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JUNE 1960

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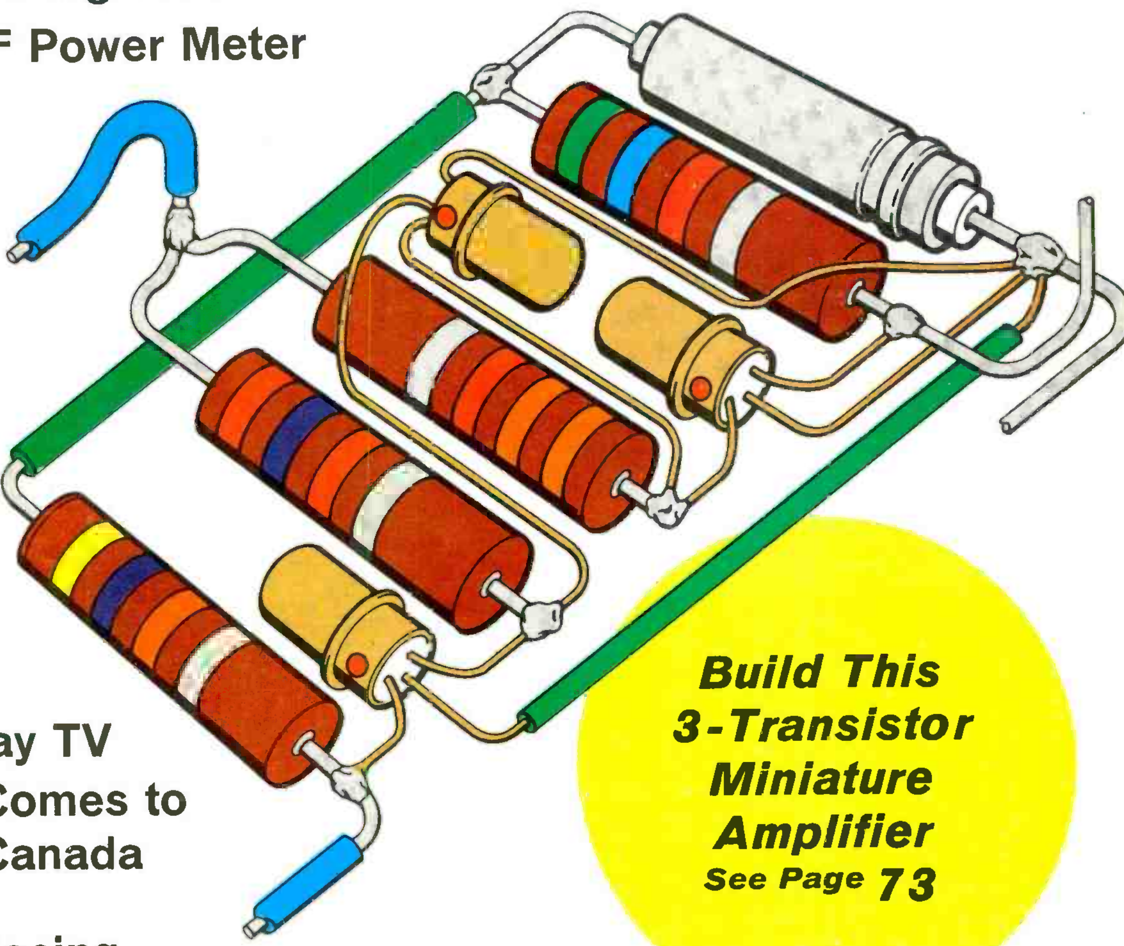

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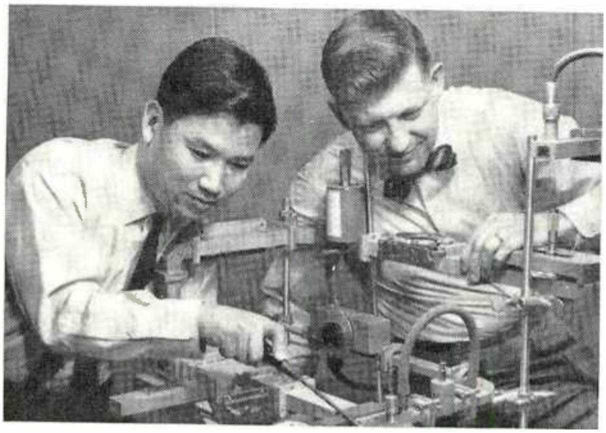
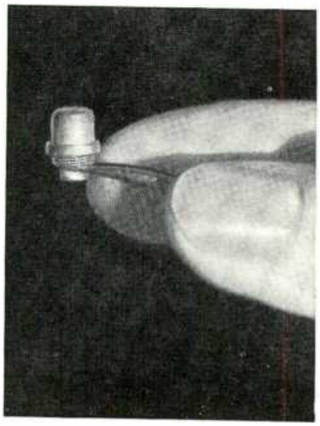


At Bell Laboratories, M. Uenohara (left) adjusts his reactance amplifier, assisted by A. E. Bakanowski. Extremely low "noise" is achieved when certain diodes are cooled in liquid nitrogen.

This is the first practical diode for amplifier as developed by A. E. Bakanowski and A. Uhlir.



How basic scientific ideas develop in the light of expanding knowledge is strikingly illustrated by the development of Bell Laboratories' new "parametric" or "reactance" amplifier.

Over 100 years ago, scientists experimenting with vibrating strings observed that vibrations could be amplified by giving them a push at strategic moments. using properly synchronized tuning forks. This is done in much the same way a child on a swing "pumps" in new energy by shifting his center of gravity in step with his motion.

At the turn of the century, scientists theorized that *electrical* vibrations, too, could be amplified by synchronously varying the *reactance* of a capacitor. Later amplifiers were made to work on this principle but none at microwave frequencies.

Then came the middle 50's. Bell Telephone Laboratories scientists, by applying their new transistor technology, developed semiconductor diodes of greatly improved capabilities. They determined theoretically *how* the electrical capacitance of these new diodes could be utilized to amplify at *microwave* frequencies. They created a new microwave amplifier with far less "noise" than conventional amplifiers.

The new reactance amplifier has a busy future in the battle with "noise." At present, it is being developed for applications in tropospheric transmission and radar. But it has many other possible applications. It can be used, for instance, in the reception of signals reflected from satellites. It is still another example of the continuing efforts to improve your Bell System communications.

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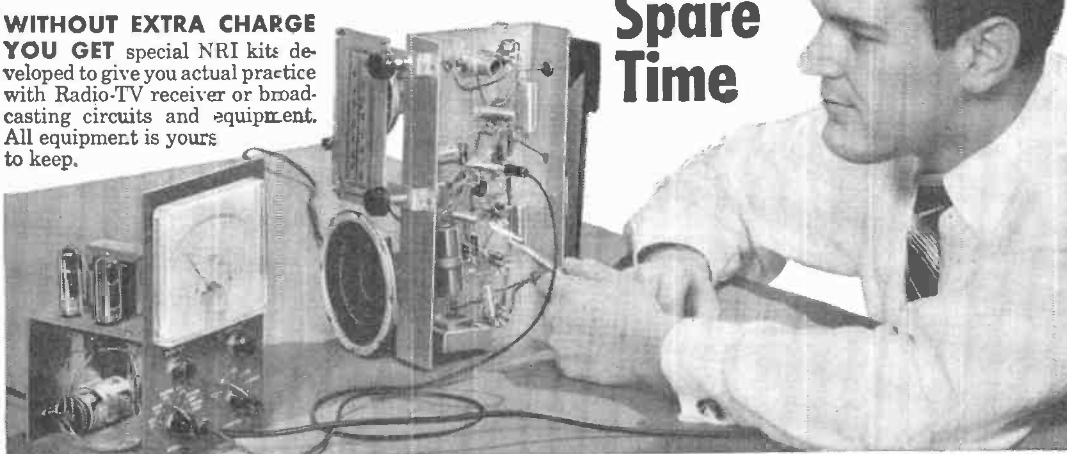

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JUNE 1960

VOLUME 12 NUMBER 6

Cover pictorial by Bruce Aldrich

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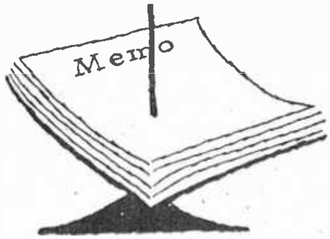

Notes from the Editor

CBS TAPE CARTRIDGE. It was on this page in our April issue that I mentioned the forthcoming appearance of the CBS tape-cartridge system. At that time I had a strong hunch that CBS might pull a rabbit out of its hat and come up with a significant advance in hi-fi/stereo. Well, the magicians at CBS, led by Peter Goldmark, the inventor of the LP record, have apparently done just that. The new system was demonstrated in New York during the recent I.R.E. show, and it made a profound impression on virtually everyone who heard it.

By any standard of comparison, the quality of the system is exceptional. And when you consider that the system uses tape which is 150 mils wide (about 1/7") moving at the speed of only 1 7/8 ips, it is well-nigh unbelievable. Very good high-frequency response (to 15,000 cps) is achieved through the use of narrow-gap heads and a new tape developed by Minnesota Mining and Manufacturing Co. This tape has smaller magnetizable particles than standard tape, thus permitting higher frequencies to be recorded on it. In addition, its oxide coating does not rub off on the heads.

Other features worthy of note include the tape cartridge itself, which is only 3½" square and contains slightly over an hour's stereo playing time; a third channel recorded down the center of the tape that provides a "delayed" sum signal for optional use with a third amplifier-speaker system to increase the amount of reverberation in the listening room; and provisions for automatic operation whereby five cartridges can be played in sequence without touching the machine.

Production models of the new system are now under development by Zenith, and the first commercial units will probably be available next year. Prices are indefinite as yet, but a pre-recorded one-hour tape cartridge will probably be under $5.95, the average cost of a stereo record.

JAPANESE TV SETS. The long-expected influx of Japanese television receivers into this country is about to begin. Sony has already demonstrated a 13½-lb., battery-powered transistorized portable to be imported in quantity very soon. Unlike the portable announced by Philco last year, the Sony set has a direct-view picture tube, 8" in diagonal measurement. Retail price will be about $250.00.

Perhaps even more interesting is the news that Hitachi is getting ready to produce color TV sets for the American market. Plans aren't certain yet as to whether Hitachi will assemble the units completely or just build the chassis. In any case, lower-priced color sets may be on the way!

Oliver Read

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03-G

FCC Report

By ROBERT E. TALL
Washington Correspondent

Citizens Band Applications

WHILE the pot continues to bubble at the Federal Communications Commission on enforcement of the new Citizens Band restrictions, other developments keep popping up.

