was placed just above it. When Bosco was released, he started quartering the back yard just as he had been taught to do when he was searching for the transmitter concealed in an artificial "bird."

Guided by the waxing and waning of the sound as he moved closer to or farther away from the transmitter, Bosco soon came to a halt directly in front of the mushroom. At this instant Carl grabbed his collar and held him until he barked with impatience. At the first bark Carl crammed a pellet of hamburger into the surprised dog's mouth.

In spite of his rather stupid appearance, Bosco was actually a very smart dog; and he got the idea quickly. In a matter of minutes he was seeking out the mushroom and barking at it until he was fed. Next, the boys started cutting down the volume of the sound heard in the earphones, but Bosco still found the morel. Finally the cap was removed entirely, and the dog still searched out the mushroom purely by sight. Even when Carl and Jerry made the mushroom increasingly hard to see by piling leaves on it, pushing it down in the grass, and so on, Bosco managed to ferret it out every time.

"I say he's ready," Jerry declared as he brushed the last crumbs of the hamburger into the eager jaws of the dog. "Anyway, we've about worn out all four of our mushrooms. Now comes the sixty-four dollar question: will Bosco find wild mushrooms in their native state? What say we find out tomorrow morning? Let's get started about six and see if we can't find some of the 'rooms that have popped up overnight."

"Good deal," Carl agreed. I'll get a pound of fresh hamburger tonight and be all set at six in the morning. As for you, Bosco, you'd better get to bed early and get a good night's sleep. You've got a big day ahead of you tomorrow whether you know it or not."

THE RISING SUN issued in a beautiful spring day the next morning, and the two boys and the dog were headed for the country by a few minutes after six. About a mile from the edge of town, they came to a field which had a grove of trees along one side, and there was a wide area next to the trees polka-dotted with tree stumps.

"This is the place," Jerry announced like a latter-day Brigham Young. "My grandfather always says that 'new ground,' especially around a beech stump surrounded by May apple plants is the ideal place for mushrooms to grow. There are lots of beech trees in that grove; so some of those stumps are almost certain to be beech, and I can see some big May apple leaves from here."

Bosco was grabbed up and tossed over the fence; then the two boys clambered over and walked across to the stumps. Just as they reached the edge of the grove, a heavy-set, red-faced man carrying a stout

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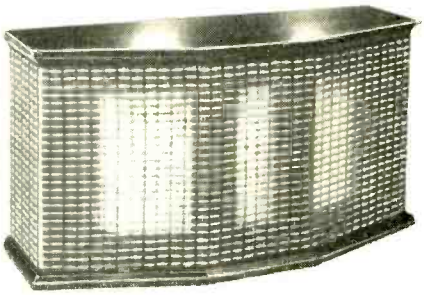

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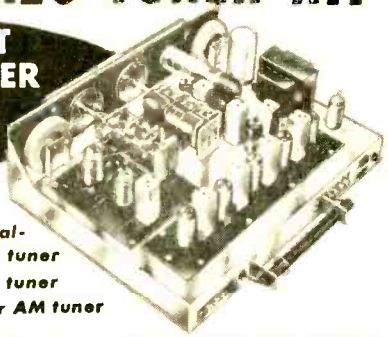

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stick in his big hands stepped from behind a tree.

"Where do you two think you're going?" he challenged.

"Why, why, why, nowhere," Carl stammered.

"That's what you think," the man said menacingly. "You're going to jail. I'm sick and tired of trespassers who ride down my

fences, leave my gates open, shoot my horses and cows, and litter my land. I'm going to make an example of you two."

"We didn't mean to do any of those things," Jerry said. "We didn't know you didn't want people in here."

"Oh, no; you didn't know!" the man mocked bitterly. "You couldn't read the 'Trespassers Will Be Prosecuted' signs posted every hundred feet all around my property. Turn around. You can see the backs of three of those signs from right here."

He was right. Three signs could be seen. The boys had climbed over the fence between two of them.

"Honest, Mister, screwy as it sounds, we didn't see those signs," Carl said earnestly. "I guess we were too interested in trying out our mushroom dog to think about anything else."

"Your *what?*" the man said incredulously.

"Mushroom dog," Carl repeated. "We think we've trained him to hunt mushrooms, and we were just going to try him out."

"Now I know you're going to jail," the man said with renewed determination. "Trespassing's bad enough, but lying's worse. Mushroom dog indeed! I'll teach you young punks to try to make a fool of me."

"But we're *not* lying!" Jerry said indignantly. "We've trained the dog to hunt mushrooms."

"All right. Have it your way. Let's see him find one," the man challenged. "If he

announcing

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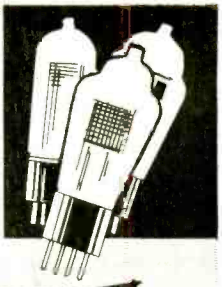

