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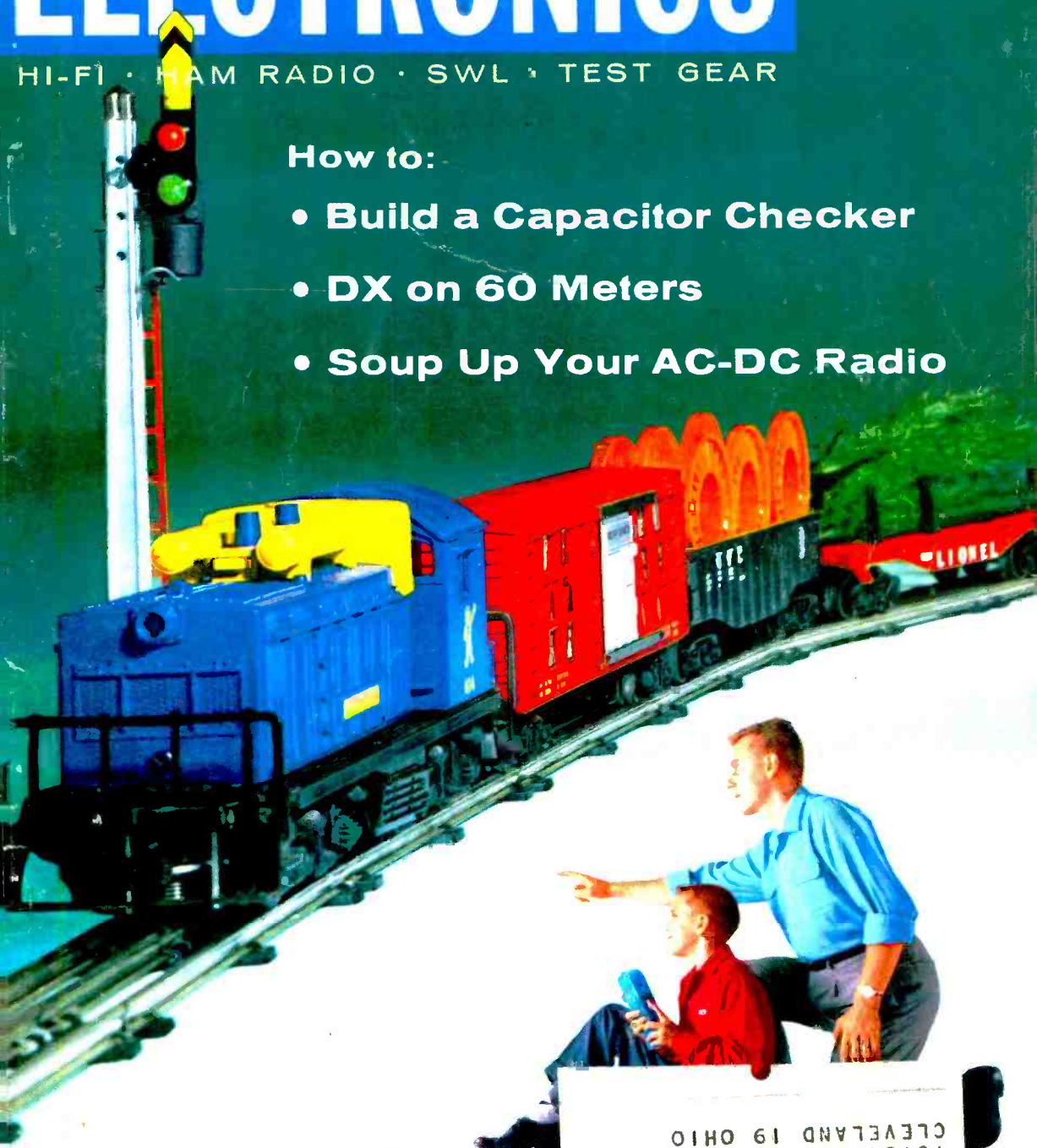
DECEMBER
1959

35
CENTS

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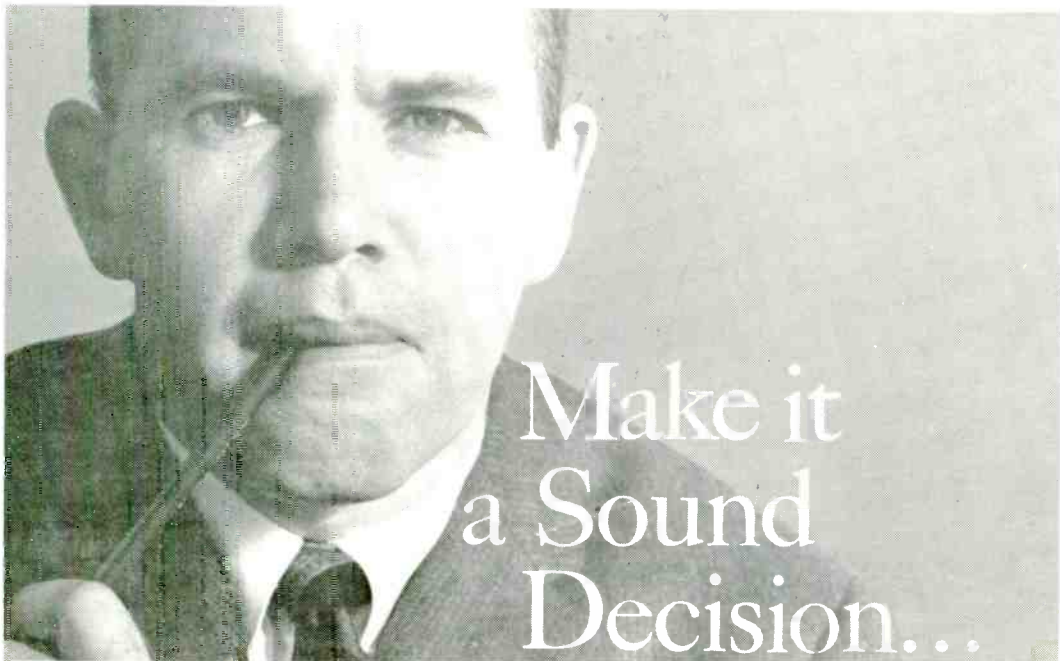
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- DX on 60 Meters
- Soup Up Your AC-DC Radio



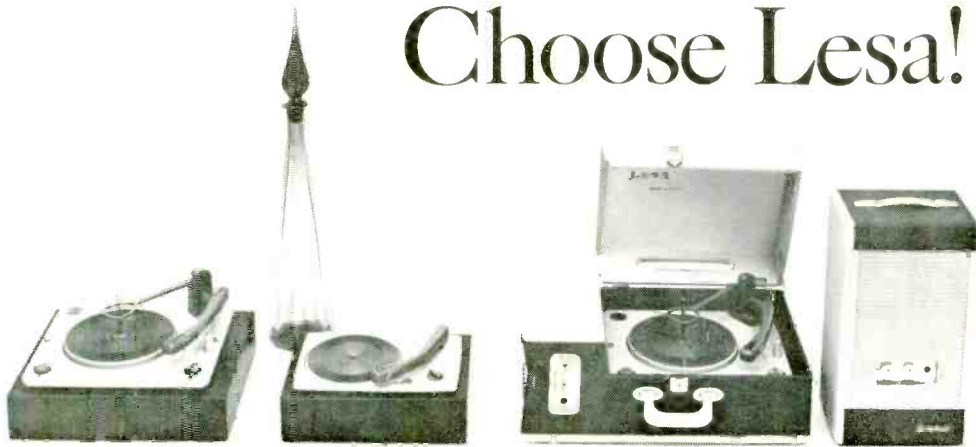
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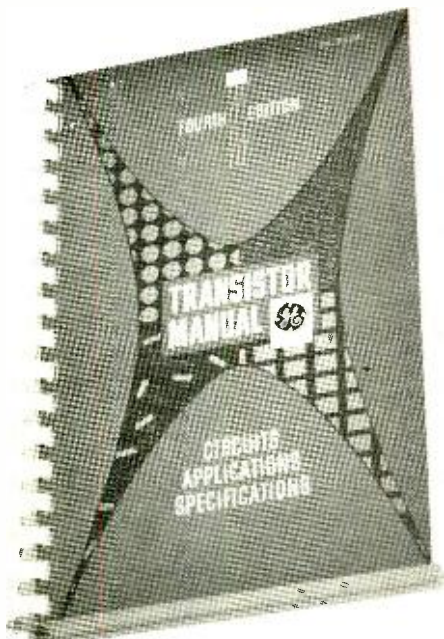
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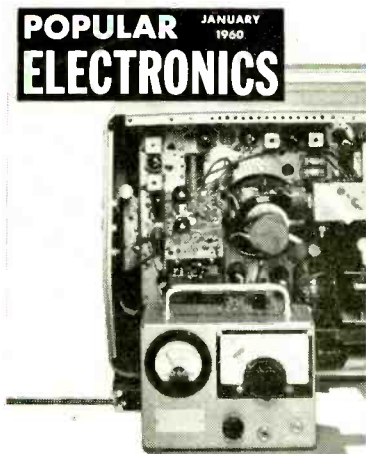
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Average Net Paid Circulation 266,479

This month's cover photo by Al Gruen
Electric trains courtesy Lionel Corp.
R/C equipment courtesy Lafayette Radio

COMING NEXT MONTH



(ON SALE DECEMBER 24)

That gadget on our January cover with the TV set backdrop is featured in an article entitled "The One-Tube Laboratory." If ever a device deserved the description "multi-purpose," this build-it-yourself unit is it. The one-tube lab will function as a modulation monitor, signal generator and calibrator, short-wave receiver, and many more instruments.

Among the other construction projects is a deluxe dry cell tester-rejuvenator which will put new life into those old worn-out 1½-volt dry cells. For the hams and SWL'ers, there's a do-it-yourself beam antenna made from standard hardware-store aluminum stock that will really pull in the DX.

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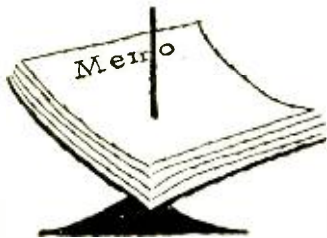
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Notes from the Editor

STEREO MUSINGS. Just a few days ago I went to the annual fall Audio Show held in New York. Naturally enough, the emphasis was on stereo. In my opinion there were several things that were noteworthy in addition to the new equipment displayed.

The technical quality of stereo records has improved tremendously since the last Show—so much so that one company, Vanguard, had the courage to run an A-B test comparing a stereo record with the master tape from which it was made. Although I didn't agree with Vanguard's contention that it was impossible to tell the difference between the two (to my ears, whenever any loud passages were reproduced, the tape was far superior to the record), the mere fact that such a test was even attempted says a lot for the quality of present-day stereo discs. I doubt that anyone would have dreamed of making an A-B comparison last year between a stereo record and a stereo tape (and a master tape, at that!).

I have been fooling around with stereo for quite a while now—I had a stereo recorder back in 1951. And I became doubly convinced at the Show, after listening to perhaps 50 stereo systems, that aside from any new approach which stereo brings to home music listening, the important criteria for judging a sound-reproduction system remain the same as those we've been using since the very beginning of high fidelity: wide frequency response, low distortion, lack of artificial coloration.

For me, directionality is not nearly as important as these three other factors. No matter how much separation and directionality your system may have, if it doesn't meet the basic standards of high fidelity, I think you have wasted your money. When you get right down to it and compare 'old-fashioned' multi-speaker mono equipment against stereo, the mono stacks up pretty well—and it is incomparably better than a great majority of the pre-packaged, all-in-one stereo systems now on the market.

Another aspect of the Show that gladdened this audiophile's heart was the concentration on music rather than 'sound' and separation to sell stereo. I can appreciate the manufacturers' early efforts to convince the buying public that stereo really was something new—by having bowling balls and locomotives rolling down the middle of their listening rooms. But I, for one, who would much rather hear Dvorak than Diesels, welcome this additional indication that stereo is coming of age.

Oliver Read



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This exciting recording is available in a special bonus package at all Audiotape dealers. The package contains one 7-inch reel of Audiotape (on 1½-mil acetate base) and the valuable "High Spirits" program (professionally recorded on standard Audiotape). For the entire package, you pay only the price of two boxes of Audiotape, plus \$1. And you have your choice of the half-hour two-track stereo program or the full-hour monaural or four-track stereo versions. Don't wait. See your Audiotape dealer now.

LIKE your classics bright and melodic? Do you enjoy music of the toe-tapping variety? Then "High Spirits" is just for you. This reel of sparkling classics shows you how vibrant and colorful music can be when it's recorded on *Audiotape*.

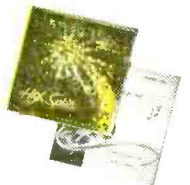
The makers of Audiotape have not gone into the music business. They are simply using this reel to allow Audiotape to "speak for itself."

"High Spirits" 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 two-track stereo, a full hour of four-track stereo, or an hour of dual-track monaural sound - all at 7½ ips. Don't pass up this unusual opportunity to put yourself in high spirits.

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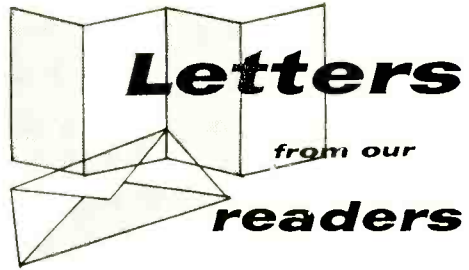
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from our
readers

Super Stereo Corrections

■ In reference to my article "Build a Super Stereo Amplifier" which appeared in the October issue, I would like to call the attention of your readers to some unfortunate typographical errors. Resistors R8, R9, R35, and R38 lost a zero somewhere along the line, and instead of being 3000 ohms, the correct value for them is 30,000 ohms. The value for R12 is 18,000 ohms, as indicated in the parts list. Also, the control grid pin of each of the output tubes is pin 5, and not pin 1 as indicated on the schematic. Any standard crystal diode, such as the 1N48 or 1N34, is satisfactory for CD1 in the 0-1 ma. meter circuit.

I would like to stress the fact that the power supply capacitors should be covered with the cardboard insulating tubes specified in the parts list. Since some of the electrolytic cans carry about one-half the B+ voltage, it is imperative that this precaution be observed to prevent shocks.

HARRY KOLBE
New York, N. Y.

Stereo and Acoustical Tile

■ After reading Mr. Lorant's article on acoustical tile in the October issue, I am convinced that Mr. Lorant has stereo confused with binaural sound. Since when does the left ear hear only the left speaker, even in a free out-of-doors sound field? Both ears hear both speakers. The factor which accounts for stereo directionality is phase difference between the two stereo channels.

So far as an acoustically deadened room contributing to better stereo or hi-fi is concerned, that's a lot of baloney. From 1930 to 1940, all recording studios and concert halls were dead and were considered the "rage." Today the trend is back to live halls and studios, and some even add reverberation artificially.

Severance Hall, home of the Cleveland Orchestra, was recently brought back to life. It had been thought to be one of the best acoustically designed halls in the country. And believe me, it was dead. You could hear a pin drop on the stage, but it was dead so far as reverberation was concerned. What was the public reaction? Some said it was spectacular and others were disturbed by the acoustics.

I have a very live music room. The walls, floor, and ceiling have an absorption coefficient of about .08 compared to .5 of acoustical tile—which means that the sound really bounces around. The frequency range of my sound system is from 25 to 20,000 cps = about 10 to 15 db, depending on the placement of the test microphone. To increase the amount of reverberation, I use six artificial reverberation speakers around the sides of the room that have a delayed reverberation of about .1 second and a decay of about 3 seconds. What is

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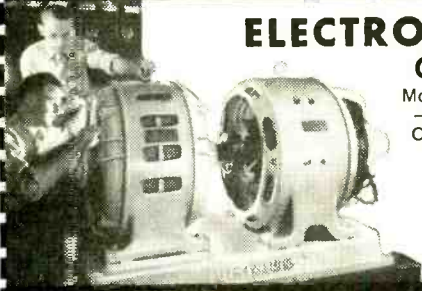
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230 Duffy Ave., Hicksville, Long Island, N.Y.

Letters

(Continued from page 10)

the result? Anyone who listens to my system claims that it is the best stereo they have ever heard. The realism is perfect to the point of expecting the draperies at the speaker end of the room to open and reveal live musicians.

I'm convinced most sound experts who have anything to say in magazines are a bunch of tin-eared characters who think they have a sound system better than anyone else's.

R. A. MARQUARDT
Garfield Heights, Ohio

P.S. Did you ever listen to stereo with just a pre-amplifier and headphones? Fantastic, isn't it?

Yes, it is; which only goes to disprove Mr. Marquardt's point that stereo is just as good when both ears hear both stereo channels. Unless the inter-channel separation is excessive, stereo is heard to best advantage by listening with headphones since each ear then hears only one channel. The importance of the factors which contribute to the stereo effect is debatable; some authorities hold that intensity differences are most important, others feel that other factors such as arrival-time difference, waveform difference, and phase difference are of primary importance.

Each to his own taste. If Mr. Marquardt likes to listen to stereo in an ultra-lively room with six extra speakers to increase the reverberation still further, we say—more power to him, but we wouldn't recommend it for most readers.

Atomic Clock?

■ Whoever wrote the article on the atomic clock in the October issue is as confused about Einstein's theories as Einstein was himself. Einstein's theory of relativity does not say "twenty years of travel in space at the speed of light," because that would be merely twenty years and no more. If Einstein made such a statement, he had in mind twenty light-years, which equal millions of ordinary years. (*Ed.: Light-years are usually considered to be a measurement of distance, rather than of time.*)

Again, who vouches for the statement that the atomic bomb was the result of Einstein's theories? Einstein was merely the "go-between" in bringing the possibility of an atom bomb to the attention of President Roosevelt. Bohr and others from Europe brought the idea over here. And the effects of motion and gravity are not opposite as stated in the article; the two forces run at a right angle to each other. Einstein's proposal that acceleration is the cause of gravity is not true; on the contrary, gravity creates acceleration.

To make the story short, neither Newton nor Einstein solved the problem of the origin and nature of gravity. That privilege has been reserved for me. I have found the answer to the problems of nature and the universe, which naturally includes the force of gravity. Kepler, Newton, Laplace, Moulton and Chamberlin, and Einstein, have been unable to solve any of the problems correctly simply because they did not realize that electricity is the foundation of all that exists.

You may think of me as a crackpot, but that does not alter the fact that I have solved every problem (yes, every problem) in nature and the

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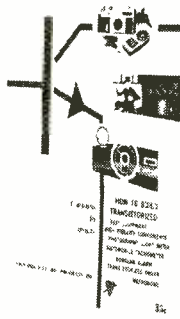
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Letters

(Continued from page 12)

universe on the basis of one single concept. Some day I hope to publish my discovery which will shake the very foundation of present-day science.

HENRY J. WETT
Miami, Fla.

Are you kidding us, Henry? Those foundations are pretty secure, you know.

Record Clubs

■ I have just finished reading your article on record clubs in the October issue. I found it very interesting, and it is true to the last word.

But let me tell you about one man's experience with a record club. From all the friendly advertising about getting so many records for the price of one, I joined one of the larger record clubs some time ago. Everything worked out fine until I wrote them a letter stating I was discontinuing my membership. Then, all of a sudden, the records started pouring in—records I had never ordered. After I had amassed quite a collection of unwanted records, I returned them to the club, again saying that I had cancelled my membership.

The pay-off came when I received a big fat bill for those records I was supposedly hiding.

I have nothing against the record clubs, but I think this practice of dumping records on people who don't want them should stop. Of course, there is the possibility that in my case it was all a mistake. However, if it was deliberate, the record clubs should realize that this is the worst kind of public relations on their part.

W. MORROW CUMMINGS, JR.
Houston, Texas



Opposites Still Attract

■ Although in all probability you have received 99,999 letters on this same subject, certainly one more can do no harm. Being just a fledgling in the field of electronics (I'm taking a correspondence course at present), perhaps I am a little anxious to show off some of my newly gained knowledge. But you really shook me up for a minute on page 88 of your October issue when you stated in the caption for Fig. 3 that "When the plates have a like charge, they will move toward each other; when they have unlike charges, they will repel each other." That ain't the way I learned it. If this were true, it would no doubt be regarded as the scientific feat of the century.

ROBERT L. THOMAS
Las Cruces, N. M.

You're right, Bob. Until some basic laws of the universe are changed, opposites will continue to attract. Try as we may, a crazy error like this will slip in from time to time. Fortunately we said it correctly in the text of the article.

-50-

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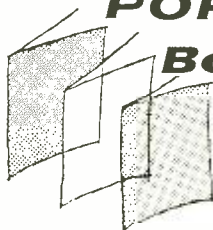


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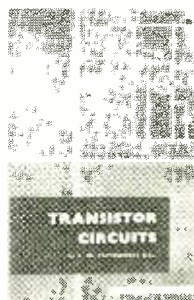
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"TRANSISTOR CIRCUITS" by K. W. Cattermole. Published by the Macmillan Company, 60 Fifth Ave., New York 11, N. Y. 442 pages. \$14.00.

If you have been looking for a comprehensive elementary treatment of transistors, you will find this book invaluable. Starting with several chapters on transistor theory and manufacture, it includes lengthy sections on single- and multi-stage amplifiers, power amplifiers, high-frequency amplifiers, power supplies and bias stabilization, negative resistance, binary circuits, waveform generation, counting and timing circuits, etc. Although it will be primarily of interest to the engineering student rather than to the average experimenter, the book is quite thorough and up to date.



"TIME TABLE FOR THE CLASSICAL REPERTOIRE" by William Colbert. Published by William Colbert, % The Audio Exchange, Inc., 153-21 Hillside Ave., Jamaica 32, N. Y. 34 pages. Soft cover. \$2.75.

This is an expensive little booklet, but it may be worth the money to tape recorder fans who do a lot of recording off the air. The average performance times for over 1200 compositions are listed, allowing the recordist to select the optimum length of tape for most classical selections. For instance, if you want to record Haydn's *Toy Symphony*, you only need to plan on seven minutes of recording time. Or, who would know offhand that Ravel's *Bolero* runs for 13 minutes and thus requires only 13 minutes worth of tape? Mr. Colbert claims an accuracy of $\pm 10\%$ for orchestral works and $\pm 20\%$ for solo performances. Operas,
(Continued on page 20)

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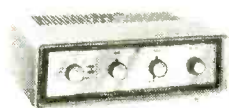
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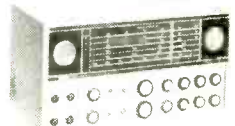
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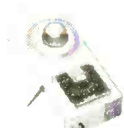
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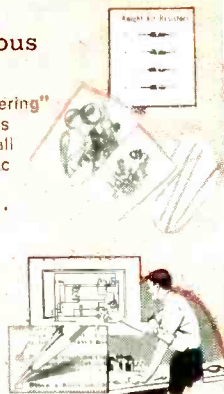
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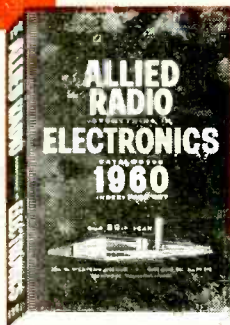
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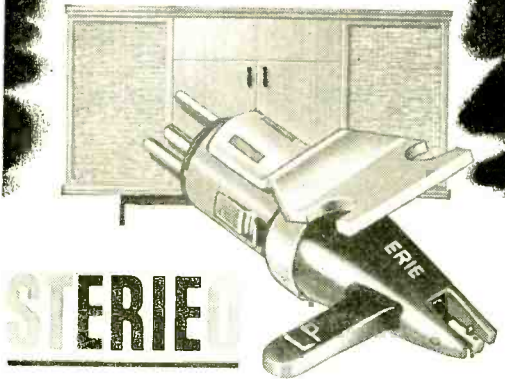
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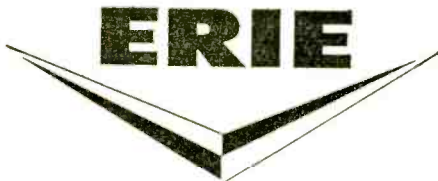
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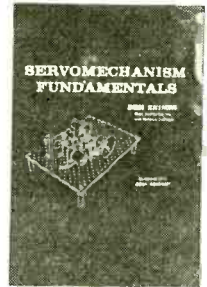
Bookshelf (Continued from page 16)

however, due to various cuts made in performance, are more variable in playing time.



"SERVOMECHANISM FUNDAMENTALS"
by Ben Zeines. Published by McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y. 257 pages. \$5.50.

Written especially for the technician, this book is a general treatment of the fundamentals of servomechanisms. The emphasis is on proper servo operation and maintenance rather than on the design of servo systems. Mathematical analyses and formulas are kept to a minimum in the text, but they are incorporated into appendices



for easy reference. Elementary forms of control systems, synchros, servo elements, electronic and magnetic amplifiers are all covered, and both d.c. and a.c. servomotors are discussed in detail. The final chapter gives examples of servos and servomechanisms. Recommended as an introduction to the subject. Particularly valuable for service technicians, it will be a source of much useful technical data.



"THE THIRTEEN STEPS TO THE ATOM"
by Charles-Noel Martin. Published by Franklin Watts, Inc., 575 Lexington Ave., New York 22, N. Y. 256 pages. \$4.95.

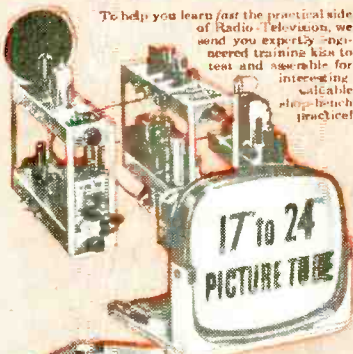
The subtitle of this book, "A Photographic Exploration," hints at its contents. It is basically a collection of 118 photographs of magnified bits of nature, ranging from atoms and atomic nuclei to snowflakes. The quality of the enlargements—going to *thirty million* times magnification in one case—is almost incredible. And the beauty of many of the pictures is breathtaking—the delicate and graceful snowflakes, for example. Perhaps the most impressive photograph is one which shows actual atoms of rhenium arranged in perfect circular patterns. This book must really be seen to be appreciated. The text,

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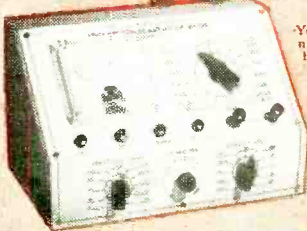


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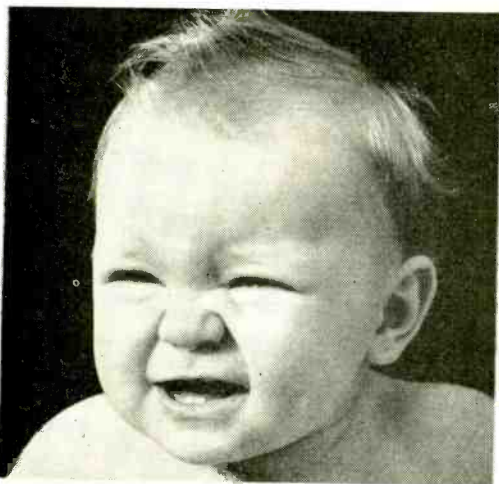
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Cosmos Industries, Inc.
31-28 Queens Blvd., Long Island City 1, N.Y.

Bookshelf (Continued from page 20)

incidentally, is clear, well-organized, and to the point.



"HOW TO GET THE MOST OUT OF TAPE RECORDING" by Lee Sheridan. Published by Robins Industries Corp., 36-27 Prince St., Flushing 54, N. Y. 128 pages. Soft cover. \$1.00.

This is a book written at a basic level for amateur recordists. Included are chapters on stereo, recording tapes, operating a tape recorder, microphone placement, editing and splicing, how to build a tape library, and tape clubs. Although the technical side of tape recorders is barely touched upon, most home recordists and newcomers to the field will find much useful and valuable information in this book.



"UNDERSTANDING TRANSISTORS" by Milton S. Kiver. Published by Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. 64 pages. Soft cover. 50 cents.

This is a short and concise introduction to transistors and transistor circuitry. About half of the book is devoted to transistor theory and the remainder to discussions of practical transistor circuits. Recommended both as a basic transistor book and for reference purposes.

Free Literature Roundup

"The Final Authority," a four-page pamphlet which tells why the design of a universal tube tester is impractical, is available from all distributors of CBS tubes. Bud Tomer, the author, points out the inadequacies of "do-it-yourself" tube testers and goes on to add that only a qualified technician can interpret a tube tester's readings accurately.

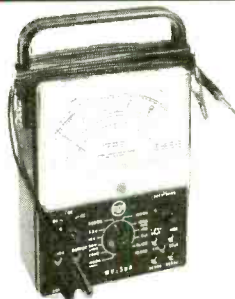
If you would like to have a resistor-capacitor color-code chart to put in your notebook or hang on your workshop wall, the folks at EICO are making them available through their distributors. For the name and address of the distributor in your area, write to Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, N. Y.

—30—

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FEATURING: ohms-divider network fuse-protected • easier-to-read scales • extra-large 5¼ inch meter • polarity reversal switch • excellent frequency response • full-wave bridge rectifier • low circuit loading • standard dbm ranges.

SPECIFICATIONS: Input Resistance—20,000 ohms per volt on DC; 5,000 ohms per volt on AC • Accuracy—± 3% DC; ± 5% AC (full scale) • Regular Scales—2.5, 10, 50, 250, 1000, 5000 volts, AC and DC; 50, μ a 1, 10, 100, 500 ma, 10 amps (DC) • Extra Scales—250 mv. and 1 volt (dc) • Frequency Response—AC-flat from 10 cycles to 50 Kc (usable response at 500 Kc) • Ohms—3 ranges: Rx1—(0-2,000 ohms); Rx100 (0-200,000 ohms); Rx10,000 (0-20,000,000 ohms) • Dimensions—W. 5¼", H. 6¾", D. 3¼"

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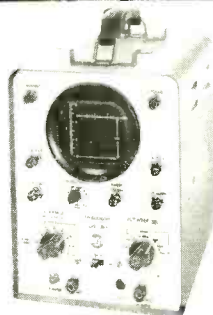
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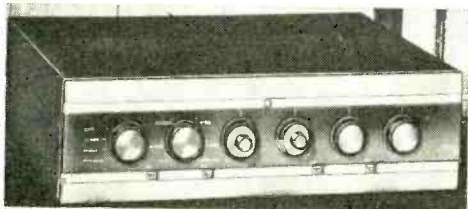
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Printed-circuit switches, printed-circuit boards, and plug-in assemblies reduce wiring time and the possibilities of wiring errors. Price, \$79.50. (*Allied Radio Corp.*, 100 N. Western Ave., Chicago 80, Ill.)

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Several Heathkits are now available in pre-wired form. Identical in specifications and features to the regular kits, these pre-wired kits are fully assembled, adjusted, and tested at the factory. The first ready-to-use Heathkits are the WIA-1A Ignition Analyzer (\$99.95), the WVP-1-6 and WVP-1-12 Vibrator Power Supplies (\$11.95), and the WCB-1 Citizens Band Transceiver (\$60.95). (*Heath Company*, Benton Harbor, Mich.)

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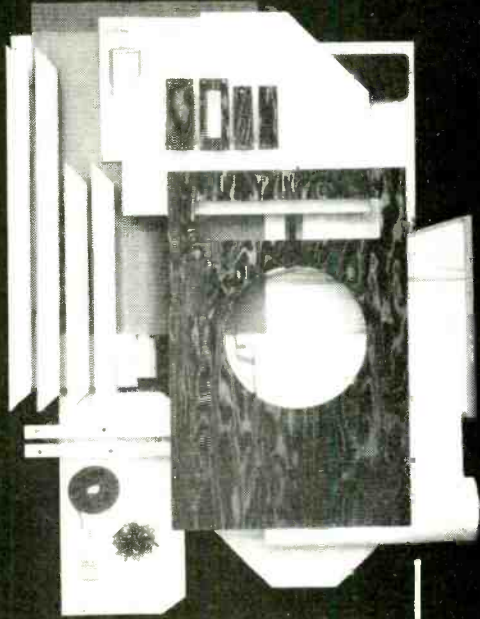
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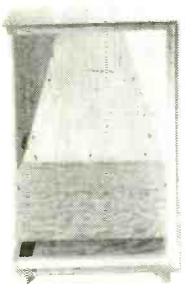
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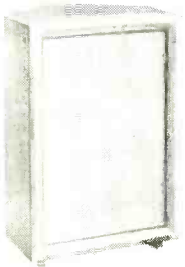
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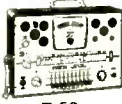
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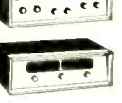
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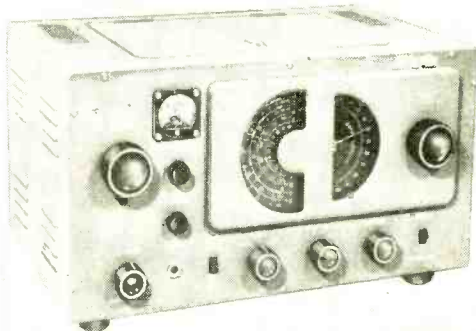


ST-45

products

(Continued from page 24)

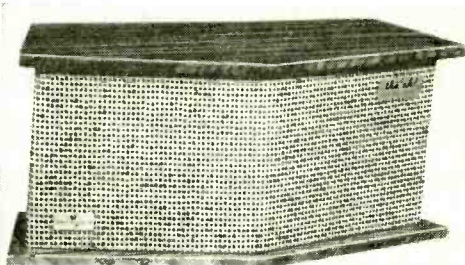
are completely variable, and switched a.v.c. and automatic noise limiting are included. Frequencies from 455 kc. to 31 mc. are covered in four ranges. Complete with cab-



inet, the receiver is priced at \$64.50 for the KT-200 kit and \$79.50 for the HE-10 factory-wired model. (Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.)

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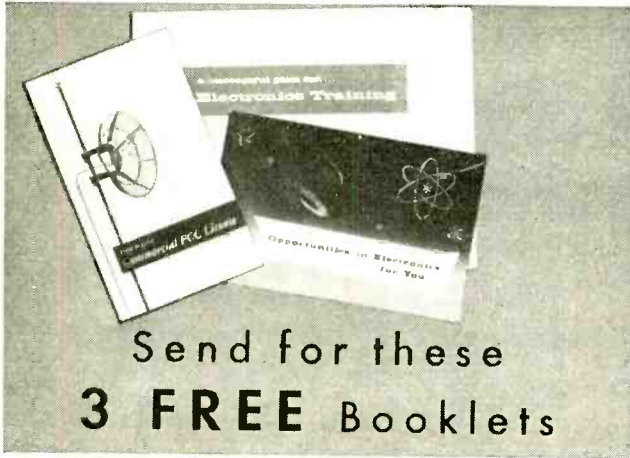
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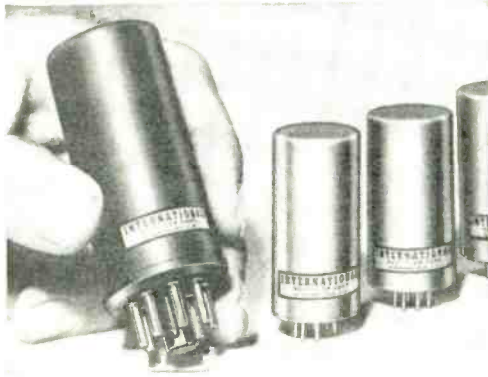
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Desk PE-59

products

(Continued from page 26)

Ave., El Segundo, Calif. Exact equivalents are available for such tube types as the 6X4, 5U4, 6X5, 5AW4, 5Z3, and many

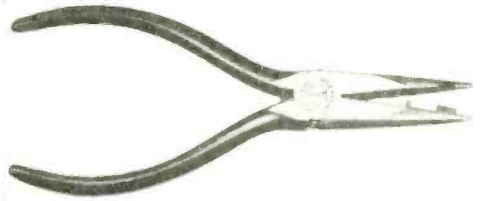


others. Current ratings vary from 85 to 600 ma. and peak inverse voltage ratings are from 1500 to 2800 volts.

LONG-NOSE PLIERS

Mathias Klein & Sons, Chicago, Ill., has recently developed a pair of long-nose

pliers with a shear cutting blade at the tip. Jaws behind the blade hold the clipped end of sheared wire firmly, and a locating pin



keeps the jaws parallel even when pressure is applied to the handles. Model No. 208-6PC comes equipped with a coil spring which holds the jaws open.

STEREO AMPLIFIER

The 20LJ dual 10-watt stereo amplifier being offered by Grommes features eight inputs and has separate bass, treble, loudness, and channel-balance controls. Distortion at full output: 2% harmonic and 3% IM. For mono operation, the two stereo channels can be used together, providing 20 watts mono output (40 watts peak). Output impedances for each channel are 4, 8, and 16 ohms, with an extra high-impedance

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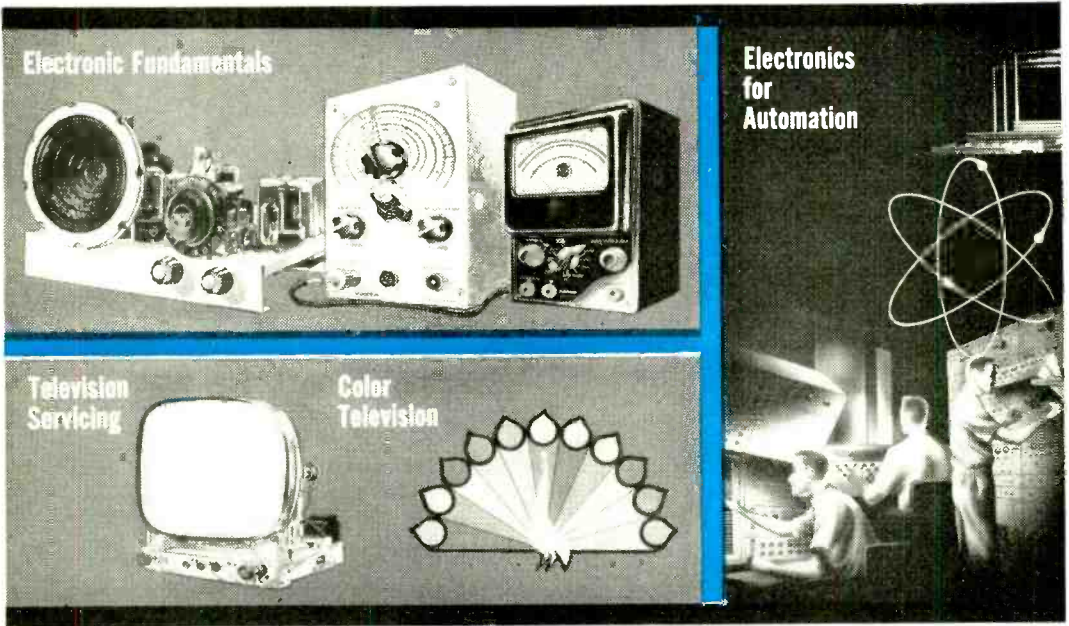
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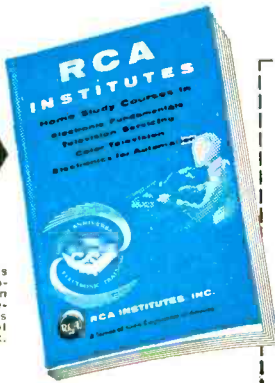


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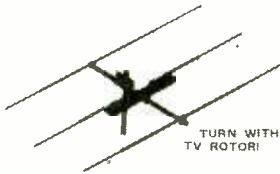
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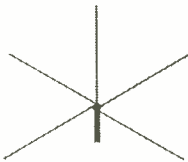
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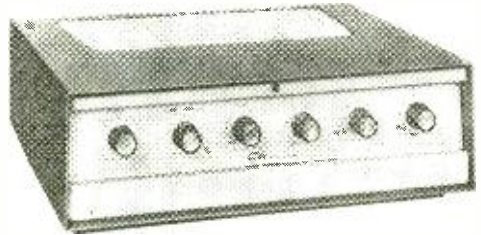
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(Continued from page 28)

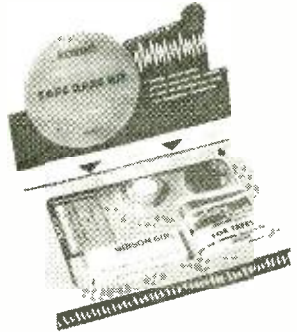
output for tape recorders. Tubes used: four 12AX7/ECC83's; four 6EL84/6BQ5's; and



one 6EZ81/6CA4. (Grommes, Div. of Precision Electronics, Inc., 9101 King St., Franklin Park, Ill.)

TAPE KIT

Robins Industries Corp., 36-27 Prince St., Flushing 54, N. Y., has produced the Gibson Girl Tape Kare Kit (TK-4H). It contains an H-4 splicer, JCT-2 jockey cloth for cleaning tape, a roll of ST-500 splicing tape, a box of ST-500 tape clips to prevent tapes from unwinding, and a tape editing book. Tape recorder owners will find this kit very useful. Price, \$3.50.