For one thing, CB'ers can look forward to a new application form being adopted by the Commission, possibly within the next several months. The new form, designed for processing by a method which makes more use of machine stamping than is possible with the present application form, is expected to permit considerable speed-up in handling.

In the present stages of planning, the new form would apply to the Class B, C and D Citizens Radio categories.

Meanwhile, the need for more "understandable" explanations on the present application form is being emphasized by FCC officials. The Commission feels that the licensee should be more specific about what he plans to do with his Citizens Band unit. A survey by the Commission shows that 63% of the Citizens Band applications being returned without action are classed as "defective" because of incomplete statements as to the intended use of the radio units. The FCC explains that the statements do not have to be elaborate, but that it does definitely want to know the intended use.

Another 12% of the applications being returned are classed as defective because the potential Citizens Bander has failed to have his application notarized. In one of his first official duties as new Chairman of the FCC, Frederick W. Ford strongly supported a legislative proposal being studied by the House Interstate & Foreign Commerce Committee that would knock out this re-

quirement. A bill along the same lines was put through the Senate last year.

The FCC told the Congressional Committee that the requirement for notarization imposes an unnecessary burden on the public, and hampers the Commission's processing work. The FCC feels that the U. S. Code already provides for fine or imprisonment if false statements are included on an application form, and the Commission can revoke licenses later if applicants prove to be untruthful.

However, FCC officials caution that the deletion of the notarization requirement will be in the future, and that any Citizens Bander who wants his license from the Commission before the change is completed must have his application notarized in the usual manner.

On a more cheerful note, Citizens Banders interested in organizing specific-purpose CB operations, such as channels for marine, motel, garage, or other types of use, have been given the green light by the FCC.

Most of the original operations along this line have been in the marine field, and in the unofficial establishing of Channel 9 as the "National Calling Frequency." But FCC officials point out that there is "no reason why" CB'ers in a given area cannot agree among themselves to use one or two, or possibly even more, of the CB channels for communications to and from transient motorists seeking information.

A high-ranking FCC official says he feels such cooperative common-channel usage is an "excellent idea," but he adds quickly that the Commission has no plans at the moment to set aside any channels on a nation-wide basis for any of the specific-purpose operations. He emphasizes that it would not be "appropriate" for the FCC to take such a step at the present time. If these unofficial nets do spring up, the FCC will watch them closely and will be guided in part by their effectiveness when the time comes to legislate on the subject of allocating channels for specific-use purposes.

One of the many petitions filed with the Commission since the latest rule revisions looks toward increased power input to the final stage, possibly an increase to 15 or 25 watts. Also, additional authorized types of emission are being considered for FCC-type accepted equipment. In the near future, CB'ers may be able to use single sideband, double sideband and/or FM. —30—

Letters from our readers

Car Radio Conversion

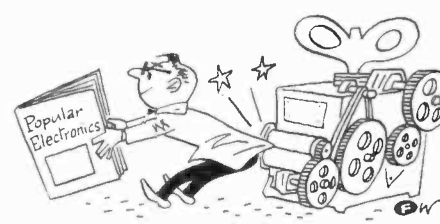
■ I converted a car radio for home use as per Mr. Louis' article in the February issue and am very pleased with the results. In fact, the performance of the converted car radio now rivals that of my expensive table radio.

Incidentally, I installed a ferrite antenna in place of the original antenna and a 12" speaker instead of the smaller car speaker. Many thanks to you and Mr. Louis for the fine article.

JONATHAN SHAPIRO
New York, N. Y.

Bouquets

■ Please allow an "outsider" to the electronics field (I'm a mechanical engineer) to congratulate you on putting out such an interesting, readable magazine. Largely through your efforts, I'm beginning to think I may someday understand the realm of the electron.



Thanks particularly for the insert feature, "Understanding Transistor Circuits," in the August, 1959 issue. I will always cherish this article as being the first real light shed on transistor circuit design for me.

Bouquets also to Lou Garner for his brief analyses of readers' circuits in his *Transistor Topics* column. They are always clearly written and understandable.

And thanks for remembering that every reader is not an electronic genius.

CHARLES H. DAVIS
Westbury, N. Y.

Foreign Vs. Domestic Watts

■ Recently while I was in a radio shop exchanging yarns with my serviceman friend, I noticed that the British-made speaker he was installing in a cabinet was marked "British rating 15 watts/American rating 30 watts." This seemed to indicate that an American watt is half a British watt, possibly also explaining why so many American amplifiers have advertised outputs of 40, 50, and even 70 watts.

However, I have always understood that wattage was calculated by multiplying the current

Letters (*Continued from page* 14)

through a load by the voltage across it. How, then, can a British watt be double an American watt? Or is this discrepancy simply traceable to overenthusiastic advertising copy writers?

J. R. H. BELL
Harvey House, Collegiate Sch.
Wanganui, New Zealand

A watt is still a watt regardless of which side of the ocean it's measured on. Reader Bell's confusion lies in the fact that there is no universally accepted method of measuring the power output of an amplifier. Generally speaking, the greater the output, the greater the distortion. This means that an amplifier's output will vary, depending upon how much harmonic distortion you are willing to allow—0.1%, 1%, 2%, or more. You can also rate the power output at a certain percentage of intermodulation distortion—2% for example. Or you can do your measuring at the point where the output waveform as observed on an oscilloscope begins to clip.

To explain the specific question raised by Mr. Bell, British manufacturers generally rate the power output of their amplifiers at lower distortion levels than do American manufacturers. For example, the Leak "Point One" series of amplifiers and preamplifiers is so named because their output is measured at 0.1% harmonic distortion.

It is fairly obvious, therefore, that any power output claim is virtually meaningless unless the manufacturer also states the distortion level at which the power output was measured. This is the general point of the new IHFM standards for measuring amplifiers: a statement of power output should always be accompanied by the distortion level at which the measurement was made.

Wireless Metronome

■ I recently completed the wireless metronome described in your January issue. Other readers who plan to build this unit may be interested to know that instead of winding coil *L1* myself, I used a standard Vari-Loopstick. This arrangement seems to work very well.

MICHAEL AXELRAD
Uniontown, Pa.

Young Experimenter

■ My son George, who is twelve years old and a novice electronic experimenter, performed some modifications on the "Sensitive Diode Transistor Radio" described by Art Trauffer in your January issue. I think these changes will be of interest to your readers.

Instead of the antenna coil recommended by Mr. Trauffer, George used a four-contact antenna coil that he salvaged from an old radio. In addition, he connected the set to an outside antenna. By trying various connections on the antenna coil and by attaching the outside antenna alternately to the stator and the rotor of the variable capacitor, George was able to receive short-wave stations as well as broadcast-band stations.

During the week of March 20th to 26th, *Radio*

(*Continued on page* 20)

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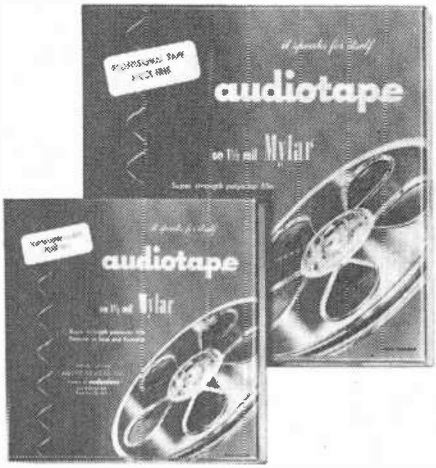

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2043/59. HI-FI GUIDE & YEARBOOK (1959 edition—Paper). $1.00

HI-FI AND TAPE

2042. TECHNIQUES OF MAGNETIC RECORDING by JOEL TALL. Brings the many aspects of this exciting new field into focus through descriptions of the various recording models, techniques and practical uses in TV, radio, and film. $7.95

2032. HI-FI GUIDE by DON HOEFLER. This is the latest and most comprehensive of this author's books on high fidelity. Here's the whole hi-fi story in simple, every-day language, easily understood by every hi-fi fan. $2.50

2031. ELEMENTS OF MAGNETIC TAPE RECORDING by N. M. HAYNES. Here's how to get professional results with tape the way the experts do. Complete nomenclature, basic techniques, how to splice and edit, how to repair and maintain your recording equipment. Illustrated. $7.95

2034. LOW-COST HI-FI by DONALD CARL HOEFLER. Hundreds of hints for budget hi-fi will be found in these fourteen chapters with over 300 detailed photographs, drawings and diagrams. $2.50

2033. HIGH QUALITY SOUND REPRODUCTION by JAMES MOIR. This book is the perfect manual both for the professional engineer and for the amateur interested in the problem of reproducing sound with a high degree of fidelity. Practically the whole sound reproducer field is covered in complete detail. The mathematical sections have been concentrated into an appendix for each chapter. Here's the whole "why" and "how" of sound reproduction. Profusely illustrated. $14.00

2035. MAGNETIC TAPE RECORDING by H. G. M. SPRATT. From the Principles of Magnetism, through Applications of Magnetic Recording, the 14 chapters and two appendices comprising this volume bring you an exhaustive coverage of the field. Covers such applications of recording as TV signal recording, medical and psychological uses, etc., in addition to conventional spheres of music and speech recording. $8.50

2036. THE PRACTICAL HI-FI HANDBOOK by GORDON J. KING. A guide to hi-fi sound reproduction for service engineers and amateur enthusiast. Chapters on amplifiers, loudspeakers, pickups, microphones, record players, disc and recording, and stereophonics. $6.00

2037. REPAIRING RECORD CHANGERS by EUGENE ECKLUND. A practical manual on repair of mechanical elements of record changers, including pickups, needles, record changing actions, motors, drives, and tripping, dropping and shut-off mechanisms. Magnetic recorder repairs also covered. Perfect guide for troubleshooting. $5.95

42. REVERE TAPE RECORDER GUIDE by K. S. TYDINGS. $1.95

2039. RIBBONS OF SOUND by K. A. BARLEBEN. A perfect introduction to tape recording principles and practices. Paper, $2.50; 581C—same title in cloth binding, $3.50

2040. TAPE RECORDERS AND TAPE RECORDINGS. An ideal sourcebook of information on all aspects of tape recording. Covers all fundamentals necessary to realize full potential of your tape equipment. Paper, $2.95

49. TAPE RECORDER GUIDE by MARSHALL. $1.95

2078. YOUR TAPE RECORDER by MARSHALL. $4.95

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IMPORTANT NEW BOOKS

2065. ELECTRONIC EXPERIMENTER'S MANUAL by DAVID A. FINDLAY. With a few dollars worth of basic tools and this book to guide you, you can explore the wonderworld of electronics experimentation more completely than ever before. Learn about every component used in experimentation, every tool, its function. 10 big sections, including one of exciting projects you'll build and use. $4.95

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2072. CLASS D CITIZENS RADIO by LEO G. SANDS. Here is the first complete book on Citizens Radio operation. Now, with more than a million vehicles equipped for its use, Citizens Radio is a major phase of the electronics field. Here's the story on the whole field—its history, rules, and everything about how it works. Learn exactly what Citizens Radio is, its applications, what you need, FCC rulings, etc. Many illustrations. $4.95

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Letters (*Continued from page 16*)

Moscow came in consistently to the degree that 90% of the programs were understandable. George also logged Geneva, Sofia, London, and some Spanish-speaking stations. Selectivity was not good, and the foreign stations did not come in strong until after six in the evening.