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0Z4	3BC5	6AB4	6BA6	6CL6	6S8GT	7B5	12AT7	12SJ7	38
1A7GT	3BN6	6AC7	6BC5	6CM6	6SA7	7B6	12AU6	12SK7	39/44
1B3GT	3BZ6	6AF4	6BC8	6CM7	6SD7GT	7B7	12AU7	12SN7GT	41
1C6	3CB6	6AG5	6BD6	6CN7	6SF5	7B8	12AV6	12SQ7	42
1C7	3Q4	6AH4GT	6BE6	6CQ8	6SF7	7C4	12AV7	12V6GT	43
1F4	3S4	6AH6	6BF5	6CR6	6SG7	7C5	12AX4GT	12W6GT	45
1F5	3V4	6AK5	6BG6G	6CS6	6SH7	7C6	12AX7	12X4	50A5
1G4	4BQ7A	6AL5	6BH6	6CU5	6SJ7	7C7	12AZ7	14A7/12B7	50B5
1H5GT	4BS8	6AM8	6BJ6	6CU6	6SK7	7E5	12B4	14B6	50C5
1L4	4BZ7	6AN8	6BK5	6D6	6SL7	7F6	12BA6	14Q7	50L6
1L6	4CB6	6AQ5	6BK7	6DE6	6SQ7	7E7	12BA7	19	56
1N5GT	5AM8	6AQ6	6BL7GT	6DG6GT	6SR7	7F7	12BD6	19AU4GT	57
1R5	5AN8	6AQ7	6BN6	6DQ6	6T4	7F8	12BE6	19BG6G	58
1S5	5AT8	6AR5	6BQ6GT	6F5	6U8	7G7	12BF6	19J6	71A
1T4	5AV8	6AS5	6BQ7	6F6	6V6GT	7H7	12BH7	19T8	75
1U4	5AZ4	6AT6	6BR8	6H6	6W6GT	7N7	12BQ6	24A	76
1U5	5BR8	6AU4GT	6BS8	6J4	6X4	7Q7	12BR7	25Z6GT	77
1V2	5J6	6AU5GT	6BY5G	6J5	6X5GT	7S7	12BY7	26	78
1X2	5R4	6AU6	6BZ6	6J6	6X8	7X6	12CA5	27	80
2AF4	5U4	6AU8	6BZ7	6J7	6Y6G	7X7	12CN5	35	84/624
2BN4	5U8	6AV5GT	6C4	6K6GT	7A4/XXL	7Y4	12D4	35A5	117Z3
2CY5	5V4G	6AV6	6CB6	6K7	7A5	7Z4	12F5	35B5	
3A4	5V6GT	6AW8	6CD6G	6N7	7A6	12A8	12K7	35C5	
3A5	5X8	6AX4GT	6CF6	6Q7	7A7	12AB5	12L6	35W4	
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16DP4	12 19	17AVP4	15 49	17QP4	13 89	21AP4	21 49	21AWP4	17 49	21WP4	17 49	24DP4	29 79
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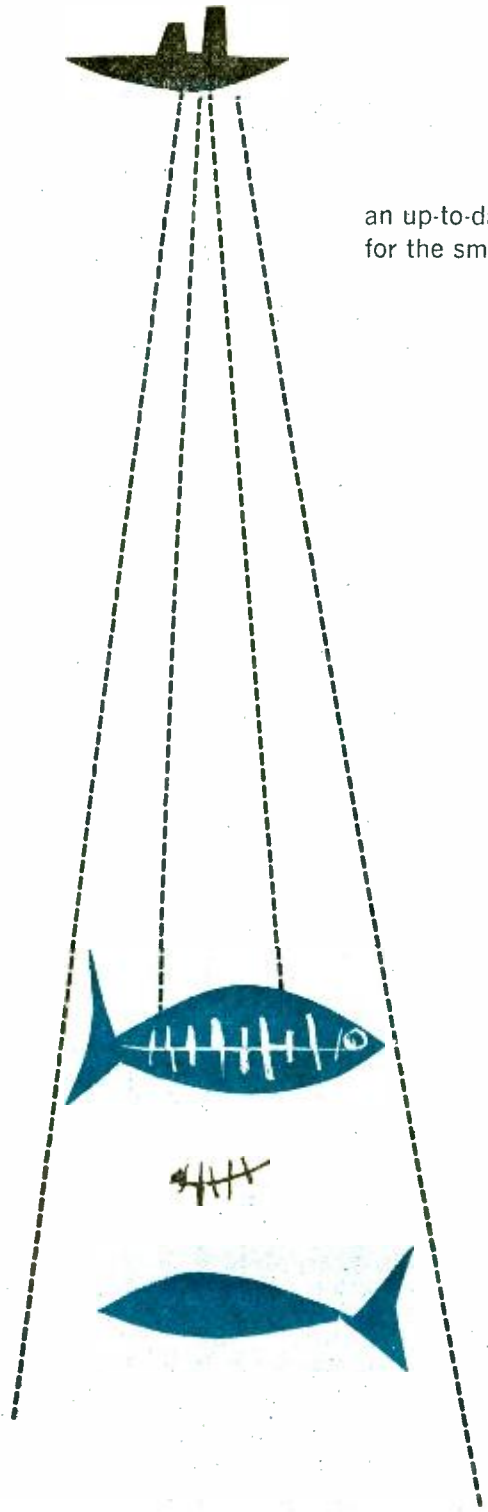


next month in

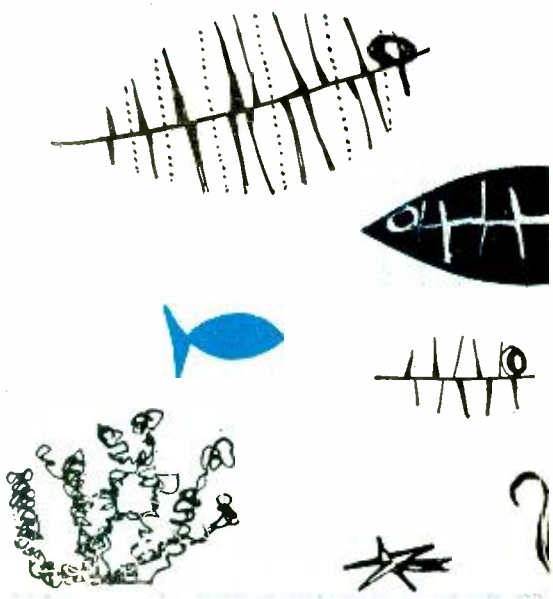
MARINE

an up-to-date survey of marine electronic equipment for the small boat owner and the technician!

For the first time in its history, POPULAR ELECTRONICS presents a complete report on this rapidly growing phase of electronics. With more craft than ever before on America's waters, the field of marine electronics is becoming more important every day. Here's your chance to get some authoritative background material on it!

Whether you now own your own boat, plan to someday, or are interested in learning more about a fascinating part of electronics, you won't want to miss this exciting feature in July PE! It covers every electronics device that is practical today for the small boat owner—tells what it is, what it does, how it works.

This easy-reading guide to the theory of marine electronics makes interesting reading, offers valuable advice on getting maximum efficiency from equipment. Articles like these cover the field thoroughly:



does, I'll believe your story. If he doesn't, you're going to jail."

THAT WAS all the break Carl and Jerry could expect. Carl took a very withered mushroom from his pocket and placed it on the ground in front of the grinning Bosco who had been sitting quietly on his haunches during all the palaver. At the same time Carl passed the packet of hamburger tantalizingly back and forth in front of the dog's near-scented nose.

"We gotta sort of prime him," Jerry explained apologetically to the grim-faced man.

"Okay, Bosco, let's see you do your stuff," Carl was whispering prayerfully into the lopping ear of the dog. "You find a mushroom and I'll buy you the sweetest steak in town to go with it!"

Bosco rose to his feet and tore off at a gallop as though this promise had galvanized him. Madly he scampered in dizzy circles amid the stumps. Suddenly he came to a halt and barked excitedly. All three rushed to his side and beheld him barking at a whole clump of mushrooms pushing their way up through the rotting leaves.

"Well, I'll be a monkey's uncle!" the farmer exclaimed as he watched Carl pop a generous handful of hamburger into the drooling jaws of the dog. "Go ahead and pick them. Can he do that again, or is he a single-shot instead of a repeater?"

In answer Carl waved the dog on, and once more Bosco started his apparently aimless circling. In less than a minute he was barking "treed" at another huge

sponge mushroom growing right between the roots of a stump. As the farmer watched the dog gulp down another patty of hamburger, he remarked anxiously:

"At this rate he'll be full of hamburger before that onion sack is full of mushrooms. Have you thought of that?"