STEREO TONE ARM

The Empire 98 Stereo/Balance tone arm, recently announced by Audio Empire, 1075 Stewart Ave., Garden City, N. Y., is claimed to be so well balanced that it will track both sides of a 45-45 stereo groove when the turntable is placed at any angle. Fea-



tures include: dual ball-bearing races for horizontal and vertical pivots; non-resonant, compliant rear counterweight; self-latching arm rest; removable cartridge shell with spring-loaded contacts; and height adjustment for both arm and arm rest. Price, \$34.50 (12"), \$38.50 (16"). —30—

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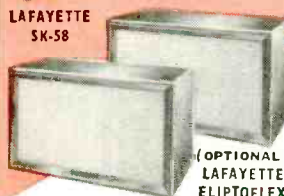
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- FREQUENCY RESPONSE 15-30,000 CPS ± 1 DB ● UNIQUE "BLEND" CONTROL ● CONCENTRIC CLUTCH—OPERATED VOLUME CONTROL ● DUAL CONCENTRIC BASS AND TREBLE CONTROLS ● 4-EL84 TUBES IN PUSH PULL

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KT 236 Stereo Amplifier Kit 5.25 Down Net **52.50**

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A completely new stereo high fidelity amplifier with a high quality of reproduction; remarkable versatility and new distinctive styling. Full range of controls include a unique "blend" control for continuously variable channel separation—from full monaural to full stereo, 4-position Selector, Mode, Loudness and Phasing switches plus outputs for 4, 8 or 16 ohm speakers. Harmonic distortion less than 0.25%, IM distortion less than 1% Hum and Noise 74 db below full output. Assembly is simple—no special skills or tools required. Complete with deluxe cabinet and legs, all parts, tubes and detailed instruction manual. Shpg. wt., 26 lbs.

KT-250 Stereo Amplifier Kit 6.45 down Net 64.50

LA-250 Stereo Amplifier, wired & tested—8.95 down Net 89.50

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KT-600 Stereo Preamplifier Kit—7.95 Down Net 79.50

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KT-310 Stereo Power Amplifier Kit—4.75 Down Net 47.50

LA-310 Stereo Power Amplifier, wired and tested—6.95 Down Net 72.50

FM-AM STEREO TUNER KIT



KT-500
IN KIT FORM
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LT-50
COMPLETELY
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- 11 Tubes (4 dual-purpose) + Tuning Eye + Selenium rectifier provide 17 tube performance
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KT-500 FM-AM Stereo Tuner Kit—7.45 Down Net 74.50

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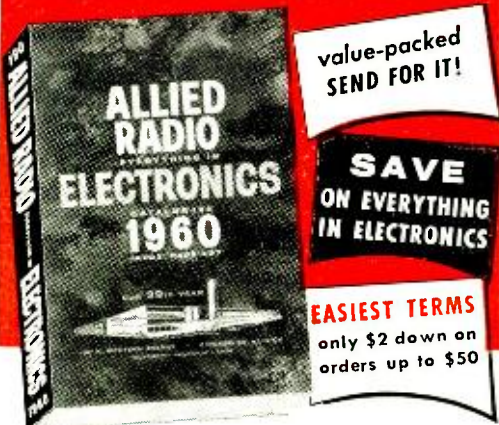
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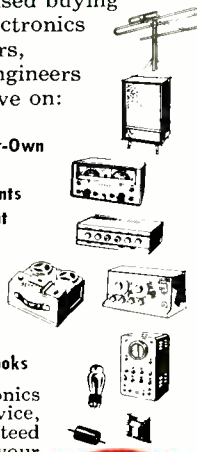
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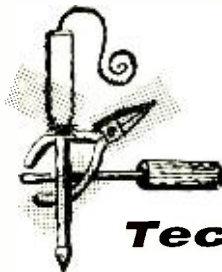
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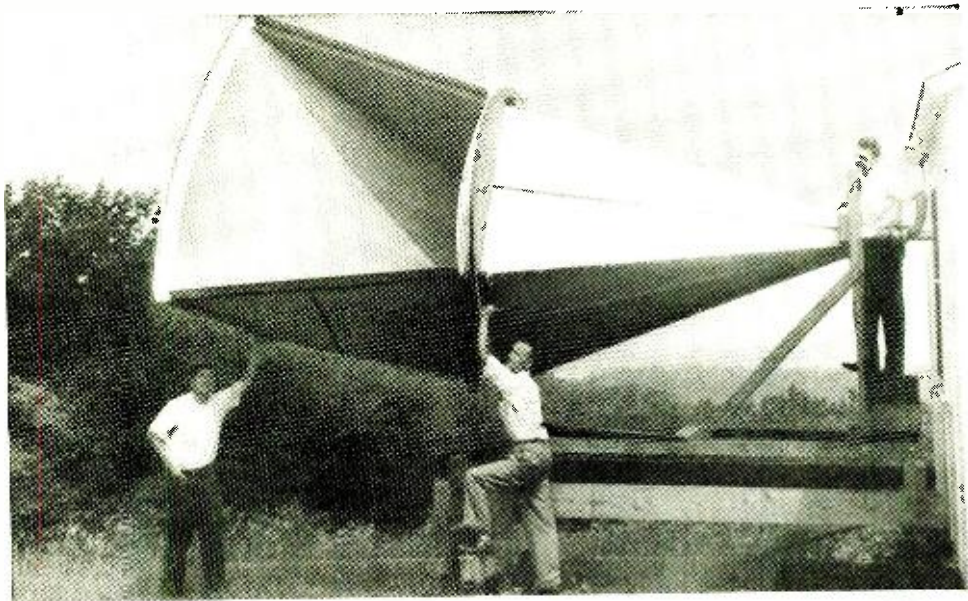
your tool kit. The bottles are spill-proof and present a professional appearance. The rubber used in the dropper stands up well in contact with radio chemicals.—Herman Landsman, Forest Hills, N. Y.

SOLID SOLDERING STAND

If you use one of the heavier soldering irons, your workbench probably bears some dark brown scars which were made when the iron fell off its stand. You can prevent this from ever happening again by making



a tip-proof stand out of an oval-type sardine can. Simply make two cuts in the shape of an "H" in the bottom of the can, bend the two flaps up, and then put "V" notches in them. You'll have a stand with



At Bell Laboratories, Holmdel, N. J., a horn reflector antenna is beamed skyward by scientists Edward Ohm, David Hogg and Robert DeGrasse. The maser amplifier, which employs a ruby cooled in liquid helium, is inside building at right. Over-all "noise" temperature of antenna, amplifier and sky is only 18°K at 5600 megacycles.

Another step toward space communications

The above antenna is part of a new ultra-sensitive radio receiving system under development at Bell Telephone Laboratories. It has extraordinary directivity. Beamed skyward, it ignores radio "noise" from the earth, yet picks up extremely weak signals from outer space.

The signals are amplified by the latest Bell Laboratories "maser" amplifier. The maser principle was first demonstrated, using gas, by Prof. C. H. Townes and his collaborators at Columbia University. Bell Laboratories scientists applied it to the solid state guided by a theoretical proposal of Prof. N. Bloembergen of Harvard University. Their latest traveling wave maser amplifier employs a ruby mounted in a waveguide. The ruby is excited to store energy. As signals pass through, they absorb this energy and are thus amplified. The device uniquely

combines the characteristics needed for practical space communication: extremely low inherent noise and the ability to amplify a broad frequency band.

At present the receiving system is being used to pick up and measure minute radio noise generated by the atmosphere. It also foreshadows important advances in long distance communications. For example, it could extend the range of space-probe telemetering systems. It could also help make possible the transatlantic transmission of telephone and TV signals by bouncing them off balloon satellites. In addition there are numerous possible applications in radio astronomy and radar.

This pioneer development in radio reception is one more example of the role Bell Laboratories plays in the pursuit of better communications technology.

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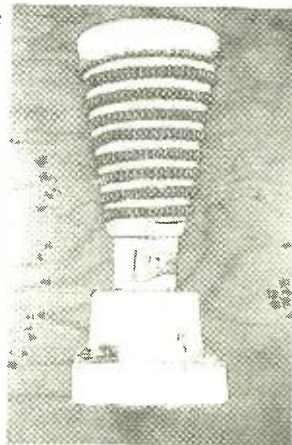
Tips

(Continued from page 34)

a base about 7" by 5" and it will take some doing to knock it over. Oh, yes, don't forget to take out the sardines before starting to work!—A. Zanelli, Tampa, Fla.

ELECTRIC SOLDER POT

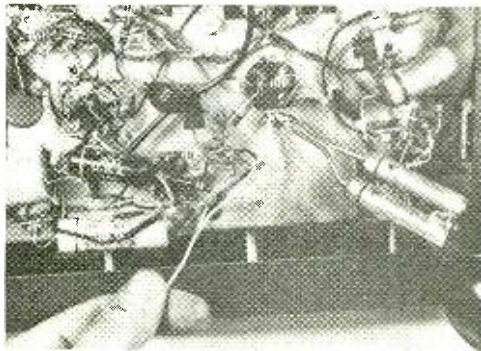
An inexpensive electric solder pot can be made from any cone-shaped heating element—the hollow ceramic cone forms an excellent molten solder container. If the only type of heating element you can locate is the type with holes, furnace cement can be used to seal any points of possible leakage. The completed unit is plugged into an appliance



outlet and solder is fed into the hollow cone until the molten solder level is within one half inch of the top rim. Be careful—the heating element is not only hot physically but is also hot with respect to the a.c. line. —Ted Lewis, Montebello, Calif.

KIT-BUILDING HINT

Although the kit instructions may not tell you this, it's a good idea when mounting can-type capacitors in a kit to solder



one lug to the chassis. Hard-to-troubleshoot cases of hum and oscillation have been traced to capacitors that developed a resistance to ground at their mounting tabs;

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

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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.

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

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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. Statistis, 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 buy 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."

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

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

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

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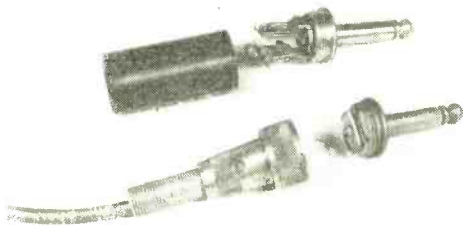
Tips

(Continued from page 36)

the best tab to solder is one that already has a grounding wire on it—this will minimize your difficulties if the can ever has to be removed.—*Elliot Gordon, New York, N. Y.*

MIKE CONNECTOR ADAPTER

A standard, large screw-terminal phone plug can be modified to form a handy adapter for a screw-type microphone connector. If the phone plug is the type with



a thin retaining bolt down its center, simply unscrew the bolt and remove the two connecting tabs. Make sure that the insulating washers and tubes do not get lost; if necessary, add washers to raise the head of the

center bolt for proper contact. If the phone plug has a rivet instead of a bolt, simply break or cut off the tabs as shown in the photo.—*Herman Landsman, Forest Hills, N. Y.*

TVI FROM DIODES

Amateur radio stations using diodes—such as the 1N34—to rectify r.f. for monitoring purposes, may find that a diode is generating enough harmonics to cause TVI through radiation from the pickup wire of the monitor. Check your monitor by disconnecting its pickup wire. If you lose your TVI, you have found the cause. To reduce TVI, move the pickup wire away from the transmitter until the TVI ceases and there is still a usable output from the monitor.—*Donald A. Zupon, Turtle Creek, Pa.*

PLASTIC BAG PROTECTS PORTABLE

When you take your portable radio on boating trips or to the beach, it's a good idea to put it into a plastic bag like the kind foods come in. The bag will prevent the highly corrosive salt air from harming the set. You will be able to hear the radio
(Continued on page 114)



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6-TRANSISTOR RADIO RA-6

Kit \$29.95

Wired \$49.95

INCLUDES P.E.P., LEAK BY BATTERY

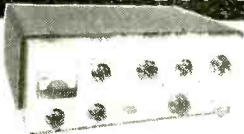
Easy creative fun to build... a lifetime of big-set entertainment wherever you go... designed so that even the novice can build it & obtain a handsome professional assembly & outstanding performance. American-made modern super-heterodyne all-transistor circuitry, plus finest quality parts throughout, assure you of highest durability & stability.

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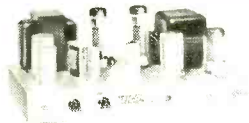


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Kit \$79.95

Wired \$119.95

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Kit \$49.95

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Delivers 50W undistorted audio. Modulates transmitters having r.f. inputs up to 100W. Unique over-modulation indicator. Output transformer matches 500-10,000 ohms. Low-level speech clipping & filtering. Inputs for xtal of dynamic mikes, phone patch, etc. 7 tubes. 6" h, 14" w, 8" d.



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Wired \$49.95

Includes complete set of coils for full band coverage: 400 kc-230 mc in 8 overlapping ranges. 500 ua meter. Plug-in coils are pre-wound, pre-calibrated to 0.5% accuracy. Transformer-operated power supply 2 1/4" h, 2 1/2" w, 6 7/8" l.

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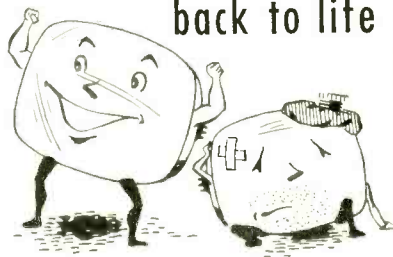


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- Checks and restores cathode emission and brightness.
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- Large illuminated meter - easy to read.
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See Page 38 for EICO'S BEST BUYS in "HAM" GEAR and TRANSISTOR RADIOS.



By **J. M. SIENKIEWICZ**
Managing Editor



*The kids will be thrilled on Christmas morning
when they see this*

RADIO-CONTROLLED ELECTRIC TRAIN

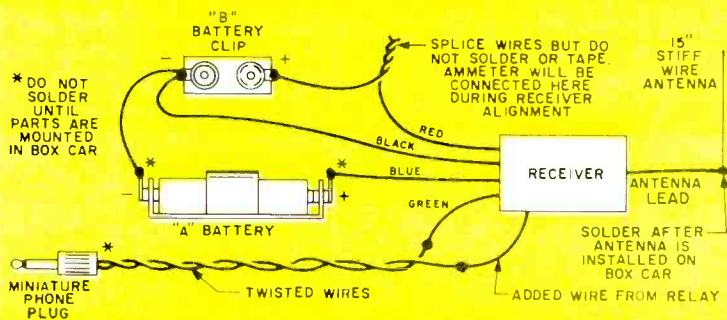
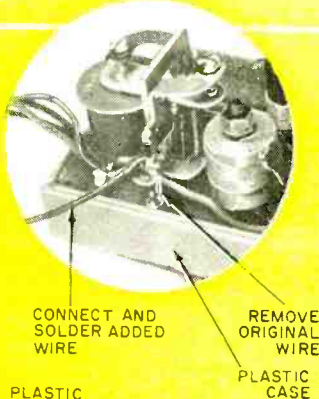
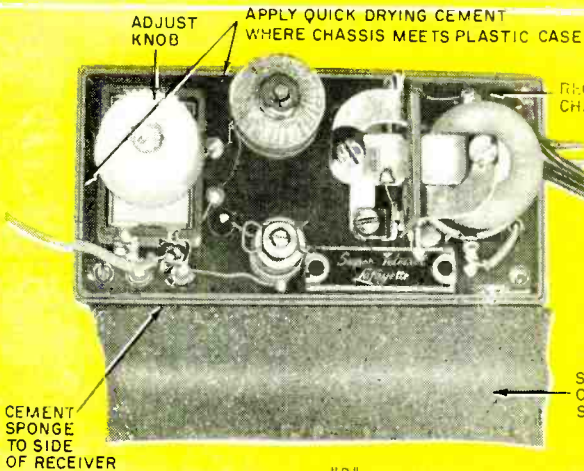
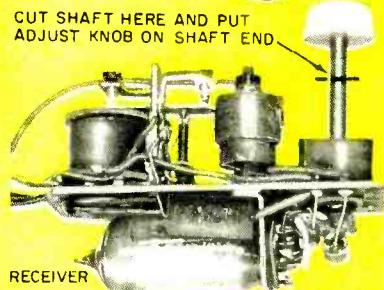
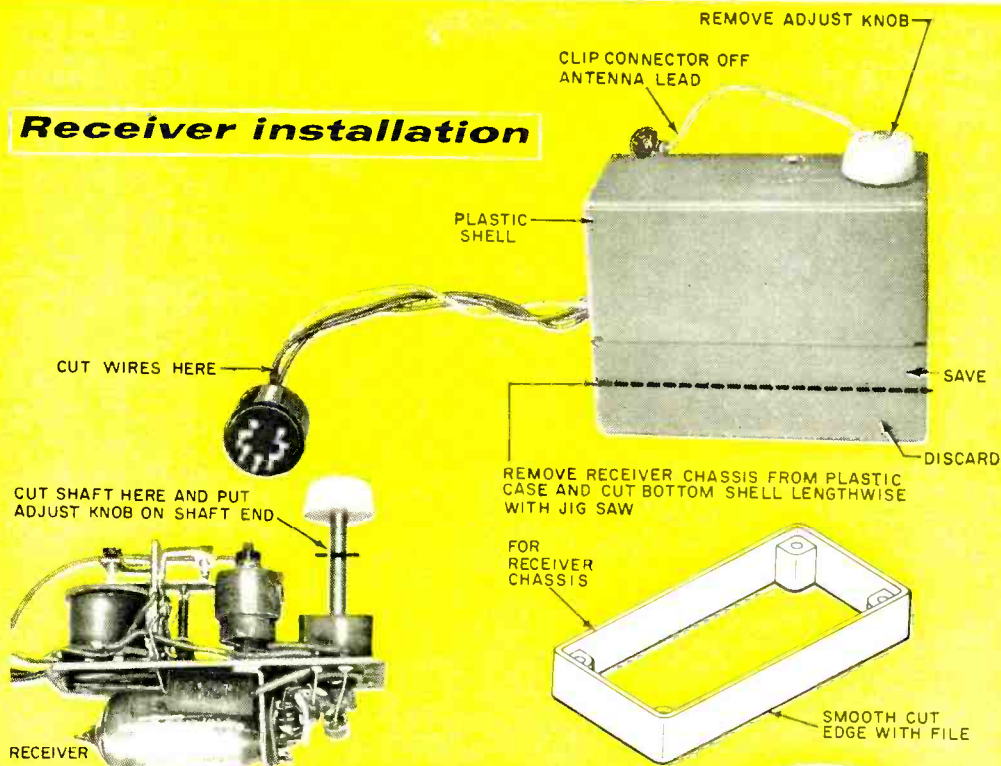
WITH the coming of winter, radio control hobbyists usually gather their planes and boats together and head indoors—to wait for spring. But the Editors of POPULAR ELECTRONICS have dreamed up a novel indoor use for R/C equipment—radio-controlled electric trains. Christmas is almost here and both Junior and Dad will get a big thrill out of this newborn hobby.

If you are not yet an R/C fan, you can get started with a completely wired radio control transmitter and receiver for less than \$30.00. If you are an R/C fan now, you can use your present transmitter, and chances are your R/C receiver will be suitable for the job.

Our R/C "O" gauge electric train was built around a Lionel Model 614 Diesel locomotive with a Model 6434 poultry dispatch boxcar housing the receiver. A Lafayette Model F-208 receiver was disassembled and modified to fit into the boxcar as shown on the following pages. Operating details are given on page 44.



Receiver installation



CAREFULLY SLIP IN RECEIVER
BE CAREFUL NOT TO JAM
RELAY CONTACTS

DRILL HOLE IN TOP OF BOX CAR FOR ANTENNA. THEN
CEMENT BALSAM BLOCK OVER HOLE. PASS STIFF WIRE
ANTENNA THROUGH HOLE AND FORCE THROUGH BALSAM
BLOCK. SOLDER ANTENNA LEAD.

DRILL SMALL HOLE
AND PASS TWISTED
WIRES THROUGH.

SOLDER PLUG
TO TWISTED
WIRES

ATTACH BATTERY CLIP

REMOVE ORIGINAL LIGHTS

REMOVE SCREW
FROM HERE TO
TAKE BOX CAR
APART

BATTERY HOLDER
WITH TERMINALS
BROKEN OFF

ATTACH
BATTERY
HOLDERS

SOLDER "A" BATTERY CONNECTIONS.
DO NOT INSERT "A" BATTERY UNTIL
WIRING IS COMPLETE AND
RECEIVER IS READY FOR TESTING

AFTER ALL DETAILS ARE
COMPLETED, CLOSE UP
BOX CAR, BEING
CAREFUL NOT TO PINCH
WIRES

RECEIVER
ANTENNA

TRANSMITTER

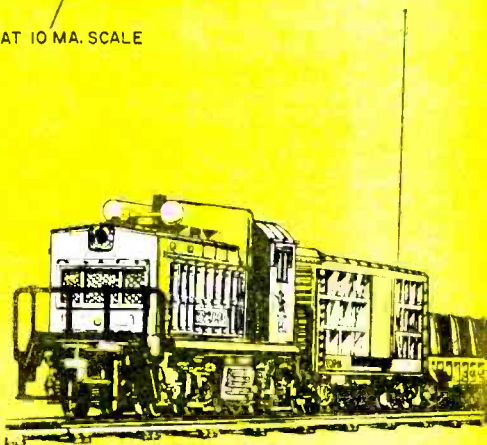
UNTWIST PIGTAIL SPLICE.
CONNECT METER FOR
POSITIVE READING

MULTIMETER

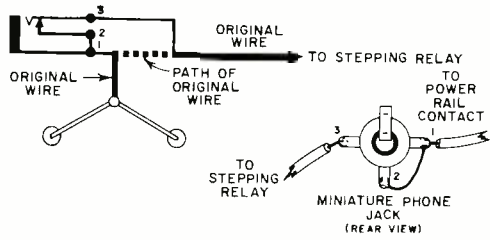
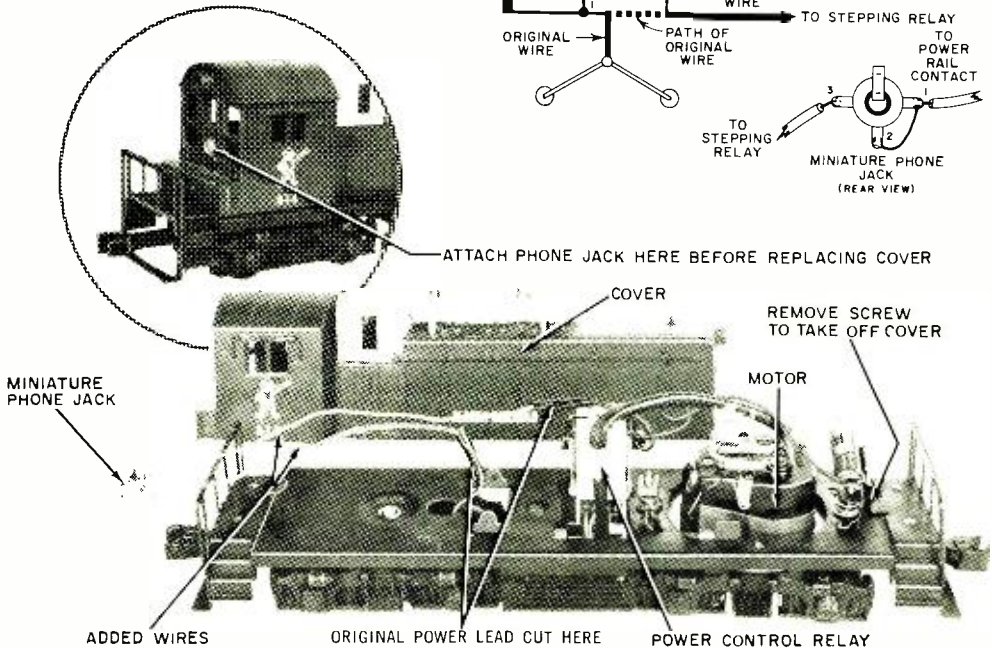
SET AT 10 MA. SCALE

Receiver Adjustment

- 1 Connect a multimeter set to the 5-10 ma. range into the B-battery positive wire at the unspliced pigtail.
- 2 When you insert the A battery into holder under car to turn on receiver (the B battery is connected during receiver installation), the meter should read approximately 2.5 ma.
- 3 Turn *A* knob all the way in (clockwise) as far as it will go, and then back it off slowly, watching the meter. Adjust knob for maximum meter reading. (Lift your hand from knob before taking meter readings, to avoid effects of hand capacity.) Note that the maximum point is quite critical and can easily be bypassed; you may have to repeat this operation before you find the maximum reading point.
- 4 When you turn on and operate the R/C transmitter, the receiver's meter reading should dip to about 1.4 ma. Repeat several times to make sure receiver holds its adjustment.
- 5 Remove motor, splice and tape the bare leads and tuck them into the boxcar. Check receiver operation by listening for relay clicks as the transmitter button is depressed.
- 6 Remove A battery from under boxcar to turn off receiver.



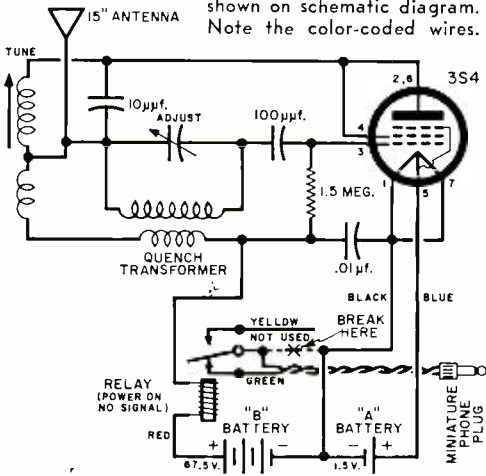
Locomotive Modification



R/C SYSTEM PARTS LIST

- 1—Diesel locomotive (Lionel Model 614)
- 1—Poultry dispatch boxcar (Lionel Model 6434)
- 1—Radio control receiver (Lafayette F-208)
- 1—Radio control transmitter (Lafayette F-249)
- 1—67.5-volt battery (Mallory M217)
- 1—1.5-volt penlight cell
- 1—Battery holder (Acme #52—terminals are broken off)
- 1—Battery holder (Acme #5)
- 1—Battery connector (H. H. Smith Type 1205)
- 1—Miniature phone jack (H. H. Smith Type 9245)
- 1—Miniature phone plug (H. H. Smith Type 9231)

Receiver modifications are shown on schematic diagram. Note the color-coded wires.



The construction details given here for the R/C train are intended as a guide—your exact setup will depend on the components you use. There are many other possible installation techniques. The locomotive modification shown above permits normal operation when the miniature phone plug is removed.

Running the train is simple. Be sure the receiver is adjusted and the batteries are in place. Set the cars up with the track power off, and plug the boxcar control plug into the receptacle on the locomotive. Then turn on the track power. You'll find that for each press of the button the power control relay in the locomotive will cycle the drive motor to *Forward*, *Stop*, *Reverse*, *Stop*, and then back to *Forward* for a new cycle.

You will need an FCC Class C Citizens Band license to operate the transmitter. If your youngster is over twelve and a citizen of the United States, he can apply along with Dad for a Class C Citizens Band station license. No exams are necessary. All that needs to be done is to read Part 19 of the FCC rules and fill out Form 505 obtained from the FCC. Have the form notarized, and mail it. To rush your license through the FCC, enclose a self-addressed and stamped envelope.



**Meet
the Man
Who
Out-Thinks
Univac**

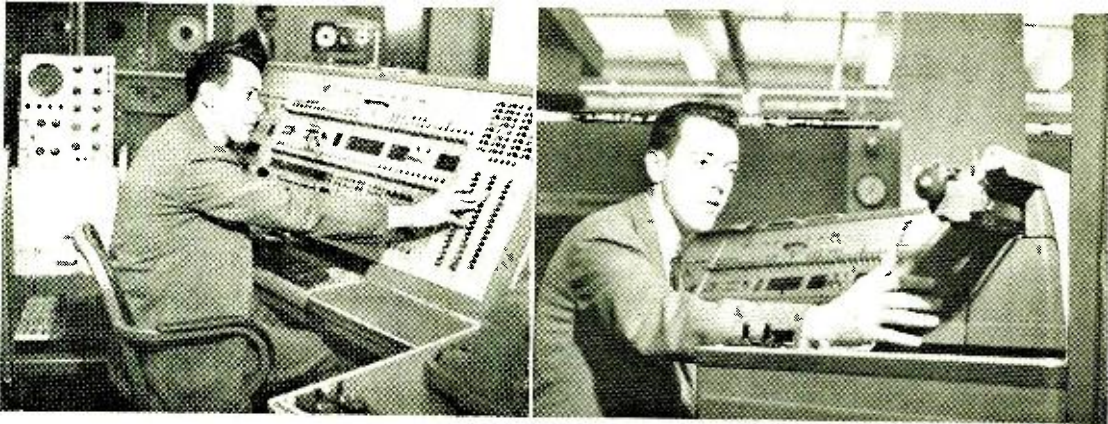
By **DICK YATES**

Ace trouble-shooter Jim Stewart matches wits with electronic computers daily and always comes out ahead

AT FOUR in the morning not long ago, in the skyscraper headquarters of one of the world's largest corporations, a giant digital computer stopped dead. Instantly, the well-trained maintenance crew checked all the obvious trouble spots; then they looked for more obscure causes of circuit failure and tried various remedies: nothing worked.

This was serious; two million dollars' worth of electronic equipment was standing idle, a mountain of statistics had to be processed before the opening of business at nine, and each passing minute put the crew into hotter water. At last, like a doctor confronted with the need for a specialist, the crew chief decided there was only one thing to do. He picked up the phone and put through an emergency call to Jim Stewart, a pleasant, sandy-haired young man who has earned a unique reputation around New York as an electronic brain specialist.

Minutes later, rubbing sleep from his eyes with one hand and balancing a container of coffee in the other, Stewart was on the job. He asked questions, gave orders, cracked a few jokes to loosen everyone's nerves, and



When trouble-shooter Jim Stewart starts to work on a computer, he first programs some tests on the control panel (left). Then, he checks results of tests on read-out typewriter. In many cases, this gives Jim enough information to deduce which circuit is causing the difficulty.

got straight to the heart of the matter by applying what he calls "logic and educated guesswork." By dawn the problem was licked, the computing center was back in business, and Jim Stewart was home in bed.

Natural Talent. Neither a mathematician nor a graduate engineer, Stewart is a 27-year-old Navy veteran who never went to college—a fact that apparently has proved no handicap in his highly successful career with one of the nation's top computer manufacturers. Officially his title is technical liaison specialist (New York region) for the Univac Division of Remington Rand. Unofficially, he is known to computer programmers and crews throughout the city as the company's ace trouble-shooter, the man to call when nobody else can figure out what's gone wrong in the complicated innards of a full-scale Univac system.

The circuitry of such a computer, involving the use of some 1500 tubes and 18,000 diodes, takes no less than 200 separate schematic diagrams to describe. "I honestly think Jim carries all 200 of those prints in his head," his superior, Ed Cousy, said recently, "but there's a lot more to his ability than factual knowledge. He has a quick, natural analytical mind. He never lets the computer scare him, but he never underestimates it either."

Rapid Progress. Stewart, a native New Yorker, has been fascinated by electricity and electronics for nearly as long as he can remember. As a kid he was "always fooling around with the radio or the toaster," and his interest in more complex equipment per-

sisted throughout high school and on into his Navy service. Offered a choice of several Navy technical school opportunities, he applied for training as a fire-control technician because he figured it would give him a broad general background in electronics. By the time his four-year hitch was over, Stewart had decided which branch of electronics he wanted to aim for in civilian life: large-scale commercial computers, a burgeoning new industry just beginning to come into its own.

An employment agency sent Stewart to the New York office of Remington Rand, where he was hired as a technician trainee in April, 1954. After an intensive study of basic digital computer technology, he was assigned to a stint on the preventive maintenance crew working with the Univac installation at Metropolitan Life Insurance Company, one of the busiest computer rooms in town. Then his promotions came rapidly, first to maintenance engineer, then to maintenance supervisor. At 24, after less than two years of employment, he was placed in charge of the eight-man maintenance crew of Remington Rand's New York Univac Service Bureau.

Later the same year, with customer installations increasing throughout the metropolitan area, Stewart's present job as roving trouble-shooter was created for him; he became the first Remington Rand employee ever assigned to that kind of work on a regional level.

Pinpointing Difficulties. Computers of the Univac class generally function with re-



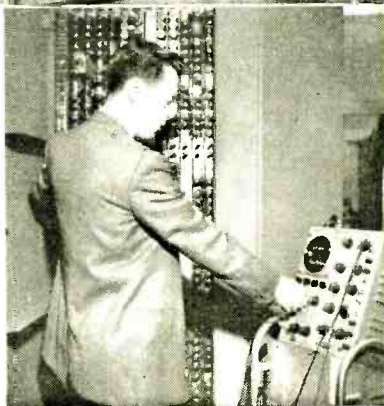
Careful study of the computer's schematics helps Jim pinpoint faulty components. At upper right, he prepares to check out a tape recording mechanism.

markable self-sufficiency. Their most common cause of breakdown, tube failure, is usually averted through the daily routine of preventive maintenance practices. When a breakdown does occur, the system automatically stops and signals, by means of a bank of indicator lights, that its "thinking" is in error. The actual testing and repair is a relatively straightforward matter; and the test equipment used is basically similar to that employed by any well-equipped TV technician. The difficulty, of course, is in isolating the faulty circuit from a baffling maze of possibilities. It's only when the maintenance crew has tried and failed to do so that Stewart's services are required.

Sometimes he is able to pinpoint the difficulty by studying the system's control panel and making one of his educated guesses; at other times he must pore over the schematics and try various solutions before he comes up with the right one.

The problem is apt to be particularly knotty in cases of intermittent rather than consistent operating failure. Stewart recalls one unusual case several years ago when a computer kept making intermittent errors. The problem seemed to defy all logic until he found that the errors had their origin in the computer's cooling system rather than its "thinking" apparatus.

"One of the mechanical blowers in the base of the system was throwing everything off," he explained. "The fan belt was worn down so that its metal links were exposed and were acting as pulse generators. The computing circuitry kept picking up pulses



Waveform analysis is also useful in diagnosing computer "illnesses." Here, Jim is checking a tube's output waveform.

from those belt-links, and it was lousing up the whole works."

Always On Call. A normal working day for Stewart begins at 4:00 p.m. and ends at midnight—these are the hours when the computers in his care are undergoing their daily preventive maintenance routines. He keeps in close touch with a number of installations at such important and dissimilar customer organizations as Sperry Gyroscope and the Reader's Digest. In the last year or two, with the gradual replacement of tubes by transistors and the general design improvement of all computer components, serious operational breakdowns are increasingly rare. But they still occur often enough so that Stewart, like a physician, must remain "on call" around the clock.

How does he feel about being roused from bed or called away from a party to diagnose an ailing machine? When asked that question recently, his answer was as simple as a

(Continued on page 131)



Report on Portable

Designed for work or play, self-powered

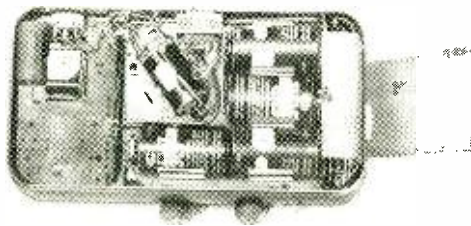
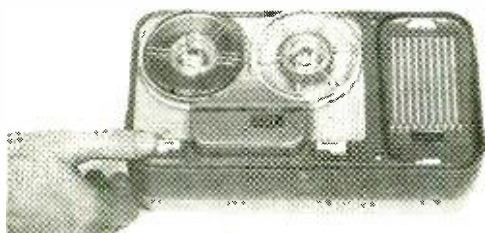
portables allow you to record "on the go"

AMERICANS are the busiest and most mobile people in the world, which makes them the most likely customers for a relatively new type of electronic equipment—the self-powered tape recorder. In addition to the units being manufactured in this country, portable tape recorders are now imported from several foreign countries, including England, West Germany, and Austria.

The editors of POPULAR ELECTRONICS recently secured seven representative portable tape recorders to put them through their paces and to see what they would and would not do. Of the seven, three are medium-priced units designed primarily for

voice recording and reproduction. The remaining four are more expensive (over \$200.00) and intended for more critical applications, such as professional and broadcast use.

General Characteristics. Most portable tape recorders have battery-powered amplifiers and motors. A few, however, have spring-wound motors; these machines are designed for use in out-of-the-way places where one cannot run down to the corner drugstore for batteries. The units which are completely battery-operated usually run from 30 to 50 hours on a set of batteries, depending on how much winding and rewinding is done, playback level, etc.



Light and compact, the PhonoTrix "Mark III" is easy to operate. Four flashlight batteries power the 6-volt Distler motor. Adapters for using this recorder with either 110 volts a.c. or 6 volts d.c. are available.



Tape Recorders

The seven units checked vary in weight from 3 to 17 pounds. At first consideration, the prospective purchaser might think, "The lighter, the better." This reasoning, however, is valid only if low weight is really essential. Extreme "portability," i.e., light weight, is usually obtained at the expense of playback quality since the playback reproduction is limited by the quality of the built-in amplifier and speaker. And, in general, better playback systems add weight to a tape recorder.

Accordingly, the heavier portables have better tone than do the ultra-lightweight units. Thus, two heavier units—the Butoba MT4 and the Stuzzi "Magnetite"—are at

the top of the class as far as self-contained playback quality is concerned. These are the only machines that approach the record-and-built-in-playback standards of typical a.c.-operated home recorders.

However, all of the seven units checked have output jacks for use with external amplifier-speaker systems. In fact, the more expensive recorders are designed primarily for use with external playback systems.

The PhonoTrix "Mark III" is one of the least expensive portables available, selling for \$99.50, which includes a leather carrying case. Two-push-button operation makes this West German import a very simple



The "Transcorder" puts up to 60 minutes of dictation on a single tape. Sold by Lafayette Radio, it is similar to a well-known higher-priced recorder.



Smart-looking Steelman "Transitape" is very easy to use and its mechanism seems to be foolproof. Recordings can be made without taking microphone out of case.

machine to use, and its quality is adequate for voice reproduction. It should be useful for dictation purposes.

One of the best points in the Mark III's favor is that it operates for 50 hours on only four ordinary flashlight batteries.

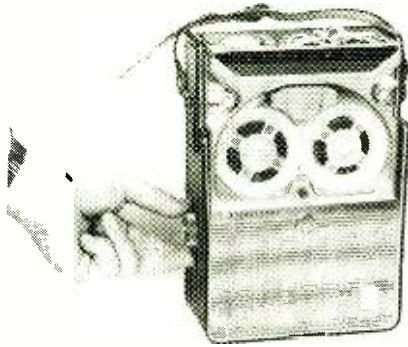
The "Transcorder," which is marketed by Lafayette Radio, is the smallest and lightest unit checked, tipping the scales at only three pounds. Designed strictly for voice reproduction, the Transcorder operates at 1 7/8 ips, and can put up to 60 minutes of recording on a single 3" tape cartridge.

This is a simple machine to operate and is small enough to be carried in a coat pocket—preferably a reinforced one. (Actually, it could be employed with a "wrist-watch" microphone for amateur sleuthing.) Power rewind is not included, but a swing-out manual rewind is easy to use and operates smoothly.

Incidentally, the Transcorder seems to be almost identical with a recorder that

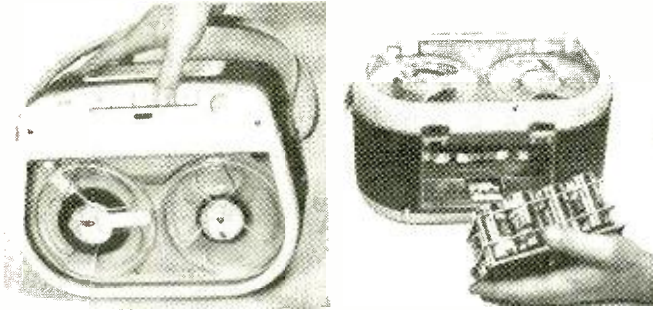
sells nationally under another trade name for \$249.50.

The Steelman "Transitape," a handsome example of modern design, is about the easiest of the seven machines to operate. The mechanism seems to be completely foolproof, and switching from play to fast rewind to fast wind while the tape is in motion causes no difficulty. Also, the tape speed can be switched from 1 7/8 ips to 3 3/4 ips while the tape is running. The microphone is cleverly packaged in a little nook on top of the recorder, and since the case is perforated above it, recordings can be made without removing the case top.



Model	Speed (ips)	Frequency Response (cps)	Recording Time (minutes)	Transistors Used	Life of Battery (hours)	Battery Type and Price	Weight (with batteries)	Reel Size (max.)	Power Rewind
Phone Trux Mark III	3 3/4	200-6000	2x22	4	50	4-1 1/2-volt "D" cells (20c each)	6 lb.	3"	Yes
Lafayette Transcorder	1 7/8	150-5000	2x30	4	12-18	Burgess 2XT (\$1.82)	3 lb.	3" (cartridge)	No
Steelman Transitape	3 3/4 1 7/8	150-7500 voice	2x12 2x24	7	Amp: 300 Motor: 50	13 Mallory RM12R (90c each)	8 lb.	3"	Yes
Butoba MT4	3 3/4 1 7/8	50-13000 60-5000	2x60 2x120	7	20-40	8 1 1/2-volt "D" cells (20c each)	12 lb.	5"	Yes
Stuzzi Magnette	3 3/4 1 7/8	80-9000 80-4000	2x23 2x45	7	30-100	4 Burgess 532 (68c each)	8 lb.	3"	Yes
Fi-Cord Model 1A	7 1/2 1 7/8	50-12000 ±3 db voice	2x9 2x36	7	2-4	4 rechargeable cells (\$3.95 set)	4 1/2 lb.	3"	No
A.C.A. Model 612-TD	7 1/2	50-10,000 2 db	2x22	11	125 (spring-wound motor)	2 Mallory TR-135R (\$2.04 each)	17 lb.	5"	No

Sturdy Butoba MT4 features push-button operation, 5" reels, and tone control for playback. A converter which fits into the battery compartment is available for powering the unit from almost any a.c. source.



Stuzzi "Magnetite," manufactured in Austria, is notable for the quality of its workmanship. At 3¾ ips, its frequency response is from 80 to 9000 cps.

Although the use of 3" reels limits one-way recording to 12 minutes at the 3¾ ips speed, this figure can be doubled by using the machine at 1½ ips. Thus, up to 48 minutes of recording can be put on a single reel by recording on both tracks.