George and I think that articles such as Mr. Trauffer's, which leave something to the imagination, are more worthwhile than those that tell the "complete" story. We were certainly amazed at our ability to pick up stations on the other side of the world with a 1½-volt radio you can hide in your hand.

JOSEPH E. FINEGAN
Rumson, N. J.

Metal Locator

■ If any of your readers have built and used the transistorized metal locator described in the June, 1959 issue, I would appreciate hearing from them. Could it possibly locate an outboard motor in

about eight feet of water? Does anyone have any suggestions?

S. GRYWINSKI
Box 266, Fisher Branch
Manitoba, Canada

The metal locator you mention won't operate through eight feet of water, but perhaps one of our readers has made a modification to increase its range. Our suggestion is that you tie the motor to the boat from now on!

Dry Cell Rejuvenator

■ I have just finished building the dry cell tester and rejuvenator described in your January issue by James E. Murphy. Although I am a novice who doesn't know a milliampere from a watt, the gadget is perking right along charging the little dry cells, and, incidentally, making my nine-year-old daughter very happy.

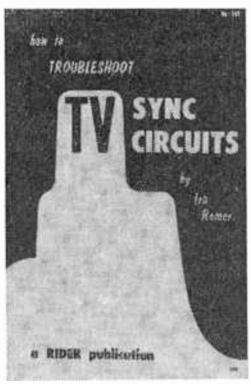
Would it be possible to extend the usefulness of this device so that it could charge six-volt lantern-type batteries and the 22½-volt batteries used in flash guns?

F. E. BLAINE
Hamburg, N. Y.

We can't give you any tried-and-tested information, but a transformer with a 12- or 14-volt secondary—rather than the 6-volt secondary specified by Mr. Murphy—might do the trick. The problem is in getting enough reverse current flow through the battery. If a second transformer proves to be satisfactory with higher-voltage batteries, some type of a switch will have to be installed to allow the original transformer to be used for rejuvenating 1½-volt batteries. —30—

POP'tronics Bookshelf

"HOW TO TROUBLESHOOT TV SYNC CIRCUITS" by Ira Remer. Published by John F. Rider Publisher, Inc., 116 West 14th St., New York, N. Y. Soft cover. 128 pages. $2.90.



Well organized and clearly written, this volume offers a wealth of information on the why's and wherefore's of sync circuits. The picture-tube photos that illustrate sync-circuit faults are excellent. Fundamentals of the subject are covered in detail, and a section is included which analyzes the various sync troubles encountered in color receivers. Fruitful reading for the television trouble-shooter.

"TRIPLE PINDEX," published by Radio Corporation of America, Electron Tube Division, Harrison, N. J. Soft cover. $1.75.

This useful book presents base diagrams for over 1500 tubes *in triplicate*. Every page is split into three horizontal sections, each showing the base diagram of the same tube. By flipping page segments, the user can have as many as three different tube diagrams in front of him at one time. This arrangement should prove a big time-saver in working on unfamiliar radios or TV receivers.

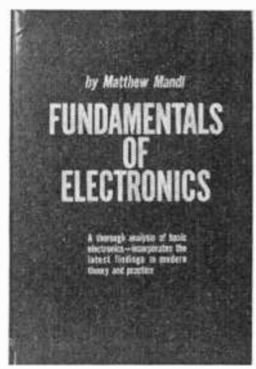
"SERVICING HI-FI AM-FM TUNERS" published by Howard W. Sams and Co., Inc., 1720 East 38th St., Indianapolis 6, Ind. Soft cover. 160 pages. $2.95.

This is a collection of "PHOTOFACT"

Bookshelf *(Continued from page 22)*

folders on AM-FM tuners and receivers produced in 1958-1959. Manufacturers represented are Altec Lansing, Challenger, Chapman, Bogen, Fisher, Grommes, Harman-Kardon, Knight, Madison Fielding, Masco, Newcomb, Pilot, Scott, Sherwood, and Stromberg-Carlson. Information on each model includes a schematic, resistance charts, photos, parts list, dial-stringing guide, etc. A special section covers speaker design and theory. Recommended to the service technician and to the hi-fi fan who likes to keep up to date on circuitry.

"FUNDAMENTALS OF ELECTRONICS" by Matthew Mandl. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York 11, N. Y. 574 pages. $10.60.



Although this book covers some very familiar ground, it should not be considered just another volume on basic electronics. It has been written with unusual care; the author presumably kept the reader in mind at every step. Each new term is explained in such a logical manner that the reader can move on to new concepts without feeling that they are unfamiliar or difficult. Any possible points of confusion are cleared up almost before they can arise. The usual organization pattern for a text on basic electronics is followed—electron theory, magnetism, d.c., a.c., vacuum tubes, transistors, basic circuits, etc. Highly recommended as a text for the beginner and as a good reference book for the more experienced reader.

"HOW TO USE METERS," Second Edition, by John F. Rider and Sol D. Prensky. Published by John F. Rider Publisher, Inc., 116 West 14th St., New York 11, N. Y. 216 pages. Soft cover. $3.50.

Brought completely up to the minute, the new edition of this book covers the field of

Bookshelf

(Continued from page 24)

meters—how they work and how to use them—in admirable fashion. The text is complete, and, as the greatest amount of space is devoted to the design of meters, the reader should obtain a solid grounding in this subject. Recommended as an excellent study and reference work.

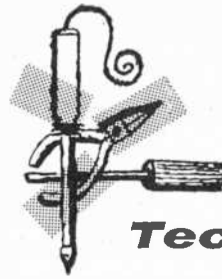
"F-M SIMPLIFIED," Third Edition, by Milton S. Kiver. Published by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 384 pages. $7.50.

Probably a great many POPULAR ELECTRONICS readers cut their FM eyeteeth on the earlier editions of this book. Those that did will remember that Mr. Kiver deals with his subject clearly and thoroughly. In this expanded and up-to-date edition, the basics of FM theory, analyses of circuits, alignment, and the fundamentals of FM transmitters are covered in detail. Although the treatment is not as simplified as the title might lead one to expect, this book provides an excellent introduction to FM for anyone who wants a thorough grounding in FM theory and operation.

Miscellaneous Literature

A new commercial sound catalog for use by architects, engineers, sound men, and consumers has been issued by Electro-Voice, Inc., Buchanan, Mich. Recommendations for public address, home recording, communications and other applications for microphones and loudspeakers are included. Ask for your copy of "Commercial Sound Catalogue No. 132."

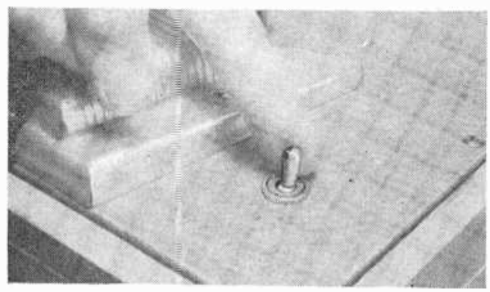
Radio amateurs will be interested in the new "Rider Global Time Conversion Simplifier." This 17" x 22" color chart tells you the time anywhere in the world at a glance. It is available from John F. Rider Publisher, Inc., 116 West 14th St., New York, N. Y., for $1.00. —30—



Tips and Techniques

SAVE YOUR RECORDER MOTOR

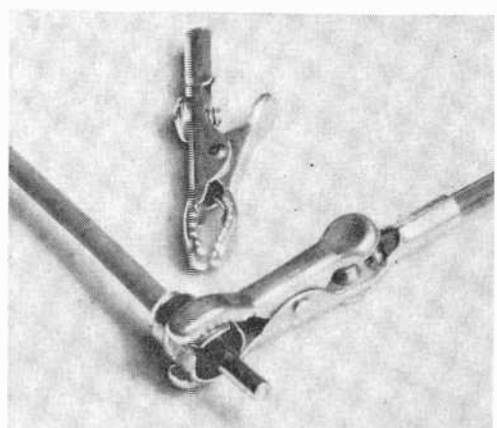
If you frequently use your tape recorder's audio section as a utility amplifier, you can cut wear on the motor by installing an s.p.s.t. switch in series with one of the motor power leads. Most recorders are vented adequately enough to cool the en-



closure without the help of the motor's fan. If your recorder does appear to heat up with the motor off, turn it on occasionally.—*John A. Comstock, Wellsboro, Pa.*

ROUND-JAWED ALLIGATOR CLIPS

Alligator clips have a habit of slipping off phono plugs, dial lamp bases, or other round objects. Bending the jaws of a clip



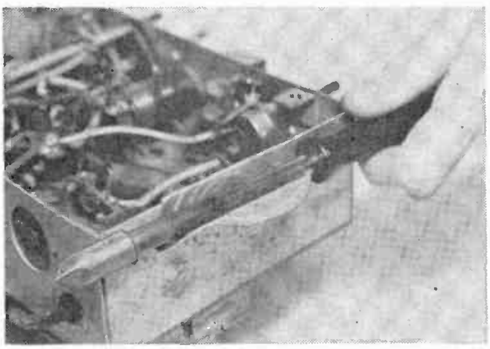
will enable them to get a firmer grip on such objects. Use a pair of long-nose pliers and carefully bend each jaw as shown. Re-

Tips (*Continued from page* 28)

inforce the bends with a small pool of solder on the outside of the jaw directly over the bend. The thumb tab on the clip can also be bent upward a bit to allow the jaws to open wider.—*Art Trauffer, Council Bluffs, Iowa.*

CLIP-ON SOLDERING-IRON HOLDER

An old tin-can lid can serve as a handy clip-on soldering-iron holder. Bend the lid



into the shape shown—a "V" with ears—and clip it over the edge of the chassis by bending one ear down. This holder is especially useful when you are working on the underside of a set.—*James Clifford, Detroit, Mich.*

REPAIR "RABBIT-EARS" ANTENNAS

A telescoping "rabbit-ears" antenna often becomes worn after much use, with poor electrical contact between sections. You can tighten the loose sections and eliminate resistive contact between them by simply extending the ears and tinning about a half-inch of the lower portion of each section with a very thin layer of solder.—*Charles Lang, San Francisco, Calif.*

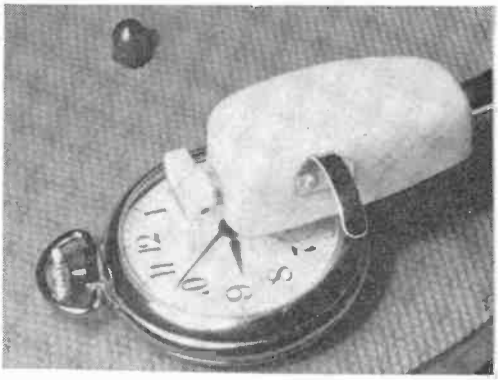
AMPLIFY YOUR WATCH TICKS

You can "play" the ticks of a watch or alarm clock over your hi-fi set by placing your crystal phono pickup on top of the watch as shown and turning the amplifier gain control full on. How does it work? The ticking of the watch vibrates the generating mechanism in the pickup; the loudness of the reproduced ticks depends on the sensitivity of your pickup, the gain of your amplifier, and the efficiency of your speaker. Better results can be obtained with the

Tips

(*Continued from page* 30)

pickup on the back of the watch. Caution: don't try this experiment with magnetic



pickups since their internal magnets may detrimentally affect small watches.—*Carl Dunant, Council Bluffs, Iowa.*

INTERMITTENT TUBES

Battery radios or three-way portables that go dead may be suffering from oscillator-tube voltages that are either too low because of weak batteries or too high because of aging tubes. Some sets will operate for a time after a brief rest and then go dead again. The obvious remedy is a set of fresh batteries, even though the old ones still meet the demands of the other tubes.