"Not old Bosco," Carl denied. "His other name is 'The Bottomless Pit.' He can eat hamburger until you'd think it would be

sticking out of his ears and still beg for more."

"Good!" the farmer exclaimed. "In that case I want to ask a favor of you boys. Will you wait until I hop across the grove to the house and get my movie camera? I want to get a picture of that dog treeing a mushroom. Here's why: when I was a boy I also had a dog that would hunt mushrooms. I didn't train him; he just seemed to pick it up himself; but he hunted almost exactly the way Bosco does.

"About a week ago I was trying to tell some of the fellows at a grange meeting about that dog of mine, and they laughed me right out of the hall. Now, if I can just get a good shot of Bosco doing what I tried to tell those smart alecks *my* dog would do, you-know-who is going to have the last laugh. Will you help me?"

"You bet!" the boys said in chorus.

"Okay, I'll be back in two shakes," the farmer said as he started off on a lope. "My name's Walt Downham," he called back over his shoulder; "and you two are welcome on my land any time you want to come."

"HEY! He's a real nice guy," Carl said as he clamped the squirming Bosco between his long legs. "Sure is funny how a guy that looked so mean and threatening and ornery a few minutes ago can look so kind and pleasant and nice now, isn't it?"

"Yeah," Jerry agreed thoughtfully. "I guess it just goes to prove that we tend to see people the way we want to see them instead of as they really are. I'm going to remember this and try to make myself take a second look the next time I meet someone I think I dislike."

"Me, too," Carl said as he watched Farmer Downham running toward them with his movie camera in his hand. —30—

Citizens Band Transceiver

(*Continued from page* 53)

A bracket for the whip antenna was made from heavy aluminum and drilled to hold an RCA type phono jack. This bracket was secured to the top of the case with two sheet metal screws, and a 36" length of piano wire (available at hobby shops) was soldered to a mating phono plug.

The 3' whip antenna is made electrically longer by inserting a coil between it and

the antenna jack on the Citizens Talkie. This coil is an Ohmite Z-50 r.f. choke and exactly 32 turns are removed (about three-fifths of the winding) to resonate it. Dab fingernail polish on the coil to prevent turns from coming loose. (See Fig. 8.)

You can get a license for the Citizens Talkie very easily. Just fill out the form enclosed with the International Crystal unit, and send it to the Federal Communications Commission, Washington 25, D. C. (*not* to your local FCC office!)

It should be pointed out that the transmitter consumes considerably more battery power than does the receiver. For the most economical operation, keep your transmissions short, sweet, and to the point. —30—

Transistor Topics

(*Continued from page* 97)

tained from a transformer-like ignition coil. In practice, the ignition coil's "primary" current, obtained from the battery, is interrupted periodically by a set of contact points serving as a momentary switch. Each time the circuit is closed and broken, the resulting rush of current develops the high voltage needed for ignition.

Such a system has many drawbacks. Each time the primary current is broken, the contact points tend to spark and arc. To minimize this sparking, which causes corrosion and reduces contact life, a small condenser is connected across the contacts. But this condenser, in itself, introduces a small time delay in establishing (or breaking) current flow. The net result is that the system's output voltage tends to drop as the rate of contact operation is increased. Thus, at higher engine speeds (rpm), when a really "hot" spark is desired, the ignition voltage may actually decrease.

Transistors can be used in the ignition system to alleviate this situation. The basic schematic diagrams of a "conventional" and a transistorized ignition system are given in Fig. 2. The latter system was developed by engineers of the Electric Auto-Lite Company, and may be offered as optional equipment in some 1960 model autos and, possibly, as standard equipment in many 1961 models.

In operation, the heavy-duty contacts and shunt condenser are replaced by a single power transistor which, in turn, is controlled by a set of *light-duty contacts;*

the latter, handling the transistor's relatively small base bias current, spark very little and have an extremely long—almost infinite—service life. Since the transistor has a very high speed of response, the system's output voltage remains fairly constant regardless of contact operation rate . . . and a good "hot" spark is maintained at high as well as at low engine rpm.

The relative performance of transistorized and conventional ignition systems is shown graphically in Fig. 3.

Telemeter Transmitter. Philco Corporation's Research Division has developed a fully transistorized telemetering transmitter for the U. S. Army's Ordnance Missile Command. Designed for possible use in space satellites, the new transmitter weighs less than 10 ounces, is 5" in diameter, 1" high, and operates in the 20-mc. band. Delivering a watt of output power, this unit has more output and is more efficient than the transistorized transmitters used in present U. S. satellites.

Transistor Course. Sylvania Electric Products is now offering, through its tube and semiconductor distributors, a 12-lesson correspondence course in "Servicing Transistor Radios and Printed Circuits." Your columnist had a chance to review this course and found it complete, accurate, and quite clear. In addition to covering topics of direct interest to the practical service technician, it discusses basic transistor circuit operation and practical transistor applications in considerable detail.

This course should be of real interest and value to experimenters and servicemen alike. For full details concerning availability, contact your local Sylvania distributor . . . or write direct to Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

Battery-Operated Recorder. Stancil-Hoffman (921 N. Highland, Hollywood 38, Calif.), a pioneer manufacturer of magnetic recording equipment, has released details on a new self-contained battery-operated recorder. Dubbed the "Minitape," this instrument uses standard ¼" tape and features a unique automatic volume control system which will handle all levels of sounds from lip distance to as far as 10 or 15 feet away from the microphone.

That does it for now, fellows.

Lou

Hams Go Video

(*Continued from page 44*)

However, the Electron Corporation, a subsidiary of Ling Electronics, Inc., hopes to change all that. Its new equipment is ready assembled, specially designed for operation on the 420-450 mc. amateur television band.

Field tests by the company indicate that this equipment provides excellent reception at a distance of 18 miles. The possibilities of relay transmission are being explored too. With a relay system, a string of hams spaced 18 miles apart could establish a network to cover real distance.

Electron Corp. officials are talking about the use of their equipment to bring amateur collegiate radio into the television picture as a non-commercial educational service. Another possibility they envision—and one linked with their hopes for college TV—is the purchase of converters and special antennas by the general public for looking in on ham television.

The u.h.f. converter, incidentally, is price-tagged at $79.50, and the receiving antenna for it costs $12.50.

Television may eventually become an important adjunct to the ham in his traditional emergency service role. Visual coverage of disasters could prove valuable in coordinating civil defense activities by adding "eyes" to the "ears" of emergency radio communications. —30—

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Jobs in Electronics

(*Continued from page 66*)

in such a course, it means that you're interested in building a career in this field, and you will have a better chance for promotion. Although not many companies pay the full 100% tuition, most will refund anywhere from 50 to 80%, usually upon successful completion of the course.