The Butoba MT4 is made in West Germany and is the least expensive recorder in the higher-priced group. Whereas the units which sell for under \$200.00 are intended primarily for voice reproduction (dictating, office conferences, etc.), the more expensive machines are intended for serious recording applications, either for recording music in the field or for "roving-



reporter" television or radio interviews.

The MT4 is one of the heaviest portables tested and has the best self-contained sound-reproducing system. It has an unusually solid feel, but still weighs only twelve pounds with all of its eight flashlight batteries in place. If you want to power the MT4 from a.c., a plug-in converter is available which fits into the battery compartment; this allows operation with any a.c. source from 110 to 240 volts at either 50 or 60 cycles.

At the speed of 3¾ ips, the manufacturer claims frequency response to 13,000 cps. Use of 5" reels makes possible 60 minutes of recording time on each track at 3¾ ips.

The Stuzzi "Magnetite" is a precision-made recorder from Austria. It is being used at the present time on transoceanic flights of BOAC, the British airline, to record all land-to-plane communications.

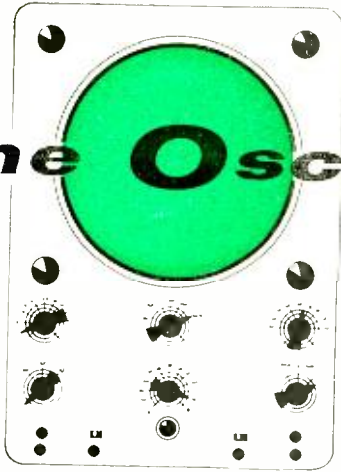
Offering push-button two-speed operation (3¾ and 1½ ips), the Magnetite's frequency response goes out to 9000 cps,

(Continued on page 130)

Record Level Indicator	Battery Condition Indicator	Price	Distributor
No	No	\$99.50 (with leather carry'g case)	Matthew Stuart & Co., 353 W. 54 St., New York, N. Y.
No	Yes	\$189.50	Lafayette Radio Corp., 165-08 Liberty Ave., Jamaica 33, N. Y.
Yes	Yes	\$199.50	Steelman Phonograph & Radio Co., Inc., Mount Vernon, N. Y.
Yes	No	\$249.50	Turning Corp. of America, 60 E. 42 St., New York 17, N. Y.
Yes	Yes	\$269.50	Ercona Corp., 16 W. 46 St., New York 36, N. Y.
Yes	Yes	\$330.00	Kingdom Products, 514 Broadway, New York, N. Y.
Yes	Yes	\$465.00	Amplifier Corp. of America, 398 Broadway, New York, N. Y.

Test Instruments

The Oscilloscope



Part 4

Probing the Power Supply

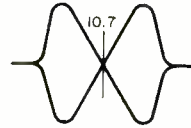
By **LARRY KLEIN**

Technical Editor

IN GENERAL, the quality of an oscilloscope is judged by how accurately the scope displays an electrical wave. The best scopes will reproduce very low voltage waveforms perfectly with frequencies ranging anywhere from zero cycles (d.c.) up to 5-10 megacycles.

Watching the Waves. We don't have to work very hard to prove the point that scopes have certain special advantages over other instruments. Let's consider some typical waveforms encountered in electronic equipment and see what a scope can do for us by way of visual analysis.

A good case in point is FM alignment. Figure 1 shows the output of an FM receiver's discriminator circuit when a 10.7-mc. FM signal from a sweep generator is fed into the i.f. stages. The manufacturer's instructions tell you to adjust the discriminator transformer so that the 10.7-mc. marker will appear at the center of the crossover lines and the crossover lines themselves will be as straight as possible. You can see that a VTVM won't tell you much about how "straight" the crossover lines are—although there are alignment techniques in which the VTVM is used.



1

Television circuits provide a barrel full of examples where the *form* of the wave, rather than the height or frequency of the wave, is the important factor.

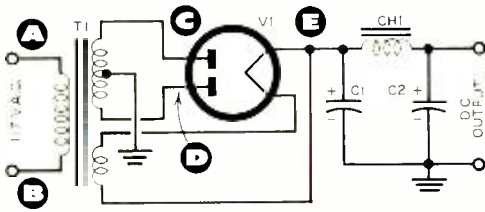
Power Supplies. Let's get down to cases and check out some "do's," "don'ts," and techniques by examining waveforms in an operating electronic circuit. The standard transformer-operated power supply makes a good guinea pig, not only because it's one of the fundamental electronic circuits, but because it produces a nice assortment of waves suitable for our discussion.

First, a few words about power supplies in general. The two types you'll encounter most often are the full-wave (Fig. 2) and the half-wave supply (Fig. 3). Whereas the full-wave power supply is always trans-

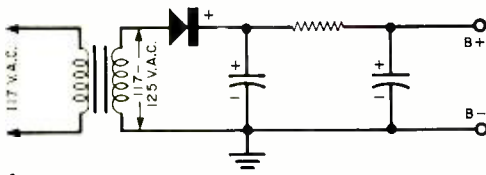
the best way to do this would be to connect the scope's input leads to points *A* and *B*, but stop for a moment and consider exactly where *A* and *B* are. That's right—directly across the a.c. line.

Now let's look at the schematic of your scope. Notice that the "Gnd." jack at both the vertical and horizontal input terminals is connected directly to the scope's metal chassis. This is an advantage (it provides shielding) *except* in connecting the scope across the a.c. line. Then there's a 50/50 chance that the "hot" side of the a.c. line is going to be connected to the ground side of the scope. If luck isn't with you, you're apt to have a 117-volt surprise the first time you reach for a control knob.

The moral of this particular story is: carefully think out what you're doing when you connect the test leads of any chassis-grounded test instrument directly or indirectly to the a.c. line. Note that generators and VTVM's also fall into the category



2



3



4



5



6

former-operated, the half-wave type (usually employing a selenium or silicon rectifier) may not be.

Although the full-wave power supply is shown in Fig. 2 with a choke in its filter circuit, in the last few years there has been a trend away from the use of power supply filter chokes. This trend is probably due mostly to technical improvement in the design of filter capacitors. Nowadays so many microfarads can be crammed into a physically small capacitor that the equipment manufacturers prefer to get rid of hum by throwing in an extra 100 μ f. or so rather than use a space-consuming, hum-radiating filter choke.

The Hot Ground. For comparison purposes, first take a look at the input voltage to transformer *T1*. One would think that

1 Typical waveform obtained during sweep generator alignment of an FM discriminator.

2 Full-wave power supply with lettered points discussed in text.

3 Half-wave transformer-operated supply using selenium rectifier.

4 Idealized sinusoidal waveform of standard 60-cycle a.c. line.

5 Full-wave rectification before smoothing effect of the filter.

6 Input filter capacitor changes previous hill-and-valley waveform into something like this.

of test equipment with a chassis ground, so be extra careful when you use them for alignment or testing of a.c.-d.c. receivers.

Once we get on the "isolated" secondary side of *T1*, we can safely connect our test leads anywhere without worrying about the test instrument being "hot." Placing the scope leads across *C* or *D* to ground will result in a 60-cycle waveform (Fig. 4) which is, with rare exceptions, identical to the input waveform. Exceptions arise when the transformer, because of some peculiar-



7 Half-wave rectification before filtering action takes place.



8 Completely filtered d.c. output. Slight a.c. ripple is only visible with high scope gain.

ity in the load, puts a "kink" in the waveform.

The ideal full-wave waveform shown in Fig. 5 won't be encountered in the full-wave power supply unless filter capacitor *C1* is missing or open. The sort of trace you are likely to find with the scope's test probes connected between *E* and ground resembles Fig. 6. Filter capacitor *C1* as the first element in the filter network is responsible for the waveform change at this point. Capacitor *C2* and choke *CH1* convert the pulsating d.c. of Fig. 6 into the ripple-free current required for a humless B+ supply.

Before filtering, the output waveform of the half-wave rectifier looks like Fig. 7 on

your scope. You can see why more filtering is required by a half-wave supply—the "valleys" between the peaks are much wider and hence place more of a demand on the filter capacitor to "fill" them during the period that the rectifier is not passing current.

A.C. Ripple. The a.c. or ripple component at the output of the power supply when viewed on the scope (at the same gain setting as the previous traces) will be so small as to be practically undetectable. However, if the scope's vertical gain control is turned up full, a trace resembling Fig. 8 will be seen. These squiggles are not significant since they represent such a small a.c. component.

It's important to be aware that the scope is showing you *only* the a.c. component in the d.c. output voltage. Although there is

a definite relationship between the peak a.c. voltage of the rectified wave and the d.c. voltage before filtering at the output of the rectifier, this relationship doesn't hold after filtering. If you're wondering how much ripple is allowable, the answer depends on the needs of the equipment the supply is supposed to power.

In touring the power supply with the oscilloscope, we've seen only a very small sample of the variety of waveforms the scope can display. The power supply was chosen for discussion here because its waveforms are basically simple and easy to interpret. As you go deeper into electronics, you'll find that more and more of what the scope screen shows is meaningful only to someone with the proper training and theoretical background.

The oscilloscope is not a magic wand that will somehow open up the mysteries of electronics to you. The oscilloscope is a tool. And like any tool, it functions best in the hands of someone trained to use it. —30—



New CRT Tester and Rejuvenator Kit

WITH millions of TV sets in use for many years now, picture-tube testing and rejuvenation assume more importance than ever before. When a TV set owner hauls in his picture tube and it checks out *dead*, he is less likely to complain about buying a new tube if an attempt is made to bring his old tube back to life.

One of the newest instruments that both checks and rejuvenates picture tubes is the Model RE-2 "Multiphase Rejuvatube" (Central Electronics, Inc., 1247 Belmont Ave., Chicago 13, Ill.). It is available factory-wired for \$89.50 or it can be purchased in kit form for \$69.50.

Features. The Rejuvatube checks standard CRT's for emission, gas, opens, shorts or leakage between elements, grid cutoff, and "life expectancy." A built-in current limiter prevents accidental burn out of the cathode ribbon, a too-common trouble experienced with early CRT rejuvenators.

A "Cube Socket Selector" allows the testing of any CRT (including color tubes) without the use of extra adapters. A selector switch permits each gun of a color tube

Central Electronics' Model RE-2

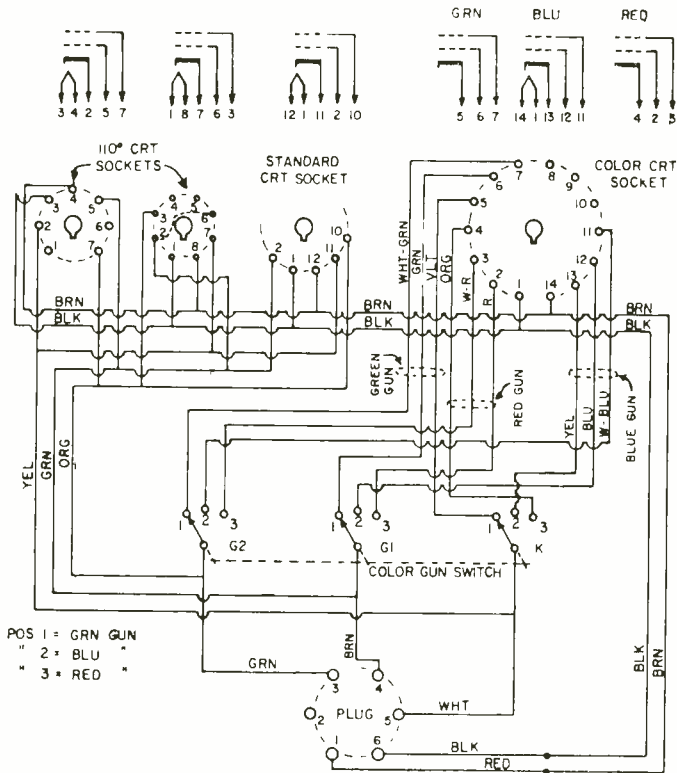
gives old tubes a new lease on life

to be tested individually. Seven-inch tubes can be checked by using an accessory cable.

Assembly of the kit is facilitated by a precut, laced wiring harness—it should only take about six hours to make a very neat job of it.

Operation. The tube is first tested for shorts or open elements, then for emission. If the emission is low and the set shows a weak picture, the rejuvenation procedure is next on the agenda.

This tester "rejuvenates" at the normal filament voltage, instead of at a boosted voltage. The rejuvenation process is continued until the meter shows no further increase in reading. For very weak tubes and the "slow-starters," a *Heater-Increase* switch permits raising the filament voltage



"Cube Socket Selector" of the Model RE-2 permits testing picture tubes without the use of extra adapters. Note three-position switch in schematic diagram of selector for individual testing of color tube "guns."



to the level of about 10 volts for a moment or two.

After rejuvenation, a second emission test is run. If the tube still checks low, the *H_g*-Increase switch is depressed, and the reading noted. If increasing the heater voltage brings the emission up to a usable level, a standard picture tube booster will allow the tube to operate satisfactorily until the end of its life.

Gas and "life expectancy" tests are standard. For gas, a 10-megohm resistor is inserted into the grid circuit and the shunting switch connected across it is opened; the resulting change in meter reading is then noted. Very high readings indicate a high

gas content and a probable lack of brightness control. The life test is made by simply turning the heater off and noting the time the meter needle takes to drop to zero; very rapid drop-off indicates a loss of active material on the cathode surface and hence a short life expectancy for the tube.

Comment. This is a fine kit and quite easy to assemble if the instructions are followed carefully. No significant difficulties were encountered in the model we put together and the instrument did everything claimed by the manufacturer. It should be a very useful addition to any TV service shop or home laboratory.

-30-

Inside the Stereo Cartridge

PUTTING the two channels needed for stereophonic reproduction in the single groove of a disc recording is one of the miracles of modern technology. However, because much misleading literature on the stereo disc has been published, many people imagine that the modulated stereo groove looks like a plowed furrow of an even depth, with one wall modulated by one stereo channel and the other wall modulated by the second channel. This is a simplified way of looking at the stereo disc, but it does not present a very accurate picture of its operation.

Background of Stereo Discs. Perhaps the easiest way to understand how the stereo disc recording system works is to trace the development of monophonic recording systems. When Thomas Edison shouted "Mary had a little lamb" into his tin-foil phonograph in 1877, his voice caused a stylus to modulate the surface of the tin foil *vertically*; and the recording stylus left a trail of depth variations behind it. This method of groove modulation is called the vertical or "hill-and-dale" method.

Ten years after Edison's first experiments, the first *lateral*-cut record was produced by Emile Berliner. In Berliner's sys-

How the various types of stereo pickups operate—their advantages and disadvantages

By **JOSEPH MARSHALL**



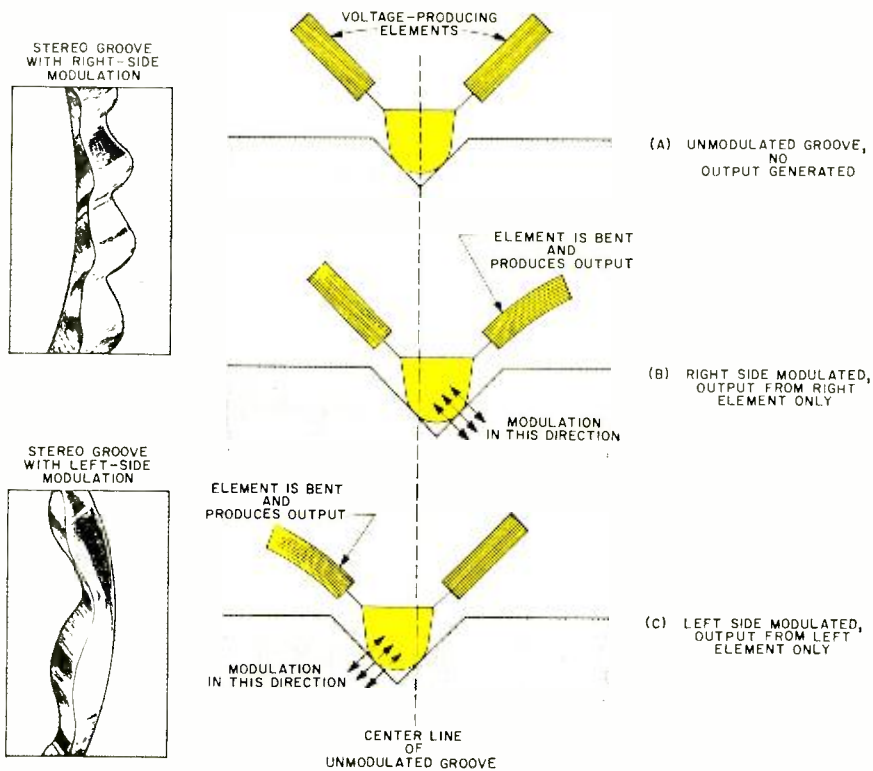


Fig. 1. Each voltage-producing element of a 45-45 stereo pickup responds to modulation in only one side of the record groove. Although the elements shown here produce output when the adjacent wall is modulated, some cartridges operate in reverse fashion. However, the general principles are the same.

tem, the cutting stylus moved from side to side. Lateral recording gradually gained popularity and eventually superseded Edison's hill-and-dale method. However, the vertical-cut system was still in use until the beginning of World War II, being employed mainly in the production of broadcast transcriptions.

The idea of using the two systems simultaneously to record two sound tracks in a single groove no doubt occurred to many people. In playback, the stylus would drive two voltage-generating elements, one of which would respond only to vertical modulations and the other to lateral modulations. In the early 1930's, vertical-lateral dual-track records were actually produced experimentally in England. Because of technical difficulties and consumer disinterest, however, these early experiments were discontinued.

Modern Developments. Little more was heard about the stereo disc until 1957,

when two British companies announced that they had advanced the old vertical-lateral system to a surprising degree of refinement. But still inherent in the vertical-lateral system was an apparently insuperable fault. As the playback stylus tracked the grooves, whenever it attempted to follow the narrower sections of the groove caused by heavy lateral modulation it would be lifted slightly due to "pinch effect" and thus would induce a spurious signal into the vertical channel. Because this "pinch-effect" distortion had no relation to the signal in the vertical channel, it would stick out like a sore thumb and make the vertical channel far inferior to the lateral channel.

Then the Westrex Company came up with a solution. Instead of trying to improve the vertical-lateral system, Westrex tilted the whole recording process by 45°; this resulted in the two channels still being at right angles to each other, but each at

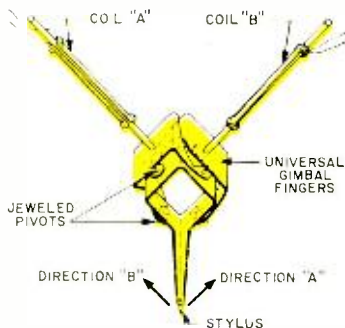


Fig. 2. Exploded view of the ESL "Gyro Jewel" moving coil stereo cartridge. When stylus moves in direction "A", coil "A" rotates within a magnetic field and produces a voltage. Movement in direction "B" causes coil "B" to produce an output.

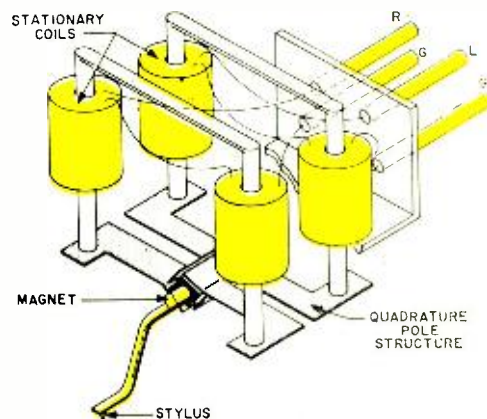
a 45° angle from the record surface. The Westrex, or 45-45 system, was also based on principles worked out in the early 1930's, and together with new and better cutters, it reduced pinch-effect distortion to the point where commercial records became practical.

The 45-45 System. The mechanics of the 45-45 system are shown in Fig. 1. For playback, two voltage-generating elements are attached to the stylus at right angles to each other, but at 45° to the record's surface. Each of these elements is so coupled to the stylus that it will produce an output only when one side of the groove is modulated. The elements in Fig. 1 most closely resemble crystal transducers, but the principles of operation are the same for all types of stereo pickups.

In Fig. 1(A), with no modulation in the groove, the stylus just goes along for the ride and no output is produced by either element. When the right side is modulated (B), the right element is bent, and thus generates a signal voltage in accordance with the audio modulation on the right side of the groove. Note that the side of the groove is not modulated laterally, but at a 45° angle; that is, right-wall modulation means that the right side of the record groove varies both in depth and in lateral displacement. To the left reproducing element, the right-wall modulation looks like a hill-and-dale cut, and to the right element it looks like a lateral cut. Since the left element responds only to being bent and not to being pushed, it produces no output. Alternately, in (C), when the left side is modulated, the left element produces an output and the right element produces none.

Types of Stereo Pickups. The two general classes of stereo pickups are the magnetics, which generate an output signal

Fig. 3. Moving magnet design is typified by the Empire 88 stereo cartridge, made by Audio Empire. Moving magnet attached to stylus induces voltages in the coils.



by the interaction of a magnetic field with a coil, and the piezoelectrics, which produce outputs when their voltage-generating elements (usually crystal or ceramic materials) are bent or twisted.

Magnetic cartridges are divided into three types: moving coil, moving magnet, and variable reluctance (sometimes called moving iron) cartridges. In the moving coil cartridge, stylus motion causes extremely small coils of fine wire to move either back and forth in a magnetic field or to rotate around a magnetic field. An example of the moving coil design is the ESL "Gyro/Jewel" cartridge; the internal construction of this cartridge is shown in Fig. 2.

Moving magnet cartridges are relatively new to the stereo scene, but two of them—the Shure and the Audio Empire—are at the very top of the class. In the moving magnet cartridge, a tiny magnet attached to the stylus arm follows the movements of the stereo groove and induces electrical

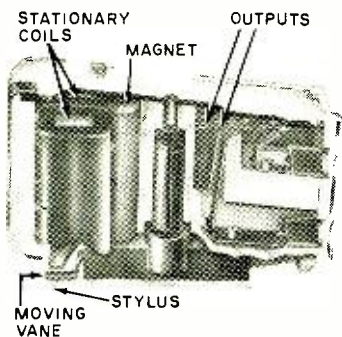


Fig. 4. Variable reluctance principle is employed by General Electric in all models of stereophonic pickups.

output signals into stationary coils. An internal view of the Empire 88 moving magnet stereo cartridge is shown in Fig. 3.

The variable reluctance principle is familiar to most hi-fi'ers from mono days, when the General Electric cartridge made "VR" a common phrase. This design is basically composed of a horseshoe magnet with a metal vane in its open end. As the stylus moves the vane in the magnetic field, the reluctance of the magnetic circuit is varied, and a signal is induced into nearby coils. Manufacturers using the variable reluctance principle in their stereo cartridges are General Electric, Dynaco, and Pickering. See Fig. 4.

Pros and Cons. All of these cartridge types have their advantages and disadvantages. The variable reluctance movement, for example, has to move only a very small and light piece of metal, and its stylus mass and compliance can be very good. On the other hand, the coils have to be quite large, with a lot of inductance. This

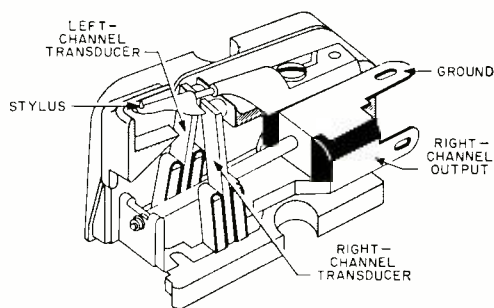


Fig. 5. CBS "Professional" stereo cartridge uses two ceramic voltage-producing elements to provide high output and to minimize hum pickup.

inductance combines with the distributed capacitance of the coils, the capacitance of the shielded cable from pickup to preamp, and the input capacitance of the preamp to form a resonant peak, and it is very difficult to keep this resonant peak above 20,000 cycles. It is extremely sensitive to cable length and to the resistive load.

The coil in a moving coil pickup is much smaller and the resonant peak can more easily be kept above 20,000 cycles where it has no serious effect on the audible response. By using very small wire, the mass of the coil can be kept down and the stylus mass and compliance of a monophonic version can be very good indeed. But in stereo versions, two coils have to be moved by a single stylus; consequently, the mass and compliance cannot be as good as in a monophonic version using the same size coil. Nevertheless, by reducing the size of the coils and mounting them cleverly, designers have been able to achieve stylus mass and compliance figures almost as good as the best monophonic moving coil pickups. However, the moving coil pickups do suffer somewhat from low output voltage.

The moving magnet pickup has coils intermediate in size between those of the VR and moving coil types. With care, it is possible to keep resonance above 20,000 cycles. This pickup is especially suited for stereo because the stylus does not have to move a bigger magnet for a stereo version than for a monophonic one. Thus the stylus mass and the compliance of a stereo cartridge can be just as good as in a monophonic version.

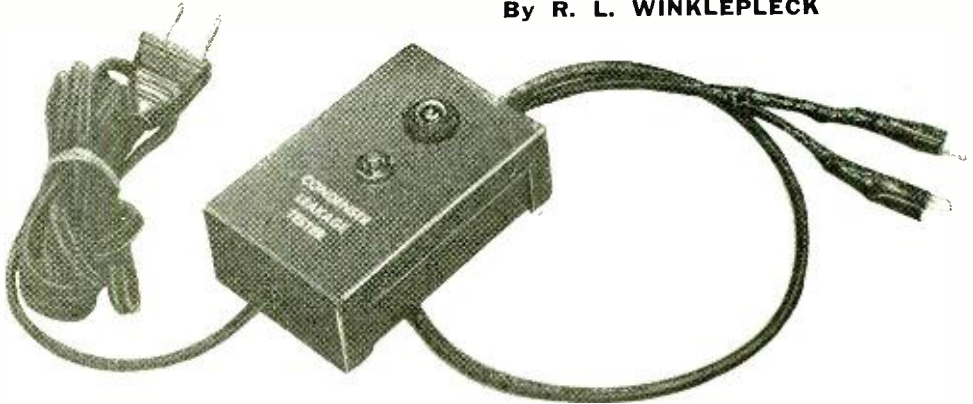
Ceramic cartridges enjoy the advantages of high signal outputs and no hum; high signal output, however, is a virtue only when the preamplifier used with the cartridge is specifically designed for it. Many preamps do not provide proper equalization for ceramic or crystal cartridges.

The CBS "Professional" stereo cartridge comes with two sets of equalizers that can be plugged right into any preamp or amplifier. This is something every manufacturer of high-fidelity ceramics should note because the ceramics can provide excellent performance when properly equalized. Many audiophiles prefer magnetics to ceramics or crystals, but part of this preference is based on prejudice and part on the fact that few ceramics are properly equalized. When they are, they are hard to tell

(Continued on page 122)

capacitor Leakage Tester

By R. L. WINKLEPLECK



WHAT do the drip, drip, drip of a faucet and the flip, flip, flip of your TV picture have in common? They are both caused by leakage—one by leaky pipes, the other by leaky capacitors.

Leaky capacitors are bad in any circuit but in TV sync circuits they're pure poison. And trouble-shooting is complicated by the fact that capacitors leaky enough to cause trouble are frequently detectable only by specialized test equipment. For instance, a capacitor with as little as 20 megohms leakage can completely upset the horizontal stability of a TV receiver and yet be immune to detection by a standard ohmmeter.

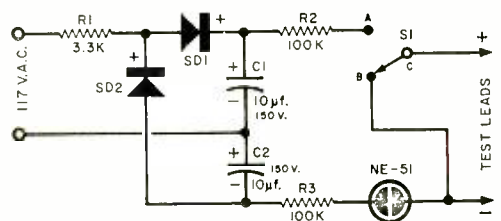
You can assemble this extremely sensitive, inexpensive leakage tester in about an hour. Since component values are not especially critical, the junk box should be able to provide its share of parts. The tester's simplicity is belied by its performance, for it will expose leaky capacitors as dependably as your ohmmeter finds off-value resistors—and you'll probably use it as often.

Essentially a voltage doubler which applies 250-300 volts to the capacitor under test through a neon lamp, the circuit is well enough isolated from the power line

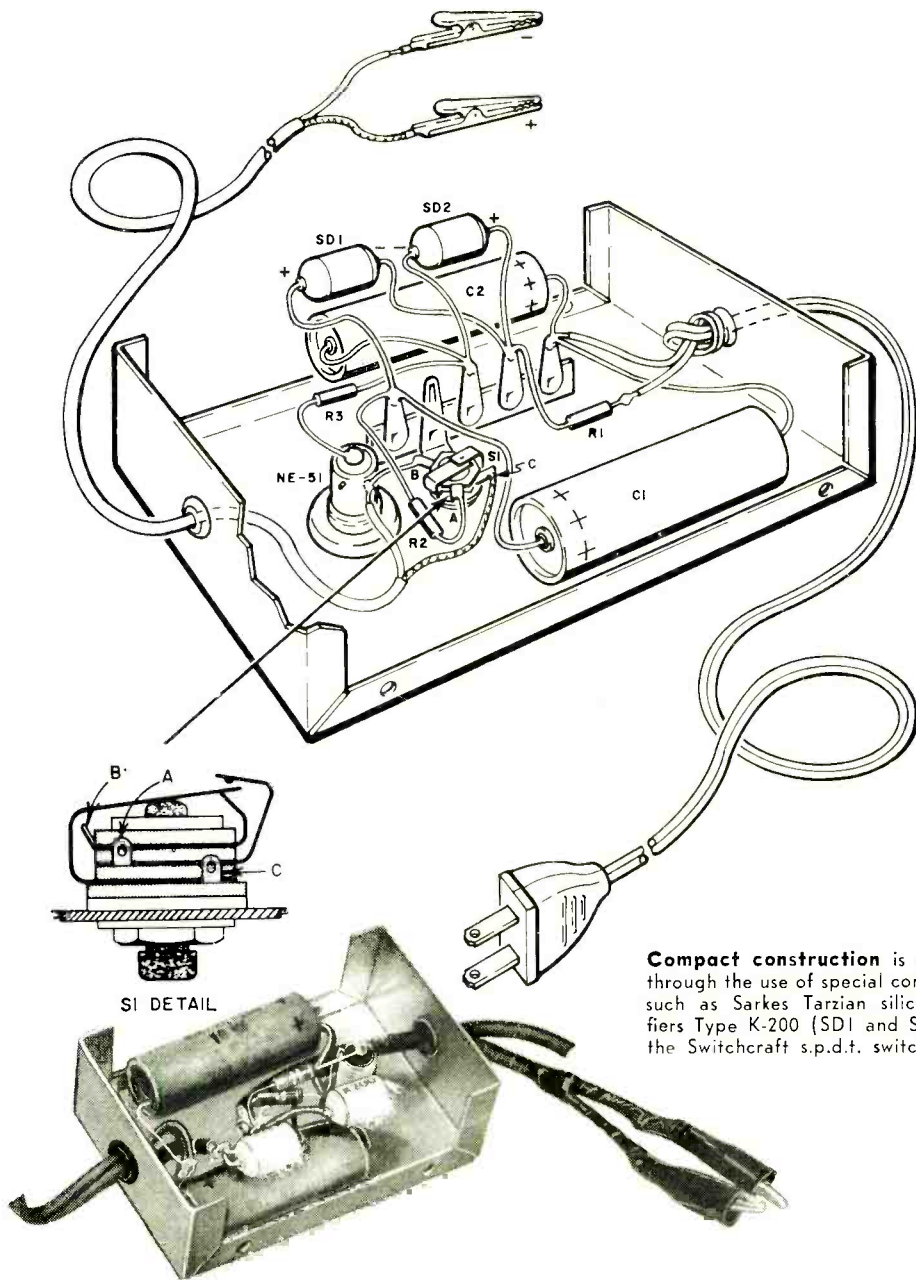
**Easy-to-build unit
checks coupling capacitors
quick as a blink**

to make an isolation transformer unnecessary. Just make sure not to connect any part of the circuit to the aluminum box.

There's little possibility of accidental shock since the s.p.d.t. push-button switch (*S1*) shorts the test leads, except during



Push-button switch *S1* is shown here in its normal position; when it is depressed, *S1* shorts the leads and applies the test voltage.



Compact construction is achieved through the use of special components such as Sarkes Tarzian silicon rectifiers Type K-200 (SD1 and SD2) and the Switchcraft s.p.d.t. switch #953.

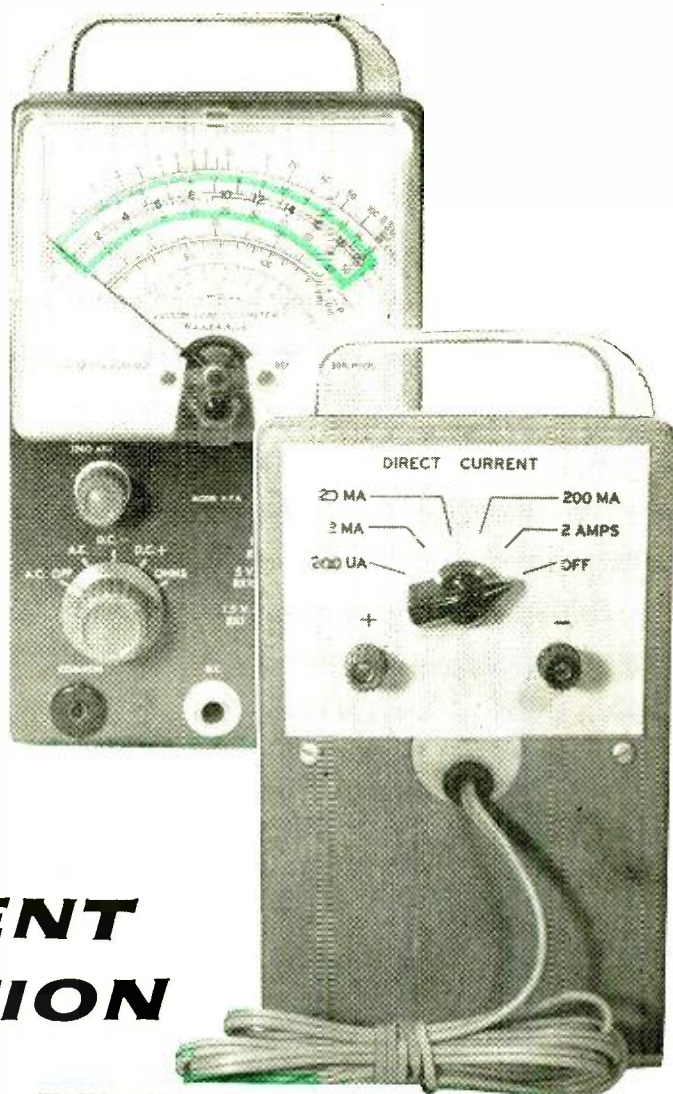
the actual leakage test. Keep in mind, however, that when *S1* is depressed there's nearly 300 volts across the test leads.

In testing a capacitor, one end of it should be disconnected from its associated circuit, and the radio or TV set must be disconnected from the power line. Attach the test leads and depress the push button. The neon lamp will blink only once if the capacitor is good. It will stay on if the capacitor is shorted or leaks badly.

A low level of leakage is indicated by repeated blinking of the lamp as the push button is held down steadily. The blinking rate indicates the degree of leakage. Exact calibration is not necessary.

If a capacitor in a sensitive circuit shows any significant leakage, discard it. For if it's not causing trouble now—it will later. Potential trouble-makers can be eliminated in double-quick time with this handy test unit.

By
MAX MILLER



Add a CURRENT FUNCTION to Your VTVM

THE VTVM is certainly one of the handiest instruments on the test bench; and if you don't have one, you're undoubtedly looking forward to the day you do. The common VTVM can be used for so many different kinds of measurements that it can be said to have only one disadvantage—it doesn't measure current. But the Heath Model 7-A VTVM has an excellent and expensive Weston 200-microampere movement which can be easily adapted for direct current reading without impairing its functioning in the VTVM.

Although the meter movement is burn-out-proof while it is part of the VTVM proper, it is not similarly protected when it is being used to read current. So be careful to avoid overload in making current readings. The only components needed for the conversion are a 3-pole, 6-position rotary

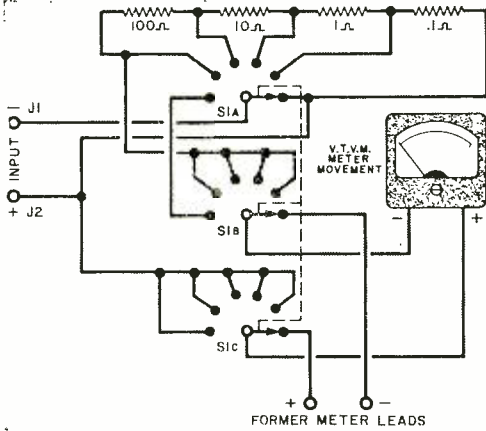
switch, four precision shunting resistors and two binding posts. The shunts used have standard values and are available from the larger electronics suppliers.

You have a choice of techniques for installing the conversion components. They can be mounted in a separate housing either attached to the VTVM or connected to it via a four-wire cable. The physical

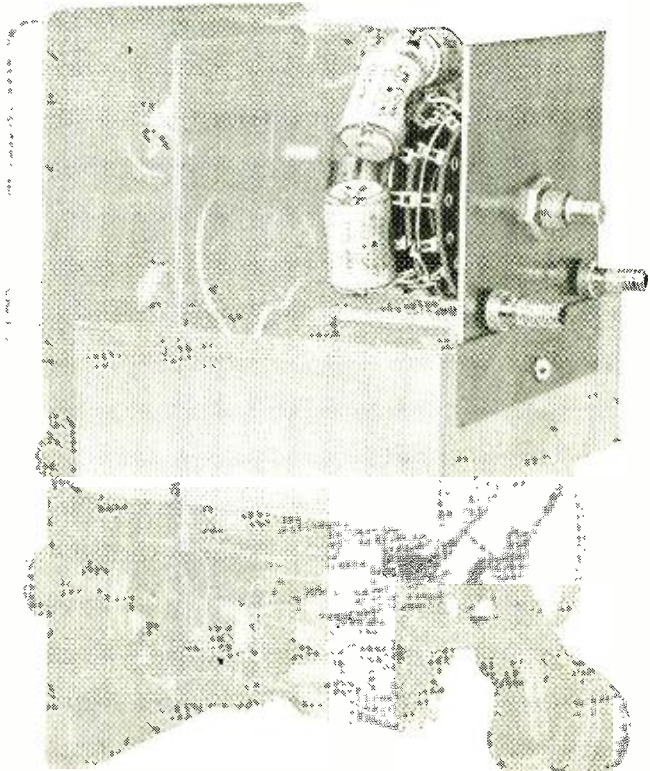
arrangement shown is somewhat complicated, but the portability of the VTVM is unimpaired and its cabinet can be removed without disturbing the conversion components.

A simple ring or Ayrton series-shunt arrangement has been used to provide several current ranges. (See "Test Instruments," POPULAR ELECTRONICS, Feb., '59, for the theory involved.) In order to use standard-value resistors, a 10X range multiple was selected, starting with the unshunted 200-microampere range and proceeding through 2, 20 and 200 milliamperes to 2 amperes.

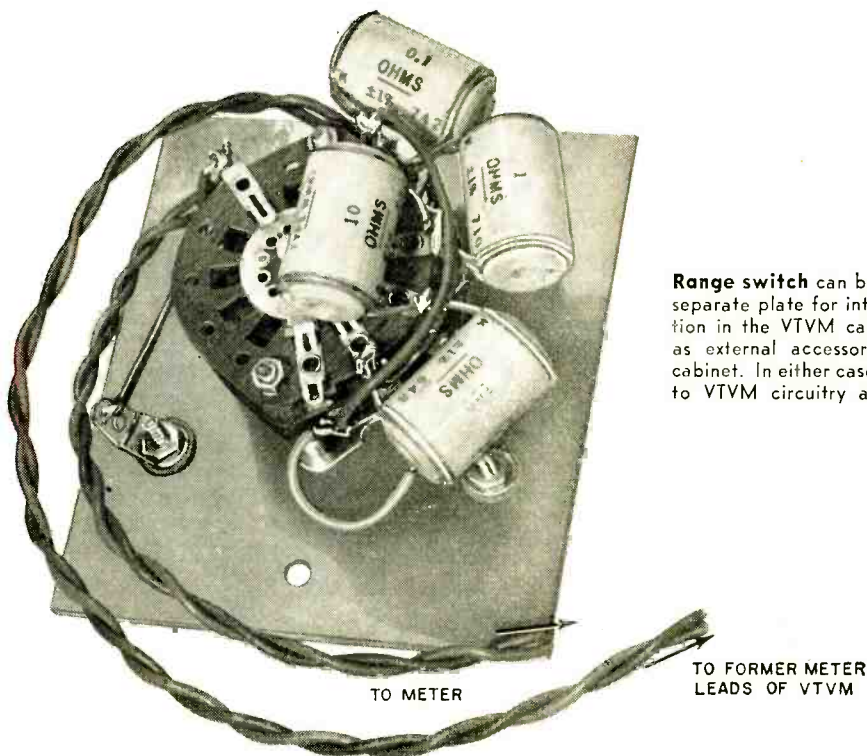
Only a single-pole switch is necessary to select the correct shunts, but the use of a three-pole switch makes for a more flexible arrangement. When the switch is in the "off" position, the VTVM circuit is normal and the conversion components are isolated. In addition, the current test leads are shorted for uninterrupted current flow through the circuit under test. With the switch in the current measurement positions, the VTVM circuit is isolated from



Use of a three-pole switch adds to the operating convenience of the meter movement conversion. Only two leads of the original wiring circuit need be changed.



Mounting technique shown is employed with Heath Model 7-A VTVM. Other manufacturers' instruments may require other approaches for proper conversion.



Range switch can be mounted on separate plate for internal installation in the VTVM cabinet or used as external accessory in its own cabinet. In either case, connections to VTVM circuitry are the same.

the meter and the current test leads are reconnected. The first position from "off" is the highest current range, to reduce the possibility of accidental overload of the meter movement.