Other sets that have been playing at reduced volume with relatively weak batteries will not operate at all with fresh batteries. In this case, the trouble may be a breakdown of aging elements in the oscillator tubes under the higher voltages from the new batteries. The remedy, of course, is to replace the faulty tubes—usually a 1A7-GT or a 1R5.—*Lt. Col. Eugene F. Coriell, Wright Patterson A.F.B., Ohio.* —30—

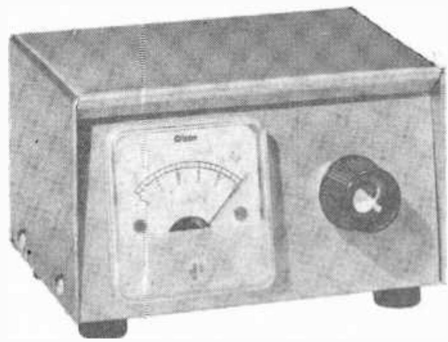
TIPS WANTED

Are you aware that POPULAR ELECTRONICS is very much interested in receiving your *Tips and Techniques* hints? If you know of any shop or circuit short-cut or innovation, tell us about it and you may receive up to ten dollars for your trouble. Just send us a short typewritten description plus a sharp photograph or circuit drawing. Unused items will be returned only if they are accompanied by a stamped, self-addressed envelope. Why keep your pet ideas to yourself? Let everyone else in on them.

NEW products

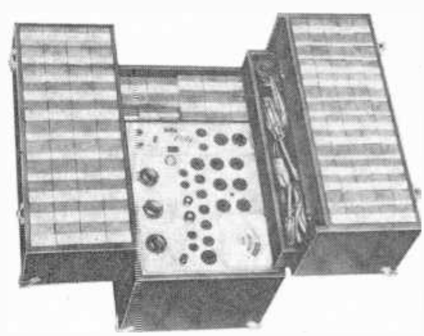
"S" METER

A smart-looking "S" meter, the Model ME-63, is calibrated in microvolts ("S" units from 1-10 and 1-5) and in decibels from S-9 to 30 db. It is housed in a 4" x 2½" x 2½" gold box with a 1¼" meter and zero-adjust control. The ME-63 can be used with any receiver that has an a.v.c. circuit. Price, $5.88. (*Olson Radio Corp.,* 260 South Forge St., Akron, Ohio.)



CADDY TUBE TESTER

A compact tube caddy with a built-in tube tester is being manufactured by *Mercury Electronics Corp.,* 77 Searing Ave., Mineola, N. Y. The Model 102-C can carry a stock of 125 tubes; has a drawer for tools, test leads, etc.; and tests over 700 tube types. Its 21 sockets are made of phosphor bronze, its panel of etched aluminum. Price, $74.50.



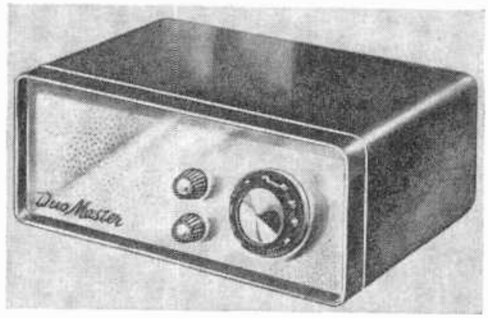
REMOTE TV TUNER

Essentially a TV set without sweep circuits and picture tube, the Tech-Master

products

(*Continued from page* 34)

Model 23A remote-control tuner can be used with any standard TV receiver. It has an r.f. stage, three i.f. stages, two audio stages,



a built-in speaker, and an output for a tape recorder or hi-fi set. The video output of the Model 23A "Duo-Master" is fed into the video detector stage of the TV set by a coaxial cable up to 60 feet in length. Price, $79.50. (*Tech-Master Corp.*, 75 Front St., Brooklyn 1, N. Y.)

TRANSISTORIZED CONVERTERS

Two "Transipower" transistorized d.c.-to-d.c. converters are being offered by *Cornell-Dubilier Electric Corp.*, South Plainfield, N. J. The Model 12TP12 is a transmitter power supply which converts 12 volts d.c. to 500 volts d.c. at 240 ma. (120 watts) or to 500 volts d.c. at 150 ma. and 250 volts d.c. at 100 ma. The Model 12TP3 is a receiver power supply which converts 12 volts d.c. to 300 volts d.c. at 100 ma. (30 watts) or to 300 volts d.c. at 70 ma. and 150 volts d.c. at 60 ma. Both units are miniaturized and light in weight. Prices: Model 12TP12, $60.00; Model 12TP3, $45.00.

TRANSISTOR INVERTER

The Arkay Model 2-120W transistor inverter converts 12 volts d.c. into 117 volts a.c. A two-transistor unit with a power capacity of 125 watts, it weighs 5½ pounds and measures approximately 10" x 4" x 5";

FEATURED IN JULY

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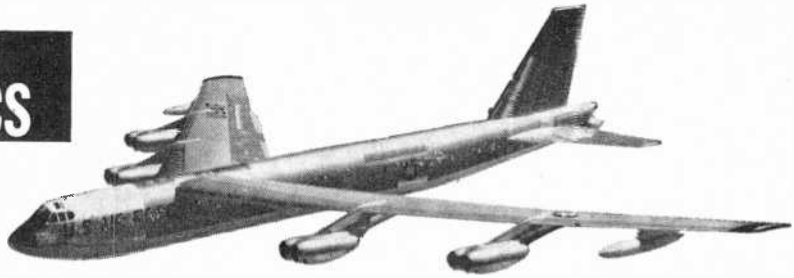

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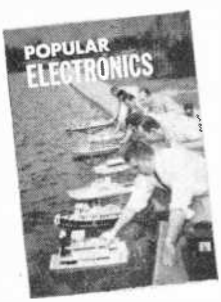

YOU'LL ALSO ENJOY THESE INFORMATIVE JULY POPULAR ELECTRONICS FEATURES:

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Want to know how to choose the hi-fi mike for your needs ...how to use it to best advantage...learn all about pick-up patterns? July POPULAR ELECTRONICS brings you the first of a two-part series that gives you a complete rundown on hi-fi microphones.

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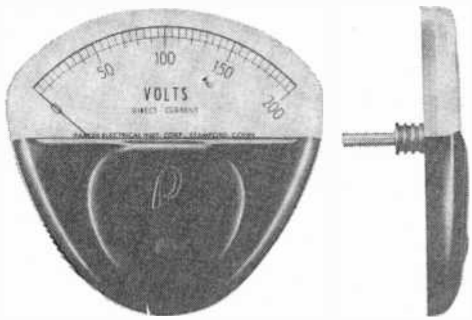
products

(*Continued from page* 36)

price, \$35.95 wired, \$29.95 in kit form. (*Arkay International, Inc.*, 88-06 Van Wyck Expressway, Jamaica, N. Y.)

THIN PANEL METER

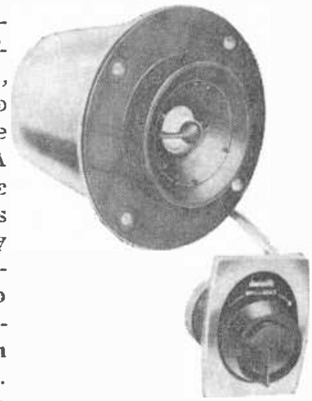
The Parker panel meter with printed-circuit movement has been announced by *Interlab, Inc.*, 437 Fifth Ave., New York 16, N. Y. The entire meter is contained in a



housing only ½" thick and the mounting screws do double-duty as electrical connectors. According to the manufacturer, an electrical overload of 1000% for one second will not disturb the accuracy of the meter.