One advantage of working while studying by home-correspondence course is the fact that the student's regular work fits in with the subject he's studying, and he is getting practical experience with the electronic instruments and techniques he's studying at home. This means that correspondence school students are able to get as good a training as enrolees of resident schools.

If a student shows real promise, a company may send him to a resident school full

time with tuition paid and a living allowance above his regular salary. Thus, he can work his way toward a regular engineering degree, or even an advanced engineering degree, at practically no expense.

Today's best job opportunities are in electronics. A small investment in an electronic education today can create a bigger and better career for you tomorrow than you ever dreamed of. For additional information on electronic careers, see articles in the January and February, 1959, issues of POPULAR ELECTRONICS, and the 1959 edition of "Your Career In Electronics" now on the newsstands. —30—

The "Trans-Pack"

(*Continued from page* 104)

disconnected from the circuit. The filament supply, if six volts, can be obtained from a 12-volt car battery by using a suitable series dropping resistor.

When the "Trans-Pack" is used to provide power for the modular six-meter station, a 2-ohm, 25-watt wire-wound resistor will drop the 12 volts of the battery down to 6 volts for the filaments. Just mount this supply in place of the regular a.c. supply. The station's front panel power switch and the line cord are not used but an additional s.p.s.t. toggle switch must be added to turn the 12-volt supply on and off.

If you are careful not to reverse the 12-volt connections, the "Trans-Pack" will run forever It is impossible to overload. If you attempt to make it work too hard, it will quit operating without damaging any of the

HOW IT WORKS

The two transistors of the "Trans-Pack" are hooked up as a free-running multivibrator. One transistor starts the oscillation by drawing somewhat more collector current than its mate (due to the inevitable differences between transistors, and as the collector current flows through transformer *T1*, a current is induced in the base winding. This winding has been so connected that the current is in the right direction to bias the conducting transistor base more negatively, and more collector current flows. The conducting transistor continues to conduct as long as the rising collector current is matched by a rising base current.

Eventually, the transformer core material saturates and its field commences to collapse. When this happens, the current in the base winding suddenly reverses, the conducting transistor is switched *off*, and the one that is not conducting is switched *on*. This results in a square-wave voltage being induced in the secondary. The secondary winding of *T1* steps up the induced voltage, and a bridge-type rectifier circuit changes the a.c. output to about 250 volts d.c.

components. If you short the output, the supply will not "take off."

The 2N256 transistors were used in the "Trans-Pack" because of their low cost. However, you can obtain more output voltage and slightly higher efficiency with more expensive transistors. The 2N301, for example, works well and is directly interchangeable with the 2N256. —30—

90-Watt Transmitter

(*Continued from page* 91)

nections without causing heat damage to nearby parts and wires.

- Use only the wiring paths shown in the pictorials. Don't take any apparent short-cuts to save wire. If the wire is too long, cut off the excess. Leads which take the wrong path due to short-cuts or excessive lengths will cause trouble.
- After the wiring is completed, perform the tests advised in the final steps. Then, make a resistance check at all tube pin connections. Eico supplies a complete voltage-resistance chart. The resistance check may locate any wiring mistakes.

Only one internal adjustment is required and this is made on the chassis bottom. Coil *L1*, a broadband plate load for the oscillator circuit, is adjusted with power *on*. Be sure to use a plastic alignment tool or a false setting will be obtained. All other front panel settings are made after a crystal or VFO frequency is selected.

Crystal or VFO. If a VFO unit is used in conjunction with the Model 720, it is connected to the VFO jack on the rear apron and switch *S1* is set to *VFO*. For crystal operation, plug a suitable crystal into the front panel *Crystal* jack and switch *S1* to *Xtal*. The crystal or VFO frequency ranges for the tunable amateur bands hare listed below:

BAND (meters)	*CRYSTAL or VFO (kc.)*
80	3500 - 4000
40	7000 - 7300
20	7000 - 7175
15	7000 - 7150
11	6740 - 6807
10	7000 - 7425

In c.w. operation, an 80-meter crystal

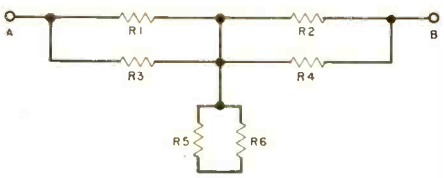
can be used for the 40-, 20-, and 15-meter bands for improved keying characteristics, provided that the *Grid Tuning* control is set within the ranges given above. This will eliminate the possibility of tuning to the wrong harmonic.

There can only be one good final check of an amateur transmitter and that is—getting on the air, and receiving a QRK5 report from a distant DX. When the transmitter is coupled to a rotary beam antenna, DX'ing all continents is no longer a chore but a weekend warm-up. —30—

Answers to Electronic Sticklers

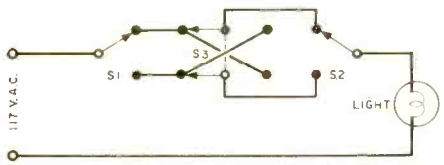
on page 92

1. If you redraw the circuit as shown below, you will immediately see that the resistance



between A and B is one ohm. R5 and R6 do not enter the calculations.

2. The circuit that will best help Joe is shown



here. A d.p.d.t. switch (S3) will do the job.

3. The bell, buzzer and battery are in series when the doorbell button is not depressed. Even if the doorbell and buzzer do not ring due to a high series resistance, the battery will be exhausted in a short time.

4. E1 will be 200 volts and E2 will be 120 volts. E1 is the output of the bridge circuit. E2 receives the rectified output of the 80-volt section on half of the cycle and the 120-volt section on the other half. The capacitor across E2 will therefore charge to an 80-volt level.

If you know of a tricky Electronic Stickler, send it in 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 Stickers.

Among the Novice Hams

(*Continued from page* 94)

grounded (front) terminal of the socket. Now switch the transmitter to the "tune" position and set *C1* to minimum capacitance. Tune your receiver until you hear the transmitter signal.

On the 80-meter unit, if the signal appears at a frequency of less than 4000 kc., remove turns from *L1*, a half turn at a time, until the frequency is 4000 kc. Then tune the receiver to 3500 kc. and tune *C1* to that frequency. Remove plates from the rotor of *C1*, a plate at a time, until the VFO tunes to 3500 kc. with *C1* at maximum capacitance. The 80-meter band should now be spread over the entire VFO dial.

Make similar adjustments to the 40-meter unit, using the frequencies of 7300 and 7000 kc.

Be sure to mount the coil rigidly so that it cannot flop around. If your transmitter is fairly old, it may be necessary to replace the original filter capacitors to obtain a T9 note. After doing this, all reports with the VFO should be T9, stable, and chirp-free.

The 80-meter unit works well on 80 and 40 meters, and the 40-meter one works well on 40 and 20 meters. Higher frequency operation is unsatisfactory.