It's possible to make rapid readings from a circuit being examined. For instance, say we're adjusting the grid bias of a tube and want to observe both the bias voltage and the plate current as the bias is varied. The regular VTVM leads are connected to control grid and cathode, and the new current leads complete the plate circuit to B-plus. Simply by switching back and forth between "off" and the correct current range, both readings can be taken in rapid sequence.

The only modification to the VTVM circuit proper consists of removing the leads to the meter movement terminals, connecting them to the correct switch contacts, and connecting the two leads from the switch to the meter movement.

In the author's model, the insulated binding posts and the switch are assembled on a small square of scrap aluminum, which is then mounted on the rear bracket of the VTVM using the screw which holds the bat-

tery. Holes are drilled in the back of the VTVM case to clear the switch shaft and the binding posts (which must not short to the case). A square of paper is glued to the outside of the case on which the current range for each switch position is shown.

There's no suitably marked scale on the Heath meter movement, but the 50-volt scale is correctly divided. Small numerals from 2 to 20 glued to the scale as shown will make for easier reading.

The space between decks of the switch specified on the diagram is quite large; so, if the switch is to be mounted inside the VTVM case, it should be reassembled with shortened spacers—allowing only enough space between decks to clear adjacent contacts. After assembly, the protruding tie bolts and shaft can be cut off. (An alternative is to use a single-deck switch such as the Mallory 3236J.)

This same type of conversion can be made on any VTVM; but unless the basic range and internal resistance of the meter movement is the same as Heath's, the values of the shunting resistors must be determined experimentally.

10¢



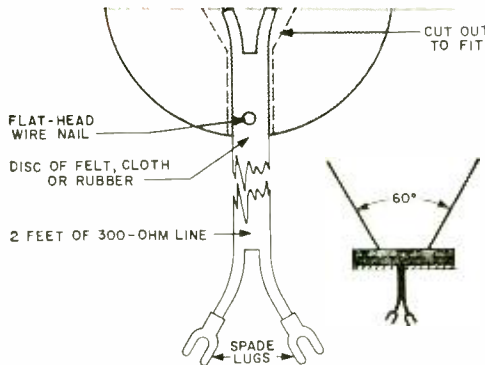
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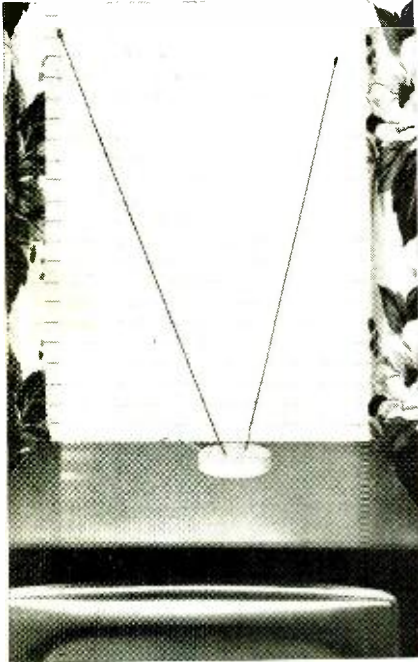


accidents. And glue a piece of felt on the base to avoid scratching your TV cabinet. —30—

Clothes-hanger wire rods are at a 60° angle from each other. Protective cloth disc covers grooved channel in which 300-ohm line is run. Be sure to clean and tin rod ends before soldering.

10¢ TV Rabbit-Ears Antenna

By ART TRAUFFER

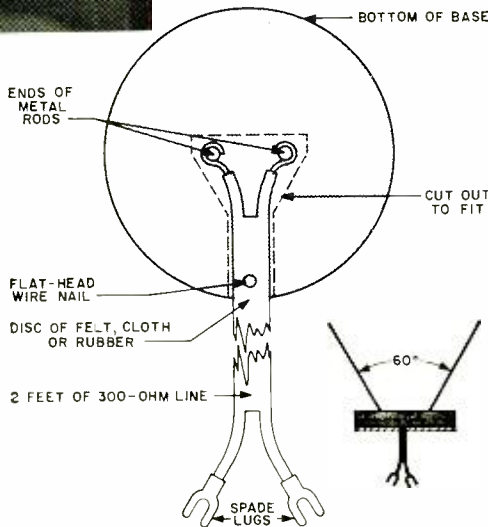


A MAZE YOUR FRIENDS with this simple TV "rabbit ears" antenna; it's easy to make, looks good, and works practically as well as a factory-made job. The two metal rods are straightened-out wire clothes hangers mounted in a wood base. A 24" length of standard 300-ohm twin-lead connects the "ears" to your TV set in the usual way. If you cut the base from scrap lumber, the complete antenna should cost no more than a dime.

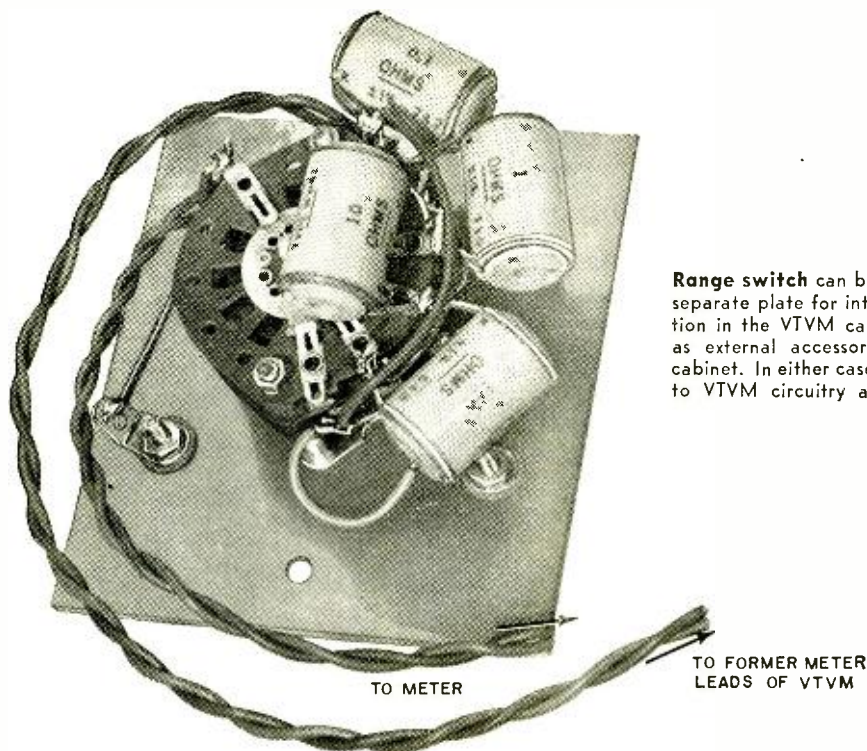
Cut the base round or square from a piece of $\frac{3}{4}$ " pine and gouge out a groove for the 300-ohm line. Drill two $\frac{3}{32}$ " holes for the rods spaced about $1\frac{3}{4}$ " apart at a 60° angle. Sand and finish the wood to match your TV cabinet.

The exact length of the two rods is not critical. Rods about 30" long will do a good job for local reception on channel 6 or under.

For best reception on channel 7 and above, the ears should be shorter. Wrap tape around the ends of the rods to improve appearance, and to prevent accidents. And glue a piece of felt on the base to avoid scratching your TV cabinet.



Clothes-hanger wire rods are at a 60° angle from each other. Protective cloth disc covers grooved channel in which 300-ohm line is run. Be sure to clean and tin rod ends before soldering.



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How to improve your listening pleasure with

ACOUSTICAL TILE

EXCESSIVE sound reflection in a music listening room cannot only decrease listening pleasure but, in the case of stereo, it can even destroy the desired effect. Luckily for the listener, however, poor room acoustics can be controlled to a great extent by the application of sound-absorbent materials; the results of treating a typical room with acoustical tile were presented in the November issue of *POPULAR ELECTRONICS*.

The first step in installing acoustical tile is to determine where you need it. In many cases, applying the tile to the ceiling will provide enough sound absorption; in others, it may also be necessary to cover the walls, either partially or completely, with acoustical tile. The photos on these three pages will show you how it should be done.



HOW TO STAPLE TILE TO CEILING

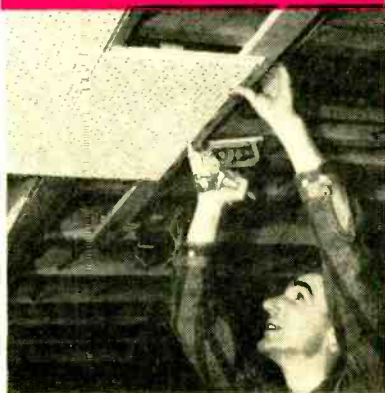


1 Before tile work is started, light fixtures and electrical wiring must be installed. If necessary, call an electrician to help you make the connections to the main switch box. Recessed fixtures are easy to install between joists and make for an attractive job with good light distribution.

2 Stapling acoustical tile to furring strips is the easiest and most popular method of installing tile. The first step is to nail 1" by 3" furring strips over the ceiling joists. To keep the acoustical tile level over uneven joists, add some shims behind the furring strips until everything is level.

3 As the furring strips are nailed up, the rows of 12" by 24" acoustical tile are stapled into position. For best results, nail up two or three furring strips, then apply the tile. This allows you to level each row of tile as you go along.

By
ANDREW LORANT



HOW TO GLUE TILE TO CEILING



1 An alternate way of applying acoustical tile is to glue it to the ceiling. To satisfy some local fire rules and increase insulation, install plaster board before applying the tile. Half-inch Gypsum Board is available at most lumber yards in convenient 4' by 8' sheets. A few scrap two-by-fours used as T-supports will hold the sheets in place while you nail the plaster board to the ceiling joists.

2 As each sheet of plaster board goes into place, be sure to mark the location of light fixtures, heating ducts, and electrical outlets. After the ceiling is up, you must cut out holes to uncover the fixtures. The decorative moldings of most fixtures will hide any rough edges.



3 Now you're set to start installing the tile. First, determine the center lines of the ceiling in both directions and mark them with a chalk line. Then work from the center out and try to end up with border tile more than 6" in width. A putty knife or small trowel is the only tool you need for applying the cement to the back of the tile.

4 There she goes! The cement on the back of the tile acts as a lubricant and the tile slides easily into place. Each piece makes a tongue-and-groove joint with the adjacent tiles. Extra adhesive can be added, if necessary, to bring a tile down to the level of adjoining tiles.

HOW TO STAPLE TILE TO WALLS



1 If you want to install acoustical tile on your walls, the first step is to "box in" any plumbing pipes that may be protruding. Such boxes serve not only to hide pipes, but may also be used as a "foundation" for lighting fixtures. Paint smaller pipes the same color as the wall.



2 Furring strips provide a surface to which tile can be stapled. Here, furring strips are nailed directly to concrete block wall. Cedar shims behind furring keep the strips even, although the block wall is slightly uneven.



3 Stapling the tiles to the furring strips is a snap. Just remember to work from left to right with the joints staggered so the top row is always to the right of the row underneath. Use a carpenter's level to check the alignment of each row as it is installed. Molding will hide the joint where wall tile reaches the ceiling.

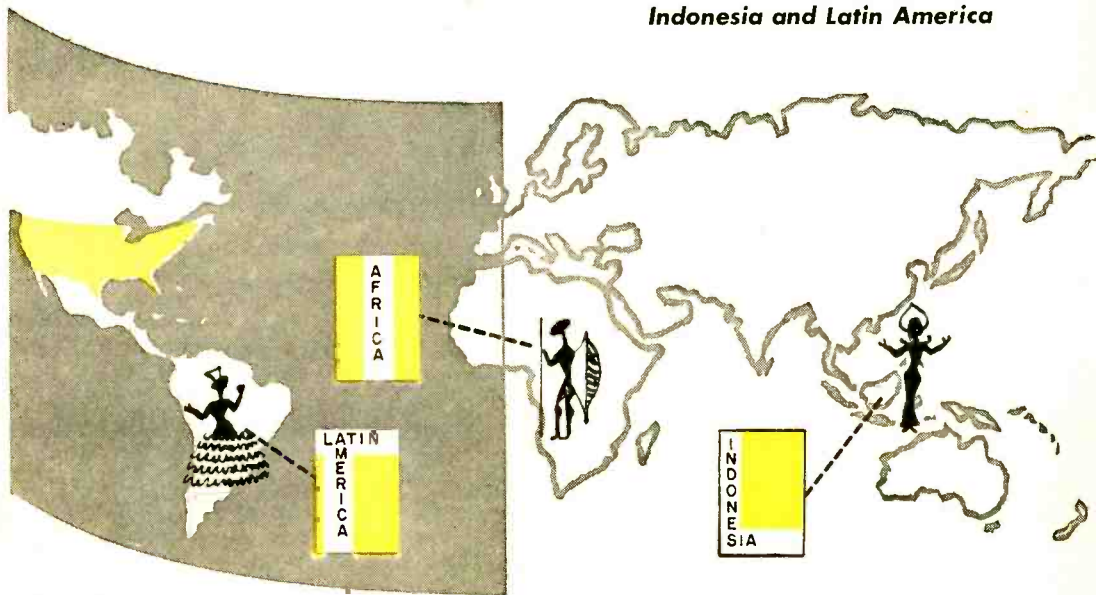


4 If desired, paneling can also be nailed on the furring strips. Here, luxurious Weldwood panels are used to achieve a rich effect. Joint where tile meets the paneling will be covered by wainscoting (wooden trim).

DX the Tropics on 60 Meters

"Path of darkness" brings you the rare ones from Africa,

Indonesia and Latin America



MANY DX'ERS who work the lower short-wave frequencies have found that best results are obtained when either the transmitter or the receiver is in a zone of darkness. This is due to the so-called "darkness factor." Understanding this phenomenon is a key to better pickup on

lower frequencies, particularly the 60-meter "tropical" band.

Long-distance radio communications are possible only because the "E" and the "F" ionospheric layers reflect signals back to the ground, enabling "skip" signals to be received great distances from the trans-

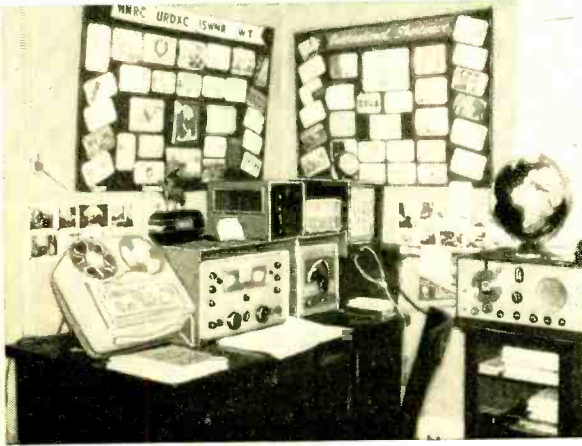
By
**GEORGE
R. COX**
WPE3JJ

RECEPTION ON 60 METERS (NOVEMBER - MARCH) FOR EASTERN U.S.A.			
Transmitter Location	Minimum Sunspot Years	Maximum Sunspot Years	Most Favorable Listening Time
AFRICA Short Path	Fade-In: 2000-2100 Fade-Out: 0800-0900	Fade-In: 2030-2130 Fade-Out: 0730-0830	0300-0700; and after 2100
ASIA Short Path	Fade-In: 0900-1030 Fade-Out: 1230-1330	Fade-In: 0930-1030 Fade-Out: 1200-1300	1030-1230
Long Path	Fade-In: 2130-2230 Fade-Out: 2330-0030	Fade-In: 2200-2300 Fade-Out: 2330-0000	After 2200
LATIN AMERICA (Central and South America, Mexico)	Fade-In: 2200-2330 Fade-Out: 1100-1300	Fade-In: 2200-0000 Fade-Out: 1030-1230	After 0000

NOTES: All times are in GMT. Africans in Tanganyika and Kenya areas peak between 0330 and 0400 and fade before 0500. South Africa and Mozambique will peak between 0330 and 0430 and fade before 0600. Stations in the Belgian Congo, the Congo Republic (French Equatorial Africa), and Libya may hold up until 0700. Other West Africans, such as the Ivory Coast and Liberia, will be among the last to fade out. The elusive Indonesians usually appear from about 1030 to 1130. Petropavlovsk, 5.050 mc., which runs 50 kw., may at times appear at 0800 or earlier. VLM-4, Brisbane, 4.920 mc., has appeared before 0700.

mitter. During daylight hours, however, a lower layer, the "D" layer, is present which absorbs radio waves and keeps them from being bounced back to earth. At noon, when the "D" layer is at its thickest, 60-meter reception is confined to within a few hundred miles of the transmitting site.

The author uses a Hammarlund HQ-160 receiver with an RME DB-22A preselector, a 10-kc. calibrator, 60' long-wire antenna and an antenna tuner.



After sunset, the "D" layer disappears, and real DX is possible.

In general, it seems more important for the transmitter to be in a darkness zone than the receiving point, especially in long-path DX. However, total darkness between the transmitter and the receiver results in

the picking up of stronger and better quality signals.

Rare Pickups. Though most of the stations in the 60-meter "tropical" band are intended primarily for local or regional reception, if there is considerable darkness between the transmitter and the reception point, you will be rewarded by some rare transmissions from Africa, Indonesia, and the Latin American countries. It is truly surprising how some low-powered stations can get out under good conditions.

A case in point is the "seasonal" CR6RH, Sa da Bandeira, Angola, outlet on 5.024 mc. I have tuned this 400-watter with a signal level almost equal to the "regular" CR6RZ, Luanda, on 4.995 mc. which runs 3 kw.

It is usually my practice during an afternoon DX session to check conditions on 41 and 31 meters first, then try 49 meters a little later. Reception on these bands sometimes gives me an indication as to how good or poor 60 meters will be when it opens. If CNR-3, Sebba-Aioun, Morocco, 6.006 mc., comes through with a fairly good signal around 2000 GMT, there may be a chance to get good reception later on 60 meters.

This method is not always reliable, however, since conditions can change quickly. Also, some stations pop through at only a certain time of the year. Simply because the Angolan on 6.026 mc. is coming through does not mean that CR7RD on 4.851 mc. or CR6RH on 5.024 mc. will follow.

Long-Path DX. Perhaps the most thrilling form of reception is long-path DX; but
(Continued on page 126)

RECEPTION ON 60 METERS (NOVEMBER - MARCH) FOR WESTERN U.S.A.

Transmitter Location	Minimum Sunspot Years	Maximum Sunspot Years	Most Favorable Listening Time
AFRICA			
Short Path	Fade-In: 0000-0030 Fade-Out: 0830-0900	Fade-In: 0030-0100 Fade-Out: 0800-0830	0400-0730
Long Path	Fade-In: 1330-1430 Fade-Out: 1530-1600	Fade-In: 1400-1430 Fade-Out: 1500-1600	1500-1530
ASIA			
Short Path	Fade-In: 0600-0700 Fade-Out: 1600-1700	Fade-In: 0700-0800 Fade-Out: 1500-1600	0900-1430
LATIN AMERICA (Central and South America, Mexico)	Fade-In: 0000-0100 Fade-Out: 1100-1400	Fade-In: 0000-0130 Fade-Out: 1100-1330	After 0130

NOTES: All times are in GMT. Unfortunately for West Coast listeners, there will be no Africans operating at 0000. However, they may be fortunate enough to catch Azores, 4.864 mc., closing at 0000; and Dakar may possibly break through when signing off at 2330 on 4.950 mc. Around 0400, Mozambique, 4.840 mc., South Africans on 4.810 mc., 4.945 mc., and Rhodesia, 4.911 mc., will provide the best reception. Long-path Africans, such as Tanganyika, French Somaliland, British Somali, Kenya, and Uganda, are usually heard best from 1430 to 1530.



Short-Wave Report

By **HANK BENNETT**
W2PNA/WPE2FT

IN complete opposition to the many DX'ers who feel that an expensive and elaborately built antenna system is a must in snaring those hard-to-get stations, Gerry Dexter has amassed an enviable log using only a 100' single-wire antenna. Now 23 years old, a student, and single, Gerry has been DX'ing for nearly nine years. He operates out of the Middle West (144 Windsor Drive, Waterloo, Iowa) and is the holder of POPULAR ELECTRONICS monitor call letters WPEØJJ.

Gerry's well-equipped listening post is headed up by a trio of receivers—a Hammarlund HQ-129X, a Hallicrafters S-40B, and a Zenith Trans-Oceanic—plus an RME DB-22A preselector. He listens mostly on the 60- and 49-meter bands (4600-6500 kc.), also in contrast to many DX'ers who prefer the higher frequencies.

In checking through Gerry's log, we find that he has heard a total of 118 countries, with 101 of them verified. In all, he has

175 verifications. These totals do not include loggings of or verifications from utility stations or other stations outside of the short-wave category.

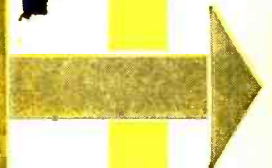
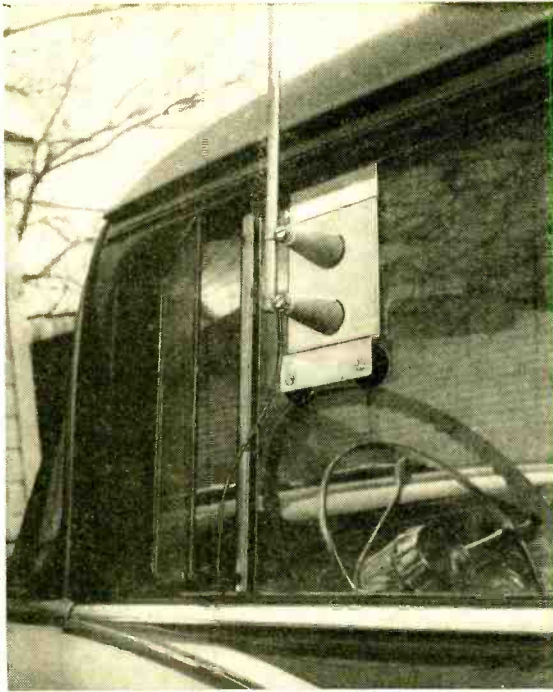
Gerry's favorites are the Swiss, Belgian, Australian and British stations, for their generally superior programing. His best DX catch: VQO2, Honiara, Solomon Islands heard during the period when VQO2 was running only 100 watts. Other catches: the Fiji Islands and some Asiatic Russian stations.

Although Gerry has DX'ed on the medium-wave bands as well as the FM and TV channels, currently he devotes 99% of his listening time to the short waves. He holds membership in the DXplorers Radio Association, the Newark News Radio Club, Universal Radio DX Club, and the International Short-Wave League. And his future plans include a career in the broadcasting field.

(Continued on page 137)

Gerry Dexter, WPEØJJ, shown with his Zenith AM-FM receiver (at left), Hallicrafters S-40B (with Q-multiplier and TV-FM booster on top of it), and RME DB-22A preselector.





Mobile Antenna Mount

**You can mount your ham or Citizens Band antenna in
a minute, without drilling** **By J. G. KARNATH, W2RRA**

THE ELECTRONIC HOBBYIST or ham is often faced with the necessity for quick installation of an antenna on his automobile for experiments with mobile transmitters, receivers, garage door controllers, and other radio-controlled devices. With the recent FCC approval of the Citizens Band, and the appearance of many construction articles on mobile equipment, the easily built antenna mount shown here will be a useful addition to any experimenter's paraphernalia.

Many times a model under test is strictly temporary and may be placed on the front seat, to be readily accessible for adjustment and change. But the wife will demand that it be quickly and completely removable for a trip to the local supermarket in the family car. This window antenna mount can be attached and removed in about one minute, and will remain firmly and

December, 1959



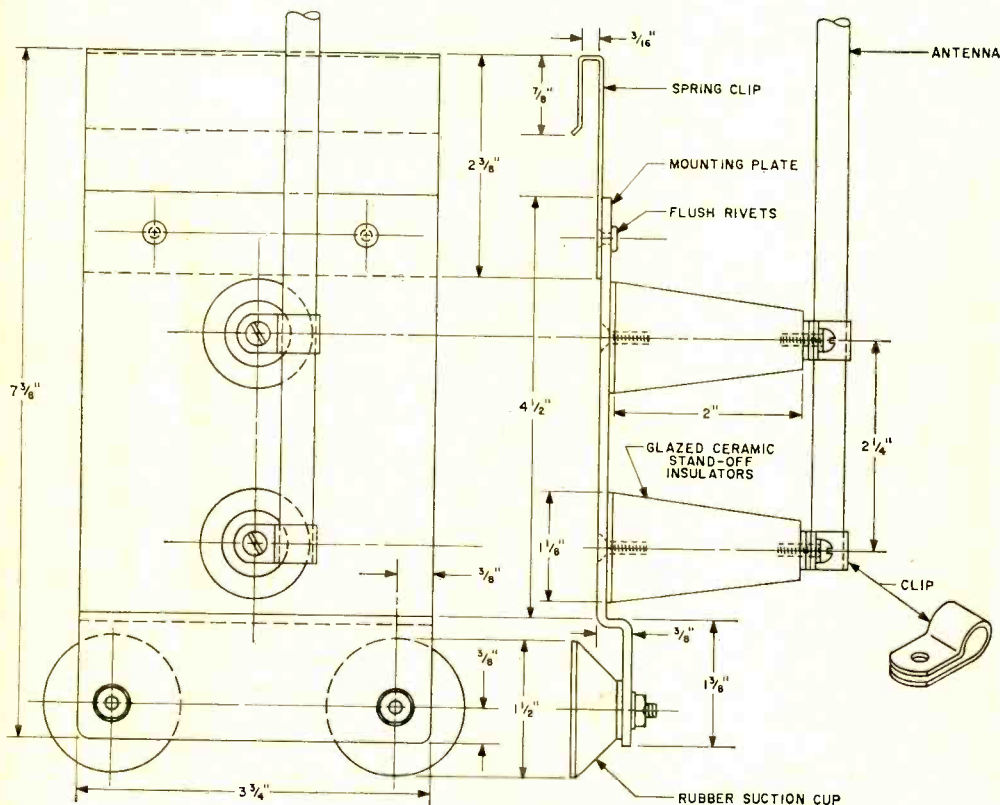
safely attached at speeds in excess of 60 mph. No mounting holes need be drilled and the car is not defaced in any way.

While the regular automobile radio antenna can be unplugged from the set and pressed into service, it is usually highly inconvenient to do so with today's crowded and complicated under-dash areas. In this case you would also need a cable with a mating socket to extend the antenna lead-in to the equipment output jack.

Another point which is often overlooked

$3\frac{3}{4}'' \times 3/32''$ mounting plate is made of aluminum, and the spring clip is formed from stainless steel approximately $3\frac{5}{8}'' \times 3\frac{3}{4}'' \times 1/32''$. Spring brass or phosphor bronze could be substituted for the steel. The two parts are riveted together as shown.

The antenna used may be of any reasonable size or configuration. The antenna element proper is held to the two stand-off insulators by metal wrap-around clips which are screwed to the threaded hole on the apex of the insulator.

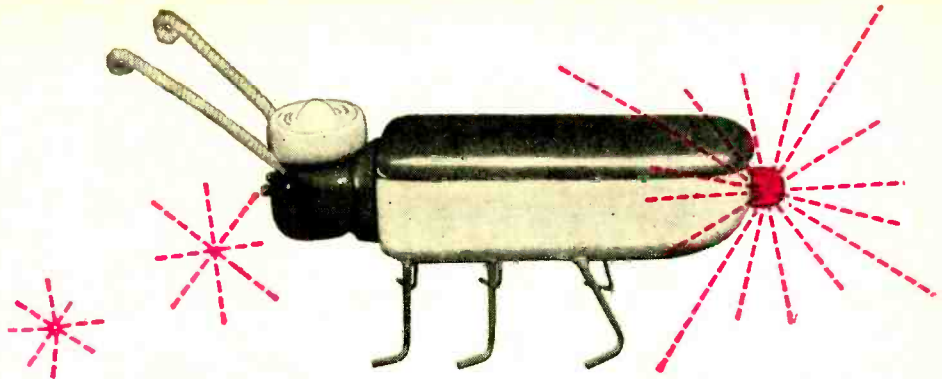


The dimensions shown for the antenna mount need not be followed strictly, but the stand-off insulators should be high enough to clear the roof over-hang. Keep in mind that the larger the mounting plate the smaller the available window area.

is the fact that the conventional auto radio antenna cable is intended for use at broadcast-band frequencies where the effects of insulation leakage and stray capacity are negligible. When it is used at much higher frequencies, however, these factors may have a very detrimental effect.

Construction is simple, as you can see from the dimensional drawing. The 8" x

Mount the unit on the vehicle by lowering the window about halfway and wetting the two rubber suction cups. Next, push the spring clip down over the upper edge of the window and wind the window closed, pressing the two suction cups firmly to the glass. You can pass the antenna lead-in through the partly opened ventilating pane to the equipment.



LIGHTNING BUG NIGHT LIGHT

By CHARLES H. WELCH

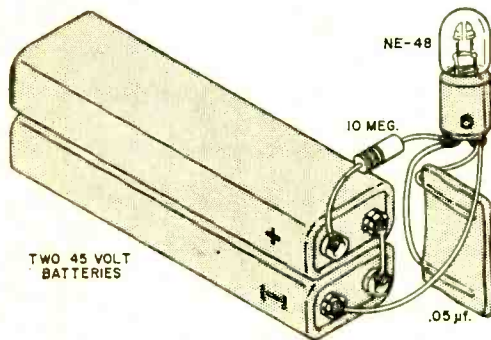
WHILE this dependable blinking "bug" furnishes no actual illumination, it is a friendly and reassuring sign in the night to the small fry. It was originally built to serve as "evidence" proving the existence of huge lightning bugs in Central America; now the outsized "insect" acts as a night light in a child's bedroom.

The flasher unit is a conventional neon-bulb relaxation oscillator which is completely self-contained inside the bug. All the components are supported by their own leads and are soldered in place. The batteries are soldered, too, since they shouldn't require replacement very often; however, be very careful when you solder because it is quite easy to damage the batteries with too much heat. The NE-48 neon lamp was chosen because its

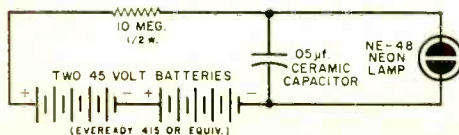
large size suits the proportions of the bug.

Build the bug itself from a 1/2"-thick sheet of balsa wood. The body is a box, with inside dimensions just large enough to accommodate the flasher unit and leave room at the neck opening for the head to plug in. Make a hole at the tail to fit the neon lamp. The thickness of the balsa permits rounding the body and shaping the wing covers. Shape the head from a block of balsa. The sombrero (necessary on the original to "certify" its Central American origin) is a plastic bottle cap.

All the balsa parts are finished with sander-sealer and model airplane dope. The legs are made of wire and the feelers are pipe cleaners. You can use India ink for the face markings and red map pins for the eyes.



The "bug's" battery terminals should be insulated carefully to prevent the kiddies from getting a 90-volt "tickle" from the battery.



By
SAUNDER HARRIS
WINXL



Blown out any resistors lately? Here are some whys and wherefores on the proper way to treat . . .

Resistors at Work

IN 1827, the ancient German city of Cologne saw the publication of a pamphlet with the typically mouth-filling Teutonic title: "Die galvanische Kette mathematisch bearbeitet." No huzzahs greeted the work; in fact, it was so coldly received that the disheartened author, a professor of mathematics, resigned his position and vanished from the academic scene for over ten years.

What does this have to do with resistors? The professor's name may give you a clue . . . it was Georg Simon Ohm.

Look in your electronic parts catalog. You'll find hundreds of resistors—big ones and little ones—of all types and sizes—ranging from a fraction of an ohm to over 20 million ohms, from 1/10 watt to 300 watts. Why are all of these resistors needed? What do they do?

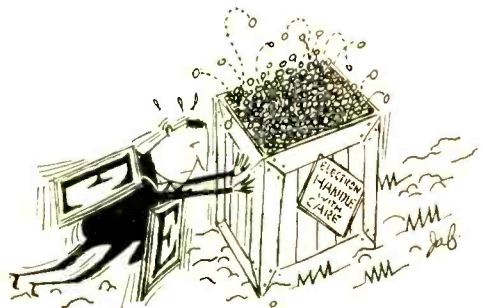
Herr Ohm answered these questions for us in 1827. Translated from technical German, the story is this: the resistor's job is to limit the flow of current. The more resistance in a circuit, the less current flow.

The Big Push. At the same time that resistors are limiting current flow, they are usually doing another important job. They are placing a specific voltage at the point in the circuit where it is required. How is this done?

We know that in any conductor where voltage "pushes" electrons there is a current flow. When the conductor has resistance, some voltage is "dropped," pushing the electrons through it. This voltage drop depends, logically enough, upon (1) the resistance of the conductor and (2) the amount of current flowing through it. The situation is like a race over an obstacle course—the higher the hurdles, the more energy is used up.

Therefore, if you want a lower voltage at any point in a circuit, insert a resistor and the voltage in its struggle to push the current through the resistance will drop to the desired value.

On the Job. The best way to understand how a resistor is chosen for a par-



Voltage pushes electrons.

ticular job is to look at some of them in action. Our basic tool for determining the value of any resistor in a circuit is the product of our friend Herr Ohm. Ohm's law expresses the basic relationship between *resistance*, *current*, and *voltage*, and can be written in three forms:

$Voltage = Current \times Resistance$ ($E = IR$)

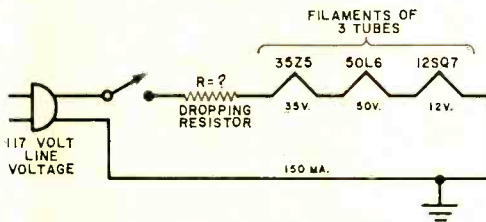
$Current = Voltage/Resistance$ ($I = E/R$)

$Resistance = Voltage/Current$ ($R = E/I$)

In practical work, we use R as the symbol for resistance, I for current, and E for voltage. Referring to the first equation above, it is easy to see where the expression "IR drop" (voltage drop) originates. The voltage drop across a resistor is always equal to the resistance times the current through it.

You'll want to remember these fundamental Ohm's law equations, because you'll be using them all through your electronics career. Now, let's put them to work.

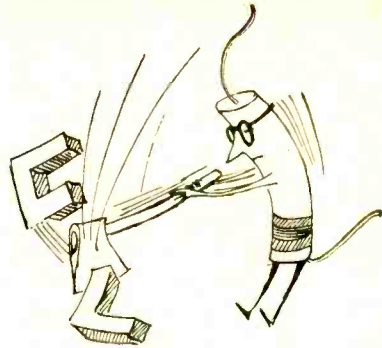
Filaments in Series. Here we have the the problem of hooking up the three tube filaments in an a.c.-d.c. phonograph ampli-



fier. This is a representative situation which arises in the design of any radio or TV receiver using series-filament operation.

Stop for a moment and look at the typical a.c.-d.c. tube, the 50L6. As you probably know, the "50" in this tube's name indicates the filament voltage; that is, the tube's filament is designed to operate at the correct temperature with 50 volts applied across it. The resistance of the filament is calculated to allow a flow of .15 ampere (150 ma.). The story is the same for the 35Z5 and 12SQ7 except that their filaments operate on 35 and 12 volts respectively.

If we were to hook up the three tube filaments in series to a 117-volt source, however, the current flow through the filament circuit would be excessive because the tube filaments were designed to add up to a total voltage drop of 97 volts and their combined resistance would not be high enough to limit the current to the



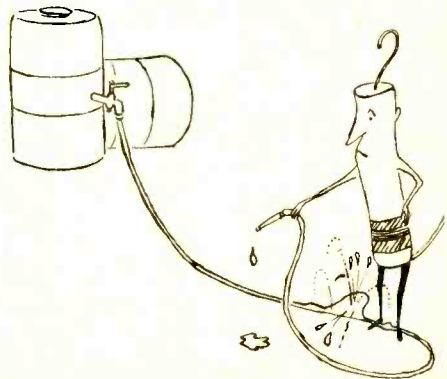
Resistors divide voltage . . .

.15-amp flow required. Since the line voltage is a nominal 117 volts, we have to provide a series resistor to drop the extra 20 volts (117 minus 97). As we already know the current and voltage values, Ohm's law ($R = E/I$) gives us the answer. Since $R = 20/.15$, the dropping resistor should have a value of 133 ohms.

As 133 ohms is not a standard value, we look in the parts catalog for the closest value to it. A standard 125-ohm resistor with a $\pm 10\%$ tolerance will do the job—that is, it will do the job if it doesn't overheat or burn out. And here's where the question of *power* enters into the problem.

Power Rating. Just as we work up a sweat pushing a lawn mower, so heat is generated by electrons pushing their way through a resistance. Unless the resistor is designed to withstand the heat generated by the current, it will burn up.

The following relationship can be used in figuring the amount of power the resistor is required to dissipate: *power* (in watts) equals the *resistance* times the *current* (Continued on page 132)



. . . and block current flow.

Intercommunication Simplified

By GLENN A. TOWILL

FOR less than \$5 you can have an intercom that employs nothing more than a microphone and a speaker, has instant operation, and is powered by flashlight cells. If your junk box is well stocked, it may not cost you a cent.

The simple system shown in Fig. 1 is suitable for one-way operation to a garage or workshop, for example, to call hubby for supper (he can't talk back to make excuses). It's a straightforward circuit, the battery, mike and speaker being connected in series with a push-button switch for on/off control. The switch is mounted beside the mike; the battery can be placed with the speaker. Interconnect the stations with a two-conductor wire or use a grounded return if a good ground is available.

A carbon-type mike must be employed here, but any small PM speaker will do. Volume is adjusted by the voltage of the battery and can be varied for the noise level in the room. Up to six volts can be applied safely, and this will provide sufficient volume for office use. The battery can be three or four flashlight cells in series, or a single six-volt "hot-shot" battery may be used, if you wish.

For a two-way intercom, twice the number of parts is needed. If three-wire cable is available, exact duplicates of the circuit in Fig. 1 can be built with a mike and speaker at either end. If the unit is to be used at great distances with two-wire cable or grounded return, switches can be added as shown in Fig. 2. Here the switches are single-pole double-throw, with a spring return to one side, such as the Centralab #1463.

Results may not be exactly hi-fi with this intercom, but you'll find that it's a handy gadget for keeping in touch with "home base."

-30-

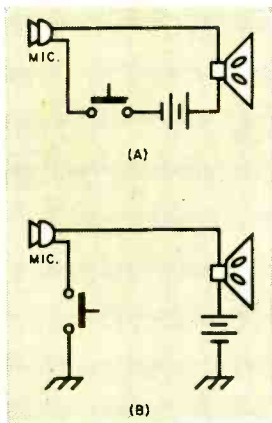
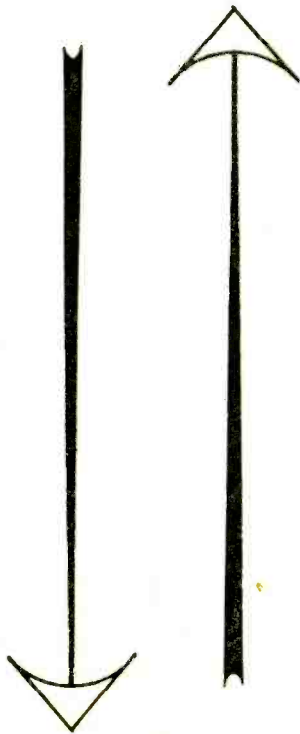


Fig. 1. One-way system using two wires between stations (A) or one wire with water pipe or other common ground connection (B).

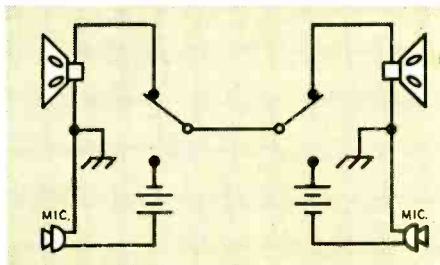
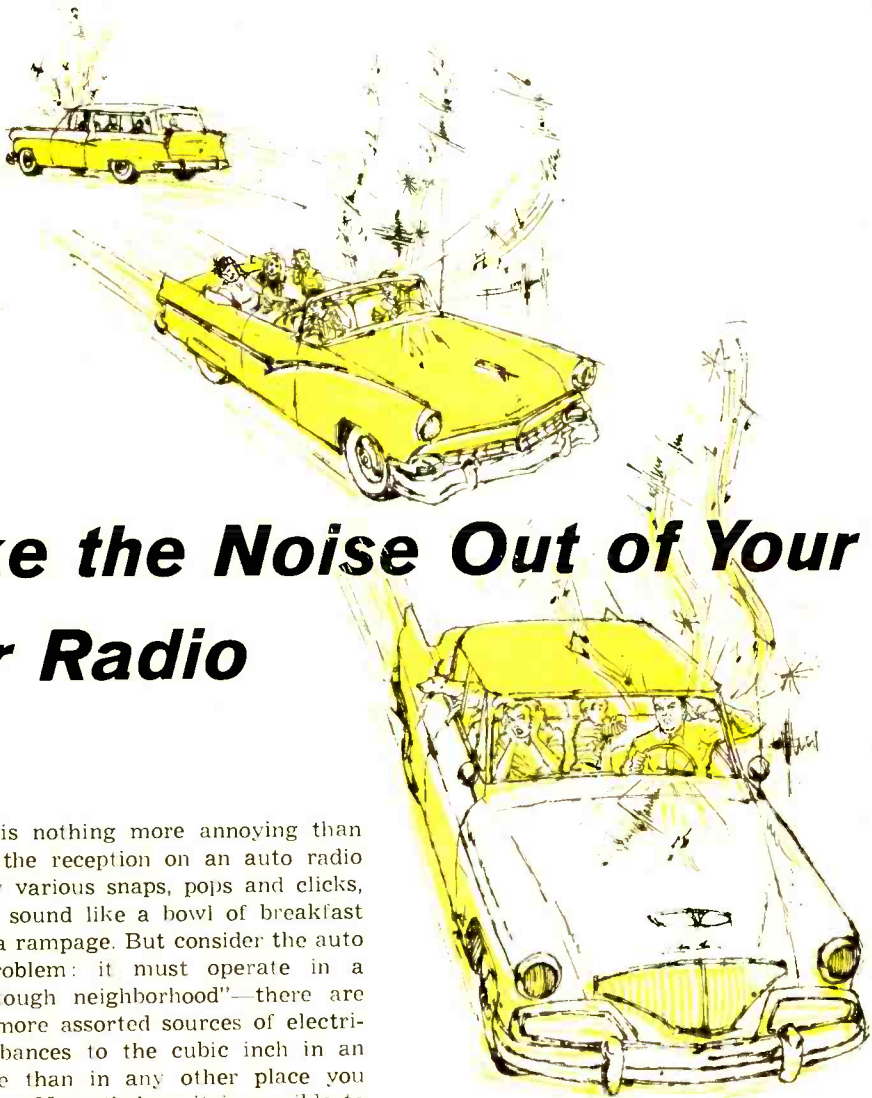


Fig. 2. Two-way system uses s.p.d.t. spring-return switch with single wire and common ground between stations.