SUPER TWEETER

Response within ± 2 db to 40,000 cps is possible with the "Sphericon" Model T-202 tweeter produced by *University Loudspeakers, Inc.*, 80 S. Kensico Ave., White Plains, N. Y. A domed phenolic diaphragm is acoustically loaded by a conoidal ring to give a 120° dispersion pattern in all directions. Highly efficient, the tweeter comes complete with built-in 3000-cps crossover network, volume control, and 36" cable. Power-handling capacity is 30 watts of integrated material; nominal impedance is 8 ohms. Size: 4⅝" in diameter, 4" deep. Price, \$24.94. –30–



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	1K3	.73
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	1LC6	.79
	1LN5	.59
	1R5	.62
	1S5	.51
	1T4	.58
	1U4	.57
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	2CY5	.71
	3AL5	.42
	3AU6	.51
	3AV6	.41
	3BA6	.51
	3BC5	.54
	3BE6	.52
	3BN4	.63
	3BN6	.76
	3BU8	.78
	3BY6	.55
	3BZ6	.55
	3CB6	.54
	3CF6	.60
	3CS6	.52
	3CY5	.71
	3DE6	.62
	3DK6	.60
	3DT6	.50
	3Q5	.80
	3S4	.61
	3V4	.58
	4AU6	.54
	4BA6	.51

Qty.	Type	Price
	4BC5	.56
	4BC8	.96
	4BE6	.54
	4BN6	.75
	4BQ7	.96
	4BS8	.98
	4BU8	.71
	4BZ6	.58
	4BZ7	.96
	4CB6	.59
	4CS6	.61
	4DE6	.62
	4DK6	.60
	4DT6	.55
	5AM8	.79
	5AN8	.86
	5AQ5	.52
	5AT8	.80
	5BK7A	.82
	5BQ7	.97
	5BR8	.79
	5CG8	.76
	5CL8	.76
	5EA8	.80
	5EU8	.80
	5J6	.68
	5T8	.81
	5U4	.60
	5U8	.81
	5V6	.56
	5X8	.78
	5Y3	.46
	6AB4	.46
	6AC7	.96
	6AF3	.73
	6AF4	.97
	6AG5	.65
	6AH6	.99
	6AK5	.95
	6AL5	.47
	6AM8	.78
	6AN4	.95
	6AN8	.85

Qty.	Type	Price
	6AQ5	.50
	6AR5	.55
	6AS5	.60
	6AT6	.43
	6AT8	.79
	6AU4	.82
	6AU6	.50
	6AU7	.61
	6AU8	.87
	6AV6	.40
	6AW8	.89
	6AX4	.65
	6AX7	.64
	6BA6	.49
	6BC5	.54
	6BC7	.94
	6BC8	.97
	6BD6	.51
	6BE6	.55
	6BF6	.44
	6BG6	1.66
	6BH6	.65
	6BH8	.87
	6BJ6	.62
	6BK5	.80
	6BK7	.85
	6BL7	1.00
	6BN4	.57
	6BN6	.74
	6BQ5	.65
	6BQ6GT	1.05
	6BQ7	.95
	6BR8	.78
	6BS8	.90
	6BU8	.70
	6BY6	.54
	6BZ6	.54
	6BZ7	.97
	6C4	.43
	6CB6	.54
	6CD6	1.42
	6CF6	.64
	6CG7	.60

Qty.	Type	Price
	6CG8	.77
	6CM7	.66
	6CN7	.65
	6CR6	.51
	6CS6	.57
	6CU5	.58
	6CU6	1.08
	6CY5	.70
	6CY7	.71
	6DA4	.68
	6DB5	.69
	6DE6	.58
	6DG6	.59
	6DQ6	1.10
	6DT5	.76
	6DT6	.53
	6EU8	.79
	6EA8	.79
	6EB8	.94
	6H6GT	.58
	6J5GT	.51
	6J6	.67
	6K6	.79
	6S4	.48
	6SA7GT	.76
	6SK7GT	.74
	6SL7	.80
	6SN7	.65
	6SQ7	.73
	6T4	.99
	6T8	.80
	6U8	.78
	6V6GT	.54
	6W4	.75
	6W6	.69
	6X4	.39
	6X5GT	.53
	6X8	.77
	7AU7	.61
	7A8	.68
	7B6	.69
	7Y4	.69
	8AU8	.83

Qty.	Type	Price
	8AW8	.93
	8BQ5	.60
	8CG7	.62
	8CM7	.68
	8CN7	.97
	8CX8	.93
	8EB8	.94
	10DA7	.71
	11CY7	.75
	12A4	.60
	12AB5	.55
	12AC6	.49
	12AD6	.57
	12AE6	.43
	12AF3	.73
	12AF6	.49
	12AJ6	.46
	12AL5	.45
	12AL8	.95
	12AQ5	.52
	12AT6	.43
	12AT7	.76
	12AU6	.50
	12AU7	.60
	12AV5	.97
	12AV6	.41
	12AV7	.75
	12AX4	.67
	12AX7	.63
	12AZ7	.86
	12B4	.63
	12BA6	.50
	12BD6	.50
	12BE6	.53
	12BF6	.44

Qty.	Type	Price
	12BH7	.73
	12BK5	.70
	12BL6	.56
	12BQ6	1.06
	12BY7	.74
	12BZ7	.75
	12C5	.56
	12CA5	.59
	12CN5	.56
	12CR6	.54
	12CU5	.58
	12CU6	1.06
	12CX6	.54
	12DB5	.69
	12DE8	.75
	12DL8	.85
	12DM7	.67
	12DQ6	1.04
	12DS7	.79
	12DZ6	.56
	12EL6	.50
	12EG6	.54
	12EK6	.56
	12EZ6	.53
	12F5	.66
	12F8	.66
	12FM6	.45
	12K5	.65
	12SA7M	.86
	12SK7GT	.74
	12SN7	.67
	12SQ7M	.73
	12U7	.62
	12V6GT	.53
	12W6	.69

Qty.	Type	Price
	12X4	.38
	17AX4	.67
	17BQ6	1.09
	17C5	.58
	17CA5	.62
	17D4	.69
	17DQ6	1.06
	17L6	.58
	17W6	.70
	19AU4	.83
	19BG6	1.39
	19T8	.80
	21EX6	1.49
	25AU4	.87
	25BQ6	1.11
	25C5	.53
	25CA5	.59
	25CD6	1.44
	25CU6	1.11
	25DN6	1.42
	25EH5	.55
	25L6	.57
	25W4	.68
	25Z6	.66
	35C5	.51
	35L6	.57
	35W4	.52
	35Z5GT	.60
	50B5	.60
	50C5	.53
	50DC4	.37
	50EH5	.55
	50L6	.61
	117Z3	.61

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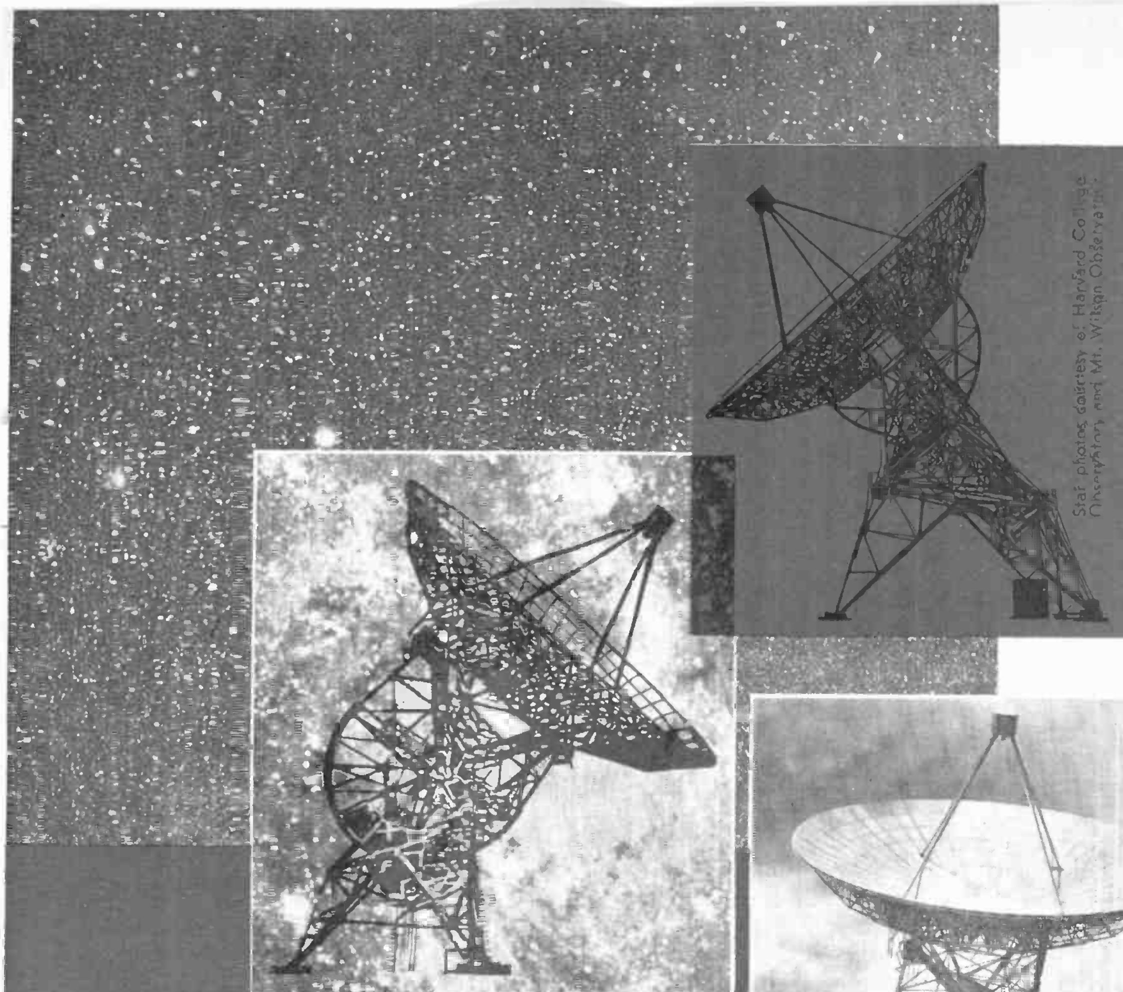


Star photos courtesy of Harvard College Observatory and Mt. Wilson Observatory

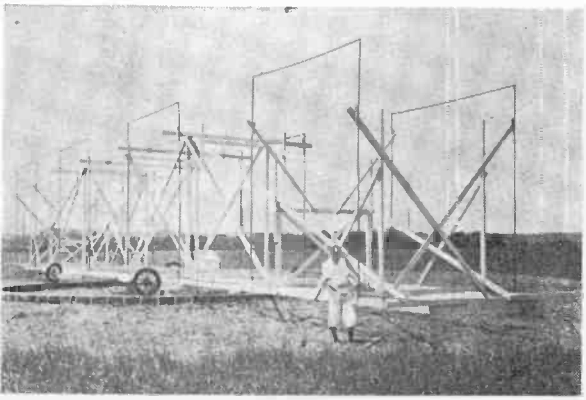
eavesdropping on OUTER SPACE

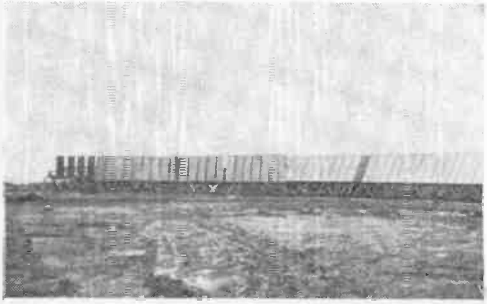
Radio astronomy, one of man's youngest sciences, seeks to solve two of man's oldest questions: What is the origin of the universe and is there life on other planets?