These units have only been tested on the DX-20 transmitter, but they should work satisfactorily with other rigs, such as the DX-35 and DX-40, using similar oscillator circuits.

News and Views

Dale Branser, KNØRPW, Winsted, Minn., has operated on 80 and 40 meters in his six months as a Novice, working 37 states and Canada. Thirty-two of the states are confirmed. Dale uses a National NC-98 receiver, a Heathkit DX-40 transmitter, and a dipole antenna. Oh, yes, he is waiting for his General to come. . . . . **(Mrs.) Lois Krebes, KN9MXA,** 6605 E. 4th, Gary, Ind., admits immediately that her father's encouragement (John, K91JW) was mainly responsible for her Novice license. Lois spent her first two months on 40 meters, working 41 states, 39 confirmed, using a DX-35 transmitter feeding a folded dipole antenna. Then, the old and battered Sky Champion receiver collapsed, and it took her dad five weeks to get it working. Lois thereupon transferred operations to 15 meters, where she added four more states, including Alaska, plus Puerto Rico and many Canadians. She hopes to work the remaining four states before her Novice license runs out, by which time she will have her General—if she can screw up her courage to take the examination.

Mike Stanley, KN8KWB, (17), Rt. 5, Fair-

mont, W. Va., stays out of the ham shack except on weekends—too much homework—but he has made 349 contacts in 29 states and Canada in six months on 40 meters. He just got on 15 meters and has already worked six states there using a doublet 25' high. His 40-meter antenna is 75' high! Mike's transmitter was built by K8ANZ, and uses a 6AG7 to drive a 6146 at 50 watts. He receives with a Heathkit AR-3 with a QF-1 Q-Multiplier. Mike offers to help prospective Novices get their tickets; he reports that, within a mile of him, two fellows have just received their licenses, two are waiting, and seven more are studying for theirs. . . . . **Phil J. Haurus, WV2AXR,** (15), 410 Edgar Road, Westfield, N. J., made 106 contacts in 18 states in 54 days on 40 meters. Then he discovered 15 meters

ANNUAL HAMFEST

The San Fernando Valley Radio Club, Inc. will hold its third Annual Hamfest and Picnic on Sunday, June 7, at the Victory-Van Owen Park, North Hollywood, Calif. For further information, contact Arnold Dahlman, W6UEI, 14940 Hartland St., Van Nuys, Calif.

and made ten contacts in six states in only three hours. Phil uses a DX-40, an AR-3 with Q-multiplier, and a 40-meter antenna. He offers to help "anybody with troubles." Phil has two pet peeves: those invisible QSL cards some hams send, and the fellow who sends faster than he knows how to send.

Johnny Shinall, KN4BYK, (15), 507 West Ave., Cartersville, Ga., is one of those rare Novices who operate all four Novice bands. On 2 meters, he runs 40 watts to a home-built transmitter, which feeds a 4-element beam. He receives with an RME 152-A converter into his Hallicrafters SX-99 receiver. On the other Novice bands, he uses a DX-40 transmitter, a Johnson "Matchbox" (antenna coupler), SX-99 receiver, and both a "trap" doublet antenna and a 15-meter dipole. Johnny has worked 30 states, Trinidad, and Canada. His favorite band is 80 meters, followed by 40 meters. . . . . **David Ojima, KN7GQH,** (16), Rt. 4, Box 186, Port Orchard, Wash., started out running. In three weeks, he worked 36 states, including Alaska, and four Canadians, all on 15 meters. He feeds his "one-element beam" from a WRL Globe Chief 90A running 75 watts, and he receives through a National NC-45.

Douglas Willoughby, KN7GJX, (16), 730 S. Country Club Drive, Mesa, Ariz., worked three months on 80 meters with a 6I6-6W6 transmitter running 30 watts and feeding a ½-wave "zepp" antenna, 25' high, and a "surplus" BC-348Q receiver. Most of his 80-meter work is done around 3:00 a.m., MST, when the DX rolls in. Doug has now added a Heathkit DX-20 transmitter and a Gonset Triband converter for his receiver. He has been giving 15 meters a whirl for 40 contacts, all U.S. call areas, and 10 new states in five days. . . . . **Mike Young, K6MBV,** 1336 Hermosa Drive, Pedro Valley, Calif., uses a 15-watt transmit-

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K1/W1 CALL AREA

Richard Frohwirth, 35 Livingston St., Bridgeport 4, Conn. Phone: ED 9-7004. (Code)
Robert Bergmann, 101 Nelson St., West Springfield, Mass. Phone: RE 7-6831. (Code)
Kenneth Johnson, 28 Dix St., Worcester 9, Mass. Phone: PL 3-2610. (Code and theory)
James McFall (13). 29 Rudolf St., Malden 48, Mass. (Code, theory, and selection of equipment)

K2/W2 CALL AREA

Marcus Wilbun, 993 Jefferson Ave., Brooklyn 21, N. Y. Phone: GL 2-0751. (Code, theory, regulations and selection of equipment)
Dan Handelsman (15), 811 Walton Ave., Bronx 51, N. Y. (Code and theory)
Richard Horwitz (12). 8 Admiral Rd., Buffalo 16, N. Y. Phone: EX 2928. (Code and theory)
James E. Kearney (14). 1700 Met. Ave., Bronx 62, N. Y. Phone: TA 2-4664. (General code and theory)
Fred Broszeit, 344 No. Alleghany Ave., Lindenhurst, N. Y. (Code and theory)
Robert Fagan (17), 142-14 116th Ave., Jamaica, N. Y. (Code, theory and regulations)
Thomas Taormina, 14 Capitol Pl., Huntington Station, N. Y. (Code and theory)
Bill Langer, 29 Larch Ave., Floral Park, N. Y. Phone: FL 4-5788. (Code and theory)
Arnold Getz (15), 320 Sterling St., Brooklyn 25, N. Y. Phone: PR 3-1473. (Code and Technician theory)
Tom Collins, 300 Niagara Falls Blvd., Buffalo 26, N. Y. (Code and theory)
Steven Stier (13). 121 Morse Ave., Bloomfield, N. J. Phone: PI 8-8021. (Code, theory and regulations)
Vernon Allen, 69 Lakeview Dr., Patchogue, N. Y. (Code and selection of equipment)
Alex Teplitz, 73 West St., Spring Valley, N. Y. (Code and theory)
Kim Boriskin, 868 E. 7th St., Brooklyn 30, N. Y. (Technician code)

K3/W3 CALL AREA

Hewitt Lines (13), 8603 Howell Rd., Bethesda 14, Md. (Code, theory and regulations)
George S. Keener, R. #2, Hagerstown, Md. (Code, theory and selection of equipment)
Cliff Atkinson, Box 411, R. #2, Gibsonia, Pa. (Code, theory and selection of equipment)
Jon Pavlakovich, R. #1, Beaver Grade Rd., Coraopolis, Pa. (Code, theory, regulations and selection of equipment)
Ronald C. Reynolds, R. #2, Box 139, Mt. Pleasant, Pa. (Code, theory and regulations)