Take the Noise Out of Your Car Radio

THERE is nothing more annoying than having the reception on an auto radio marred by various snaps, pops and clicks, making it sound like a bowl of breakfast cereal on a rampage. But consider the auto radio's problem: it must operate in a "mighty tough neighborhood"—there are probably more assorted sources of electrical disturbances to the cubic inch in an automobile than in any other place you could name! Nevertheless, it is possible to enjoy noise-free radio reception in a car if the proper methods are used to reduce or eliminate the noise.

Electrical Noise Types. Noise can be divided into three classes: pulse, hash and intermittent noise. *Pulse* noise is always regular in nature, a series of identical "pops"; *hash* is a continuous roaring or scratching sound; and *intermittent* noise can be made up of pops, clicks or other miscellaneous noises occurring at irregular intervals and resembling natural static. The *type* of noise you hear will give you the first clue as to its cause and location.

Causes of Noise. Figure 1 shows the potential trouble points in the electrical system of a typical car. Each of the parts

Part 1

You don't have to be a Sherlock Holmes to track down those interference sources . . . here are some trouble-shooting tips that will pay off in an improved music/noise ratio

By JACK DARR

shown will generate a different type of noise, with the ignition system being the worst offender.

Spark plugs are fired by means of a pulse of current generated in the ignition coil. This coil has two windings, a large secondary and a much smaller primary. There are cam-operated breaker points in the distributor which make contact at regular intervals. When the points close, a pulse of current is sent through the small primary winding, which induces a similar but much higher voltage pulse (up to 20,000 volts) in the secondary. This high voltage is fed, via the distributor, to the correct spark plug—where it arcs between the points, thus firing the cylinder.

You'll be able to identify this noise by the regular 'popping' sound in the speaker. Its frequency will vary directly with the engine speed, ranging from a slow "pop-pop-pop" at idling speed up to a fast "buzz" at high speeds. The box at the right of the "engine" in Fig. 1 shows what this noise looks like on an oscilloscope—a series of regular pulses, each beginning with a very high peak, then dying away rapidly.

The next potential noise source is the battery-charging system of the car: the generator and voltage regulator. Here, you'll find *two* types of noise, both of which are illustrated by oscillograms in Fig. 1. The first is a typical *hash* noise, from the brushes of the generator; this will be a sort of "growl" at low speeds and will change to a high whine as the engine is raced. The second is "voltage-regulator noise," and comes from an irregularly spaced fast-make-and-break of the relay points inside the regulator; it's an *intermittent* popping noise, and can easily be confused with spark plug noise until you learn to detect the slight difference.

Listen carefully to the noise; if it is all irregular, it is probably VR noise. Let the engine idle very slowly: at low speeds, the generator is not charging, and no current is flowing through the regulator. Then speed the engine up slowly and watch the ammeter. If the noise begins just as the ammeter shows a charge, or the "GEN" light goes out in cars not equipped with a dash ammeter, then it is definitely regulator noise. Spark plug noise, of course, is present at all times when the engine is running, and is usually slightly worse at low speeds, due to the longer duration of the sparks.

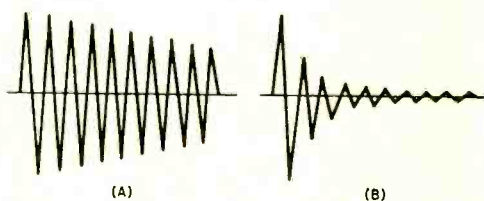


Noise-producing elements of a typical car electrical system with oscilloscope traces showing noise types.

Another—and very similar—noise, which confuses even the experts at times, comes from such instruments as the fuel gauge, oil pressure gauge, and similar equipment. Figure 1 shows only one of these, the fuel gauge, as they are all basically alike. In the fuel tank there's a small rheostat, actuated by a float mechanism, which "telemeters" information to your dashboard gauge. Battery current flowing through this circuit can cause an irregular noise, similar to VR noise.

To identify this noise source positively, turn the ignition switch on—but *don't* start the engine. With the radio turned up to high volume, but not tuned to a station, stamp heavily on the floor. Or kick the rear bumper. If you hear a loud "pop" whenever the car is jarred, you've got fuel-gauge noise.

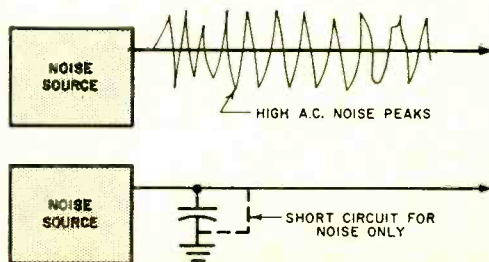
Suppressing Noise. There are two ways of eliminating electrical noises in any car: *suppression* and *bypassing*. Suppres-

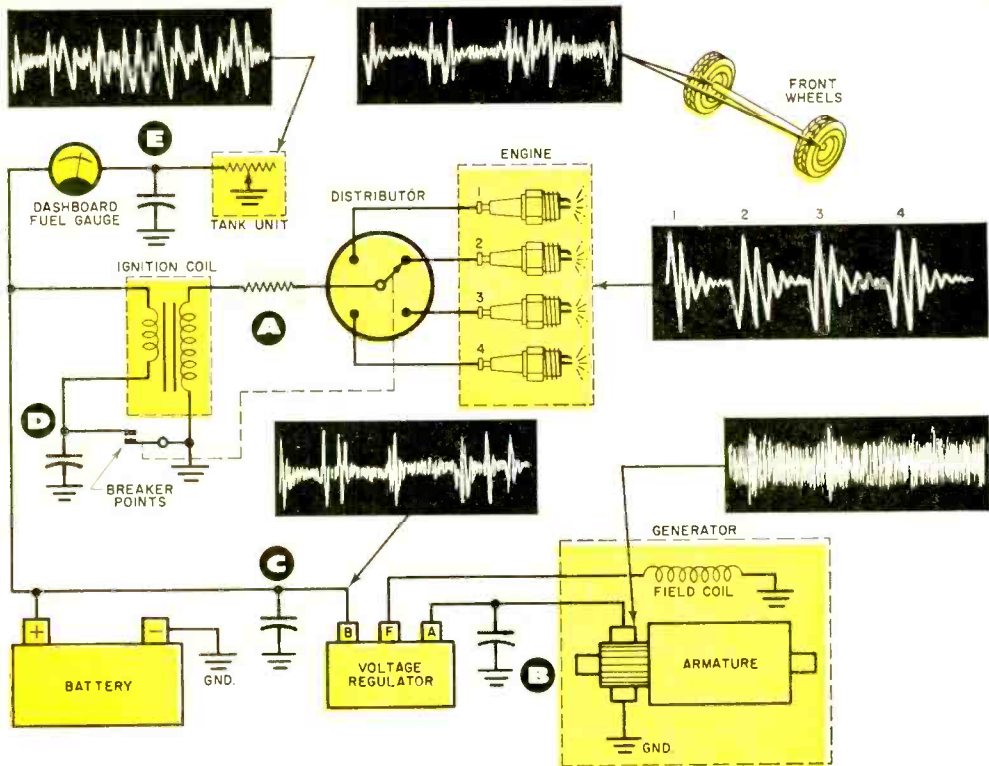


Waveform of an ignition pulse before suppression (A), and after installation of suppression resistor (B).



Inserting a bypass capacitor in a noise-carrying d.c. line effectively "shorts out" the a.c. noise peaks.

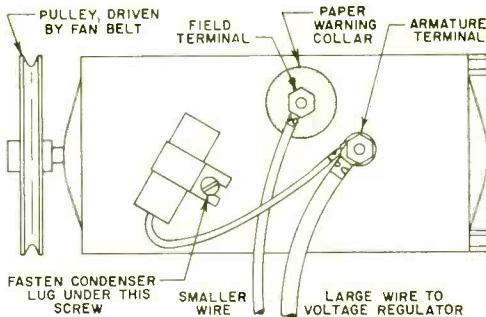
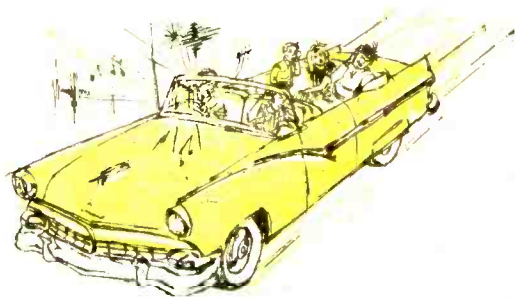




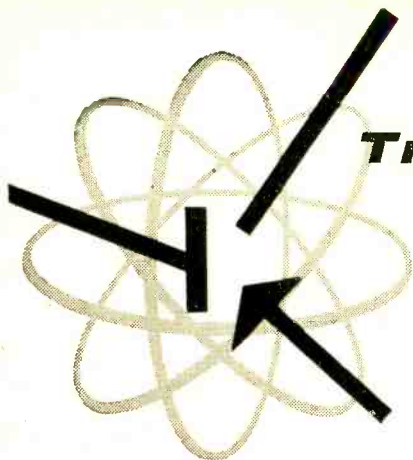
sion is used only in the ignition system, and always on the high-voltage side. It means putting a large resistor in series with the offending pulses, to "damp" their peaks, as shown in Fig. 2. The undamped pulses of an ignition system are shown in Fig. 2(A). By adding a 10,000-ohm resistor in series with the circuit, as shown in Fig. 1(A), we can cut down both the peak amplitude and total duration of the pulse.

Specially built carbon resistors are installed in the high-voltage lead between the ignition coil and the distributor cap. This puts the resistor closest to the place where the most bothersome arc occurs, at the distributor cap. The resistors are made in three types. To install the "cable type" (1) which has hollow threaded ends, cut the wire in the center, and screw the two wire ends into the threaded portion of the suppressor. The plug-in type (2) is provided with sockets and plugs, and the wires from the distributor are simply pulled off and plugged into the suppressor and the suppressor plugged into the distributor. A special resistance lead (3), which looks exactly like ordinary wire, but has 10,000

(Continued on page 123)



Armature brush noise of the generator is eliminated by a bypass capacitor which is installed directly on the generator housing.



Transistor Topics

By LOU GARNER

WHEN December 25th dawns crisp and cold, many happy individuals will find transistor radios under their Christmas trees. Small, useful, attractive, and not overly expensive, personal receivers are among the nicest of presents; and they have the added advantage of being suitable for almost any individual, regardless of age, sex, or personal interests.

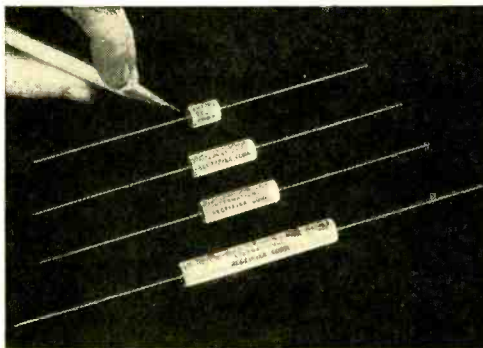
A very high percentage, if not a majority, of the transistorized receivers distributed this holiday season will be of Japanese manufacture, for imports of Japanese-made electronic equipment are running at an all-time high. In 1958, for example, Japan exported more than two-and-a-half million receivers to the United States. Final figures are not in yet for 1959, but there's a good chance that the total will be close to 4,000,000 sets—with a majority of these being transistorized portables.

Interestingly enough, not all "Made In Japan" receivers carry recognizable Japanese brand-names. A number of American manufacturers are buying components in Japan for assembly here under a "Made In U. S. A." tag. Others have contracts with Japanese manufacturers to produce some receiver models under their own brand-names. To such well-known Japanese brands as Sony, Yashica, and Hitachi, then, we can add a number of receiver models distributed by Channel Master, Motorola, and Bulova. Many of the largest of U. S. manufacturers have working agreements with Japanese firms, including such outfits



Transistorized hearing aid now available from Sonotone is no larger than a man-sized thumbnail.

Silicon cartridge rectifiers introduced by International Rectifier have peak inverse voltage ratings from 600 to 10,000 volts.

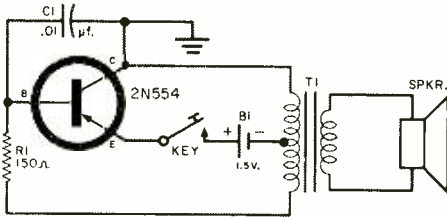


as RCA, General Electric, Western Electric, and Motorola.

At one time, Japanese-made products were frequently poorly executed copies of American, German, Swiss, and British designs. No longer. Today the majority of Japanese imports are of good quality and, often, represent a high order of creative

engineering. For example, Japan's famous Sony Corporation, as this is written, is the only firm in the world producing a fully transistorized AM-FM portable receiver. And in addition to portable receivers, Japanese firms are producing transistorized tape recorders, portable stereo phonographs, radiophonographs, hearing aids and intercoms.

Readers' Circuits. Looking for a good present for a budding electronics technician or a beginning radioman? You might consider the merits of a transistorized code practice oscillator (CPO). If the prospec-

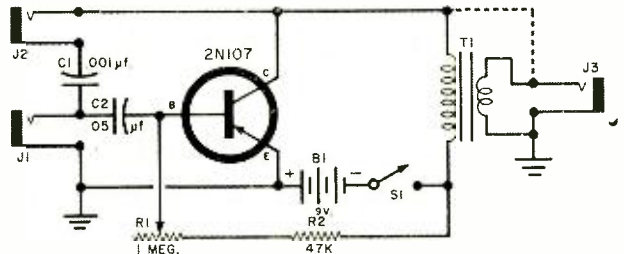


modified Hartley oscillator arrangement, with *T1* providing the feedback necessary to start and maintain oscillation and also matching the transistor to the loudspeaker's voice coil impedance. Base bias is supplied through the transformer's primary and limited by *R1*. Capacitor *C1* helps determine output frequency (or "tone"). Operating power is supplied by *B1*, controlled by the hand key serving as a s.p.s.t. power switch.

Bob suggests assembling the CPO on a small aluminum chassis; he used a "surplus" pie pan measuring 6" x 4½" x 1½".

Fig. 1. Reader Robert Bari's low-cost code practice oscillator circuit.

Fig. 2. Greg Lupfer's circuit can be used as a CPO or an audio amplifier.



ive recipient is on the young side, you can assemble one yourself, presenting the youngster with a ready-to-operate unit. On the other hand, if he has learned to wield a soldering iron and can handle a pair of "dikes" and long-nose pliers without mishap, your gift may well consist of the necessary parts for CPO assembly, plus a diagram, and, if needed, a little professional advice. Here are two suitable low-cost CPO circuits.

Submitted by Robert Bari (207 N. Washington Ave., Bergenfield, N. J.), the circuit shown in Fig. 1 requires only seven electrical parts, is powered by a single size "D" flashlight cell, and can be assembled quite easily in an hour or so. According to Bob, this unit supplies ample output power for group code practice.

A *p-n-p* power transistor is used in a

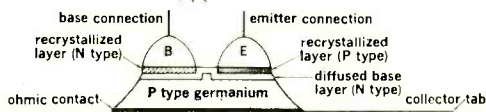
The chassis serves not only as a mounting base for the circuit but also as a heat sink for the power transistor; note that the 2N554's collector is connected directly to circuit ground. *T1* is a standard power transistor output transformer (Argonne No. AR-503), and *R1* is a ½- or 1-watt resistor. Try values for *C1* from 0.01 μ f. to 0.1 μ f., finally installing the unit which gives the most pleasing tone. For best results, use as large a PM loudspeaker as you can, preferably from 4 to 8 inches (or larger).

The circuit in Fig. 2, submitted by Greg Lupfer (513 E. 2nd St., Litchfield, Minnesota), can be used either as a small "booster" audio amplifier or as a CPO, depending on how connections are made to jacks *J1*, *J2*, and *J3*. It is an excellent project for the gadget-minded hobbyist.

In operation, a *p-n-p* transistor is used as



Fig. 3. The new Amperex OC170 transistor has a cutoff frequency of 70 mc., made possible through the use of a very thin base layer.



a conventional common-emitter amplifier. The input signal is supplied through jack *J1* and d.c. blocking capacitor *C2* to the transistor's base-emitter circuit. Base bias is supplied through *R1* and current-limiting resistor *R2*. The amplified signal appearing across the secondary winding of impedance-matching transformer *T1* is available at jack *J3*. When the circuit is used as a CPO, the feedback needed to sustain oscillation is obtained from the transistor's collector and coupled back through *J2* and *C1* to the base circuit. Operating power is supplied by a single 9-volt battery.

You can duplicate Greg's combination instrument by assembling the circuit on a small metal chassis or a fiber board. Layout and lead dress are not critical. Note that *J2* is insulated from circuit ground. Transformer *T1* is a standard transistor output transformer (Argonne No. AR-167, for example). Although a G.E. type 2N107 transistor is specified, any *p-n-p* transistor with similar characteristics can be used in this circuit; suitable alternates are the 2N34, CK722, GT-222, and so on. You can employ *n-p-n* types if *B1*'s polarity is reversed.

To use the completed instrument as an audio amplifier, connect your signal source to *J1* and your output load—such as a small PM loudspeaker or a pair of earphones—to *J3*. Turn the instrument on and adjust *R1* for optimum operation.

To use it as a CPO, connect a standard hand key to *J2* and your earphones to *J3*,

and adjust *R1*, holding the key depressed. Try values from 0.001 $\mu\text{f.}$ to 0.1 $\mu\text{f.}$ for *C1*, installing the final value which gives the most pleasant tone. In some cases, you may find that better results are obtained if the feedback signal is taken from *T1*'s secondary winding rather than the transistor's collector circuit, as shown. Note the connection indicated by a dotted line in Fig. 2: if you are unable to obtain oscillation with this connection, try reversing *T1*'s secondary leads.

New Transistor. Introduced recently by the Amperex Electronic Corporation (Hicksville, L. I., N. Y.), the OC170 is a low-cost v.h.f. germanium transistor. Designed for use as a mixer-oscillator for mobile radio equipment, car radios and short-wave receivers, and as an r.f. or i.f. amplifier for FM receivers, this unit has *p-n-p* characteristics and a cutoff frequency of 70 mc. Its average beta is 80.

The OC170's excellent high-frequency characteristics result from a new manufacturing process which permits the formation of an extremely thin base layer having a short transit time. The process represents a combination of the best features of the well-known alloying and diffusion techniques.

In practice, the transistor is built up on a piece of *p*-type germanium. Two small metal pellets are placed on it; pellet *B*, the base pellet, contains only an *n*-type impurity, while pellet *E*, the emitter pellet, contains both *p*-type and *n*-type impurities. The resulting assembly is heated, with the germanium dissolving into the metal pellets until saturation is reached, and the pellet impurities diffusing into the solid germanium.

The *p*-type impurity in pellet *E* has a low diffusion constant and, therefore, very little penetration. The *n*-type impurities used in both pellets have a greater diffusion constant and readily penetrate the germanium, forming a diffused *n*-type layer. When cooled, the layer of germanium recrystallizes as in normal alloying.

The result (as shown in Fig. 3), is a *p*-type collector, a thin diffused *n*-type base layer, and a *p*-type emitter. Connections are made to the original *p*-type germanium and to the two metal pellets.

The new Amperex process makes possible base layers only a few microns thick. It is easily controlled, assuring a high yield

(Continued on page 113)

Across the Ham Bands

By
HERB S. BRIER
W9EGQ

TVI—Causes and Cures

MY young friend, Jim, really looked down in the dumps when he walked into my shack. "What's wrong, Jim," I asked. "Burn out your last 6146?"

"Worse! I've got television interference! The neighbors for about half a block around our house are mad at me. And my own family half blames me every time *our* TV picture jumps."

"But when did this all start? You never had TVI trouble before."

"Well, Herb, I think it began when I switched to the higher frequency bands. When I worked 80 and 40, my TVI was nil. Oh, maybe I'd put a line on my own TV once in a while, but that's all. But now—boy! When I fire up on 10, 15 and 20, some of the neighbors complain that I kill the picture on their best channel. And that crank next door says I'm blotting out *all* the channels. In *my* house, I clobber chan-

nel 2 on the new 17" set in the living room when I'm on 10 and 20, but I don't bother the other channels. On that old 12-incher in my shack, though, all the channels go bad. I guess a certain amount of TVI is inevitable. . . ."

Without saying a word, I switched my TV set to channel 2 and tuned my transmitter to 29 mc. I picked up my microphone and said: "Hello test. This is W9EGQ."

Jim's jaw dropped. "By golly—no TVI! What's your secret, Herb?"

"Sit down, Jim," I said, "and get ready for your first lesson in TVI—its causes and its cures."

"Fundamental" Interference. The first step in curing TV interference is to find out what causes it. There are two main causes. Sometimes it's due to the offending transmitter radiating harmonics in a

Ham of the Month

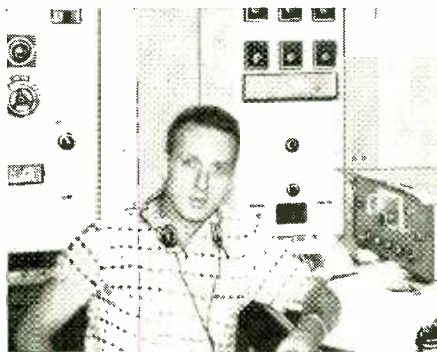
Our December "Ham of the Month" is Max V. Stout, K5CDA/Maritime-Mobile, Radio Officer, SS "Penn Shipper," Penn Shipping Co., 405 Park Ave., New York 22, N. Y. Max has another address in the call book, but he is more likely to be found in Calcutta, Port Said, or the Fiji Islands. He has a 35-wpm code certificate and is a member of the Rag Chewer's Club and the Old Timer's Club.

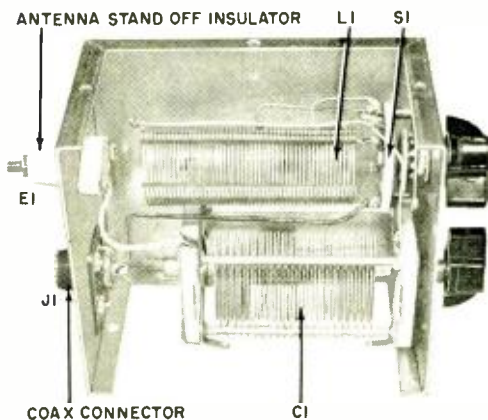
Max got his start as a ham in April, 1938, as W9JTY, and was active on the air until he joined the Navy in 1940. Aided by his ham experience, he quickly became a full-fledged radio man and spent World War II on various ships in the Pacific. He still recalls vividly the endless watches

spent with phones clamped tightly over his ears as code messages were exchanged to avoid revealing information to the enemy.

Since 1945, Max has been a sea-going commercial radio operator, except for two land hitches totaling 4½ years. On his last trip, he spent a continuous 30-hour radio watch getting help for a crew member seriously injured in a shipboard accident.

Transferring from ship to ship and conflicting rules and regulations often keep K5CDA off the air. When he is not able to transmit, Max likes to send reports to low-power stations he hears miles from nowhere. He receives on a Hammarlund HQ-160, and has an EICO 720 transmitter. Look for K5CDA on 15 meters.

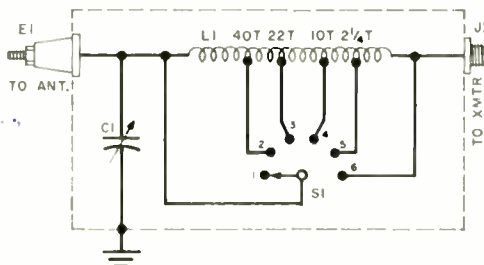




This antenna coupler will match your antenna to your receiver as well as to the transmitter. Scrape paint around coax connector mounting hole to assure good ground. See page 133 for details.

PARTS LIST

- C1—250- μ f. midget variable capacitor
- E1—Output insulator
- J1—Coaxial connector
- L1—48 turns of ≈ 20 wire, 1" dia., 3" long, tapped as shown (B & W 3015)
- S1—S.p., 6-pos. switch (Centralab PA-2001)
- 1—3" x 4" x 5" aluminum box



television channel. We'll talk about this a bit later. The second cause is the TV receiver not having sufficient selectivity to reject the *fundamental* signal from a nearby transmitter, even though the signal is far from the TV channels. The signal rides into the receiver along with the TV signal. "Fundamental" interference often affects several TV channels simultaneously, and operation on any ham band can cause it. It's most common on the 14-, 21-, 28- and 50-mc. bands because they are closest to the TV channels.

While older TV receivers are very susceptible to "fundamental" interference, a majority of the TV receivers manufactured in the last year have built-in high-pass filters and are almost immune to it. These filters greatly attenuate the frequencies below 40 or 52 mc. In any event, the standard cure for such interference is to connect a high-pass filter between the TV antenna and the TV receiver, installing it as close to the set's tuner as possible and grounding it to the chassis.

High-pass filters which cost about \$3.50 attenuate fundamental TVI about 60 db without affecting the strength of the TV signals. Those that sell for a dollar or so give about 20 db protection to the TV re-

ceiver from lower frequency signals, which is sufficient when TVI is not too heavy.

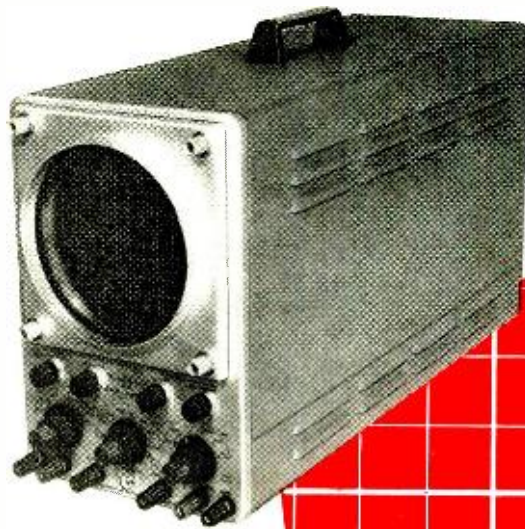
Transmitter Harmonics. If the installation of a high-pass filter doesn't eliminate the TVI, your problems are probably being caused by harmonics. All transmitters generate some harmonics in addition to their fundamental signals. If one of them falls in an occupied TV channel, it causes interference on that channel on nearby TV receivers. The second to fifth harmonics of the 14-, 21-, and 28-mc. amateur bands cause the most trouble, because they land in TV channels 2 to 6 (54 to 88 mc.) and are far stronger than the harmonics from the lower bands.

Connecting a low-pass filter between the transmitter and the antenna will cut the strength of these harmonics 60 to 90 db for a standard, multi-section filter (less for the "economy" models) with negligible effect on the fundamental signal. However, even though the harmonics are stopped by the low-pass filter, they can leak out through gaps in the transmitter shielding and via any conductor—power leads, key lead, etc.—which is not thoroughly bypassed and filtered before it leaves the transmitter.

(Continued on page 133)

**Assembles a
D.C. Oscilloscope**

**Special circuits
in Heathkit OR-1
achieve response
down to d.c.**



UNLIKE the common "garden variety" oscilloscope, the OR-1 kit now available from the Heath Company (Benton Harbor, Mich.) can be used to measure d.c. potential in addition to a.c. signals. Such d.c. measurement is made possible through the use of direct-coupled horizontal and vertical amplifiers which have no coupling capacitors between stages.

If you connect a battery to the input of a regular scope, the trace will jump and then return to its original position. Any d.c. signal applied to the input of the OR-1, on the other hand, will cause a proportional change in the deflection electrode voltage. At full gain, a 1.5-volt battery would cause the trace to deflect approximately 15 centimeters.

The vertical and horizontal amplifier sections are identical, which results in very little relative phase shift between channels. Although this scope is intended for "read-out" applications with computers, it is also useful for visual observation of electrocardiogram and electro-encephalogram sig-



nals. The bandwidth and phase-shift characteristics make the unit ideal for audio testing and alignment of single-sideband equipment.

Circuit Description. The input signal (either channel) is fed to a frequency compensated switched attenuator. Following the attenuator switch is a 6C4 cathode follower with a vernier gain control located in the cathode circuit. The 6C4 drives a 6BQ7 common-cathode phase splitter and voltage amplifier. Potentiometer *R12* varies the bias on one half of the 6BQ7 tube, thereby controlling the vertical position of the trace.

The plate signal is then directly coupled to the grids of a 12AU7 which amplifies the signal and couples it to the cathode-ray

tube's deflection plates. The CRT used is a 5ADP2 "flat-face" type. Approximately 2000 volts on this tube produces an extremely fine scanning spot; it is possible to make excellent 35-mm. photographs of events displayed on the face of the tube.

Both the sync and sweep sections are quite adequate. Sync signals are taken from the vertical amplifier (or from the external sync jack) and fed to a sync cathode follower, half of a 12AT7. This tube is direct-coupled to the sweep multivibrator which generates the time base for the oscilloscope. Another cathode follower (the other half of the 12AT7), couples the sweep signal to the horizontal amplifier system.

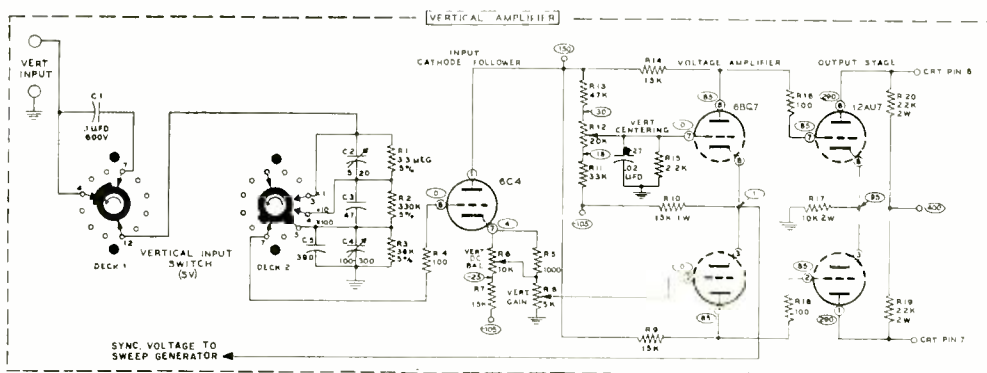
An external capacitor can be connected to the sweep generator to slow the time

The job is made easier by clear instructions, subassemblies, and a wiring harness.

The first thing that will impress you upon completion of the unit is its commercial appearance. The anodized front panel, two-tone lettering, and black and red knobs make it downright pretty!

Drift is a problem with some direct-coupled oscilloscopes. Every so often it is necessary to readjust the centering controls. Not so with the OR-1. The trace position settles down within two minutes, which is unusually good with this type of scope.

Two of the specifications in the instruction manual were found to be conservative. The bandwidth is listed as extending from d.c. to 200 kc. (1 db point). However, the scope is quite usable (for other than phase



Identical vertical and horizontal amplifiers are used in the OR-1 oscilloscope. A 6C4 cathode follower keeps the input impedance high and enables the use of a non-frequency discriminating gain control in the cathode circuit. The signal is then coupled to the upper half of a 6BQ7 by the voltage developed across the large cathode resistor R10 and continues in push-pull to the cathode-ray tube.

base down. For example, if a 20- μ f. capacitor were connected to the external capacity jack, it would take the spot approximately 20 seconds to cross the face of the tube.

The power supply consists of three separate sections. The "low" voltage portions provide positive voltages up to 450 regulated and unregulated and a negative 105 volts. Silicon rectifiers in a full-wave voltage doubler circuit are used, and the outputs are stabilized with gas regulator tubes. The negative high voltage is obtained by using a 1V2 tube as a half-wave rectifier.

Trying It Out. About 30 hours after you tack up the fold-outs and pictorial diagrams, you should be able to try out the unit. Understandably, there are many construction steps to a kit of this complexity.

measurements) out to 1 mc., or so. The phase shift (relative to the two channels) in the sample tested was only 2° at 200 kc. and virtually unmeasurable below 20 kc. When the OR-1 was used as an a.c.-coupled scope, the phase shift was about 3° at 8 cycles.

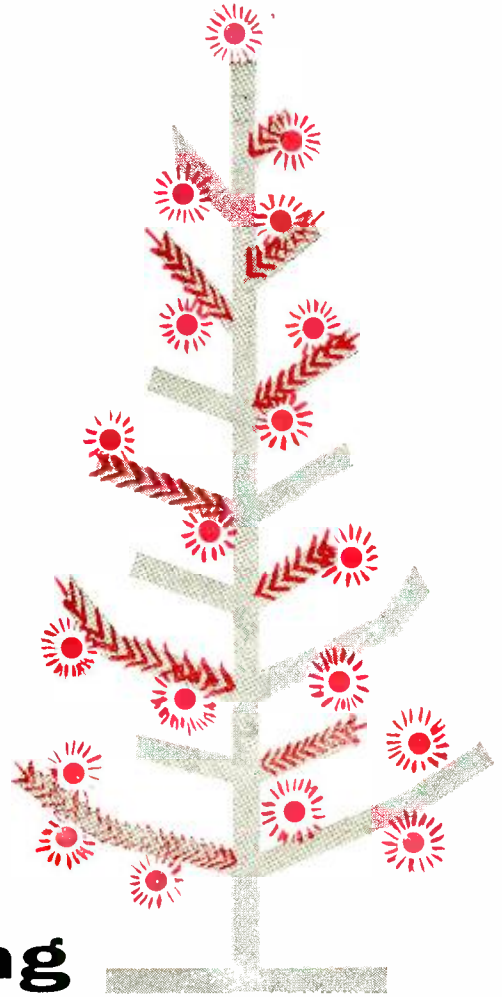
As with most scopes, it is difficult to synchronize low-level sine waves (less than 1 cm.). But sharp waveforms, such as square waves, snap right in at almost any level. The automatic sync feature will appeal to those not too familiar with scope operation.

All things considered, the Heath OR-1 looks like an excellent piece of engineering. If you want a better than average scope, or need the d.e. features the OR-1 provides, it is highly recommended.

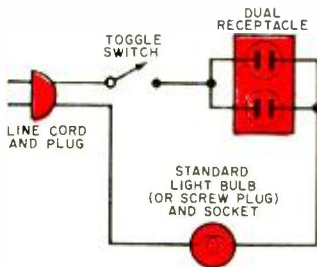
A SIMPLE rewiring job will make your Christmas tree lights burn cooler and last longer. The lights will produce a softer glow, and the tree won't dry out so fast because of excessive heat developed by the lights.

Series-String Lights. The amount of heat-producing current through series-string lights can be cut in half by just wiring two sets in series. Cut into the first set at any point and splice in the second set, using the wires that go to the second set's a.c. plug as connecting wires. You can either discard the extra a.c. plug or throw it in your junk box for later use.

Check the circuit resistance at the a.c.



Cooler Operating Christmas Tree Lights



plug of the first set when the wiring is completed. A reading from 100 to 500 ohms will indicate that the job was done correctly.

Parallel-String Lights. Reducing the current through parallel-string lights is almost as simple. Just wire an ordinary lamp socket in series with a dual receptacle (see diagram above). You can control the current through the lights by varying the wattage of the light bulb placed in the socket. A light bulb of between 40 and 150 watts should be about right, depending on the amount of brightness you want to cut down.

By A. C. LANGUIRAND

-30-

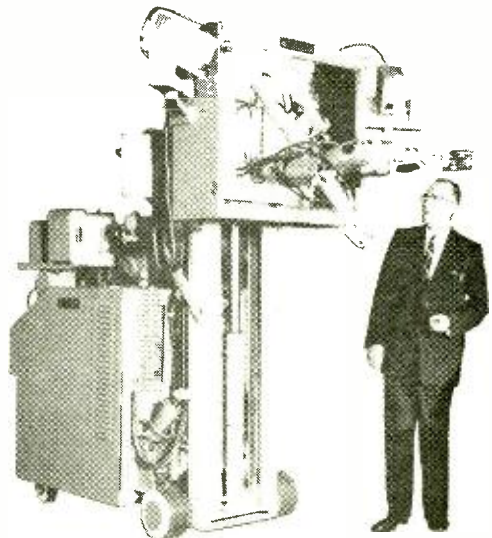


"Pocket-Sized" Missile Launcher

◀ The "Red-Eye," a new surface-to-air shoulder-fired guided missile system, is now being developed by Convair-Pomona under a contract totaling approximately \$6,000,000. Capable of shooting down low-flying jets or conventional aircraft, the Red-Eye can be carried and fired by one man. The U. S. Army and the Marine Corps plan to employ this device in terrain where no other type of anti-aircraft weapon can be transported. The four-foot 20-pound unit contains propellant, an electronic guidance system, and a warhead. (Authenticated News Photo)

Robot Robot

▶ "Man's replacement for man," the "Mobot Mark I," goes through some exercises to show its complete mobility, television camera "eyes," and steel arms that enable it to find, lift, and place objects. It was developed by Hughes Aircraft for use in the Atomic Energy Commission's "hot" labs at Albuquerque. The Mobot is operated from an R/C console at a safe distance from the radioactive area.



Portable TV System

◀ A four-piece completely portable TV station weighing only nine pounds has recently been engineered by Lockheed. The young lady is displaying the camera and control unit. In the foreground are the 50-watt FM transmitter and the power supply. The miniature system has a 1000-mile transmitting range and its picture quality compares with that of commercial television. Powered by a 28-volt battery, it is rugged enough to withstand being rocketed into space. (Authenticated News Photo)



By
JIM KYLE, K5JKX



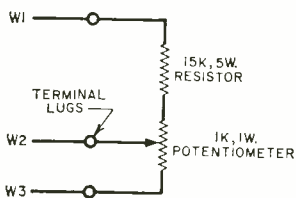
Soup Up Your AC-DC Short-Wave Receiver

ARE YOU HAVING TROUBLE separating the c.w. stations with your inexpensive short-wave receiver? How is the selectivity when you're working phone stations? If you own one of the many receivers which use an oscillating i.f. stage for c.w. reception, you can add this simple regeneration control to the i.f. stage and put new life into the old set. You'll find that AM reception is improved to the point where those weak phone stations will cut through the noise and static as never before.

Some of the receivers that use an oscillating i.f. stage include the Hallcrafters S-38 series (B through E) and the National SW-54, NC-60, and NC-66. The modifications are very simple and will cost \$5 or less, depending on the stock in your junk box. Results are excellent and are somewhat like the effect of adding a Q-multiplier.

Construction. The 1000-ohm, 1-watt potentiometer, the 15,000-ohm, 5-watt resistor, and the terminal strip are mounted in an aluminum box of any convenient size. Wire the components according to the schematic diagram and connect three 18" or longer leads (*W1*, *W2*, and *W3*) to each of the three "output" terminals. Run this three-wire cable through a grommet

Get more selectivity on c.w. and voice signals with a regen control



Twist wires W1, W2, and W3 into a three-conductor cable. Selectivity decreases as the arm of the pot is moved toward W1.

in the box. Now modify the receiver depending on the make and model as follows:

Hallcrafters S-38B through S-38E. Locate the cathode pin on the i.f. tube socket. In the S-38B, C, and D, this is pin 5 of the 12SG7, and in the S-38E it's pin 7 of the 12BA6. Solder wire W2 to this pin. Next, connect wire W3 to the negative lead of the power supply filter capacitor. Wire W1 is soldered to pin 4 of the 50L6 audio output tube in the S-38B, C and D, and to pin 6 of the 50C5 in the S-38E. Be careful not to short the three-wire cable to the chassis.

National SW-54, NC-60, NC-66. Locate pin 7 on the 12BA6 i.f. tube. Note that a 100-ohm resistor is connected from this pin to a nearby tie point. Disconnect the resistor lead from this tie point and solder the free end to wire W2. Now solder wire W3 to the tie point. Wire W1 is then soldered to pin 6 of the 50C5 audio output tube. Again, make sure that the wires do not

short against the chassis when you replace the chassis in the cabinet.

Using the Control. Turn on the receiver and let it warm up. Flip the AM-c.w. or "voice-code" switch to the c.w. or code position. If you have an S-38, flip the standby-receive switch to standby. Use of this switch eliminates extra wiring.

Turn the potentiometer control fully clockwise, then tune across your favorite band. If everything is working right, you'll hear a whistle on each station.

Now slowly turn the control counter-clockwise until the whistle just disappears. This is the proper operating point for receiving voice but you'll find that this setting varies according to the strength of the signal. For code, leave the control just at the point of oscillation.

As you tune across a signal now, you'll find the voices sound "bassier." Your increased selectivity is actually cutting some of the "highs" out of the signal. Advance the control for more "highs."