By KEN GILMORE

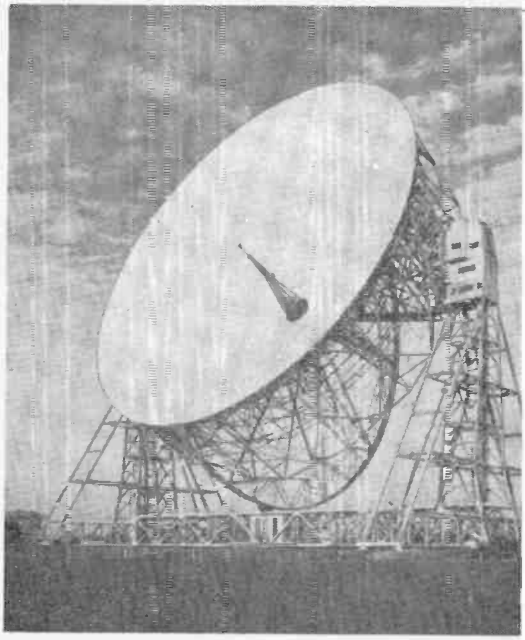
THE YEAR was 1931. The place: an abandoned farm near Holmdel, New Jersey. A brilliant young scientist from Bell Laboratories—Karl Jansky—had been assigned the job of tracking down mysterious noises that were interfering with with radio communications. Suddenly, he picked up a disturbance he had never heard before: something between a whoosh, a crackle, and a frying sound. The next night the noise was there again, and the next night, and the next—always from the same direction.

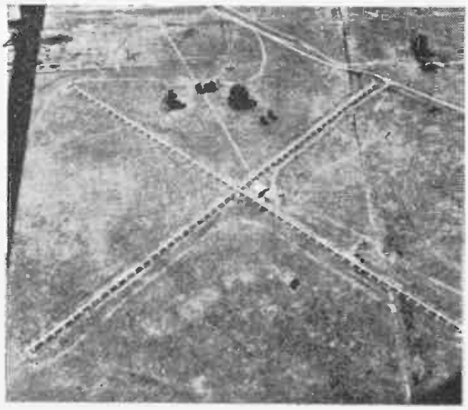
Several months later, as Jansky sat reviewing his carefully kept records an astonishing fact



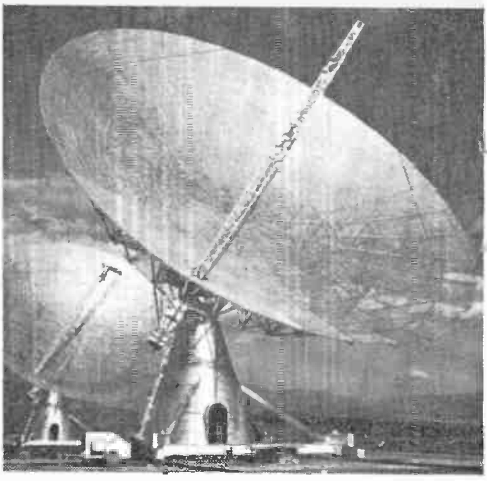


Karl Jansky, pioneer radio astronomer, is shown here with the rotating antenna he used in the early 1930's when he discovered that radio waves from outer space could be received on earth. Jansky's work was done at the Bell Telephone Labs in Holmdel, N. J.

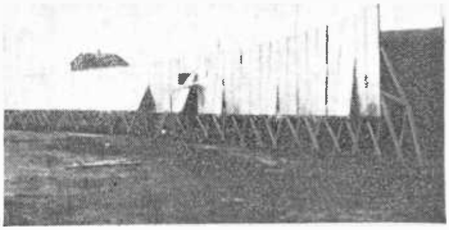




Aerial view of the Mills Cross radio telescope near Sidney, Australia. Each arm of the antenna is one-third of a mile in length. The antenna's great size enables it to be used in the study of wavelengths longer than those that can be picked up by a conventional parabolic antenna.



The twin 90' antennas at the California Institute of Technology provide the highest resolution of any radio telescope now in operation or under construction. Within two months after the pair was first put to work, they established the locations of nine radio stars outside the Milky Way, thereby exceeding the total of all the extra-galactic radio sources previously identified.



▲ **Primary reflector** of radio telescope at the Pulkovo Observatory in Russia looks more like a board fence than a scientific instrument. Each panel is about 4' by 10' and can be adjusted individually. The 425' multi-paneled reflector directs all energy it receives into a much smaller secondary reflector located 200' away at the focus of the primary reflector.

◀ **The largest** fully steerable radio telescope in the world, the Jodrell Bank installation in England, has a reflector bowl 250' in diameter. Although the telescope is used extensively in tracking man-made satellites, its main job is to receive and record radio waves that originate in outer space at distances up to a billion light-years away. The giant installation was designed by the radio astronomy department of Manchester University.

struck him. The strange noise had appeared exactly four minutes earlier every night. Quickly checking an astronomy textbook, he felt a wild excitement as his hunch was confirmed: because of the earth's rotation around the sun, the stars rise four minutes earlier every night. The weird sound was coming from outer space!

Karl Jansky's discoveries were reported in a scientific paper, but his fellow engineers failed to see their significance. Jansky's boss told him to continue his studies on regular static; reluctantly, he did so. He died a few years later, before the world began to appreciate the importance of his work.

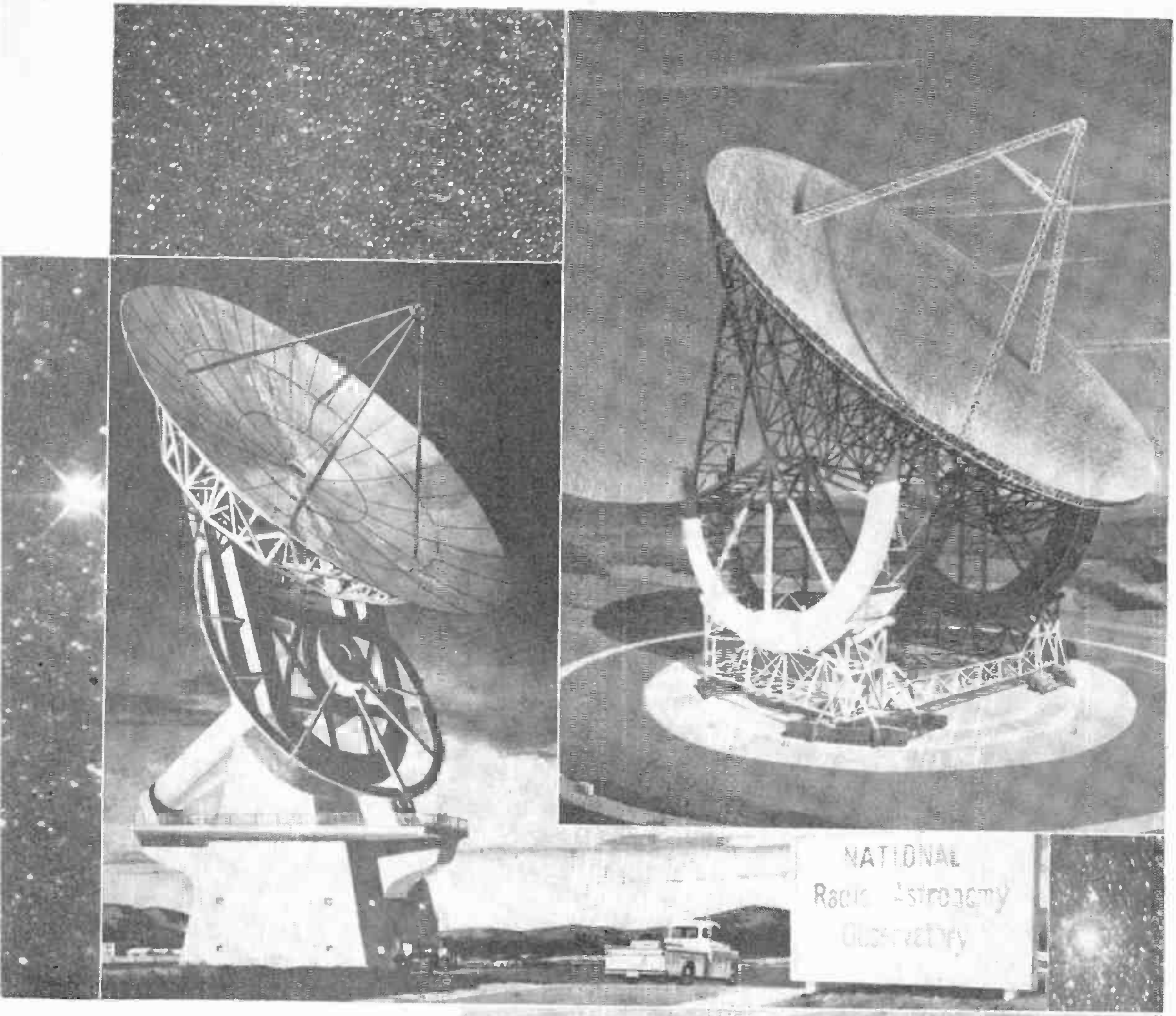
But Jansky's discoveries had fascinated a young engineer who was living in Wheaton, Ill. In his spare time, Grote Reber built a 30' dish antenna and began to search the heavens. He made the first radio map of the sky, isolating the now well-known "hot spots"—sources of strong radio signals from outer space. Before anyone else became interested in Reber's research, however, along came World War II, bringing with it rapid advances in the entire field of electronics—among them, radar.

In February, 1942, while the English were waiting apprehensively for a German attack, British radar was suddenly jammed by a blast of hissing, crackling noise. The British, certain that the Germans had found a way to disable their radar, prepared for the attack they thought was coming. It never came. Later, physicist J. Stanley Hey determined that the noise had come not from across the channel, but from across the universe! Similar experiences were reported by other radar operators around the world.

After the war, the first radio telescopes began sprouting here and there. These early telescopes were made from radar sets because radar was the most sensitive equipment available, and besides, surplus radar could be had for a song. As demand grew for better and more powerful equipment, a new branch of electronics began to evolve—radio astronomy!