K4/W4 CALL AREA

Charles Joines, Box 306, Sparta, N. C. Phone: 214. (Code)
Harvey Dawkins (15), 2214 Marshall Ave., Newport News, Va. Phone: CH 7-3114. (Code and theory)

K6/W6 CALL AREA

Frederick R. Washburn, 1001 E. Chestnut Ave., Santa Ana, Calif. (Code, theory and selection of equipment)
George von Gaertner, 7951 Stewart Ave., Los Angeles 45, Calif. Phone: OR 8-0713. (Code, theory and regulations)
Myron Johnson, 507 D Ave., Coronado, Calif. (Code and theory)
Bill Robbins, 15929 Dalmatian Ave., La Mirada, Calif. Phone: LA 1-3379. (Code and theory)
Lonnie Thomas (14), 11551 Venice Blvd., Los Angeles 66, Calif. (Code)
Bob Audell (14), 1636 West 248th St., Harbor City, Calif. Phone: DA 6-5589. (Code)
Darryl & Jeffrey Sue, 3771 Westside Ave., Los Angeles 18, Calif. (Code, theory and regulations)
Frank Basile, 1176 I St. Ext., Petaluma, Calif. Phone: PO 2-8114. (Code, theory and regulations)
Louis Encinger, 622 43rd Ave., San Francisco, Calif. (Code, theory and selection of equipment)

K7/W7 CALL AREA

Ray Myers, 144 S. E. Main St., Roseburg, Ore. (Theory and selection of equipment)
David McMullen, 1600 Franklin St., Lebanon, Ore. (Code and theory)

K8/W8 CALL AREA

Samuel Flanagan, 1556 W. Chicago Blvd., Detroit 6, Mich. (General code and theory)
Richard Samuels, 43 Meadowbrook Ave., Youngstown 12, Ohio. (Code)
David Schrock (13). West Barre Rd., Archbold, Ohio. (Code, theory and selection of equipment)
Dan Wilt, 354 E. Park Ave., Barberton, Ohio. (Code)
Paul Brown, 2921 Page Ave., Jackson, Mich. (Code and theory)
Bobby Scherzer (15), R. R. #1, Hemlock, Mich. (Code and theory)
Bill Odebrecht, R. R. #4, South Haven, Mich. (Code and theory)
Larry McGrath (19), 318 N. Wooster Ave., Strasburg, Ohio. Phone: 5181. (Code, theory, regulations and selection of equipment)
Byron Brown, 501 Byron St., Plymouth, Mich. (Code, theory and selection of equipment)
Ron Murray (15), 9413 N. Saginaw St., Mt. Morris, Mich. (Code, theory and regulations)

K9/W9 CALL AREA

Bob Thomas, 121 Edds Ave., Pekin, Ill. (Code, theory and selection of equipment)
Jim Young, Box 381, Hennepin, Ill. (Code, theory and selection of equipment)
Dennis Jasinski, 1933 W. Fairmount, Milwaukee 9, Wis. Phone: CO 4-5691. (Code and theory)
Charles Sommers, 324 Center St., Kewaunee, Wis. (Code and selection of equipment)
Larry Moreland (15). 1505 So. Maple St., Marion, Ind. (Code, theory and selection of equipment)
David Leonard (14), 5304 E. Raymond St., Indianapolis 3, Ind. Phone: FL 9-3612. (Code, theory, regulations and selection of equipment)

KØ/WØ CALL AREA

Ronald Stordahl, Box 126, Thief River Falls, Minn. Phone: MU 1-2693. (Code, theory and regulations)
Thomas J. Lambert, 1021 N. Carroll St., Carroll, Iowa. (Code and theory)
Lowell & Ray Johnson, 2017 E. 31st St. N., Sioux Falls, S. D. (Code, theory and regulations)
Neil Berglund, 4009 N. 81st Ave., W., Procton 10, Minn. (Code, theory and selection of equipment)

VE AND OTHERS

Tony Lewis (15), Box 22, Mono Rd., Ontario, Canada. Phone: BO 285-W-4. (Theory and regulations)
Barry Levy, 89 Neptune Dr., Toronto 19, Ont., Canada. (Code, theory and selection of equipment)
Henry J. Ruhl, McCord, Sask., Canada. (Code, theory, regulations and selection of equipment)
Louis A. Lavoie, Hydro Quebec Stores Dept. Labrieville South, Cte. Saguenay, Que., Canada. (Code, theory and selection of equipment)
Jose A. del Rosario, 1126 Vallejo St., Rio Pedras, P. R. (Code and theory)

ter, a 40-meter dipole, and a Hallicrafters S-38D receiver. In 10 months as a Novice, Mike worked 41 states, with 39 confirmed, and three foreign countries. He gets a bit upset when he calls "CQ DX" and a ham in a neighboring state answers him.

John P. Chihorek, KN3GHI, 62 South Main St., Ashley, Pa., expects to have his General by the time this is published, and he offers to help prospective amateurs. John's Novice record to date is 43 states and nine countries. He rates Yugoslavia as his best DX. The roof of his ham shack keeps the rain off a Heathkit DX-35 transmitter and a Hallicrafters SX-99 receiver. Hanging majestically above the shack is a 40-meter dipole. . . . For those of you who think that it takes a beam and high power to work a lot of DX, **Tom Gabbert, K6INI,** has worked over 100 countries using a Gotham V-80 vertical antenna and 65 watts of power. . . . . **Dick Abbot, WV2AFQ,** (13), 952 Downey Road, Valley Stream, N. Y., has worked 100 countries less than K6INI, but he is just as proud of his record of 15 states, all confirmed, worked on 80 meters. Dick feeds a long-wire antenna with a DX-40 transmitter, and he receives with a National SW-54 receiver.

Next month I hope to be able to include *your* News and Views on these pages; so write that letter, and enclose a picture of yourself and your station if you have one. 73,

Herb, W9EGQ

Short-Wave Report

(*Continued from page* 106)

The following is a resume of the latest reports. All times are Eastern Standard and the 24-hour system is used. At time of compilation, all reports are correct. Stations often change frequencies and/or schedules with little or no advance notice.