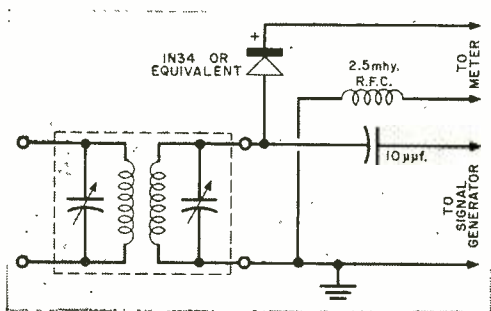
With the control nearly "off," the set will be almost dead to incoming signals; but as you turn it up, the i.f. stage gets more and more sensitive until the point of oscillation is reached. Flip the AM-c.w. switch back to AM to compare "before and after."

A few minutes' practice with the set after the surgery will tell you more about how to use it than any description could, so give it a try. You'll keep that low-priced receiver a while longer, for it will be doing its job and more besides.

-50-

Finding I.F. Transformer Frequencies

Haven't you often wished that you could determine the frequency of an unmarked i.f. transformer? Here's an easy way to do it. Use a signal generator and a sensitive milliammeter or low-range voltmeter

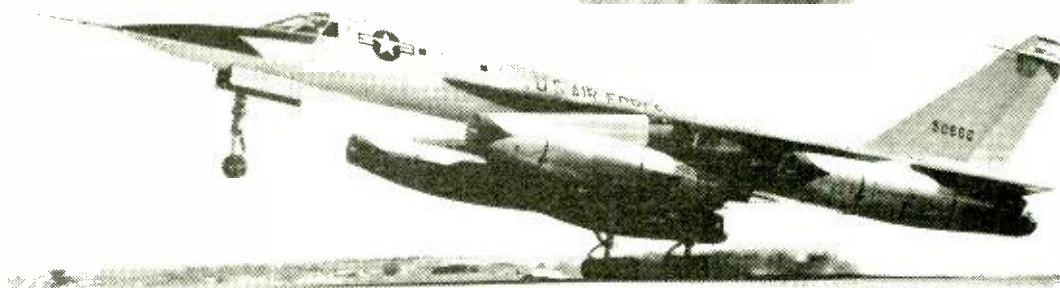


connected as shown in the diagram. When the signal generator is tuned to the resonant frequency of the transformer, a sharp rise in the meter reading will result. A 5000-ohms-per-volt meter will be sensitive enough for most applications, but if the signal generator used has a low output, try a 20,000-ohms-per-volt unit or a VTVM to obtain a satisfactory reading.

—Robert B. Kuehn

As a former serviceman, your skill could be valuable to the U.S. Air Force. If so, the Air Force has an important job and a guaranteed future waiting for you in this new Age of Space. You'll work with the most modern equipment and learn the newest techniques of your specialty. And don't forget: your previous service counts toward rank, pay and retirement income. Talk it over with your local Air Force Recruiter, or mail the coupon.

**FORMER SERVICEMEN:
YOUR EXPERIENCE
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NEW AGE OF SPACE**



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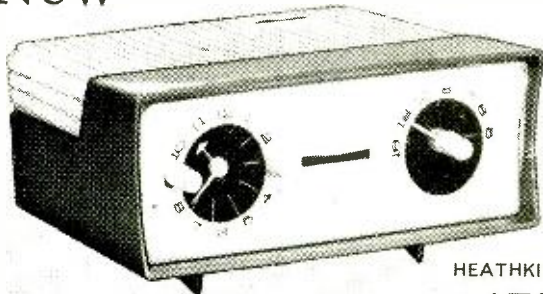
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Transistor Clock Radio Kit

New



HEATHKIT TCR-1

\$45⁹⁵



LEATHER CARRYING CASE
HEATHKIT No. 93-3
Shpg. Wt. 2 lbs.

\$4⁹⁵

Everything A Clock Radio Can Offer And Portable Too!

- Completely portable, all transistor circuit
- Runs up to 500 hours on standard batteries
- Deluxe features at half the cost
- Easy to assemble—even by beginners

"YOUR CUE" TRANSISTOR CLOCK RADIO KIT (TCR-1)

Take all the deluxe features found in the most expensive clock-radios, add the convenience of complete portability, plus a modern 6-transistor battery operated circuitry . . . then slash the price at least in half, and you have the new HEATHKIT "Your Cue", Transistor Portable Clock Radio.

Packing every modern clock-radio feature into a compact, beautifully styled turquoise and ivory plastic cabinet, "Your Cue" lulls you to sleep, wakes you up, gives you the correct time and provides top quality radio entertainment any time, any place. It can also be

used with the Heathkit Transistor Intercom system, below, to provide music or a "selective alarm" system.

An "alarm-set" hand, hour hand, minute hand and sweep second hand grace the easy-to-read clock dial. The "lull-to-sleep" control sets the radio for up to an hour's playing time, automatically shutting off the receiver when you are deep in slumber. Other controls set "Your Cue" to wake you to soft music or conventional "buzzer" alarm. A special earphone jack is provided for private listening or connection to your intercom or music system.

Six easily obtainable penlight-size mercury batteries power the radio receiver up to 500 hours, while the clock operates up to 5 months from a single battery of the same type. Ordinary penlight cells may also be used, with reduced battery life. The handsome two-tone cabinet, measuring only 3¹/₂" H. x 8" W. x 7¹/₂" D. fits neatly into the optional carrying case for beach use, boating, sporting events, hunting, hiking or camping. Shpg. Wt. 5 lbs.

Transistor Intercom Kit


Master unit can call any one, any combination, or all five remote stations. Remote stations can turn system "on" and call another. Each remote unit equipped with "privacy" switch. Master unit can be connected to new transistor clock-radio shown above (or any radio not AC-DC operated) to supply music or alarm to system; separate listen and talk volume controls; handsome case of two-tone ivory and turquoise high-impact plastic. Remotes are "look-alike" miniatures of master. Eight flashlight batteries power system up to 300 hours. Master and remotes sold separately; order up to five remote stations for each master station ordered.

INTERCOM AC POWER SUPPLY (XP-1): Adapts Intercom for permanent operation from household AC current. Fits in space normally occupied by battery supply. Shpg. Wt. 2 lbs. Heathkit XP-1 \$9.95



BATTERIES NOT INCLUDED
HEATHKIT XI-1 Master. **\$27⁹⁵**
Shpg. Wt. 6 lbs.
HEATHKIT XIR-1 Remote. **\$6⁹⁵**
Shpg. Wt. 4 lbs.

HEATH COMPANY / Benton Harbor, Michigan

 a subsidiary of Daystrom, Inc.

New Stereo Amplifiers

14/14-WATT STEREO AMPLIFIER KIT (SA-2)

A complete dual channel amplifier/preamplifier combination the new Heathkit SA-2, in one compact, handsomely styled unit provides all the modern features required for superb stereo reproduction... yet is priced well within your budget.

The SA-2 delivers 14 watts per stereo channel, and 28 watts total monophonic. Maximum flexibility is provided by the 6-position function switch which gives you instant selection of "Amp. A" or "Amp. B" for single channel monophonic; "Mono. A" or Mono. B" for dual channel monophonic using either preamp with both amplifiers; and "stereo" or "stereo reverse". A four position input selector switch provides choice of magnetic, phono, crystal phono, tuner, and an extra high level auxiliary input for use with tape recorder, TV, etc. The magnetic input is RIAA equalized and features 3 mv sensitivity - adequate for the lowest output cartridges available today.

The dual-concentric volume control is equipped with a friction clutch which can be set to lock the two controls together once the balancing of the two amplifiers has been accomplished.

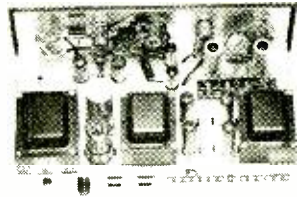
Ganged dual tone controls adjust bass and treble response of both channels simultaneously. Proper speaker phasing may be conveniently accomplished with the speaker phase reversal switch located on the rear chassis apron. A hum balance control is provided for each channel. Two AC outlets, one controlled by the power switch, provide convenient accommodation for accessory equipment. As beautiful as it is functional, the SA-2 features the latest Heathkit styling in vinyl-clad steel with leather-like texture in black with inlaid gold design. Shpg. Wt. 23 lbs.

SPECIFICATIONS—Power output: 14 watts per channel, "hi-fi"; 12 watts per channel, "professional"; 16 watts per channel, "utility". **Power response:** ± 1 db from 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc mixed 4:1. **Hum and noise:** mag. phono input 47 db below 14 watts; tuner and crystal phono, 65 db below 14 watts. **Controls:** dual clutched volume; ganged bass; ganged treble; 4-position selector; speaker phasing switch. **AC receptacle:** 1 switch; 1 normal. **Inputs:** 4 stereo or 8 monophonic. **Outputs:** 4, 8 and 16 ohms. **Dimensions:** 4 3/4" H. x 15" W. x 8" D. **Power requirements:** 117 volt, 50/60 cycle, AC, 150 watts (100W).

best stereo buy ever!



HEATHKIT SA-2
\$52⁹⁵

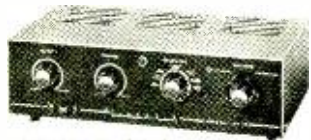


ECONOMY STEREO AMPLIFIER KIT (SA-3)

This amazing performer delivers more than enough power for pure undistorted room-filling stereophonic sound at the lowest possible cost. Featuring 3 watts per stereo channel and 6 watts as a monophonic amplifier, the SA-3 has been proven by exhaustive tests to be more than adequate in volume for every listening taste. You will find its ease of assembly another plus feature. Heathkit construction manuals, world famous for their clarity and thoroughness, lead you a simple step at a time to successful completion of the kit. Tastefully styled in black with gold trimmed control knobs and gold screened front and rear panel. A tremendous buy at this low Heathkit price. Shpg. Wt. 13 lbs.

SPECIFICATIONS—Power output: 3 watts per channel. **Power response:** ± 1 db from 50 cps, 20 kc at 3 watt output. **Total harmonic distortion:** less than 3%, 60 cps to 20 kc. **Intermodulation distortion:** less than 1% at 3 watts output using 60 cps and 6 kc mixed 4:1. **Hum and noise:** 55 db below full output. **Controls:** dual clutched volume; ganged bass; ganged treble; 7-position selector; speaker phase reversal switch; on-off switch. **Inputs (each channel):** tuner, crystal or ceramic phono. **Outputs (each channel):** 4, 8, 16 ohms. **Finish:** black with gold trim. **Dimensions:** 12 1/2" W. x 6 1/2" D. x 3 1/2" H.

Go stereo for just \$29.95



HEATHKIT SA-3
\$29⁹⁵

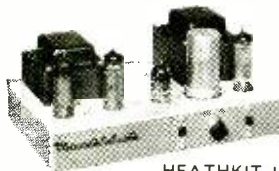
New Amplifiers



HEATHKIT EA-3
\$29⁹⁵



HEATHKIT FM-4
\$34⁹⁵



HEATHKIT UA-2
\$22⁹⁵



HEATHKIT W-7A
\$54⁹⁵



"BOOKSHELF" 14-WATT HI-FI AMPLIFIER KIT (EA-3)

Without doubt one of the finest investments you can make in a top quality amplifier and preamplifier combination. Features three switch-selected inputs, separate bass and treble tone controls, RIAA equalization and a special hum balance control. Tastefully styled in black simulated-leather with brushed gold trim. Shpg. Wt. 15 lbs.

NOTE THESE OUTSTANDING SPECIFICATIONS—Power output: Hi-Fi rating 14 watts; Professional rating 12 watts. **Power response:** ± 1 db 20 cps to 20 kc at 14 watts output. **Total harmonic distortion:** less than 2%, 30 cps to 15 kc at 14 watts output. **Intermodulation distortion:** less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. **Hum and noise:** mag. phono input 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts. **Output impedances:** 4, 8 and 16 ohms.

HIGH FIDELITY FM TUNER KIT (FM-4)

This handsomely styled FM tuner features better than 2.5 microvolt sensitivity, automatic frequency control (AFC) with on-off switch, flywheel tuning and prewired, prealigned, and pretested tuning unit. Clean chassis layout, prealigned IF transformers and assembled tuning unit makes construction simple and guarantees top performance. Flywheel tuning and new soft, evenly lit dial scale provide smooth, effortless operation. Housed in attractive vinyl-clad steel case with gold design and trim. A multiplex adapter output is also provided. Your best buy in an FM tuner. Shpg. Wt. 8 lbs.

UNIVERSAL 14-WATT HI-FI AMPLIFIER KIT (UA-2)

Living up to its title "universal" the UA-2 performs with equal brilliance in countless Hi-Fi and PA applications. Easily meets 14 watt hi-fi and 12 watt professional standards. Power response is ± 1 db from 20 cps to 20 kc at 17 watts output. Harmonic distortion is less than 2% and IM distortion is less than 1% at 14 watts output. Output taps are provided for 4, 8 and 16 ohm speakers. High quality, remarkable economy and ease of assembly make it one of the finest values in high fidelity equipment. Shpg. Wt. 13 lbs.

55-WATT HI-FI AMPLIFIER KIT (W7-A)

Best buy in its power class! Combines modern components, unique output transformer, power supply and circuit design to bring you a superb high fidelity amplifier at less than a dollar a watt. Power response is ± 1 db from 20 cps to 20 kc at full 55 watt output. Total distortion is less than 2% at full output. Output taps are 4, 8 and 16 ohms plus 70 volt line for use in wired music systems. On-off switch, gain control, and max, or unity damping switch are located on the front panel. Clean, open circuit layout are precut, cabled wiring harness for easy assembly. Shpg. Wt. 28 lbs.

STEREO-MONO PREAMP KIT (SP-2A, SP-1A)

Available in two outstanding versions! SP-2A (stereo) and SP-1A (monophonic). SP-1A convertible to stereo with conversion kit C-SP-1A. Use as the control center of your entire high fidelity system. Six inputs in each channel accommodate most any program source. Switch selection of NARTB or RIAA, LP and 78 rpm record compensation.

HEATHKIT SP-2A (two-channel stereo). Shpg. Wt. 15 lbs. **\$56.95**
 HEATHKIT SP-1A (single-channel monophonic). Shpg. Wt. 13 lbs. **\$37.95**
 HEATHKIT C-SP-1A (converts SP-1A to SP-2A). Shpg. Wt. 4 lbs. **\$21.95**

New Tape Recorders



Have fun making your own recordings with one of these outstanding tape recorder kits

STEREO MONO TAPE RECORDER KITS

Our most versatile tape recorder kit, you can buy the new two-track (TR-1AH) or four-track (TR-1AQ) versions which record and playback both Stereo and Monophonic programming or the two-track Monophonic record-playback version (TR-1A). Precision bearings and close machining tolerances hold flutter and wow to less than 0.35%. NARTB equalization, separate record and playback gain controls and a safety interlock. Provision for mike or line inputs with 6E5 "magic eye" tube as sound level indicator.

MODEL TR-1A: Monophonic two-track record/playback with fast forward and rewind functions. Includes one TE-1 Tape Electronics Kit. Shpg. Wt. 24 lbs. \$10.00 DN., \$3.00 MO. **\$99⁹⁵**

MODEL TR-1AH: Two-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-1 Tape Electronics Kits. Shpg. Wt. 26 lbs. \$15.00 DN., \$13.00 MO. **\$149⁹⁵**

MODEL TR-1AQ: Four-track monophonic and stereo record/playback with fast forward and rewind functions. Two TE-1 Tape Electronics Kits. Shpg. Wt. 36 lbs. \$15.00 DN., \$13.00 MO. **\$149⁹⁵**

PROFESSIONAL QUALITY TAPE RECORDER KITS

Precision tape mechanism complete and tested, build only the amplifier. Two circuit boards for easy assembly, and high stability. Separate record and playback heads and amplifiers for monitoring while recording. Includes sound level meter, counter, pause control, record interlock, 2 (switch-selected) speeds 3 $\frac{3}{4}$ and 7 $\frac{1}{2}$ IPS. Response: ± 2.5 db 30 to 12,000 cps at 7 $\frac{1}{2}$ IPS. NARTB equalization. Compares to \$350 to \$400 units. Shpg. Wt. 30 lbs.

MODEL TR-1E: 4-track stereo playback, monophonic record & play. **\$169⁹⁵**

MODEL TR-1D: 2-track stereo playback, monophonic record & play. **\$169⁹⁵**

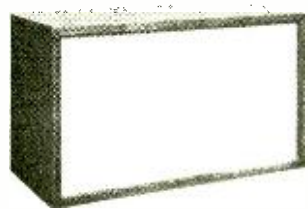
MODEL TR-1C: monophonic record playback. **\$159⁹⁵**

MODEL C-TR-1D: converts TR-1D to TR-1E, 2 lbs. **\$14.95**

MODEL C-TR-1C: converts TR-1C to TR-1D, 2 lbs. **\$19.95**

MODEL C-TR-1CQ: converts TR-1C to TR-1E, 2 lbs. **\$19.95**

New Acoustic Suspension Hi-Fi Speaker System Kit



HEATHKIT AS-2M
\$79⁹⁵

HEATHKIT AS-2U
\$69⁹⁵

HEATHKIT AS-2B
\$79⁹⁵

The Acoustic Research speaker is accepted as most praiseworthy in the world of hi-fi sound reproduction. Heathkit, sole kit licensee from AR Inc., now offers a kit version of this remarkable speaker system in money saving, easy to build form. The 10" acoustic suspension woofer delivers clean, clear extended range bass response and a specially designed "cross-fired" two-speaker tweeter assembly provides outstanding high frequency distribution. Response at 10 watts input ± 5 db from 42 to 14,000 cps. Impedance 8 ohms. Cabinets are preassembled and available prefinished in birch or mahogany and unfinished in furniture-grade birch only. Shpg. Wt. 32 lbs.

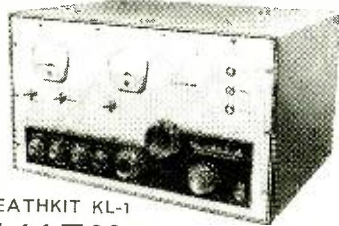
HEATH COMPANY / Benton Harbor, Michigan  a subsidiary of Daystrom, Inc.

New



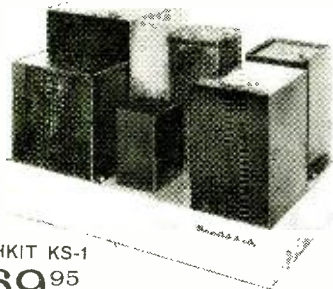
Ham Radio Gear

Maximum power
at minimum cost



HEATHKIT KL-1
\$415⁰⁰

Top power,
plus economy and safety



HEATHKIT KS-1
\$169⁹⁵



HEATHKIT XC-2
\$36⁹⁵



HEATHKIT UT-1
\$28⁹⁵

"CHIPPEWA" KILOWATT LINEAR AMPLIFIER KIT (KL-1)

Operates at maximum legal amateur power inputs in SSB, CW or AM service using any of the popular CW, SSB and AM excitors as a driver. Premium tubes (4-400's) push the "Chippewa" to top performance levels while a centrifugal blower provides maximum cooling. Shpg. Wt. 70 lbs.

SPECIFICATIONS—RF section: Driving power required (10 meter): Class AB1 (tuned grid) 10 watts peak; Class C (tuned grid) 10 watt; Class AB1 (swamp- J grid) 60 watts peak. **Power input:** Class AB1 (SSB voice modulation) 1000 watts PEP; Class AB1 (SSB-400 tone) 1000 watts; Class AB1 (AM linear) 1000 watts; Class C (CW) 1000 watts. **Power output (20 meters):** Class AB1 (SSB-voice modulation) 300 watt PEP; Class AB1 (SSB-400 tone) 150 watts; Class AB1 (AM linear) 300 watts; Class C (CW) 750 watts. **Output impedance:** 50 to 75 ohms (unbalanced). **Band coverage:** 80, 40, 20, 15 and 10 meters. **Panel metering:** 0 to 50 ma, grid current; 0 to 100 ma -green current; 0 to 5000 plate-volt; 0 to 1000 ma plate-current. **Tube complement:** Five 1 tubes, (2) 4-400's; 6C4; 6X4; 6Y6; 6BD6; 6X4; 6Y6; 6X4; 6Y6. **Power requirements:** AC (pub. r supply primary circuit), 250 watts, 115 volt, 50/60 cycles; DC, 3000 to 4000 volts, 450 ma. **Cabinet size:** 19 1/2" W. x 11 1/2" H. x 10" D.

KILOWATT POWER SUPPLY KIT (KS-1)

Ideal companion for the "Chippewa" Linear Amplifier . . . and supplies plate power to most other RF amplifiers in medium to high power class. Features oil-filled, hermetically sealed plate transformer and 60 second time delay relay. Shpg. Wt. 105 lbs.

SPECIFICATIONS—Maximum DC power output: 1500 watts. **Nominal DC voltage output:** 3000 or 1500 volts. **Maximum DC current output:** Average 500 ma, peak 1000 ma. **Regulation:** 150 to 650 ma (typical linear amplifier), 8% to 300 ma (typical class C amplifier), 10%; 0 to 500 ma, 15%. **Ripple:** Less than 1%. **Tube complement:** (1) 800A mercury vapor rectifier. **Recommended ambient temperature:** 50 to 100 degrees F. **Circuit:** Two half-wave, mercury vapor rectifiers in a full wave, single-phase configuration with swinano chow input filtering. **Line power requirements:** 115 V, 50/60 cycles, 20 amperes; 230 V, 50/60 cycles, 10 amperes. **Chassis size:** 17 1/2" W. x 12" H. x 13" D.

2 METER CONVERTER KIT (XC-2)

Extends coverage of the Heathkit "Mohawk" Receiver to the 2 meter band. Use also with receivers tuning a 4 mc segment between 22 and 35 mc with appropriate crystal. Shpg. Wt. 7 lbs.

"BEST BUY" UTILITY POWER SUPPLY KIT (UT-1)

Converts "Cheyenne" and "Comanche" mobile transmitter and receiver to fixed station operation. May also be used to provide filament and plate voltage for wide variety of ham gear. Shpg. Wt. 15 lbs.

FM TEST OSCILLATOR KIT (FMO-1)

Complete FM test facilities in one compact, easy to use instrument. First of its kind on the market.

SPECIFICATIONS—Output frequencies: for RF alignment, 90 mc (FM band low end), 100 mc (FM band middle range), 107 mc (FM band high end). **Modulation:** 400-cycle incidental FM. **IF and detector alignment:** 10.7 mc sweep. **Sweep width markers:** 200 kc to over 1 mc, variable, 10.7 mc (crystal), 100 kc sub markers. **Modulation:** 400-cycle AM. **For other applications:** 10.0 mc (crystal) and harmonics, 100kc, 400 cycle audio. **Controls:** main frequency selector, modulation switch/concentric level control, marker oscillator switch/concentric level control, sweep width—power switch, output control, AF-RF (source impedance) switch. **Power supply:** transformer, selenium rectifier. **Power requirements:** 105-125 V, 50/60 cycles, 10 watts. **Cabinet size:** 7 1/2" H. x 4 1/2" W. x 4 1/2" D.

RF SIGNAL GENERATOR KIT (RF-1)

High precision performance . . . for troubleshooting and aligning RF and IF circuits of all kinds. Preassembled and aligned bandswitch/coil assembly. Shpg. Wt. 7 lbs.

SPECIFICATIONS—Frequency range: Band A, 100 kc to 320 kc; Band B, 310 kc to 1.1 mc; Band C, 1 mc to 3.2 mc; Band D, 3.1 mc to 11 mc; Band E, 10 mc to 32 mc; Band F, 32 mc to 110 mc. **Calibrated harmonics:** 110 mc (crystal) and harmonics, 100kc, 400 cycle audio output; approx. 3 V across 50 ohm load for 30% depth. **400 cycles audio output:** approx. 10 V open circuit. **Tube complement:** V1 12AT7 RF oscillator, V2 6AN8 modulator and output. **Power requirements:** 105-125 V 50/60 cycles AC, 15 watts. **Aluminum cabinet dimensions:** 6 1/2" W. x 9 1/2" H. x 5" D.

New Test Equipment



HEATHKIT RF-1
\$27⁹⁵

HEATHKIT FMO-1

New Citizen's Band Transceiver



**WIRED OR
KIT FORM!**

- No Tests to Take—No Operators License Required
- Any Citizen 18 or Older can Have Own Station
- Hundreds of Business and Personal Uses

CITIZEN'S BAND TRANSCEIVER KIT (CB-1)

Have your own wireless communications system! Make necessary personal contacts with family, friends, or associates from your car, home, boat or office. Light, compact, easy to use, the Transceiver reliably covers distances from one to ten miles depending on location, antenna and type of installation. Transmitter frequency is crystal controlled. Receiver tunes any of the 23 channels assigned to the 11 meter "Citizen's Band". Operates from 117 volt AC line using internal power supply, or from 6 or 12 V. batteries using separate vibrator power supply. Can be transferred in minutes from fixed to mobile operation. All pertinent FCC regulations, and station license application forms are furnished. Comes complete with microphone, two power cords, station identification card, set of stick-on call letters and crystal for one channel. Smartly styled in rich mocha and beige. Shpg. Wt. 10 lbs.



Kit Model, Heathkit CB-1 \$42.95
 Wired Model, Heathkit W-CB-1 \$60.95 (\$6.10 d.w.n. \$6.00 mo.)
 Both Models Include Transceiver, crystal, microphone and Two Special Power Cords.

ANTENNAS

- CBU-1 "UTILITY" ANTENNA**.....\$9.95
 Good coverage, portable antenna for temporary mobile or fixed installations. Shpg. Wt. 3 lbs.
- CBM-1 "MOBILE" ANTENNA**.....\$19.95
 Best coverage mobile antenna. 9' whip. Bumper mount. Shpg. Wt. 7 lbs.
- CBF-1 "FIXED LOCATION" ANTENNA**.....\$19.95
 Excellent coverage. 1/2 wave, 9' elements. 50' connecting cable and mounting bracket. Shpg. Wt. 7 lbs.

WIRED AND KIT FORM POWER SUPPLIES FOR MOBILE USE OF CB-1

- 6-VOLT VIBRATOR POWER SUPPLY**
 KIT: model VP-1-6, Shpg. Wt. 4 lbs.....\$7.95
 WIRED: model W-VP-1-6, Shpg. Wt. 4 lbs.....\$11.95
- 12-VOLT VIBRATOR POWER SUPPLY**
 KIT: model VP-1-12, Shpg. Wt. 4 lbs.....\$7.95
 WIRED: model W-VP-1-12, Shpg. Wt. 4 lb.....\$11.95

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U.S. NAVAL WEAPONS STATION
YORKTOWN, VIRGINIA



Carl and Jerry

By
JOHN T. FRYE
W9EGV

Tipsy, Jr.

"WOULD YOU PLEASE tell me what we're doing here?" Carl asked plaintively of his chum, Jerry. The two boys were huddled in semi-darkness before an open window in the upper part of a boathouse on the edge of a lake. It was nearly midnight, and a howling gale was blowing outside. A short distance behind them were the gay pre-Christmas lights of Johnson City, a town some 40 miles from where the boys lived. In front of them was nothing but the dark glistening surface of the large frozen lake that bordered Johnson City.

Carl's question was understandable. Four hours previously he had stepped off the bus after visiting an uncle at the state capital only to be grabbed by Jerry who explained they were going to Johnson City at once on a mysterious errand and that the trip had been cleared with Carl's folks. In a matter of minutes the two boys were in a state police patrol car speeding to Johnson City. Once there, the patrolman helped them unload several pieces of electronic gear from the trunk of the car and carry it up to the loft of the boathouse; then the patrol car left. Jerry at once began to supervise the assembly of the equipment, keeping Carl so busy that he couldn't ask any questions.

Finally, everything was apparently in order. A dish-type reflector with a telescope sight mounted on it was connected by a coaxial cable to a chassis that contained several glowing tubes. Separate leads from this chassis ran to a meter, to a pair of ear-phones, and to an oscilloscope.

"Where do you want me to start?" Jerry asked with a grin.

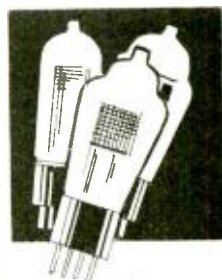
"You might start with what this nasty-looking bunch of equipment is supposed to be," Carl suggested.

"This is a small-potatoes copy of the

Always say you saw it in—POPULAR ELECTRONICS

Your best buy . . .

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1A7GT	2BN6	6AC7	6BC5	6CM6	65A7	7B6	12A18	12S17	39/44
1B3GT	2B76	6A4	6BC8	6CM7	65D7GT	7B7	12A17	12SN7GT	41
1C6	2C86	6AG5	6BD6	6CN7	65F5	7B8	12A16	12SQ7	42
1C7	2Q4	6AM4GT	6BE6	6CDB	65F7	7C4	12A17	12V6GT	43
1F4	2S4	6AM6	6B15	6CP6	65G7	7C5	12A18GT	12V6GT	45
1F5	2V4	6AK5	6BG6G	6C56	65M7	7C6	12A17	12X4	50A5
1G4	4BQ7A	6A15	6BH6	6CUS	65J7	7C7	12A17	14A7/17B7	50B5
1MSGT	4B5B	6AMB	6B16	6CUB	65V7	7E5	12B4	14B6	50C5
1I4	4B77	6ANB	6B15	6D6	65L7	7E6	12B8A	14Q7	50L6
1I6	4C86	6AQ5	6B17	6DE6	65O7	7E7	12B7	19	56
1I6	5AMB	6AQ6	6B17GT	6DGA6T	65O7	7E7	12B8A	19AU4GT	57
1MSGT	5A8	6AQ7	6B16	6DO6	6T4	7F8	12B16	19B6G	58
1S5	5A18	6A85	6B06GT	6F5	6UB	7G7	12B16	19J6	71A
1T4	5AV8	6A55	6B07	6F6	6V6GT	7H7	12B17	19I8	75
1U3	5A24	6A16	6B08	6H6	6V6GT	7H7	12B06	24A	76
1U5	5B8	6AU4GT	6B5B	6J4	6X4	7Q7	12B17	25Z6GT	77
1V2	5J6	6AUSGT	6B5G	6J5	6S5GT	757	12B17	26	78
1X2	5P4	6AU6	6B26	6J6	6X8	7X6	12CA5	27	80
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2A1A	5UB	6AV5GT	6C4	6K6GT	7A4/XXL	7Y4	12D4	35A5	1127.3
2B1A	5V4G	6AV6	6CB6	6K7	7A5	7Z4	12F5	35B5	
2C5	5V6GT	6AV8	6CD6G	6N7	7A6	12AB	12K7	35C5	
2A4	5X8	6AX4GT	6C16	6O7	7A7	12AB5	12L6	35W4	
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148CP4	11.99	18PP4	12.19	17HP4	16.99	20PP4	15.49	21AU4	18.79	21AP4	18.39	24CP4	27.79
16AD4	16.09	18PP4	12.19	17HP4	16.99	20PP4	15.49	21AU4	18.79	21AP4	18.39	24CP4	27.79
16DP4	12.19	17AP4	15.49	17CP4	13.89	17AP4	21.49	21AP4	17.49	21PP4	17.49	24PP4	29.79
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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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3123 Gillham Road, Kansas City 9, Missouri

GRANTHAM SCHOOL OF ELECTRONICS, Dept. 93-T4
821 — 19th Street N.W., Washington 6, D. C.

Combat Surveillance Radar AN/TPS-25—called "Topsy-25" by the G.I.'s—developed by the Army Signal Corps in collaboration with Hazeltine Corporation. Topsy is a pulse-type Doppler radar so sensitive it can



detect a man crawling through tangled scrub two miles away.

"You know about the Doppler effect. It's what makes the sound from an approaching train whistle seem to rise in pitch. Because the sound source is moving toward you, the sound waves are 'bunched together' and produce an apparent increase in frequency. If the train is moving away, the sound waves are 'stretched out,' and the pitch seems to go down.

"In Doppler radar, the frequency of a reflected signal is compared with that of the signal source. When the echo is returned from a stationary target, there's practically no difference in frequency; but when the signal comes back from a target with radial velocity—that means the straight-line distance between the target and the observing point is changing—there's a Doppler frequency shift in the echo signal. The amount of frequency shift depends on the radar frequency and the radial velocity of the target.

"When I saw a magazine article on Topsy, I made up my mind to try to build a very simplified version; so I collected all the information I could get. Inasmuch as Topsy is classified, that wasn't much; but one press release said a radial velocity of one

(Continued on page 106)

NOT USED, NOT PULLED OUT OF OLD SETS

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—074M	.79	—4AU6	.54	—6AL5	.47	—6BZ7	.97	—6X4	.39	—12AT6	.43	—12DB5	.69	—17DQ6	1.06					
—1AX2	.62	—4BA6	.51	—6AM8	.78	—6C4	.43	—6X5GT	.53	—12AT7	.76	—12DE8	.75	—17L6	.58					
—1B3GT	.79	—4BC5	.56	—6AN4	.95	—6BC6	.54	—6X8	.77	—12AU6	.50	—12DL8	.85	—17W6	.70					
—1DN5	.55	—4BC8	.96	—6AN8	.85	—6CD6	1.42	—7AU7	.61	—12AU7	.60	—12DM7	.67	—19AU4	.83					
—1G3	.73	—4BE6	.54	—6AQ5	.50	—6CF6	.64	—7A8	.68	—12AV5	.97	—12DQ6	1.04	—19BG6	1.39					
—1J3	.73	—4BN6	.75	—6AR5	.55	—6CG7	.60	—7B6	.69	—12AV6	.41	—12DS7	.79	—19T8	.80					
—1K3	.73	—4BQ7	.96	—6AS5	.60	—6CG8	.77	—7Y4	.69	—12AV7	.75	—12DZ6	.56	—21EX6	1.49					
—1L6	1.05	—4BS8	.98	—6AT6	.43	—6CM7	.66	—8AU8	.83	—12AX4	.67	—12EL6	.50	—25AU4	.87					
—1LA6	.69	—4BU8	.71	—6AT8	.79	—6CN7	.65	—8AW8	.93	—12AX7	.63	—12EG6	.54	—25BQ6	1.11					
—1LC6	.79	—4BZ6	.58	—6AU4	.82	—6CR6	.51	—8BQ5	.60	—12A27	.86	—12EK6	.56	—25C5	.53					
—1LN5	.59	—4BZ7	.96	—6AU6	.50	—6CS6	.57	—8CG7	.62	—12B4	.63	—12EZ6	.53	—25CA5	.59					
—1R5	.62	—4CB6	.59	—6AU7	.61	—6CU5	.58	—8CM7	.68	—12BA6	.50	—12F5	.66	—25CD6	1.44					
—1S5	.51	—4CS6	.61	—6AU8	.47	—6CU6	1.08	—8CN7	.97	—12BD6	.50	—12F8	.66	—25CU6	1.11					
—1T4	.58	—4DE6	.62	—6AV6	.40	—6CY5	.70	—8CX8	.93	—12BE6	.53	—12FM6	.45	—25DN6	1.42					
—1U4	.57	—4DK6	.60	—6AW8	.89	—6CY7	.71	—8E8	.94	—12BF6	.44	—12K5	.65	—25EH5	.55					
—1U5	.50	—4DT6	.55	—6AX4	.65	—6DA4	.68	—10DA7	.71	—12BH7	.73	—12SA7M	.86	—25L6	.57					
—1X2B	.82	—5AM8	.79	—6AX7	.64	—6DB5	.58	—11CY7	.75	—12BK5	.70	—12SK7GT	.74	—25W4	.68					
—2AF4	.96	—5AN8	.86	—6BA6	.49	—6DE6	.59	—12A4	.60	—12BL6	.56	—12SN7	.67	—25Z6	.66					
—2BN4	.60	—5AQ5	.52	—6BC5	.54	—6DG6	.59	—12AB5	.55	—12BQ6	1.06	—12SQ7M	.73	—35C5	.51					
—2CY5	.71	—5AT8	.80	—6B7C	.94	—6DQ6	1.10	—12AC6	.49	—12BY7	.74	—12U7	.62	—35L6	.57					
—3AL5	.42	—5BK7A	.82	—6B7C8	.97	—6DT5	.53	—12AD6	.57	—12BZ7	.75	—12V6GT	.53	—35W4	.52					
—3AU6	.51	—5BQ7	.97	—6BD6	.51	—6DT6	.53	—12AE6	.43	—12C5	.56	—12W6	.69	—35Z5GT	.60					
—3AV6	.41	—5BR8	.79	—6BE6	.55	—6E8	.79	—12AF3	.73	—12CA5	.59	—12X4	.38	—50B5	.60					
—3BA6	.51	—5C8	.76	—6BF6	.44	—6EA8	.79	—12AF6	.49	—12CN5	.56	—17AX4	.67	—50C5	.53					
—3BC5	.54	—5CL8	.76	—6BG6	1.66	—6EB8	.99	—12AJ6	.46	—12CR6	.54	—17BQ6	1.09	—50DC4	.37					
—3BE6	.52	—5EA8	.80	—6BH6	.65	—6HG6T	.58	—12AL5	.45	—12CU5	.58	—17C5	.58	—50EH5	.55					
—3BN4	.63	—5EU8	.80	—6BH8	.87	—6J5GT	.51	—12AL8	.95	—12CU6	1.06	—17CA5	.62	—50L6	.61					
—3BN6	.76	—5J6	.68	—6BJ6	.62	—6J6	.67	—12AQ5	.52	—12CX6	.54	—17D4	.69	—117Z3	.61					
—3BU8	.78	—5T8	.81	—6BK5	.80	—6K6	.58													
—3BY6	.55	—5U4	.60	—6BK7	.85	—6S4	.48													
—3BZ6	.55	—5U8	.81	—6BL7	1.00	—6SA7GT	.76													
—3CB6	.54	—5V6	.56	—6BN4	.57	—6SK7GT	.74													
—3CF6	.60	—5X8	.78	—6BN6	.74	—6SL7	.80													
—3CS6	.52	—5Y3	.46	—6BQ5	.65	—6SN7	.65													
—3CY5	.71	—6AB4	.46	—6BQ6GT	1.05	—6SQ7	.73													
—3DE6	.62	—6AC7	.96	—6BQ7	.95	—6T4	.99													
—3DK6	.60	—6AF3	.73	—6BR8	.78	—6T8	.80													
—3DT6	.50	—6AF4	.97	—6BS8	.90	—6U8	.78													
—3Q5	.80	—6AG5	.65	—6BU8	.70	—6V6GT	.54													
—3S4	.61	—6AH6	.99	—6BV6	.54	—6W4	.57													
—3V4	.58	—6AK5	.95	—6BZ6	.54	—6W6	.69													

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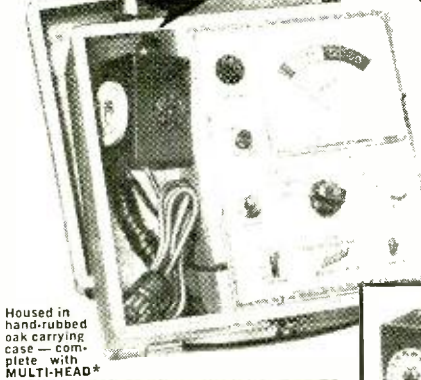
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NEW

CRT TESTER-REACTIVATOR Model CRT-2

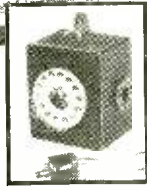
NOW . . . a TESTER-REACTIVATOR really designed to test, repair and reactivate EVERY PICTURE TUBE MADE — whether black and white or color . . . with exclusive features never before found in picture tube testers.



Housed in hand-rubbed oak carrying case — complete with MULTI-HEAD*

Model CRT-2
\$57.50
Net

TERMS: \$13.50 within 10 days. Balance \$11 monthly for 4 months.



The CRT-2 steps in and solves the limitations and shortcomings of present day CRT Testers. Unlike ordinary CRT testers that keep entering the field with a limited range of operation, the CRT-2 employs a new brilliantly engineered circuit designed to test, repair and reactivate every black and white or color picture tube made. The CRT-2 eliminates the guesswork and risk that until now, has always been present when a picture tube is reactivated. It accomplishes this by providing perfect control of either the 'Boost' or 'Shot' method of reactivation.

THE CRT-2 DOES ALL THIS RIGHT IN THE CARTON, OUT OF THE CARTON OR IN THE SET

- TEST**
- ✓ for quality of every black and white and color picture tube
 - ✓ for all inter-element shorts and leakage up to one megohm for life expectancy
- REPAIR**
- ✓ Will clear inter-element shorts and leakage.
 - ✓ Will weld opens between any two elements in the tube gun
- REACTIVATE**
- ✓ The unique controlled 'SHOT' (high voltage pulse) method of reactivation provided by the CRT-2 will restore picture tubes to new life in instances where it was not possible before. Furthermore the high voltage is applied without danger of stripping the cathode as you always have perfect control of the high voltage pulse.
 - ✓ The 'BOOST' method of reactivation also provided by the CRT-2 is used effectively on tubes with a superficially good picture but with poor emission and short life expectancy. It will improve definition, contrast and focus greatly and add longer life to the picture tube.