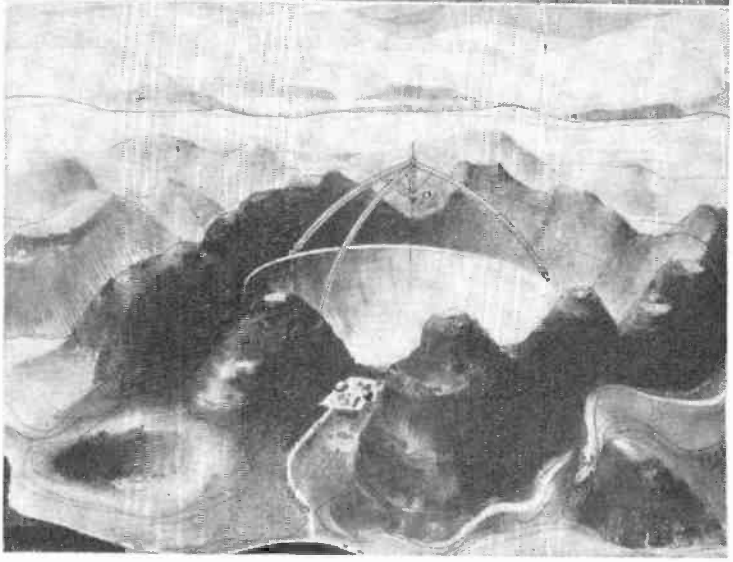
The Edge of Space. Until the radio telescope came along, astronomers could only look at stars within range of optical telescopes. The rest were hidden by interstellar dust clouds. But radio telescopes can hear signals from behind this dust. Thus, radio astronomy has revealed whole systems of previously undiscovered stars. In addition, radio telescopes have allowed man to probe space over seven billion light-years away—more than three times as far as the most powerful optical telescope can "see." Bigger radio telescopes now under construction will extend the range to perhaps 40 billion light-years, *to the very edge of space!*

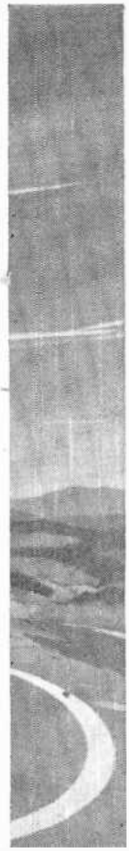
These new instruments should allow scientists to settle a long-standing argument about the beginning of the universe. Did it—as backers of the so-called "steady-state" theory hold—have no beginning, but always exist as it is now? Or is the "expanding-universe" theory correct? Supporters of the latter view believe that all matter was once a single, vast, super-dense



▲

Under construction at the National Radio Astronomy Observatory in Green Bank, W. Va., is this 140′ precision telescope. The surface of the reflector will be more than one-third of an acre in area and is designed to be accurate within a quarter of an inch. When completed, the 210′-high instrument should be the most highly accurate radio telescope in the world.





This giant radio telescope is being built for the U. S. Naval Research Laboratory in Sugar Grove, W. Va. The huge reflector will be 600′ wide, twice the length of a football field. The entire 20,000-ton installation will rotate on rollers which ride circular tracks on the ground, allowing the dish to be aimed at any point in the sky above the horizon.

Over three football fields across, this 1000′-wide antenna is being built into a natural bowl of coral limestone in Puerto Rico for use by Cornell University's Radiophysics and Space Research Center. One of its first tasks will be to study the undersurface of the planet Jupiter.

body. But, eons ago, something caused it to explode. The present planets and galaxies speeding through space, they say, are the result of that explosion.

Which theory is right? The radio telescope may uncover valuable clues. If, for example, the galaxies farthest out seem bunched more closely together than those nearest the center, then the universe is probably expanding. The reasoning goes like this. Since it takes billions of years for light from the edge of the universe to reach us, galaxies at the outer edge will be seen not as they are today, but as they were several billion years ago. On the other hand, should radio telescopes show that galaxies are distributed fairly evenly throughout space, this would be strong evidence that the steady-state theory is correct.

Life On Other Planets. Radio telescopes are also being used to search for intelligent life on distant planets, in a quest known as *Project Ozma*. It began on April 11th when two young scientists, Dr. Frank Drake and William Walton of the National Radio Astronomy Observatory in Green Bank, W. Va., pointed the 85′ dish antenna shown on page 41 at two nearby stars—Tau Ceti and Epsilon Eridani—and listened for patterns of artificial signals mixed in with the natural noise.

Dr. Drake—at 29 one of the world's leading radio astronomers—feels the chances are good that eventually we will "tune in" on life in outer space. We know that at least some—probably many—stars have habitable planets similar to ours. The odds are overwhelming that life developed on some of them just as it did on earth. Some of these beings have probably progressed as far or further than we have, and should be capable of sending radio signals.

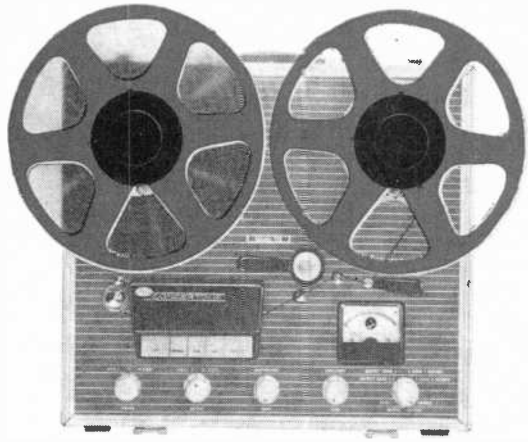
Are we close enough to pick up these transmissions? It's pretty much a matter of what size radio telescopes we use. Dr. Drake calculates that the 85′ antenna he is now using should be able to pick up artificial signals from as far away as 10 or 12 light-years. A 600′ antenna—such as the one now being built about 30 miles away from Dr. Drake's present instrument—should be able to detect signals that originate 100 light-years away. Within that range are 10,000 stars, and astronomers think the odds are good that there are technically advanced civilizations on some of them.

Ironically, if and when we do hear signals from outer planets, we will probably not know it for months. An incoming signal would be so weak that it would be lost in background noise (it took computers almost a year to confirm our radar contact with Venus in 1958). Eventually, however, high-speed computers which analyze all signals received will isolate any transmission that cannot be accounted for by natural background noise.

Could we break the language barrier between us and an alien civilization? Scientists working on the problem think so. They theorize that races seeking radio contact in space would transmit pulses coded by some

(*Continued on page* 110)

INSIDE the Hi-Fi Tape Recorder



Bias, erase and equalization circuits

By JOSEPH MARSHALL

RECORDING signals on magnetic tape necessitates some specialized, but important, electronic circuits. Bias current for the record and erase heads must be generated by an oscillator circuit. Equalization for both record and playback must be provided by other circuits. Still other circuits are required to amplify input signals until they are of sufficient amplitude to drive the record head.

Bias Current. One of the keys to successful magnetic recording is bias current. "Bias," here, has an entirely different meaning than its usual one with amplifiers. In tape-recorder terminology, bias refers to high-frequency oscillations which are fed to the recording head along with the input signal. The bias current decreases distortion and increases signal output. Interestingly enough, experts don't agree on how bias works—but it does. It is perhaps most convenient to imagine that the bias "shakes up" the magnetic fields on the tape, making it easier for them to be modulated.

Frequency stability of the bias oscillator isn't critical, but its frequency should be at least four times the highest signal frequency to be recorded to avoid beat notes. Thus, most bias oscillators operate at from 40 to 100 kc. Typical oscillator circuits include the single-ended Colpitts, the Hartley, the tuned plate, and the push-pull Colpitts circuit.

Because any harmonic distortion generated by the oscillator will cause noise to be transferred to the tape, the push-pull design (which cancels out the even-order harmonics) is found in the better recorders, such as the Ampex 910 (Fig. 1). Ampex even goes so far as to include a control to balance the currents through the oscillator tubes, thus minimizing harmonic distortion. This control is called "Noise Balance."

For simplicity and economy, some recorders have a single tube operating as oscillator in the record mode and audio output in playback. The Telectro 320 employs a 6AQ5 for audio output during playback; switching an *LC* network into the grid circuit enables the same tube to function as an oscillator during record.

A push-pull audio output stage is even simpler to convert. It will function as a push-pull oscillator stage if the control ratio) must be made. Increased bias reduces distortion and boosts signal output, but it causes the frequency response at the high end to drop off. In general, the best compromise for the bias is a level 2 db below the point that gives maximum output at 1000 cps.

Some recorders provide a small variable capacitor in series with the bias oscillator and the record head for adjusting the amount of bias. More commonly, a fixed ca-

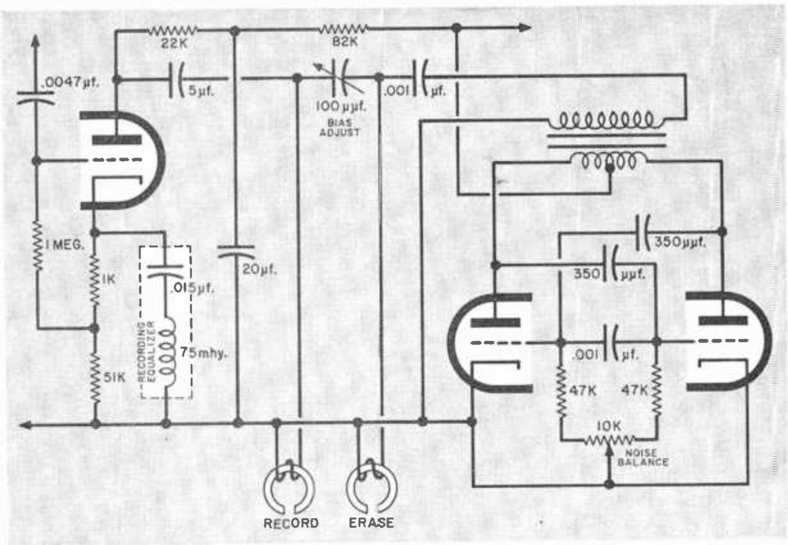


Fig. 1. Recording circuit of the Ampex 910. The 10,000-ohm potentiometer allows the push-pull oscillator to be balanced for minimum harmonics. Erase current is supplied through the .001-µf. capacitor, and bias for the record head can be adjusted by the 100-µµf. capacitor. Network in cathode circuit of driver tube boosts high frequencies in recording process.

grids of the output tubes are switched to small capacitors which terminate at the plates of the opposite tubes. The output transformer serves as the tank. This arrangement is used in the Telectro 300.

Erase Current. As we have seen, bias is a high-frequency alternating current. When recorded or magnetized tape is brought through the field created by an alternating current and then is slowly removed from the field, it will be demagnetized. This is how the erase head works. It produces a fluctuating magnetic field which demagnetizes, or erases, the tape.

Although the same oscillator usually supplies current for both bias and erase, the two functions require different amounts of current, with the erase head demanding roughly 20 times more than the playback head. The amount of bias for the record head is rather critical because a compromise between distortion, high-frequency response, and output (or signal-to-noise pacitor is employed to adjust the bias to the desired current value.

Coupling the record and erase heads to the bias oscillator is a little tricky because they require different amounts of current, and, in addition, the oscillator circuit should not be loaded down by the heads. Usually a transformer is included in the frequency-determining tank to isolate the heads from the oscillator and to provide good impedance matching.

The circuit used in the Bell recorders has the record head fed from the secondary of the transformer, while the erase head is coupled directly to the oscillator through a capacitor. In the Pentron recorders, the erase and record heads are fed by different taps on the output transformer. Ampex couples the record head to the oscillator by means of a variable capacitor in series with the capacitor feeding the erase head.