Albania—*R. Tirana,* 6900 kc., has changed the Eng. xmsn and is now heard at 1730-1700, parallel with 7850 kc. Both channels have 3-kw. power. (*DL, 541*)

Belgian Congo—*R. Congo Belge,* OTM2, Leopoldville, 9380 kc., is heard well at 0000-0130 with music programs and ID every half hour. The s/on at 0000 features a unique IS played on a hollow log drum. (*TP, 442, 584*)

Dominican Republic—HIN, Ciudad Trujillo, is the correct call for the station on 3310 kc., instead of HIL. It is heard at 1900-2305 irregularly. (*100*)

Ecuador—*Radio Popular Independiente,* Cuenca, 5060 kc., is a new station noted at 1900-2330. (*100*)

HCJA5, *R. Atenas,* Jipijapa, 3990 kc., was heard on 0012 with Spanish songs and talks but it was heavily QRM'ed by amateur stations. (*477*)

Ethiopia—*Voice of Ethiopia,* Addis Ababa, 15,345 kc., has been noted at 1315-1322 with Eng. news; it closes at 1420 with native music and announcement and Eng. ID. Another Eng. period is heard from 1530 to 1600/close. (*61, 420*)

Formosa—*The Voice of Free China* carries Eng. from Taipei at 2030-2045 to N.A. and Ha-

waii; at 0505-0550 in General Overseas transmission; and at 0730-0830 to S.E. Asia on BED7, 7230 kc., BED6, 815 kc., BED66, 9575 kc., and BED57. 15.345 kc. All reports go to New Park, Taipei, Formosa. (*JT, PV*)

French Equatorial Africa—On the *Radio Australia* DX Program it was reported that *Radio AEF* will answer quickly *if* two IRC's are sent with each report. The new schedule reads: 0030-0130, 0630-0730, and 1130-1600 on 7295 and 4795 kc., with each xmtr rated at 4 kw. A 50-kw. xmtr is used at 1200-1400 on 9625 kc. (*377*)

Germany—Regional stations noted include *Bayerischer Rundfunk,* Munich, 6085 kc., 10 kw., at 1900-2100 (although it is a 24-hour station), and *Norddeutscher Rundfunk*, Hamburg, 6075 kc., 20 kw., at 1800 with German news and classical music, and at 0000-0100 in German with some English included. (*HD, HP, 501, 562*)

Ghana—Contrary to some reports. *R. Ghana,* Accra, is being heard clearly on 3366 kc. at 0100-0115 with home news, and at 0115-0125 with "Radio Newsreel." (*587*)

Greece—Forces Broadcasting Station, Tripolis, 6003 kc., is weak to fair at 0030 with a Greek news relay from Athens which is followed by vocals in Greek. The Kozanzi outlet on 7950 kc. is fair from 0000 in native language. A reported 9950-kc. listing in some quarters is in error. (*166*)

Indonesia—YDG, Surakarta, 3305 kc., has been logged from 0215 to 0231 s/off with Far Eastern instrumental music. The xmsn ended abruptly at 0231. (*61*)

Italian Somaliland—Mogadiscio, 7070 kc., was noted during the 0430-0500 xmsn in Somali. Italian is scheduled at 0500-0545 although some Italian was noted before that time. You'll have to dig pretty deep for this one! (*61*)

Japan—*Radio Japan* has begun service to Central and South America in Spanish and Japanese from 2200 to 2300 on JOA24, 17,855 kc., and JOB21, 15,325 kc. Another Latin American period is noted on 11,705 and 9525 kc. at 0400-0420 (Spanish), 0420-0440 (Portuguese), and 0440-0500 (Japanese). (*PV, 149*)

Luxembourg—*R. Luxembourg* is noted on 6090 kc. with pop music and records at 1300-1900. Weekdays they present a religious service at 1800-1830. (*AR*)

New Zealand—*R. New Zealand,* Wellington, has been heard on 15,280 kc., ZL4, at 2145-2300 with music and 'soap-operas'; on 15,220 kc., ZL10, from 1730 s/on to 1745 with news in native language and music; and on 9540 kc., ZL2, at 0230 with news, at 0240 with sports, and music following at 0245. (*BG, JM, LP*)

Peru—OAX8E, *R. Loreto,* Iquitos, 9590 kc., is heard well at times with American pop records to 1930, hymns to 1945, native music to 2000, and all announcements in Spanish. (*RS, 557*)

Portugal—*Emissora Nacional,* Lisbon, continues to be heard well in the English xmsn to South Africa at 1215-1300 on CSA66, 17,895 kc., with news at 1230. (*501*)

The 15,100- and 15,125-kc. channels are also at strong level with musical programs from

1700 and earlier to past 1730. The ID is preceded by a gong. *(BG)*

Portuguese India (Goa)—*Radio Goa*, 6025 kc., has been tuned at 0615-0630 with Oriental songs and music. The 0630 ID is followed by an English talk to 0640. *(226)*

Reunion—St. Denis, 3385 kc., was noted at 0315 with European instrumental music and French anmts to 0330; French news was read until 0344. Following the ID, a talk in French was noted to 0400, at which time the station faded. This is another rare catch that may require a lot of patience. *(61)*

Rhodesia and Nyasaland—A station with the ID of *Federal Broadcasting Corp.* was logged at 0355 with European music to 0359. English anmts and the ID at 0400 were followed by an English newscast. This may be Salisbury on 3395 kc. *(61)* (Editor's Note: Salisbury has English scheduled at 0200-0400 and at 1000-1530 weekdays, at 0800-1630 Saturdays, at 0300-0700, 1000-1500 Sundays.)

Saudi-Arabia—A verification dated January 1959 gives this schedule: at 1200-1410 on 6100 kc., and at 2230-2345 and 0600-0820 on 11,850 kc. *(226)*

Sierra Leone—*Freetown Calling*, 3316 kc., signs on at 0200 with news from London, talks, and religious program. This is followed at 0230 in native language. *(541, 562)*

South Africa—*Springbok Radio*, 9720 kc., is often noted from 0000 to 0100 s/off with pop music, many commercials, and a newscast at 0030. This is an all-English show. *(584)*

South Korea—*Voice of Free Korea*, Seoul,

SHORT-WAVE ABBREVIATIONS

anmt—Announcement
Eng.—English
ID—Identification
IRC—International Reply Coupon
IS—Interval signal
kc.—Kilocycles
kw.—Kilowatts
N.A.—North America (n)
QRM—Station interference
R.—Radio
s/off—Sign-off
s/on—Sign-on
xmsn—Transmission from station
xmtr—Transmitter used by station

carries English to N.A. at 0030-0100 on 11,925 and 15,410 kc., to Hawaii at 0230-0300 on 11,925 kc., to South Asia at 0900-0930 on 9640 and 15,410 kc., and on the General Overseas program at 0530-0600 on 7935 and 9640 kc. *(BG, PV, 364, 501, 584)*

Surinam—A station called *Radio Nickerie* is reported to be operating from the Nickerie district of Surinam over 3240 kc. at 1630-2100. Has anyone heard it? *(477)*