- 1. THE MULTI-HEAD (patent pending) . . . A SINGLE PLUG IN CABLE AND UNIQUE TEST HEAD** — A tremendous advance over the maze of cable and adapters generally found with other testers. Enables you to test, repair and reactivate every type of picture tube with greater convenience than ever before . . . 50 degree to 110 degree types from 8' to 30', whether 12 pin base, 8 pin base, 14 pin base . . . even the very latest 7 pin base. A special color switch on the MULTI-HEAD enables you to test, repair and reactivate each of the red, green and blue color guns separately.
- 2. WATCH IT REACTIVATE THE PICTURE TUBE** — You actually see and control the reactivation directly on the meter as it takes place, allowing you for the first time to properly control the reactivation voltage. This eliminates the danger of stripping the cathode of the oxide coating. It enables you to see the speed of reactivation and whether the build-up is lasting. You will see if the cathode contamination is too great and if the picture tube is too far gone to be reactivated.
- 3. CONTROLLED "SHOT" WITH HIGHER VOLTAGE FOR BETTER REACTIVATION** — Stronger than any found in other testers . . . high enough to really do the job — yet controlled to avoid damage to the picture tube.
- 4. UNIQUE HIGH VOLTAGE PULSE CIRCUIT** — Will burn out inter-element shorts and weld open circuits with complete safety to the picture tube.
- 5. VISUAL LIFE TEST** — Enables both you and your customer to see the life expectancy of any picture tube right on the meter. The fact that your customer can see the results of your tests as you make them virtually eliminates resistance to picture tube replacement when necessary.
- 6. TESTS, REPAIRS AND REACTIVATES SPECIAL LOW SCREEN VOLTAGE TUBES** — Many new type picture tubes use special low voltage of approximately 50 volts. The CRT-2 will test, repair and reactivate these types with the same thoroughness as the regular types with complete safety.
- 7. SEPARATE FILAMENT VOLTAGES** — Including the very latest 2.35 volt and 8.4 volt types as well as the older 6.3 volt types.
- 8. TESTS, REPAIRS AND REACTIVATES 'SF' PICTURE TUBES** — found in the newest Sylvania and Philco TV sets. These picture tubes have different base pin connections than standard picture tubes and there is always an element of risk that the tube may be burned out when tested with ordinary picture tube testers. The CRT-2 is designed to accommodate this new base pin arrangement and will test the tube with no danger of damage.

ADDITIONAL FEATURES

- Employs the time proven dynamic cathode emission test principle
 - Large 4 1/2" meter with heavily damped movement for smooth action, accuracy and long life
 - Provides separate shorts test for each element in the picture tube
 - Filament continuity is shown on a separate glow indicator
 - An easy to read instruction manual contains all the latest testing information on old and new type picture tubes
 - Housed in handsome hand-rubbed oak carrying case with special compartment for MULTI-HEAD and line cord.
- * patent pending

IN-CIRCUIT CONDENSER TESTER Model CT-1

Here is an IN-CIRCUIT CONDENSER that DOES THE WHOLE JOB! The CT-1 actually steps in and takes over where all other in-circuit condenser fail. The ingenious application of a dual bridge principle gives the CT-1 a tremendous range of operation . . . and makes it an absolute 'must' for every serviceman.

in-circuit checks:

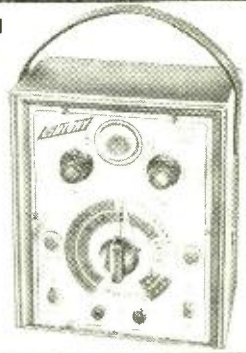
- ✓ Quality of condensers even with circuit shunt resistance (This includes leakage, shorts, opens, intermittents)
- ✓ Value of all condensers from 200 mmfd. to .5 mfd.
- ✓ Quality of all electrolytic condensers (the ability to hold a charge)
- ✓ Transformer, socket and wiring leakage capacity

out-of-circuit checks:

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

OUTSTANDING FEATURES

- Ultra-sensitive 2 tube drift-free circuitry
- Multi-color direct scale 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 every greater accuracy
- Isolated power line
- Housed in sturdy hammerstone finish steel case . . . comes complete with test leads



Model CT-1
\$34.50
Net

TERMS: \$9.50 within 10 days. Balance \$5 monthly for 5 months

EASY TO BUY IF SATISFIED — see order form on facing page

FOR 10 DAY FREE TRIAL

Convince yourself at no risk that CENTURY instruments are indispensable in your every day work. Send for instruments of your choice without obligation... try them for 10 days before your buy... only then, when satisfied, pay in easy-to-buy monthly installments — without any financing or carrying charges added.

NOW a Battery Operated Peak-to-Peak VACUUM TUBE VOLT METER Model VT-1

WITH LARGE EASY-TO-READ 6" METER —

featuring the sensational new MULTI-PROBE Patent Pending

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

- 1 DC Probe 2 AC-Ohms Probe 3 Lo-Cap Probe 4 RF Probe

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 maze of entangled cables, lose time alternating cables or hunting for a misplaced probe. With just a twist of the MULTI-PROBE lip 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.

FUNCTIONS

DC VOLT METER... Will measure DC down to 1.5 volts full scale with minimum circuit loading and give accurate readings of scale divisions as low as .025 volts... Will measure low AC and oscillator bias voltages from 1 volt 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 VOLT METER... True Peak-to-Peak measurements as low as 3 volts of any wave form including TV sync, deflection voltages, video pulses, distortion in hi-fi amplifiers, AGC and color TV gating pulses... Scale divisions are easily read down to 1 volt... 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 OHMMETER... Measures from 0 to 1000 megohms... Scale divisions are easily read down to 2 ohms... Will measure resistance values from 2 ohms to one billion ohms... Will detect 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 attenuator — 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-phon 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 — R1/10/100/1K/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



Housed in hammertone steel-case complete with MULTI-PROBE

Model VT-1
\$58.50 Net
TERMS: \$14.50 within 10 days. Balance \$11 monthly for 4 months.

FAST-CHECK TUBE TESTER Model FC-2

Simply set two controls... insert tube... and press quality button to test any of over 700 tube types completely, accurately... IN JUST SECONDS!

Over 20,000 servicemen are now using the FAST-CHECK in their every day work and are cutting servicing time way down, eliminating unprofitable call-backs and increasing their dollar earnings by selling more tubes with very little effort. See for yourself at no risk why so many servicemen chose the FAST-CHECK above all other tube testers.

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

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

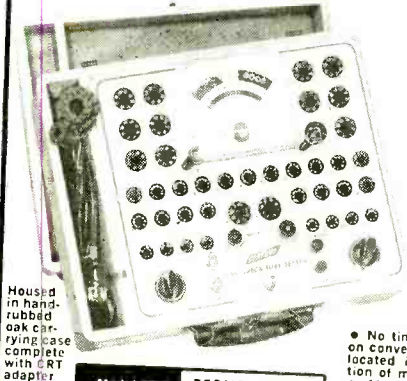
RANGE OF OPERATION

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

SPECIFICATIONS

- No time consuming multiple switching... only two settings are required instead of banks of switches located inside cover. New listings are added without costly roll chart replacement
- Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale mounted on panel
- Large beryllium tube sockets never need replacement
- 7-pin and 9-pin straighteners protected against accidental burn-out
- Special scale on meter for low current tubes
- Fully line voltage variation
- 12 filament positions
- Special scale on meter for low current tubes
- Compensation for no shock hazards
- Long lasting etched aluminum panel
- Separate gas and short jewel indicators
- Line isolated

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



Housed in hand-rubbed oak carrying case complete with CRT adapter

Model FC-2
\$69.50 Net
TERMS: \$14.50 within 10 days. Balance \$11 monthly for 5 months.

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CHECK INSTRUMENTS DESIRED

- Model CRT-2 CRT TESTER REACTIVATOR \$57.50 \$13.50 within 10 days. Balance \$11 monthly for 4 months.
- Model CT-1 In-Circuit Condenser Tester \$34.50 \$9.50 within 10 days. Balance \$5 monthly for 5 months.
- Model VT-1 Battery Vacuum Tube Volt Meter \$58.50 \$14.50 within 10 days. Balance \$11 monthly for 4 months.
- Model FC-2 Fast-Check Tube Tester \$69.50 \$14.50 within 10 days. Balance \$11 monthly for 5 months.

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

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Sintered-plate Nickel Cadmium alkaline storage batteries designed for "NIKE" Missile and now surplus due to design change. A lifetime battery with no known limit of service over 5000 recharges on test without loss of capacity. Other features: Virtually indestructible, compact & lightweight, withstands heavy shock and vibration. Flat sulfate curve during discharge retains charge year or more. High discharge rate up to 50 amps. for this cell, no corrosive fumes to harm clothing or equipment. spill-proof construction, discharge in any position. Indefinite storage without deterioration, operates in temperatures - 60° F to +200° F. Each cell is approx. 6 ampere hour capacity. Nominal voltage per cell is 1.8 volts. A 6 V. battery requires 5 cells. Cell size 6" H. x 2" W. x 1 1/2" T. Wt. 6 oz. ea. Uses Polonium-Hydroxide "30" electrolyte. Negligible loss during lifetime service. Add only distilled water once a year. A fraction of Government cost.

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All cells warranted to your satisfaction or money refunded (less postage), Dept. D

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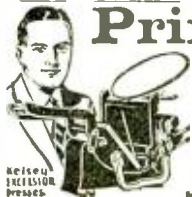
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mile per hour produced a frequency shift of 30 cycles. That gave me a clue as to Topsy's operating frequency."

"It did?" Carl questioned.

"Sure. I read that the Doppler frequency shift in cycles is equal to 89.4 times the radial velocity in miles per hour divided by the wavelength in centimeters: so—"

"Include me out of any math," Carl interrupted.

"Now cut that out!" Jerry said sternly. "If you're ever going to get anywhere in electronics, you've got to stop gagging every time someone dangles a little math formula in front of you. Let me show you how easy it is.

"Substituting in the formula, 30 cycles equal 89.4 times 1 mph divided by X centimeters. By a little algebra mumbo-jumbo we can rearrange this so that X centimeters equals 89.4/30, or approximately 3 centimeters. We know that the frequency of a radio signal in cycles per second is equal to the speed of light, 300,000,000 meters per second, divided by the wavelength of the signal in meters. If we want our frequency in megacycles, we just chop 300,000,000 down to 300. Three hundred divided by .03 gives us 10,000 megacycles as the frequency of a 3-centimeter wavelength."

"That didn't hurt too much," Carl admitted; "but don't try to tell me you built this gear in the two days I was gone."

"No. I was going to try to convert some war-surplus u.h.f. gear; but Sam, the technician who takes care of the state police electronic equipment, said he had one of the radar speed indicators that had been superseded by a newer model and that I could play around with the old unit if I liked. Since it operated just a little above the 10,000-10,500 mc. band, Sam helped me lower the frequency. The police obtained special permission for us to use pulsed transmissions in the amateur band.

"On the speed-detecting unit, the audio beat frequency between the radar oscillator and the Doppler-shifted echo frequency was amplified and clipped and used to actuate an audio frequency indicating meter calibrated in miles per hour. We brought out the unclipped signal to phones and the scope. The telescope sight on the dish antenna helps point the narrow radar beam at a desired target. Want to see it work?"

"Sure!" Carl said promptly.

"Okay. Take the antenna to that window at the other end of the boathouse and point

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| 1H5GT | 6AC7 | 6BN6 | 6SQ7 | 12AU6 | 25BQ6 |
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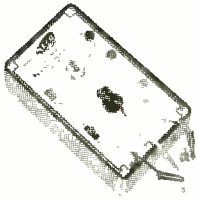
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the beam at different moving objects at that intersection across the way. I'll sit here and listen to the signal in the phones and watch the 'scope and try to tell you what you see in the telescope sight. Remember to keep the beam on objects that are moving toward us or away from us instead of those moving left-right or vice-versa."

CARL CARRIED the dish antenna to the other end of the boathouse, opened the window, and sighted through the telescope at a street intersection about a block from the edge of the lake.

"Okay, what do I see?" he challenged.

"A man walking," Jerry answered promptly. "He sounds like 'wump-wump-wump-wump.' Each 'wump' is produced by the fast movement of his leg as he takes a step."

"I get that, but how do you know it's a man?"

"Get a woman in your sights and I'll show you."

"Okay," Carl called a few minutes later; "now I'm looking at a woman."

"I know," Jerry said. "See the difference on the scope trace? She moves her arms



differently and swings her hips more; so you can still pick out the separate pulses of signal for each step, just as is the case with the man; but these pulses have lots more little frills to them in the case of a woman . . . Now you're looking at a car,"

Jerry broke off. "and it's a straight-stick job. An accelerating car produces a tone of rising pitch, and it's easy to hear the little steps in this tone when a driver shifts gears by hand."

"That thing's uncanny," Carl remarked as he brought the antenna back to the window overlooking the lake. "Now for question number two—what are we doing out here on a cold and windy night like this?"

"This morning the state police asked me if we would like to help them and the police of Johnson City with a nasty problem. Three times in the past two weeks a thief has smashed a show-window in a store here and made off with valuable merchandise displayed for the Christmas season. Each time he was chased to the vicinity of the lake and then lost completely. The police think he has some method of making a quick getaway, but they can't figure what it is. There's never any sound of a plane motor taking off; the lake is frozen, so a boat is out; he never has had time to put on skates and take off.

"Sam suggested maybe we could see something with Topsy, Jr., here, that was invisible to squad car spotlights. This boat-house is on a kind of point that lets us scan the whole lake shore bordering the business part of town. Incidentally, I guess we better get with it. It was always shortly after midnight that the thief struck before. We'll take turns swinging that antenna back and forth so the beam covers the lake. The other guy can listen and watch the scope."

"At this stage, I'm probably a better beam-swinger than scope-watcher," Carl said; "so I'll start. As I get it, we should hear no sound nor see anything on the scope as long as Junior here doesn't see a moving target. Is that right?"

"Exactly," Jerry nodded as he huddled farther down in his heavy coat. "Man, listen to that wind! I doubt if the joker shows tonight. It's not fit out for man nor beast—wups!" he suddenly exclaimed; "back up a bit. I think I heard something."

Obediently Carl retraced the slow arc he had been describing with the antenna. He did not need Jerry's upraised hand to tell him to stop when the antenna was pointing straight out across the lake. The thin horizontal line on the scope face expanded into several crowded cycles of a sine wave, and the meter swung to the right.

"Wow!" Jerry exclaimed in a hoarse

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whisper. "Something is coming— or going — out there at a seventy-mile-an-hour clip. Watch the scope and keep the beam right on the thing. Keep the antenna pointing so the scope trace is maximum."

"You mean you can't tell if the target is going or coming?"

"Only by noticing if the heat signal becomes stronger or weaker, but this thing is coming. See that scope trace growing? Can you see anything? I can't hear anything but the wind."

"No-o-o." Carl began as he peered out into the darkness. "Wait a minute! See something out there that looks like a big, black cloud?"

Before Jerry could answer, a huge triangular dark shadow swept silently toward them, slowed down, and came to a gentle stop directly beside the boathouse.

"What do you know, an ice boat!" Carl breathed as the two boys peered down through a little side window at the pilot of the boat, who quickly furled the sail and made the boat fast in a position for a quick



take-off. In less than a minute he was striding toward the bright lights of the city.

"Now what?" Carl asked.

"I don't know," Jerry admitted. "He may or may not be our man. You go to that phone booth at the filling station up there by the intersection and call the chief of police at this number and tell him what we've seen. In the meantime I'll try to fix that ice boat so the fellow can't make a quick getaway."

AS CARL RAN OFF, Jerry frantically searched the boathouse for something to use to delay the ice boat. His flashlight fell on several large sheets of coarse sandpaper, and he grabbed these up along with a length of bailing wire. Working with des-

perate haste in the darkness, he slipped a sheet of the paper coarse side down under each of the three runners and bound it tightly in place with the bailing wire. As he finished wrapping the steering runner at the bow of the boat, he felt a shadow looming over him; but it was only Carl.

"Let's get back in the boathouse," Jerry said through chattering teeth. "It's scary—I mean cold—out here."

"The chief said he would send a squad car over as soon as possible," Carl reported as they climbed the stairs: "but most of the cars are on the other side of town on a tip that holdup men are going to hit an all-night truck stop there."

"May be a decoy action," Jerry observed as he peered out the window toward town. "Oh, oh! Here comes someone running. I'll bet it's the guy with the ice boat."

And it was. In a trice the man had vaulted into the narrow cockpit of his slim craft, had jerked a rope that loosened the great dark sail on its 20'-high mast, and was waiting expectantly for the boat to start. When the sail filled but nothing happened, he lunged impatiently, for he could see bobbing flashlights coming down the



path he had just covered. Finally, muttering a curse, he leaped from the boat and tried to push it to a start. Failing, he ran swiftly across the ice out into the darkness.

Two foot patrolmen, brandishing flashlights, came to a sliding stop beside the boat.

"He ran out on the ice," Jerry called to them. "Follow him and listen to us. We'll tell you which way to go. Carl, run down

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and grab that megaphone at the foot of the stairs."

Jerry already had the running thief in the beam of Topsy, Jr., and he kept the beam on him while Carl bellowed instructions to the two policemen whose positions were shown by their flashlights. If the thief had just known enough to stand perfectly still, he might have escaped; but he did not know this, and the two officers soon collared him.

As all three came slipping and sliding across the ice back to the boathouse, two squad cars came roaring up with screaming sirens and flashing red lights. The surprised thief still clutched the bag of jewelry he had scooped through the show window he had broken. He readily admitted to the other thefts and explained that he lived across the lake. He only "struck" when a strong wind assured him a quick getaway.

A SQUAD CAR took off with the thief, and the boys were soon inside a warm state police car heading for home.

"That was a nice piece of work you fellows did tonight," the patrolman complimented them. "Sam told the captain he could depend on you two, and it looks as though he was right."

"All the credit belongs to Little Old Topsy back there in the trunk," Carl drawled sleepily.

"That's right," Jerry said; "and since it's only a very crude version of the real AN/TPS-25, think of what its old man can do!"

-30-



Transistor Topics

(Continued from page 84)

and thus a low price. In production quantities, the OC170 sells for well under \$2.00.

Transistor Publications. Lafayette Radio (165-08 Liberty Ave., Jamaica 33, N. Y.) has issued a new "Semi-Conductor Directory." This valuable booklet is free on request. It includes a comprehensive and complete listing of all current transistors, diodes and rectifiers. Units are listed in numerical order by type number, complete with a condensed description and basic application information as well as the name of the manufacturer.

The fourth edition of G.E.'s famous "Transistor Manual" has just been published. This 227-page book includes 21 chapters covering such topics as basic semiconductor theory, transistor construction techniques, biasing, switching characteristics, servicing techniques, specifications, and many, many practical transistor circuits. An excellent buy at one dollar, it can be purchased through your local G.E. distributor or direct from General Electric Co., Semiconductor Products Dept., Charles Building, Liverpool, N. Y.

Product News. One of America's leading hearing aid manufacturers, Sonotone, has introduced a new transistorized unit no larger than a man's thumbnail (see photo).

A new series of silicon cartridge rectifiers has been introduced by the International Rectifier Corporation (1521 E. Grand Ave., El Segundo, Calif.). With PIV ratings from 600 to 10,000 volts, these units are ceramic-encased to prevent surface creepage and to minimize flashover problems. The d.c. output current ratings range from 75 to 250 milliamperes.

Specific Products (P. O. Box 425, Woodland Hills, Calif.) is now producing a fully transistorized receiver designed specifically for the reception of WWV standard signals. With an over-all sensitivity of 2 microvolts, this crystal-controlled receiver tunes to 2.5-, 5.0-, 10-, 20- and 25-mc. signals. It is equipped with a built-in S meter and a built-in loudspeaker. Measuring only 9" x 12" x 5", the instrument weighs only six pounds and is powered by six size D flashlight cells.

That does it for now, fellows. See you next year. But before signing off, Season's Greetings to you all!

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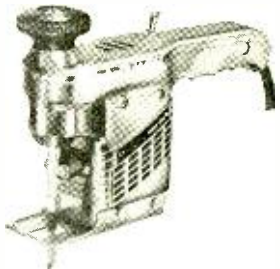
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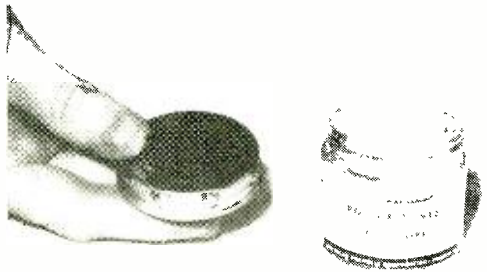
Tips and Techniques

(Continued from page 38)

and operate the controls quite easily without removing it from the bag. But be sure to keep the radio in the shade—the plastic bag and sun make an efficient hot house to "fry" your transistors and batteries.—*John A. Comstock, Wellsboro, Pa.*

SOLDER "BUMPS" AID LID REMOVAL

Several minutes can be wasted trying to remove the lid from a jar of coil dope or service cement. Once a new jar is opened and the lid and jar threads are exposed to the air, the lid freezes on so tightly that it is almost impossible to remove. When the



jar has a metal lid, you can easily overcome this trouble by applying several drops of solder all along the edge of the lid as shown. The solder "bumps" will keep your hand from slipping and thus allow you to unscrew the lid quite easily.—*Charles Lang, San Francisco, Calif.*

HUM-FREE RECEIVER RECORDINGS

Excellent tape recordings can be made from the phone jack of most communications receivers. In the S-40B, S-85, SX-99, and similar receivers, audio is taken from the plate of the first audio stage, bypassing the output tube and transformer. This should result in good audio quality, but I noticed a 60-cycle hum in my receiver when recording from the phone jack. I got rid of the hum by replacing the unshielded wire between the audio tube socket and the "hot" terminal of the phone jack with shielded mike cable. I connected the shield braid to a ground lug near the tube socket. —*Steve Cohen, K1IOL, Manchester, N. H.*

STOP ARCING

Arcing between the plates of a variable capacitor whose voltage rating has been exceeded can be reduced, if not eliminated,

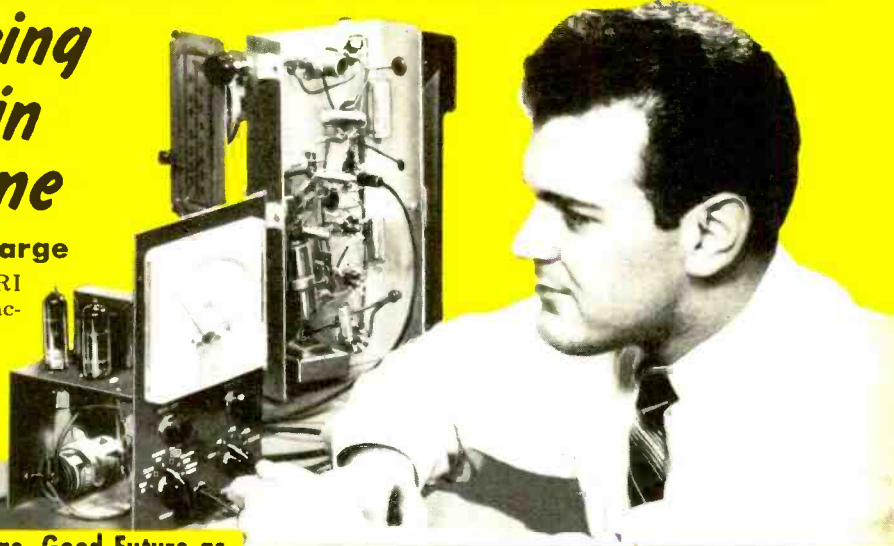
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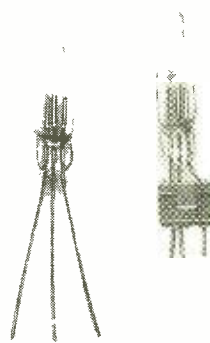
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PAGE

by dripping oil on the plates. Apply just enough oil to form a thin film on the surface. Since oil has a higher dielectric rating than air, any arcing will usually be completely stopped.—*Mark Wirth, St. Joseph, Mich.*

SOCKET FOR NE-77 NEON LAMP

You can use a transistor socket for a NE-77 three-electrode neon lamp. The three leads of the NE-77 are similar to those of transistors. Just trim the leads down to about 1/4" and the neon bulbs will easily fit into the 3- or 5-pin socket.—*Jim Martin, Brooklyn, N. Y.*



TOUCH-UP PAINT FOR COLOR-CODING

Automotive touch-up paint in a 3-oz. brush applicator can is good for color-coding. Available in many colors, it comes in handy for coding electric wires, terminals, parts, etc. In a pinch, you can also use a few coats for insulating wire joints or as a cure for arcing.—*Jerome Cunningham, Chicago, Ill.*

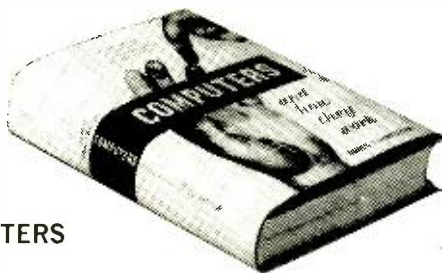
SOLDERING PLUG PINS

Soldering the pins of multi-cable connectors is one of the trickiest jobs the experimenter is called upon to perform. Part of the trouble is due to the fact that solder does not adhere to the nickel-plated pins easily. To get the best possible solder joint with this type of connector, use a vise and a small hand drill to ream out the inside of the pins. This will expose a clean surface of brass which can be readily tinned, and thus will assure a solid connection. Use a bit slightly smaller than the diameter of the pins.—*W. B. Bernard, Arlington, Va.*



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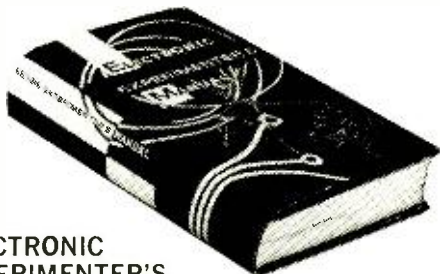
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COMPUTERS AND HOW THEY WORK tells you how computers read, write and remember. You'll learn the two digit mathematical language of computers, where $1 + 1 = 10$. Using this language you can add, subtract, multiply and divide by simple addition.

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On the Citizens Band



By TOM KNEITEL, 2W1965

DURING the past few months we've noticed a Citizens Band station operating nightly with a professional-sounding dispatcher at the mike. This station, 2W1602, is operated by the 111th Precinct Auxiliary Police in the Bayside section of Queens, New York City.

Just like a regular police operation, there is communication between the base station and the patrol cars. The base station is a home-brew job fed into a ground plane on the roof of the station house, and the mobile units are equipped with Heath transceivers.

The "brains" behind this ingenious operation are Lt. Ed Webster and Ptl. George Sloan, who plan to expand the mobile fleet from the present three units to eleven in the near future.

In case you haven't heard, the FCC is really swinging the ax over the length and breadth of our little band. Violation notices ("pink tickets") are being generously doled out to stations in all parts of the country. About 44% of the people who have been awarded the notices are would-be DX'ers, 61% are filibusterers who hamper the "party-line" type operations of CB, 57% are guys who can't stay within the frequency tolerances allowed by the FCC, and 3% belong to the overmodulators club.

Put away your adding machines, fellows. We already know that these figures add up to more than 100%. It's just that some stations have earned themselves double and triple citations.

Speaking of off-frequency operation, it bears keeping in mind that just because you buy a ".005" crystal and plug it into your rig, you aren't necessarily operating "on frequency." A crystal is guaranteed to function properly only within the circuit for which it was designed.

If you plan on using crystals not supplied with your transmitter, or specifically recommended by the transmitter's manufacturer, you had better have your frequency

Always say you saw it in—POPULAR ELECTRONICS

checked against professional frequency-measuring equipment operated by the holder of a first or second class commercial FCC license. There's sure to be someone in your area with the necessary license and equipment.

A clever suggestion has been made by Ron Cohen, 3W0801, of Wyncote, Pa. Ron proposes that one channel be set aside, on a strictly voluntary and unofficial basis, to be monitored by both CB and SWL stations.

Motorists passing through a city or town could obtain road information or the location of the nearest overnight accommodations. The big help would be when the motorist has trouble off the main highway.

Small boats would also be thankful for such an arrangement. Any comments on the idea?

Some spiffy new CB transceivers are being brought out by Chickasha Electronics. One rig, the 1000-D, has a wheelbarrow full of features including a superhet receiver with "r.f." stage, a noise limiter, squelch, and a high-sensitivity circuit. Not that you could want much more, but they've even made the receiver tunable over the entire band, and the whole deal

goes for half the price you'd imagine, either in kit form or in the pre-wired factory-tested model.

With the FCC's hammerlock on CB DX work, most of the former "DX kings" must now be content just to listen for distant stations. Many listeners, because they can't "give the DX guy a shout and tell him how good he's comin' in," have taken up the habit of informing the distant station operator of his power-house signal via mail, through the use of SWL-type "QSL cards." The CB "op" who receives the report usually acknowledges it by sending the reporter his own station card in return.

We've seen some of these cards and they're quite nice-looking. If you have one for your station, we'd like to see it.

A handy CB call book is now available from International Crystal. It lists all Class D stations by call letters, giving the operator's name and address for each station. The back of the book is chock full of additional information useful to CB'ers. If you'd like one, send \$1 to George Beyers, 10W0376, % International Crystal Manufacturing Co., 18 N. Lee, Oklahoma City, Oklahoma.

-30-

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Inside the Stereo Cartridge

(Continued from page 60)

from magnetics. Construction of the CBS "Professional" ceramic cartridge is shown in Fig. 5.

Actually, a good stereo pickup is not the direct result of any particular type of movement; much more important is the way the design is carried to completion. In any list of the finest pickups, you will find examples of every design principle.

Desirable Characteristics. What we want in a high-fidelity pickup, whether monophonic or stereo, is a flat frequency response over the full audio range with the lowest possible distortion. It is no great problem to produce a pickup which is flat to about 15,000 cycles; the real headaches come in trying to cover that remaining half-octave to 20,000 cycles. The ear does not miss those final 5000 cycles as such; but the pickup that reproduces them will have qualities that make it better in the more audible portion of the audio range.

Because of its over-all importance, the compliance of a pickup is a good measure of its merit. Generally speaking, the higher

the compliance, the wider and smoother the frequency response and the lower the distortion. Quality stereo cartridges have a compliance of 3.5×10^{-6} cm/dyne or better and the present trend is toward compliances about 5×10^{-6} .

On the other hand, very high compliance under some circumstances can be too much of a good thing. A high-compliance pickup works best with a light stylus pressure. This calls for the use of the best tone arms. Few changers will handle a pickup with a compliance over 5×10^{-6} satisfactorily. And low stylus pressure calls for advanced turntable suspension systems to prevent floor vibration or acoustic feedback from raising havoc with the reproduction. The high-compliance pickup demands quality associated equipment; and if it is used with inferior equipment, its advantages may not be realized or may even turn into vices.

Tracking Pressure. The stylus of a stereo pickup is .5 or .7 mil in radius as compared with the 1-mil radius of a micro-groove monophonic pickup. At the same stylus pressure, a .7-mil stylus will place twice as much stress and a .5-mil stylus four times as much stress on a groove as a

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1-mil stylus will. Thus, the stereo pickup should operate at pressures below 4 grams.

Most magnetics and the higher quality ceramics will operate well at these low pressures. The Shure "Studio Dynetic" in the integrated arm tracks at 1½ grams; the Dynaco "B & O," the ESL, the Grado, Audio Empire, and Weathers will operate at 2 grams in good arms; the Scott-London also tracks at 2 grams. Stylus wear is not significant and the average diamond stereo stylus should last several times as long as a diamond mono stylus operating at 6 to 8 grams.

Few changers permit such low tracking pressures, however. One or two will track at 2 to 3 grams, but most need up to 5 grams. Record wear at tracking pressure this high will be more severe than with a monophonic pickup tracking at 6 to 8 grams.

Constant Improvement. Pickup designers have done a remarkable job in the brief two years since the stereo disc became a reality. The first stereo pickups were pretty crude, and there were those who said that stereo pickups could never be as good as monophonic designs.

The fact is that today's stereo pickups are on about the same performance level as monophonic pickups were two years ago. Two or three of the best stereo pickups are as good as their best monophonic ancestors. And since progress never ceases in the high-fidelity field, we have every right to expect that future stereo cartridges will exceed the best of yesterday's monophonic models.

Next month we will go into the design problems of hi-fi turntables. —30—

Car Radio Noise

(Continued from page 81)

ohms of resistance, is used by Ford and some other manufacturers; these leads have "RADIO" stamped along the wire, and can be obtained at Ford garages and radio supply houses.

If you run into a really stubborn case of plug noise, and the distributor suppressor can't lick it entirely, try a full set of suppressors, one on each spark plug. These will have to be of the plug-in variety. Better still, if the car is to be used for mobile short-wave work, replace the plugs with the special "resistor plugs" made by AC;

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they are much more effective than external suppressors, especially above the broadcast band.

Bypassing Noise. Bypassing is the other noise elimination technique. If you find a device that is making noise, it will always be in the form of the pulses we showed in Fig. 1. This a.c. hash is "added" to the d.c. of the car's electrical system. So, to get rid of the a.c. noise and leave the d.c. unaffected, we must use something that will pass only the noise, and not the d.c. . . . in other words, a capacitor. See Fig. 3.

The noise pulses and the d.c. voltage will be found "mixed" in the line coming out of the device. Actually, of course, these noise pulses aren't really a.c. such as is available at a wall outlet; they're a "pulsating d.c."; but we can treat them as if they were a.c. If we connect a large capacitor from the device to ground, the noise pulses will "see" a nice low-resistance path back to ground, and go that way, leaving the d.c. line free of noise. They are "bypassed" to ground.

Typical uses of this method are shown in Fig. 1, at (B), (C), (D) and (E). Notice the noise waveforms shown at each point. The capacitor indicated by the box will pass the noise component to ground, keeping it out of the wiring system.

For best results, the bypass capacitor should always be connected directly to the terminals of the device causing the noise. For instance, if you found a fuel-gauge noise, you'd hook the bypass capacitor right at the fuel-tank unit, never at the dash indicator: the tank unit is the *source* of the noise.

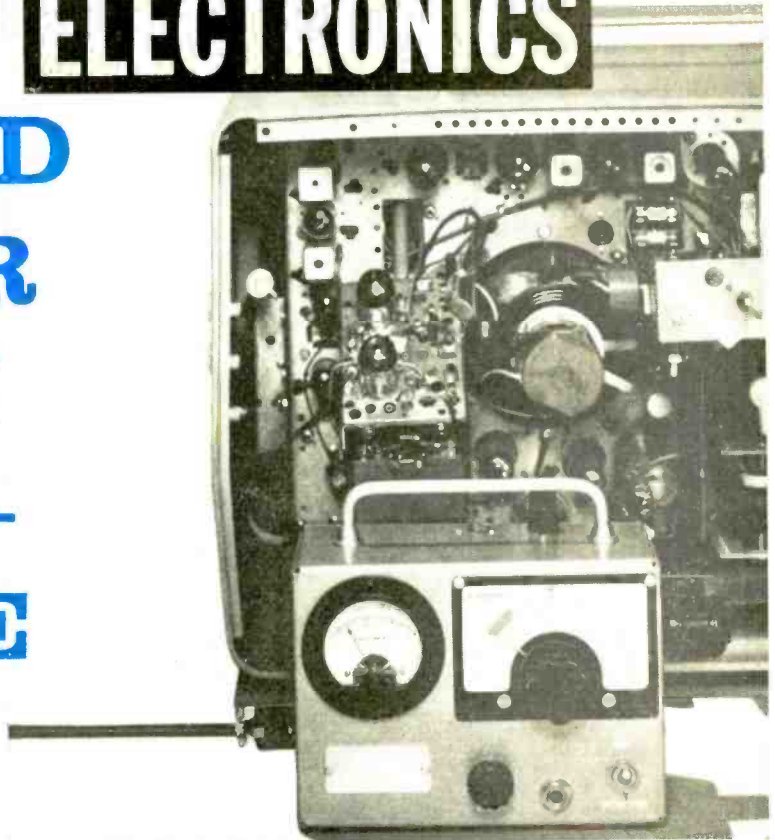
To bypass generator noise caused by the brushes, the capacitor is connected right on the generator housing, to the armature lead, as shown in Fig. 4. A voltage-regulated generator always has two leads; the armature and the field. Never connect the bypass to the field terminal; this will upset the voltage-regulator action, (and usually *increase* the noise, incidentally!). You can easily tell the terminals apart, as the armature terminal will be connected to the biggest wire. The field terminal usually has a little red paper collar on it, as a warning *not* to hook up a bypass capacitor there!

There's still some hash coming through, you say? Well, try and live with it till next month, when we give auto radio noise its final quietus by tackling wheel, body and antenna pickup problems.

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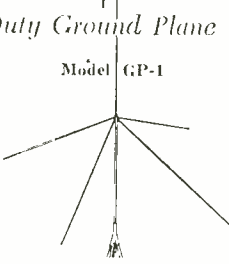
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DX the Tropics on 60 Meters

(Continued from page 71)

it requires great patience due to its unpredictable nature. At times it is very short-lived because of rapid changes in conditions. West Coast DX'ers have success with African stations via the long path from around 1400-1530 GMT, an extremely unlikely reception time for East-erners. On the East Coast, Asian stations are sometimes noted around 2130-2330 GMT, at which time the "daylight factor" would be a handicap for West Coast listeners. A most remarkable long-path Australian is VLX-4, Perth, on 4.897 mc., heard best on the East Coast from January through March, peaking around 2230-2300 GMT.

Winter months provide the best conditions for DX'ing on 60 meters because the days are shorter and thus there is less trouble with the "D" layer eating up the signal. During low-count sunspot years, signals will be of excellent strength and quality, as many DX'ers learned during the 1954 and 1955 seasons. Since the maximum sunspot year has now passed, it is reasonable to expect a gradual improvement on 60 meters until 1965—when the next minimum sunspot cycle will occur.

The tables on pages 70-71, designed for listeners in both Eastern and Western USA reception areas, will be helpful to old and new listeners alike on the 60-meter band. All times are *approximate* and are based on my five-year study of 60-meter reception during the months from November to March and for a median noise level.

Plenty of patience and perseverance are needed when you are DX'ing on 60 meters. Local noise or interference may at times render the desired signals unreadable. An antenna fed with coaxial low-loss lead-in will often lessen such noise considerably.

Don't be fooled by broadcast-band harmonics which may appear from time to time. An inexperienced DX'er, for instance, might think he is tuned to Uganda on 5.026 mc. at 1800 GMT when it is more likely that he is hearing a BCB harmonic on 5.030 mc. Identification is not always easy for there are many other types of interference—such as c.w.-QRM—in addition to local TVI or interference from appliances.

If you want real DX, remember that 60-meter reception thrives best along the "path of darkness."

—30—

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The sea of mail that poured in during October made our Monitor Registration Director, Tom Kneitel, cry "Uncle!" So, the editors of POPULAR ELECTRONICS have come up with an idea to speed the mailing of the certificates. If you have not registered yet, fill out the form below and send it with a *stamped, self-addressed business envelope* to: Monitor Registration, POPULAR ELECTRONICS, One Park Ave., New York 16, N. Y. Please include ten cents to help cover the cost of processing your certificate.

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Receiver	Make	Model
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	Make	Model
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Principal SW Bands Monitored	Number of QSL Cards Received	
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Type of Antenna Used		

Signature	Date	
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FROM time to time the Federal Communications Commission makes announcements of vital importance to our readers. The following is a report on three such items which affect amateur radio and Citizens Band service.

Third Party Messages. Effective August 30, 1959, the FCC announced that Mexican and United States amateur radio stations may exchange international messages or other communications with third parties. This privilege has some limitations. The communications are restricted to conversation or messages of a technical or personal nature, which normally would not be handled by public telecommunications services. Needless to say, no fees or considerations may be accepted by hams for extending this service for a third party.

Other countries which have similar third party agreements with the United States are Canada, Chile, Costa Rica, Cuba, Ecuador, Liberia, Nicaragua, Panama, and Peru. It is hoped that the State Department, responsible for negotiating these international agreements, can further expand this list of countries.

FCC Rules, Volume VI. Rules for Amateur, Citizens, and Disaster Services in the new loose-leaf form will soon be available from the Government Printing Office. Part 12—Rules covering Amateur Radio Service, Part 19—Rules covering Citizens Radio Services, and Part 20—Rules covering Disaster Communications Service are included in Volume VI, dated August 1959, which is now being printed. The cost of the volume, including amendments for an indefinite period, is \$1.25 (domestic mailing) and \$1.75 (foreign mailing). Send orders to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Since Part 19 is not presently available from the Government Printing Office, an applicant for a license in the Citizens Radio Services who does not have a copy may file his application provided he certifies, under "Remarks" on FCC Form 505, that he has placed an order with the Government Printing Office for the new Volume VI, and strikes out that part of the certification which deals with possession of a current copy of Part 19. This provision is valid only until Volume VI is placed on sale.

Citizens Band. The construction, installation or servicing of Class C and D licensed

Citizens Band transmitters no longer requires a licensed commercial radio operator if *all* the following conditions are met.

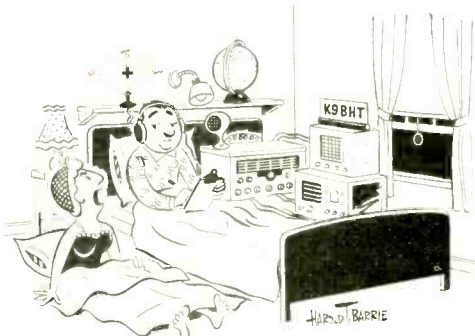
- The transmitting equipment must be crystal-controlled with a crystal capable of maintaining the station frequency within the prescribed tolerance.

- The transmitting equipment either must have been factory-assembled or provided in kit form by a manufacturer who furnished all components together with full and detailed instructions for their assembly by non-factory personnel.

- The frequency-determining elements of the transmitter, including the crystal(s) and all other components of the crystal oscillator circuit, must have been pre-assembled, pre-tuned to a specific available frequency, and sealed by the manufacturer so that replacement of any component or any adjustment which might cause off-frequency operation cannot be made without breaking the seal and thereby voiding the certification of the manufacturer.

- The transmitting equipment must have been so designed that none of the transmitter adjustments or tests normally performed during the installation, servicing, or maintenance of the station, during normal station operation, or during the final assembly of kits or partially pre-assembled units, may reasonably be expected to result in off-frequency operation, excessive plate input power, over-modulation, excessive harmonics or other spurious emissions.