Sweden—*Radio Sweden's* latest schedule reads: to Western N.A. at 2130-2245 on 11,810 kc.; to South America at 1800-1930 on 11,705 and 15,240 kc.; and to S.E. Asia at 0945-1100 and the Far East at 0730-0845 on 15,240 and 17, 840 kc. Other transmission periods remain unchanged. *(477)*

Switzerland—The International Evangelical Radio Station will be on the air soon in 22 languages including English, Swedish, French, German, Spanish, and Portuguese at 0130-

1900 on medium and short waves. Further details are requested. (*501*)

United States—The *Voice of America* amateur program is now a weekly part of the "Report From the United States." Conducted by Bill Leonard, it contains news of interest to hams and short-wave listeners, propagation reports, and other features. It is broadcast on Sundays as follows: at 0115-0130 on 15,165, 15,210, 11,970. 11,960, 11,810, 11,785, 9740, 9700, 9585, 9530. 7205, and 6140 kc.; at 0215-0230 on 17,845, 15,380, 15,295, 15,210, 11,810, and 9700 kc., at 0715-0730 on 25,950, 25,880, 21,735, 21,445, 17,795, 15,330, 11,875, 11,790, 11,775, 9745, 9650, 9515, 7160, 7110, 6145, and 6020 kc; at 1215, 1230 on 21,610, 21,500, 21,455, 17,740, 15,210, 15,200, 11,875, 11,760, 9615, 9520, 7110 6140, and 3980 kc.; and at 1815-1830 on 25,630, 21,740, 17,880, 17,830, 17,770, 15,340, 15,275, 15,210, 15,200, 15,150, 11,900, 11,895, 11,875, 11,790, 9615, and 7160 kc. For a special verification card for this program, send your reports to Amateur Radio, Box 922, Washington 4, D. C. (*501*)

SHORT-WAVE CONTRIBUTORS

John Brunst (*JB*) Jacksonville, Fla., *WPE4BQ*
Harry Deitz (*HD*), Queens Village, N. Y., *WPE2UM*
Bradley Graham (*BG*), Fayerweather Island, Conn., *WPE1KJ*
Dominic Lorenzini (*DL*), Landisville, N. J., *WPE2UN*
Jim Maynard (*JM*), Lexington, Ky., *WPE4FY*
Allan Rothschild (*RO*), Rockaway Park, N. Y., *WPE2UO*
Heino Pistel (*HP*), Waynesboro, Va., *WPE4MM*
Larry Peterson (*LP*), Santa Rosa, Calif., *WPE6CP*
Tom Prosser (*TP*), Winslow, Ariz., *WPE7DD*
Adrian Rose (*AR*), London, England, *G2PE3S*
Robert Salamack (*RS*), Amsterdam, N. Y., *WPE2TK*
John Tracy (*JT*), Cheyenne, Wyo., *WPE7CI*
Pedro Vasquez, S/Sgt. (*PV*), Laredo, Texas, *WPE5EK*
John Beaver (*61*), Canon City, Colo., *WPEØAE*
Roger Legge (*100*), McLean, Va., *WPE4FI*
J. Art Russell (*149*), San Diego, Calif., *WPE6EZ*
George Cox (*166*), New Castle, Del., *WPE3NF*
William Bing (*226*), New Orleans, La., *WPE5AG*
Chris Pamatatitis (*364*), Chicago, Ill., *WPE9KN*
Ken Boord (*377*), Morgantown, W. Va., *WPE8GB*
A. R. Niblack (*420*), Vincennes, Ind., *WPE9KM*
Werner Howald (*442*), Los Angeles, Calif., *WPE6FA*
Jerry Berg (*477*), West Hartford, Conn., *WPE1BM*
Paul Buer (*501*), Harrison, N. Y., *WPE2UP*
Alan Roth (*541*), Bridgeport, Conn., *WPE1BY*
Pete Kavaleski (*557*), Hancock, Mich., *WPE8KI*
Tom Miller (*562*), Dexter, Mo., *WPEØGG*
Denny Reeves (*584*) Peoria, Ill., *WPE9KL*
Dick Schreiber (*587*), Wheat Ridge, Colo., *WPEØEH*

USSR—Regional outlets heard recently include Stalinabad, Tadzhik, on 4635 kc. at 1840; ID at 1900; around 2000 the signal equals the strength of the Ecuadorian on the same frequency. Vladivostock, Siberia, 5015 kc., is heard at 0505 with native music and language; the 4040-kc. channel is still on after 1700. Ulan Ude, Siberia, 6135 kc., is heard weakly from 1727 s/on with a musical number. Novosibirsk, Siberia, s/on 1800 with native news; exercises at 1930 with piano. (*166*)

Tashkent, Uzbek, is often found on 11,690 and 7100 kc. around 0700-0800 with English to South Asia. (*RO*)

Clandestine—*Radio Rebelde*, formerly *R. Liberacion*, Honduras outlaw station, is now heard on 5910 kc. irregularly at 1900-2300. (*JB, 100*)

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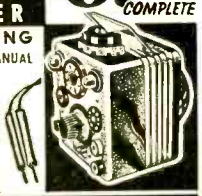

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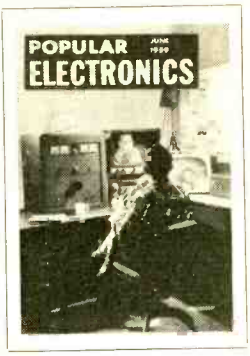

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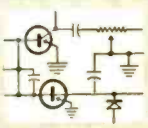

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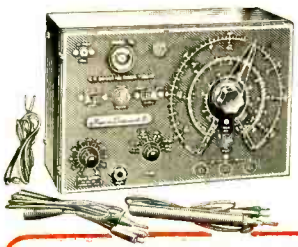
ALL PURPOSE BRIDGE

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
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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.

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✓ SIGNAL TRACER SECTION
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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!

✓ 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
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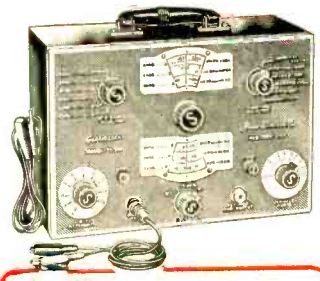

Model TV-50A GENOMETER . . .
Total Price $47.50
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R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 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.

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The Model TV-50A comes absolutely complete with shielded leads and operating instructions. **Only $47.50**

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Read emission quality direct on "BAD-GOOD" meter scale.

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Model 82A comes housed in handsome, portable Saddle-Stitched Texon case. Only **$36.50**

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Superior's New Model 77

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WITH NEW 6" FULL-VIEW METER

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AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

SPECIFICATIONS

• **DC VOLTS**—0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS** (Peak to Peak)—0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER**—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS:** −10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

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- **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.

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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**

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