- The manufacturer of the transmitting equipment or of the kit from which the transmitting equipment is assembled must have certified in writing to the purchaser of the equipment (and to the Commission upon request) that the equipment was designed, manufactured and furnished in accordance with the above conditions. —30—



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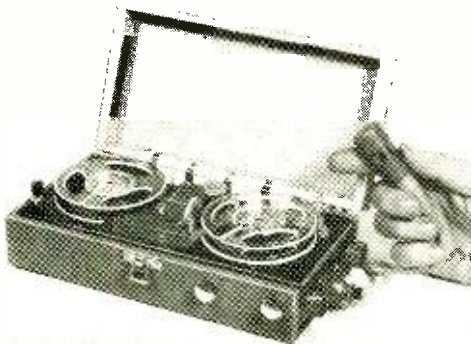
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Tape Recorders

(Continued from page 51)

according to the manufacturer. Battery life is from 30 to 100 hours, and batteries are available from most radio parts suppliers for \$2.72 per set of four. Although the Magnette's push-button control system is perhaps a little more complicated than that of the other recorders, the user will have no trouble operating it with a little practice.

The "Fi-Cord" is produced in England under Swiss patent rights. It is almost unbelievably small considering it has such



"Fi-Cord" Model 1A is an example of fine machining and careful attention to detail. This unit features a mike-mounted on-off switch, printed-circuitry and rechargeable batteries.

outstanding performance specifications. Although it weighs only 4½ pounds, the manufacturer claims a frequency response of 50 to 12,000 cps ± 3 db. It boasts two speeds: 1½ ips for voice, and 7½ ips for full-range fidelity.

Powered by four 2-volt imported rechargeable batteries, the Fi-Cord runs about three hours on each battery charge. The charger sells for \$39.90 and will pay for itself quickly if considerable recording is done. The internal playback arrangements are not adequate for quality reproduction, but this is not a shortcoming since the manufacturer assumes that only professional users will buy the Fi-Cord and will play back the recorded tapes on a separate machine.

Partly because the Fi-Cord is not intended for casual operation, it is not particularly

convenient to use and has no power rewind. It is, however, probably the best tape recorder in the world on a pound-for-pound basis.

A.C.A.'s Model 612-TD is one of that firm's selection of over 60 portable models. Amplifier Corporation of America makes fine tape recorders for discriminating users all over the world (and at pretty prices, we might add). As the Model 612-TD is intended for locales where batteries are not readily available, this recorder employs a spring-wound motor. Keeping it wound up might seem like a nuisance, but once you get into the rhythm, it's not difficult to stay with it. About every five minutes, a little bulb lights up to signal that a few more turns are in order.

Although the Model 612-TD has no playback amplifier and speaker, it uses a total of no less than 11 carefully selected transistors. To keep flutter and wow from intruding, a heavy flywheel is attached to the capstan when the machine is in operation. The flywheel is removable and is detached when the recorder is being transported.

Summing Up. Portable tape recorders can be a lot of fun and they can pay their own way if there is a business need for



Spring-wound motor is employed by Amplifier Corp. of America's Model 612-TD. This precision-made recorder is intended for use in remote areas where extra batteries are not available.

them. Whether you want to dictate letters, record conferences or interviews, or go into the backwoods to collect some authentic folk songs or perhaps even some birdcalls, you'll find there is a portable that can do the job.

-30-

The Man Who Out-Thinks Univac

(Continued from page 47)

doctor's: "It's part of my job." Then he grinned. "Besides, it's not too bad. One time I was playing cards when the phone rang, and I was glad to get away. I was holding deuces in five-card stud."

Stewart lives with his wife and two small daughters in the Bay Ridge section of Brooklyn, where he owns a comfortable two-family house. Off duty, his main recreations are reading and hi-fi, though unlike most electronics buffs he has not built his own hi-fi set: "I'd like to, but I don't have the time." In common with many men whose jobs are intellectually taxing, Stewart makes it a firm policy not to talk business at home. His wife is interested in the work, but "she understands how I feel. I want to keep the two things—home and job—as separate as possible."

Even so, computers are never very far from his thoughts; he has been known to come up with the answer to a trouble-shooting problem in his sleep.

"A couple of weeks ago," he recalls, "just as I was getting ready for bed, one of the

crew chiefs phoned me to say his computer had gone off and he couldn't get it to go on again. He was pretty sure the trouble was in a relay circuit and he'd tried to bypass it by grounding out a contact with another relay, but it hadn't worked. There was no emergency, so I told him I'd be in the next day. A couple of hours later I woke up—I guess I'd been dreaming about it—and called the guy back. I said 'Try putting the ground wire on the other side of the relay.' He did and the unit went on immediately."

Future Prospects. Stewart's employers consider that his future in the Remington Rand organization, and in the electronics industry, is as sound as a gilt-edged security. Already his excellence on the job is beginning to take him into management areas of the business.

Stewart himself dismisses any long-range questions about his career with an amiable shrug. "I don't really think about it too much," he said. "All I know is I want to stay close to computers, and I'd like to be in on some of the technical developments of the future. In the meantime, I just figure I'm lucky to have found the kind of work I like."

-30-

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Resistors at Work

(Continued from page 77)

rent squared, or $W = I^2R$. Substituting values, we find that $W = (0.15)^2 \times 125$, or 2.8 watts.

To avoid any possibility of the resistor burning up, or overheating adjacent components, we allow a safety factor of 100% or more. Our final choice would be a 125-ohm wire-wound resistor with a power rating of 5 to 10 watts. The use of a somewhat higher wattage resistor than required never does any harm.

One of the things most puzzling to the novice is the exact significance of resistor wattage ratings. Let's see if we can find a clue to what's happening by examining two 100-ohm resistors—one rated at ½ watt, the other at 100 watts.

Their size difference is immediately apparent, but what does the physical size have to do with the wattage rating? The answer is that a larger size allows the resistor to get rid of more heat. The matter of wattage (or power dissipation) then breaks down into the simple question:

what's the maximum amount of heat a resistor can take (and get rid of) without a change in its electrical characteristics?

This need to get rid of heat explains the puzzling fact that a resistor can have two wattage ratings—one in free air and the other under chassis. It also explains why some wire-wound resistors are designed with a flat side or made to be clamped to the chassis. Obviously, if a resistor can get rid of heat by having the metal chassis conduct it away, it thereby achieves a higher wattage rating at no increase in physical size. Fins on the resistor would be another answer to heat radiation, but the increase in physical size that would be required makes the idea impractical except in very special circumstances.

What we've given you here is but a small part of the resistor story. In the big picture, the resistor is a vital member of the team of electronic components serving in equipment ranging from signal generators to space satellites. An understanding of the resistor and its functioning is a basic step toward the understanding of any electronic circuit or device.

-30-

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Across the Ham Bands

(Continued from page 86)

Consequently, installing a low-pass filter on a poorly shielded or filtered transmitter is about as useful as trying to burglar-proof a house by double-locking the front door while forgetting to close the windows and the back door. Fortunately, all the better ham transmitters sold for at least the past five years are very good on these points. Also, the less-expensive commercial 50- to 75-watt "Novice" rigs usually are adequately shielded and filtered for areas where TV signals are not too weak.

To hook up a low-pass filter, mount it on the back of your transmitter and connect it to the output coax fitting with a double-ended connector such as a Dow Key DKF-2 and a right-angle coax connector (or through a short piece of coaxial cable). Then, connect your antenna or antenna coupler to the output side of the low-pass filter. If the coupler or transmitter output is reasonably close to a 50-ohm load, the transmitter should handle about the same amount of power as always, but TVI should be substantially reduced.

When you buy a low-pass filter, invest in a good one—though the cheaper ones are better than nothing at all. I use a 1-kw., 52-ohm unit with a cutoff frequency of 40 mc. However, if you are working six meters, use a filter with a 52-mc. cutoff.

LONG-WIRE ANTENNA COUPLER

With the antenna coupler diagrammed and pictured on page 86, you can transform the unknown impedance of a random-length, end-fed antenna to about 52 ohms. At this low impedance, you will be able to use a standard low-pass filter for TVI elimination. Harmonic radiation from the transmitter will also be reduced a couple of "S" units with this coupler.

Build the coupler in a 3" x 4" x 5" aluminum box, and follow the layout in the photo. Wire the coil to the switch (Centralab PA-2001, or equivalent) as follows.

First, unwind a quarter turn from each end of the 48-turn, 1"-diameter coil (B & W #3015 "Miniductor"). Then solder taps of about #20 solid wire at 2¼, 10, 22, and 40 turns from one end. Connect the end of the coil nearest the 2¼-turn tap to the switch contact marked 6 on the diagram

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Alfred Badson, 1494 E. 1/2nd St., Bronx 72, N. Y. Phone: TI 2-3335. (Code, theory, regulations and selection of equipment)
Harold Baer (15), 182 E. 51st St., Brooklyn 3, N. Y. Phone: PR 8-1548. (General code)
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Leonard Feinstein, 841 Ave. Z, Brooklyn 35, N. Y. Phone: NI 6-2350. (Code, theory and selection of equipment)
Joseph Messner, 18 W. Woodburn, Pine Hill, N. J. (Code and theory)
Alfred Weissmann, 42-30 Union St., Flushing, N. Y. Phone: LN 3-6385. (Code, theory, regulations and selection of equipment)
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David Digweed, 80 Sherwood Ave., St. Catharines, Ont., Canada. (Code and theory)
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Ken Webb, WV2BQM, operates in Amityville, N. Y.

and its opposite end to the movable switch contact. Use a fairly stiff piece of wire for this connection to help support the coil. Skip contact 1 on the switch, and connect the coil taps to contacts 2 through 5. Now connect the stator of the 250- μ f. variable capacitor to the movable switch contact and to the output terminal. Finally, connect switch contact 6 to the coaxial connector.

If you have an SWR or reflected power meter available, connect it between the coupler and your transmitter, and adjust the switch and capacitor for minimum SWR on various frequencies. Record the settings for future use. Lacking such a meter, set the coupler controls to some arbitrary positions, and attempt to load the transmitter in the normal manner. After a few trials, you should find several settings that will load the transmitter. Choose the combination that results in the rated input to the transmitter with the least heating of the antenna coil or the transmitter tank coil. You'll find that the coupler will handle the output of a 100-watt transmitter safely.

News and Views

Do you have ignition noise on your mobile? Paul, K5OSQ, cured his by going to a Mercedes Benz automobile with a diesel motor, and he gets 30 to 35 miles per gallon. . . . Ivor, VK3XB, reports that many of the Novices he has been working lately on 7150 kc. started listening for him after reading our September column. But one KN8 kept calling Ivor "K3XBV," even after Ivor sent "I am a VK" over and over. The lad replied "K3XBV DE KN8--- R. R. What is a VK?" Ivor then sent "Australia" a half dozen times, but that didn't get through, either.

Eldon Peterson, KN0UAX (14), 127 N. Washington, Lindsborg, Kans., uses the KN5PGM

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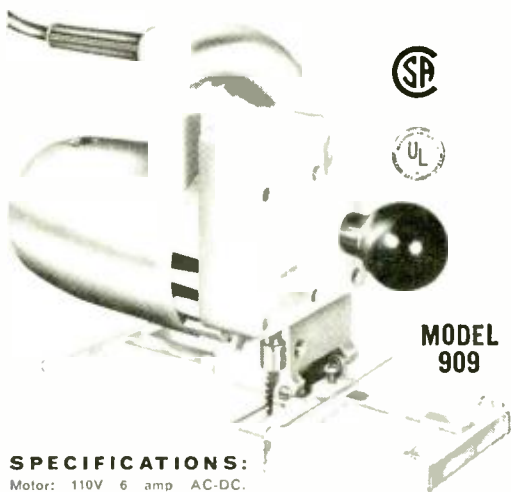
fine scroll work...complete safety

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AMAZING—First and only portable electric saw to give you all these features!

- cuts a 6" board or 6" log
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1. The names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Ziff-Davis Publishing Company, 431 So. Wabash Ave., Chicago 5, Ill.; Editor, Oliver Read, One Park Ave., New York 16, N. Y.; Business manager, Leonard O'Donnell, One Park Ave., New York 16, N. Y.

2. The owner is: Ziff-Davis Publishing Company, 431 So. Wabash Ave., Chicago 5, Ill.; Estate of William B. Ziff, One Park Ave., New York 16, N. Y.; A. M. Ziff, One Park Avenue, New York 16, N. Y.

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

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5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.)

L. O'DONNELL, Business Manager.

Sworn to and subscribed before me this 17th day of September, 1959.

(SEAL) WILLIAM PROEHMER, Notary Public.
(My commission expires March 30, 1960)

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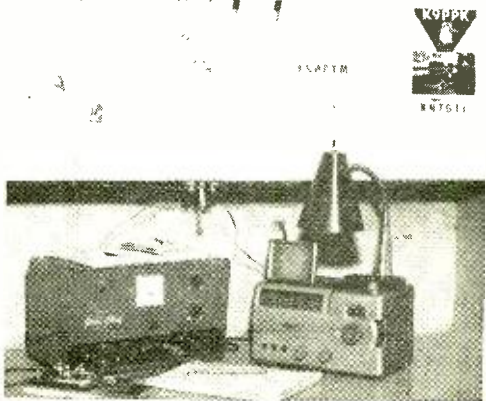
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two-element beam described in the May, 1959, column with excellent results. He has it mounted on a used 35' telephone pole, and the total installation cost him \$4.36. In three months on the air, Eldon has made 210 contacts in 32 states on 40 and 15 meters, running 50 watts to a Knight transmitter and receiving on a Hallicrafters S-85 with an added Heathkit QF-1 Q-Multiplier. He also has a 40-meter doublet antenna. . . . **Lewis H. Lowe, KNØTHU**, Box 364, Pelican Rapids, Minn., worked eight states in his first eight contacts. And after three months on the air, he has 24 states, 15 confirmed. Lewis likes 40 best but works 80, too. . . . **George, W2MMQ**, Philmont, N. Y., has made 1000 contacts since getting his Novice license in June, 1957, with his WRL Globe Scout transmitter, Hallicrafters S-85 receiver, and dipole antenna.

Jim Stockwell, WV6GDS (14), 5718 Aladdin St., Los Angeles 8, Calif., has made over 100 contacts in 19 states and Canada in two months on the air. He operates 40 and 15 meters, feeding a 40-meter folded dipole antenna with a Heathkit DX-40, and he receives with a Gonset G-33 receiver. Jim's newest project is putting up a Cubex tri-band cubical quad antenna. . . . **Joe Chusid, WA2FNA** (15), 3390 Emeric Ave., Wantagh, N. Y., worked 27 states, Puerto Rico, Canada, and Venezuela as a Novice. He runs 75 watts to a Heathkit DX-40 feeding a Hy-Gain vertical antenna on 40, 20, and 15 meters and receives with a National NC-109. Now that he has his General, he will schedule anyone needing New York for WAS on any band, except 10 meters.

Glenn E. Zook, KN9STH, 1006 W. 16th St., La Porte, Ind., prefers the 40-meter band because he finds the operators on this band are more willing to chew the rag than those on 80 or 15 meters. Glenn has two transmitters, a WRL Globe Chief 90-A and a home-brew 60-watter, and he receives on a Hallicrafters S-107. His antenna farm contains a three-band dipole for 80, 40, and 15 meters, and a 15-meter folded dipole. In addition, he is building a two-element rotary beam. The antenna supports include a 30' "T" and a 20' telephone pole, obtained from K9BPV, whose wife wouldn't let him put them up. One of Glenn's



Shack of Hal Bergeson, KN7GOG, Lewiston, Utah.

Always say you saw it in—POPULAR ELECTRONICS

pet peeves is the fellow who sends 12 wpm but wants you to send 5. . . . **Ken Quin, KN5TSQ**, 1020 S. 13th St., Edinburg, Texas, now has 47 states and 21 countries worked with his Heathkit DX-20, Knight receiver, and a DB-23 preselector ahead of the receiver. He needs Asia for WAC (Worked All Continents).

That's it for this month. Keep your reports, pictures, items and views coming. Merry Christmas to you all. 73,

Herb, W9EGQ

Short-Wave Report

(Continued from page 72)

Before we go into some of our usual current report listings this month, we thought you might be interested in the schedules for the numerous stations in the *Radiodiffusion d'Outre Mer Network* (French Overseas Radio Network). Many of these stations are heard at good volume during the late afternoons. Medium-wave outlets are given for the benefit of our readers in European Countries.

The majority of the stations listed here are located in French-African Territories; Tananarive (Madagascar) is off the African East Coast; Noumea and Papeete are Pacific Islands; St. Pierre and Miquelon are islands in the North Atlantic. All times shown are Eastern Standard and the 24-hour system is used throughout.

Abidjan—*Radio Cote D'Ivoire*: 0130-0300 (Sundays at 0215-1730), 0715-0830 (Saturdays to 1900), and 1245-1730 on 1493 kc. (4 kw.); 4940 kc. (10 kw.) at 0130-0300 and 1245-1900; and 7215 kc. (1 kw.) at 0430-1230. TBT: 66 hours weekly.

Bamako—*Radio Soudan*: 0130-0230 (Sundays at 0345-1300), 0715-0800 (Saturdays to 0900), and 1330-1715 (Saturdays at 1300-1800, Sundays to 1700) on 1430 kc. (1 kw.); 4835 kc. (4 kw.) at 0130-0400 and 1300-1800; and 9745 kc. (4 kw.) at 0400-1300. TBT: 48 hours weekly.

Bangui—*Radio Bangui*: 0200-0700 (Sundays only) on 9513 kc. (3 kw.); and 1145-1400 on 5982 kc. (3 kw.). TBT: 18½ hours weekly.

Brazzaville—*Radio Inter-Equatoriale*: 0030-0130 (Sundays at 0200-1600), 0600-0730, and 1130-1600 on 1484 kc. (600 watts); 4795 kc. (4 kw.) from 1130 to 1600; 7295 kc. (4 kw.) and 9545 kc. (50 kw.) at 1200-1355. TBT: 56 hours weekly.

Cotonou—*Radio Dahomey*: 0030-0130 (Sundays at 0300-0700), 0615-0715 (Saturdays at 0700-0800), and 1200-1600 (Mondays/Wednesdays from 1150, Saturdays at 1100-1800, Sundays from 1100) on 1475 kc. (1 kw.); 4870 kc. (4 kw.) at 0030-0130 and 1100-1800; and 7190 kc. (4 kw.) at 0300-0800. TBT: 48 hours, 20 minutes weekly.

Dakar—*Radiodiffusion De La Federation Du Mali*, (formerly *R. Inter*): 0130-0300 (Sundays at 0130-1830), 0700-0900 (Saturdays to 1830), and 1400-1830 on 1538 kc. (10 kw.); 4950 kc.

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0A2	5X8	6BH6	6SF5	7Z4	19BG6
02B	5Y3QT	6B15	6SF7	7J8	19B
1A7GT	6Y4G	6BN6	6SJ7	12A05	19B8
1B3QT	6A7	6BK6	6SK7	12A26	2A4
1H3GT	6AB	6BK7	6SL7GT	12AT7	25AV5
1L4	6AB4	6GL7GT	6HNA	12AU6	25B06
1L8	6AC7	6H4GT	6H4GT	12AV6	25DMS
1M3GT	6AF4	6HEGT	6H7GT	12AV7	25L6GT
1Q3QT	6AG5	6HEGT	6H7GT	12AX4GT	25W4GT
1S5	6A07	6H5GT	6H7GT	12AX7	25Z5
1S8	6A4GT	6H5GT	6H7GT	12A27	25Z6
1T4	6AH6	6H6	6H7GT	12B1	2H
1U4	6AK5	6C4	6H7GT	12BA4	5215
1U8	6AL5	6C5	6H7GT	12BA7	19B5
1V2	6AL7	6CB	6H7GT	12B6	35C5
1X2	6AN8	6CB8	6H7GT	12BF6	35L6GT
2A3	6AN8	6CB8	6H7GT	12BF6	35W
2F4	6A05	6CF8	6K	12BQ6	35V4
3BC5	6A06	6CF8	6K	12BQ6	35Z5GT
3B8	6A06	6CL6	6K	12BR7	37
3BZ6	6AR5	6CM7	7A3	12C45	39/44
3CB8	6AS5	6CN7	7A6	12J5	42
3CF8	6AT8	6CS6	7B3	12K7	43
3CS8	6AT8	6CS6	7B3	12L6	44
3LF4	6AU8GT	6DE6	7B4	12Q7	50A5
3Q4	6AUB	6DF6	7B6	12S47	50B5
3V4	6AUB	6DF6	7B6	12S7	30C5
4B7A	6AV5GT	6H6	7B7	12S7	50L6GT
4B7B	6AV8	6J4	7B8	12V6GT	57
5A5B	6AW8	6J5	7C4	12W6GT	71A
5A7B	6AX4GT	6J7	7C5	12W6GT	76
5AV8	6AX5GT	6K6GT	7C6	12W6GT	77
5AW4	6B	6K7	7C7	12W6GT	80
5B7	6B4	6K8	7E6	12W6GT	88
5B8	6B4	6K8	7E7	12W6GT	1A
5B8	6B4	6K8	7E7	12W6GT	76
5U4G	6BD4	6N7	7F7	12W6GT	77
5V4G	6BE6	6Q7	7H7	12W6GT	77
5V4G	6BF5	6S4	7H7	12W6GT	77
5V6GT	6BF6	6SGT	7H7	12W6GT	77
	6BGG	6SA7	7Q7	12W6GT	77
		6SC7	7X7/XXFM	14Q7	80
			7Y4	14Q7	80
				19AU4GT	84/624
					11723
					11726

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14B/CP4	9.95	17AVP4	12.50	20CP4	13.50	21WP4	14.00
16DP4	12.00	17BP4	9.95	20HP4	14.50	21YP4	14.50
16EP4	12.75	17CP4	17.00	21AP4	22.10	21ZP4	13.50
16GP4	14.50	17GP4	17.60	21ALP4	15.75	24CP4	23.50
16KP4	9.95	17HP4	12.50	21AMP4	15.75	24DP4	24.50
16LP4	10.95	17LP4	11.50	21ATP4	15.75	27P4	39.95
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(4 kw.) at 0130-0300 and 1300-1830; 7210 kc. (4 kw.) at 0330-1300; 7210 kc. (25 kw.) at 0130-0300 and 1300-1730; and 11,895.5 kc. (25 kw.) at 0700-1300. TBT: 68 hours weekly.

Radio Senegal—0130-0300 (Sundays at 0300-1800), 0730-0900 (Saturdays to 1800), and 1230-1800 on 1304 kc. (8 kw.); 4893 kc. (4 kw.) at 0130-0300 and at 1230-1800; and 7171 kc. (4 kw.) from 0300 to 1230. TBT: 69½ hours weekly.

Djibouti—*Radio Djibouti*: 0400-0500 and 1000-1430 on 1538 kc. (1 kw.); 4780 kc. (4 kw.) from 1000 to 1430; and 6000 kc. (4 kw.) between 0400 and 0500. TBT: 38 hours weekly.

Douala—*Radio Cameroun II*: 0045-0230 (Sundays at 0200-0800), 0615-0730, and 1200-1600 (Saturdays from 1000) on 1448 kc. (1 kw.) and 6184 kc. (1 kw.) (temporary use; assigned frequency is 6115 kc.). TBT: 54 hours weekly.

Fort Lamy—*Radio Tchad*: 0630-0830 (Sundays at 0400-1600) and 1200-1600 on 1538 kc. (1 kw.); 4904.5 kc. (4 kw.) from 1200 to 1600; and 9585 kc. (4 kw.) between 0400 and 1200. TBT: 48 hours weekly.

Garoua—*Radio Cameroun III*: 0615-0800 (Fridays to 0830, Sundays from 0430) and 1230-1600 (Thursdays from 1200, Saturdays/Sundays at 1200-1630) on 1348 kc. (1 kw.); 5010 kc. (4 kw.) at 1200-1630; and 7240 kc. (4 kw.) at 0430-0830. TBT: 41½ hours weekly.

Libreville—*Radio Gabon* has inaugurated experimental daytime xmsns on 9690 kc. Fixed xmsns are expected to be announced shortly.

Lome—*Radio Togo*: 0100-0300 (Sundays at 0230-0900), 0700-0830 (Saturdays to 1730), and 1230-1700 (Sundays from 1200) on 1394 kc. (1 kw.); 5036 kc. (4 kw.) at 0100-0400 and 1200-1730; and 7265 kc. (4 kw.) at 0400-1200. TBT: 64 hours weekly.

Niamey—*Radio Niger*: 0030-0115 (except Sundays), 0645-0745 (Sundays at 0600-1600), and 1230-1600 on 1511 kc. (1 kw.); 5020 kc. (4 kw.) at 0030-0115 and 1230-1600; and 9710

MONITOR REGISTRATION

SWL fans throughout the world have swamped the POPULAR ELECTRONICS editorial offices with Short-Wave Monitor registration forms. The tremendous number of applications has resulted in an increasing backlog of unfilled requests, and Tom Kneitel, Director of Monitor Registration, has become a bit upset by the volume of unanswered mail. So the Editors, with Tommy's blessing, have come up with a plan to cut down the time required to process applications. The plan is: all applicants who want prompt service should include a stamped self-addressed business envelope (approx. 9½" x 4") with the registration form. Those who do will get the certificate within two weeks; those who do not send a return envelope will have to wait a while longer. See page 127 if you have not yet sent in your application.

kc. (4 kw.) at 0600-1230. TBT: 41½ hours weekly.

Noumea—*Radio Noumea*: 1400-1500 (Saturdays at 1600-2100), 1900-2100, and 0200-0530 on 1400 kc. (1 kw.) and 6035 kc. (4 kw.). TBT: 47½ hours weekly.

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Papeete—Radio Tahiti: 1645-1800 (Sundays from 1500) and 2230-0230 (Tuesdays from 2200, Saturdays to 0245) on 6135 kc. (4 kw.); and 11,825 kc. (4 kw.) at 1500-1800. TBT: 39 hours, 15 minutes weekly.

St. Louis—Radio *Mauretanie*: 0715-0815 on 9610 kc. (4 kw.) and 1445-1800 on 1349 kc. (1 kw.) and 4855 kc. (4 kw.). TBT: 22 hours, 45 minutes weekly.

St. Pierre—Radio *St. Pierre Et Miquelon*: 1030-1200 (Thursdays to 1215) and 1830-2100 on 570 kc. (1 kw.). TBT: 28 hours, 15 minutes weekly. DX'ers in Northeastern N. A. may be able to hear this one at times.

Tananarive—Radio *Madagascar*: Broadcasts in French are scheduled at 2230-0000 (Saturdays at 2300-1430), 0400-0600 (Saturdays to 1430), and 1000-1430 on 1394 kc. (1 kw.); 5010 kc. (4 kw.) between 0900 and 1430; 9515 kc. (4 kw.) between 2230 and 0900. TBT: 67½ hours weekly.

Broadcasts in Malgache are scheduled at 2230-0000 (Saturdays at 2300-0600), 0400-0600

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	QSL—Verification
B/C—Broadcasting	R—Radio
Eng—English	s/aff—Sign-off
ID—Identification	s/on—Sign-on
IS—Interval signal	TBT—Total broadcasting time
kc.—Kilocycles	VOA—Voice of America
kw.—Kilowatts	xmsn—Transmission
N.A.—North America	xmt—Transmitter
QRM—Station interference	

(Saturdays to 1300), and 1000-1300 on 1502 kc. (1 kw.) and 7155 kc. (4 kw.); on 3232 kc. (4 kw.) between 1000 and 1300; and 9693 kc. (4 kw.) between 2230 and 1100. TBT: 53 hours weekly.

There is a special Sunday program (language not specified) at 0845-1145 on 1466 kc. (300 watts) and 7260 kc. (4 kw.).


Yaounde—Radio *Cameroun I*: 0030-0230 (Sundays at 0100-1700), 0615-0800, and 1200-1600 (Saturdays at 1000-1700) on 1538 kc. (1 kw.); 4975 kc. (4 kw.) at 0030-0230 and 0900-1700; and 9657 kc. (4 kw.) between 0200 (as indicated but presumably should read 0230) and 0845. TBT: 65½ hours weekly.

Your Short-Wave Editor is deeply indebted to ZC4PE1A, our "Middle Eastern Correspondent" reporter, for the above listings. They represent his final report before returning to the USA. We are most grateful for his valuable assistance in the past and trust that reports from his home will be forthcoming in the near future. Now for a few reports from other areas.

Afghanistan—Kabul has been noted on 15,190 kc. at 0100-0300 with ID in Eng., French, German, Russian, and other languages. Another new outlet on 15,385 kc. is tuned at 1340 with Eng. ID. This 1300-1400 xmsn is QRM'ed by Moscow's European Service. (WPE3NF, WPE8GB)

Ascension Islands—British Cable and Wireless, Ltd., is conducting tests between the Ascension Islands and Slough from a special

December, 1959



*** FREE ***

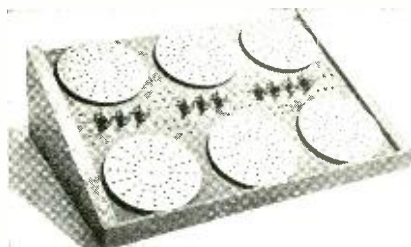
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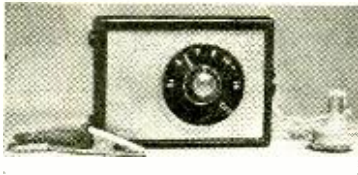
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xmtr which transmits over 2000 different channels between 5500 kc. and 50,000 kc., employing one at a time and covering all within a space of 15 minutes. The receiver at Slough is synchronized with this xmtr. The tests, which will end in June, 1960, are being made to study radio propagation effects on all communications frequencies simultaneously and, ultimately, to improve tele-communications over long distances. (WPE3HP)

Barbadoes—Barbadoes Cable & Wireless is operating on various channels in the 25- and 31-meter bands with network feeds between Barbadoes and Trinidad for medium-wave station. There are no ID's and the broadcasts are subject to unannounced stopping as well as to frequency changes. (WPE3HP)

Liberia—The United States has signed an agreement with Liberia that will permit the VOA to construct a relay station in that

CERTIFICATES RETURNED

Some Short-Wave Monitor Certificates mailed to our readers have been returned due to insufficient or incorrect addresses. More may have been lost in the mail. If your name appears on the list below, drop us a post card giving us your correct and complete address. Send it to: Monitor Registration, **POPULAR ELECTRONICS**, One Park Ave., New York 16, N. Y.

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- Ronald Varner, Washington, D. C.
- J. H. Welch, U. S. Navy
- Jim L. White, Harrisburg, Pa.

country which will be the most powerful xmtr in Africa. (WPE6EZ)

Martinique—Radiodiffusion Television Francaise, Fort de France, has returned to the air on 5995 kc. and is heard daily from 1800 s/on to 2041 s/off with classical music and talks. The signal is good. (WPE1BM)

Netherland New Guinea—R. Omroep, Biak can be tuned on 5045 kc. from 0545 to 0730/close. Varied music is presented, American pop music on Fridays. The anmts are in Dutch with final ID in English. (WPE5EK)

North Borneo—R. Sabah, Jesselton, now operates on 7240 and 9740 kc. and carries Eng.

Always say you saw it in—POPULAR ELECTRONICS

at 0630-0800 (news at 0630). Sundays and Fridays 2345-0015, Saturdays 2220-2300. (ER)

Rhodesia and Nyasaland—The Federal B/C Co., Broadcasting House, P.O.B. 8008, Causeway, Salisbury, South Rhodesia, does not issue QSL cards. Their letter shows the schedule to be: 9505 and 6018 kc. at 0500-0700 (Sundays from 0100); 3396 kc. daily at 1000-1500. (TL)

Solomon Islands—A letter from VQO2, Honiara, 5960 kc. states: "This station is on the air from 0300 to 0530 (from 0400 Saturdays

SHORT-WAVE CONTRIBUTORS

Jerry Berg (WPE1RM), West Hartford, Conn.
 Richard Morcroft (WPE3HP), Pittsburgh, Pa.
 George Cox (WPE3NF), New Castle, Del.
 John Cobb, Jr. (WPE4AJ), Cartersville, Ga.
 S.Sgt. Pedro Vasquez (WPE5EK), U. S. Army, Japan
 J. Art Russell (WPE6FZ), San Diego, Calif.
 Richard England (WPE8FV), Columbus, Ohio
 Ken Boord (WPE8GB), Moigantown, W. Va.
 A. R. Niblack (WPE9KM), Vincennes, Ind.
 Gerry Dexter (WPE0JJ), Waterloo, Iowa
 Middle Eastern Correspondent (ZC-WPE1A)
 Theys Lambert (TL), Teheran, Iran
 Eugene Rubin (ER), Milwaukee, Wis.
 Ron Satterfield (RS), Indianapolis, Ind.

and Sundays). The present service started last Jan. 5th with 5 kw. on the short waves and 660 watts on medium waves. The xmsn is radiated from an eight-element vertical incidence array designed to concentrate the radiation as far as possible within the Solomon Islands, but we have been receiving many reports from Australia, New Zealand, and the USA." The letter was signed by R. F. Calvert, Broadcasting Officer, Box 115, GPO, Honiara, Solomon Islands. (WPE4AJ)

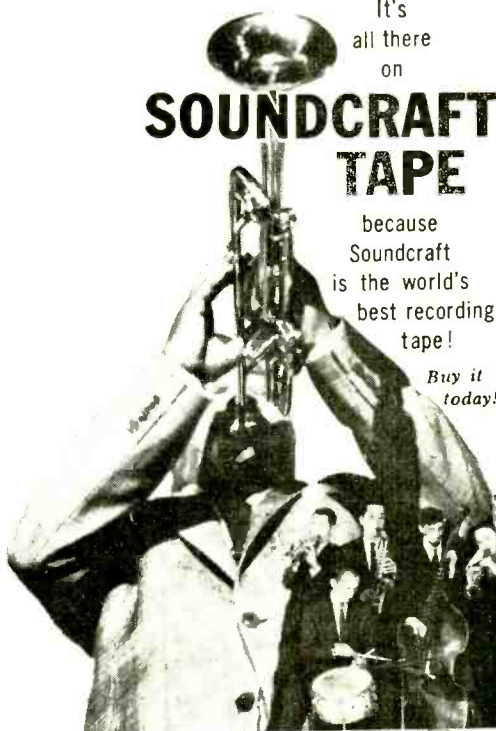
Switzerland—The *Evangelical Broadcast* from Beatonborg, 11,767 kc., is noted at 1545 with a religious program; Eng. ID at 1600; s/off at 1800. Xmtr location may be in Morocco. (WPE3NF, WPE8FV, WPE8GB, and WPE9KM)

Trinidad—The only short-wave station operating here at present is *Piarco Air Radio* (an airways station), heard well on 8837 kc. from 1900 with plane contacts and aviation weather. A letter from the government-operated *Radio Trinidad* indicates an indefinite suspension of commercial s.w. broadcasting. (WPE3HP)

Tunisia—A letter from *Radio Tunisia* indicates that this station is not as yet on the air and that DX'ers who report hearing it are actually hearing other stations. However, a station with a Tunis ID is definitely noted on 7210 kc. with drums IS and French s/on at 0131. (WPE1BM, WPE0JJ)

USA—The Friday evening boxing matches can be heard in the Spanish broadcast to Latin America over Press Wireless stations WFL51, 11,035 kc., WFK24, 14,431 kc., WFK63, 13,840 kc., and WFL65, 15,850 kc. The broadcast usually runs from 2000 to 2200 after a test xmsn. (RS)

Clandestine—*Radio Free and Fighting Algeria* is probably the Arabic clandestine station noted on 6983 kc. to 1805 s/off. The Algerian is now back on the air after a long absence. (WPE3NF)



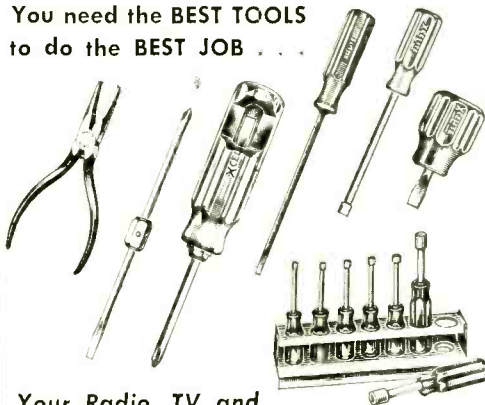
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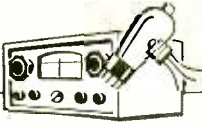
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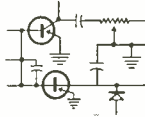
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December, 1959



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C.R.T. TESTER

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From 50 degree to 110 degree types
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Test ALL picture tubes—in the carton—out of the carton—in the set!

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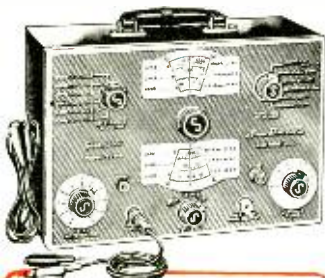
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\$38⁵⁰

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A truly do-it-yourself type

TUBE TESTER

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- ③ Press down the quality button—

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Superior's

New Model

TW-11

STANDARD PROFESSIONAL

TUBE TESTER

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MOSS ELECTRONIC, INC.

Dept. D-686 3849 Tenth Ave., New York 34, N. Y.

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

- | | |
|---|---|
| <input type="checkbox"/> Model 83 Total Price \$38.50
\$8.50 within 10 days. Balance \$6.00 monthly for 5 months. | <input type="checkbox"/> Model 82A Total Price \$36.50
\$6.50 within 10 days. Balance \$6.00 monthly for 5 months. |
| <input type="checkbox"/> Model TV-50A Total Price \$47.50
\$11.50 within 10 days. Balance \$6.00 monthly for 6 months. | <input type="checkbox"/> Model 77 Total Price \$42.50
\$12.50 within 10 days. Balance \$6.00 monthly for 5 months. |
| <input type="checkbox"/> Model TW-11 Total Price \$47.50
\$11.50 within 10 days. Balance \$6.00 monthly for 6 months. | <input type="checkbox"/> Model 79 Total Price \$38.50
\$8.50 within 10 days. Balance \$6.00 monthly for 5 months. |

Name

Address

City Zone State

All prices net, F.O.B., N. Y. C.

SHIPPED ON APPROVAL NO MONEY WITH ORDER — NO C. O. D.



Model 77—VACUUM TUBE VOLT-METER. Total Price . . . \$42.50
Terms: \$12.50 after 10 day trial, then \$6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

Superior's New Model 77 **VACUUM TUBE VOLTMETER** WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price

- Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- Employs a 12A7 as D. C. amplifier and two 90E's as peak-to-peak voltage rectifiers to assure maximum stability.
- Meter is virtually burn-out proof. The sensitive 400

micro-ampere meter is isolated from the measuring circuit by a balanced push-pull amplifier. • Uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

SPECIFICATIONS

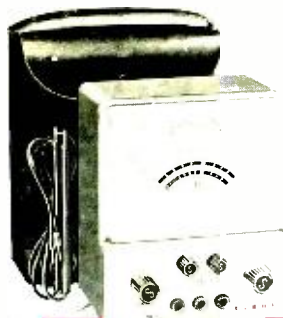
- **DC VOLTS**—0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance.
- **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1,500 volts.
- **AC VOLTS (Peak to Peak)**—0 to 8/40/200/400/800/2,000 volts.
- **ELECTRONIC OHMMETER**—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 meg-ohm/10 megohms/100 megohms/1,000 meg-ohms.
- **DECIBELS**—-10 db to +18 db, -10 db to +38 db, +30 db to +58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v).
- **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, Intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

Comes complete with operating instructions, probe leads, and streamlined carrying case. Operates on 110-120 volt 60 cycle. Only **\$42.50**



Model 79—Super Meter
Total Price **\$38.50**
Terms: \$8.50 after 10 day trial, then \$6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

SUPERIOR'S NEW MODEL 79 **SUPER-METER** WITH NEW 6" FULL-VIEW METER

A Combination **VOLT-OHM MILLIAMMETER**

Plus **CAPACITY, REACTANCE, INDUCTANCE & DECIBEL MEASUREMENTS**
Also Tests **SELENIUM & SILICON RECTIFIERS, SILICON & GERMANIUM DIODES**

The model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development. It includes not only every circuit improvement perfected in 20 years of specialization but, in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic pro-

duction. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes — components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

SPECIFICATIONS:

- **D.C. VOLTS:** 0 to 7.5 15 75 150 750 1,500.
- **A.C. VOLTS:** 0 to 15 30 150 300 1,500 3,000.
- **D.C. CURRENT:** 0 to 1.5 15 150 Ma. 0 to 1.5 15 Amperes.
- **RESISTANCE:** 0 to 1,000 100,000 Ohms. 0 to 10 Megohms.
- **CAPACITY:** .001 to 1 Mfd., 1 to 50 Mfd.
- **REACTANCE:** 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms.
- **INDUCTANCE:** .15 to 7.5 Henrys. 7 to 7,000 Henrys.
- **DECIBELS:** -0 to -18, -14 to -38, -34 to -58. The following components are all tested for QUALITY at appropriate test po-

tentials. Two separate BAD-GOOD scales on the meter are used for direct readings. All Electrolytic Condensers from 1 MFD to 1000 MFD. All Germanium Diodes, All Selenium Rectifiers, All Silicon Diodes, All Silicon Rectifiers.

Model 79 comes complete with operating instructions, test leads, and streamlined carrying case. **\$38.50**
Use it on the bench—use it on calls. Only

TRY FOR 10 DAYS BEFORE you THEN if satisfi

pay in easy, interest free, monthly payments. See coupon inside

We invite you to try before you buy any of the models described on this and the preceding pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need pay only the down payment and then to pay the balance due in monthly indicated rate. (See coupon side for time payment schedule details.)

NO INTEREST OR FINANCIAL CHARGES ADD

If not completely satisfied you are privileged to return the to us, cancelling any financial obligation.

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