Record Equalization. As pointed out in a previous article in this series, an unequalized tape recording produces a response that rises at a 6-db-per-octave slope until it reaches a maximum at some frequency between 2500 and 10,000 cycles, depending on the head and the speed of the tape. Above this upper frequency, there is a downward slope due to losses in the head. Figure 2 gives the unequalized recording curves of a high-quality head operating at 15 and 7½ ips. Obviously, to obtain a flat response, we need to flatten out these curves as much as possible in the recording process.

The extreme high end should be boosted at least enough to make up for the recording losses. Unfortunately, it is not easy to do this because the high-frequency roll-off is greater than 6 db per octave. To compensate for such a sharp roll-off, some fairly elaborate networks are required. In the Ampex 900 series, a tuned circuit in the cathode of the tube that drives the record head peaks the high-frequency response to make up for the roll-off. In the Concertone, a feedback loop is run from the recording head to an early stage; because the inductance of the head is included in the feedback loop, a sharp boost is possible.

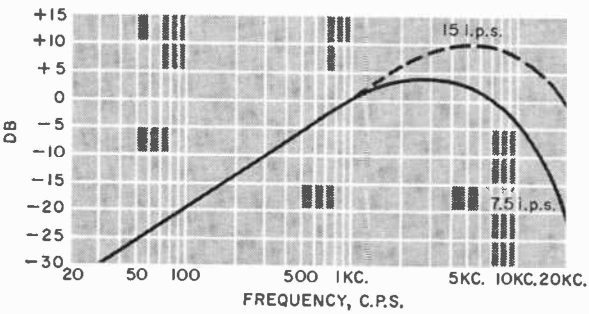


Fig. 2. Unequalized recording curves for a high-quality head.

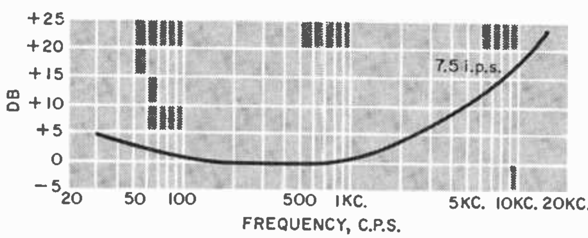
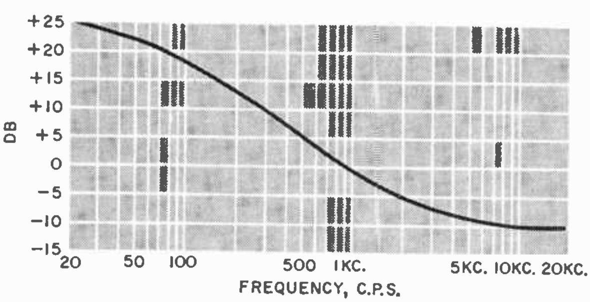


Fig. 3. Recording equalization curve used by Ampex at 7½ ips.

Fig. 4. NAB playback equalization curve for 7½-ips tapes.



In home-type recorders, such expensive and elaborate measures are not justified. Simple *RC* networks, in either interstage coupling or feedback networks, are used to obtain partial compensation of the high-end roll-off during recording. If the recorder is used at two or more speeds, the compensation has to be changed also. Usually extra treble boost is switched in at the lower speeds.

It will be noted from the curve of Fig. 2 that the response at 30 cycles is fully 30 db below the response at 1000 cycles. Since a 30-db boost in playback would raise serious hum problems, it is desirable to provide a little low-bass boost in the recording process to simplify the problem of playback equalization. Thus, for best overall performance, the equalized recording curve should look something like the Ampex 7½-ips curve in Fig. 3, where we have a boost at both ends. The more elaborate recorders provide boost at both the high and low ends, but, to minimize hum troubles, home-type machines usually do not include low-end boost.

Playback Equalization. Frequency response equalization for playback is obtained in the same way as record equaliza-

(*Continued on page* 116)

Volt/Ammeter Kit

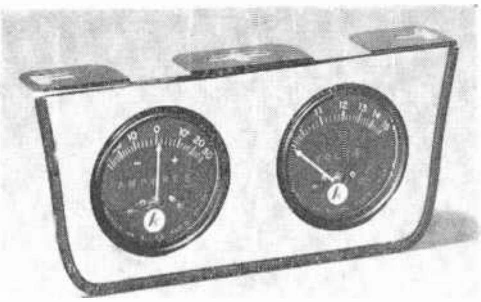
New Knight-Kit checks charge-discharge current and battery voltage on the spot

SINCE the day that car manufacturers began to do away with ammeters, many car owners have had only a single red warning light to tell them what's going on in the car's electrical system. The warning light goes on when the battery is putting out more current than the generator is pumping into it. But the light doesn't indicate *rate* of discharge—a 30-amp or a 1-amp discharge results in the same glowing red light. What's more, the light gives virtually no indication of the battery's condition.

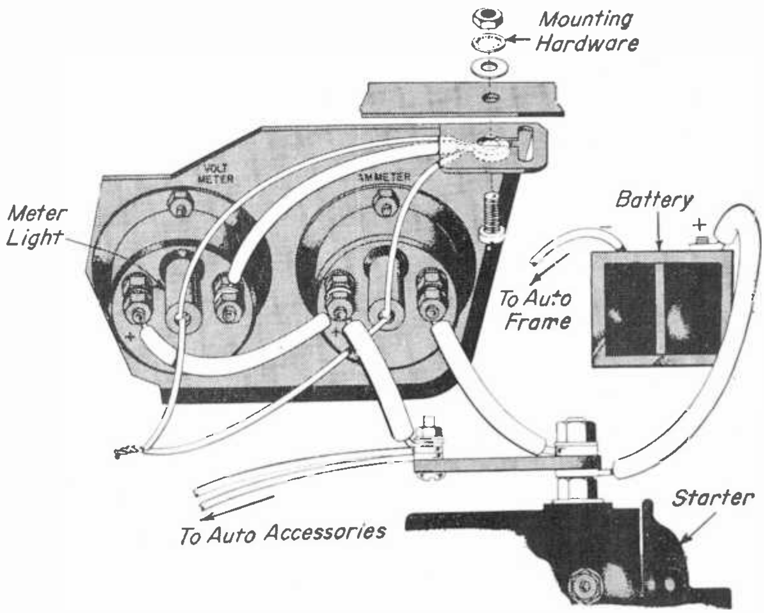
The Knight 83 Y 711 ammeter-voltmeter kit supplies the missing ammeter and gives you a matching voltmeter to boot. You can see the actual rate of charge or discharge on the ammeter, and the voltmeter gives you a rough indication of the condition of your battery. The ammeter scale ranges over 30-0-30 amperes and the voltmeter scale from 9 to 15 volts.

Both meters are mounted side-by-side on a chrome-plated, rubber-trimmed panel. Installation of the "twin" meters is simplified by universal under-the-dash mounting brackets and solderless terminals.

This ammeter-voltmeter will work with any 12-volt electrical system, car or boat, with either positive or negative grounds. Wiring diagrams supplied show how to connect the unit to systems of either ground polarity. The kit is available from Allied Radio Corporation (100 N. Western Ave., Chicago 80, Ill.) for $10.75. —30—



Illuminated meters show battery charge-discharge current and voltage at a glance.



Wiring diagrams provided make kit easy to install. Meter panel mounts under dash.

Electronics Adds a New Angle to Angling

Photos from Three Lions

Biologist Ben Patton displays a 5¼-lb bass which he caught with the aid of an electronic fishing system. He holds in his left hand an electronic "fishing pole," or, more accurately, the system's positive electrode.

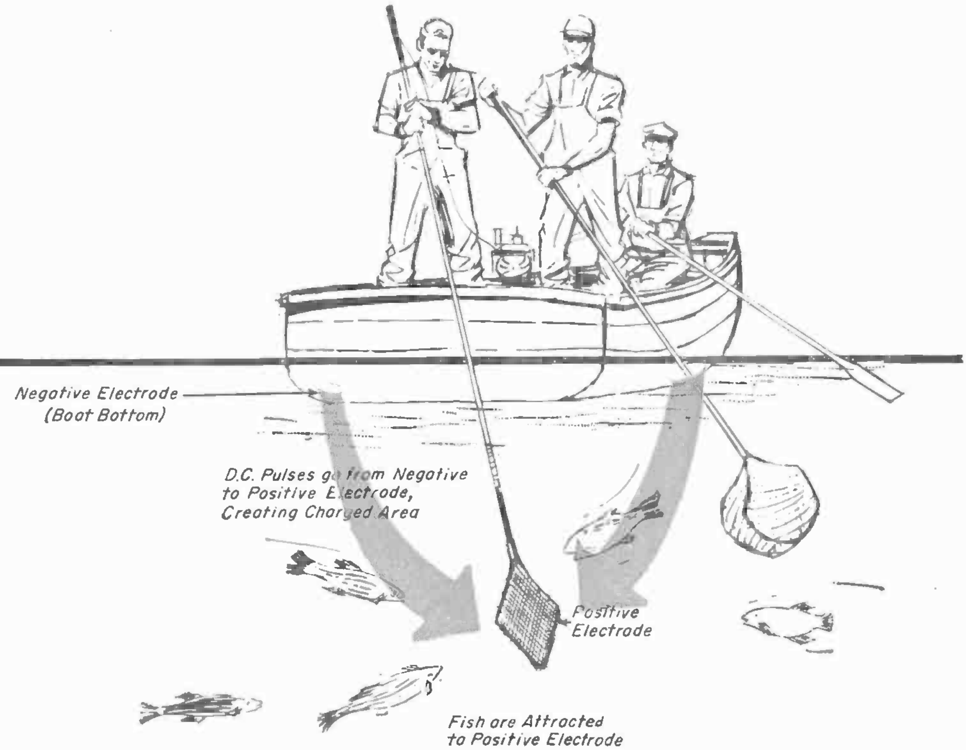
Portable pulsing system stuns fish,

THIS summer some unusual fishermen will be drifting down country streams in the vicinity of Seattle, Washington. To the uninformed, they'll appear to be fitted out only with dip nets; yet they'll bring in up to 1200 fish in an hour. The secret of their angling success will be a piece of electronic gear that gives nearby fish a jolt of electricity, causing them to surface near the waiting nets.

Invented at the U. S. Fish and Wildlife Service, this amazing gadget is used by scientists to collect samples of fish in streams where nets and other fishing implements are impractical. Its results are enough to put any fisherman into ecstasy. On a recent field trip, quarter-mile drifts down a stream were made, and 50 to 60 fish were pulled in on each drift.

Electronic fishing is not a new idea, but this is the first truly portable system that has been devised. It consists of a 230-volt gasoline-powered generator, a transistorized square-wave pulsing unit, and two electrodes. The positive electrode is an expanded grid about 15" x 24" mounted at the end of a pole. The bottom of the fishing boat, which is aluminum, serves as the negative electrode.

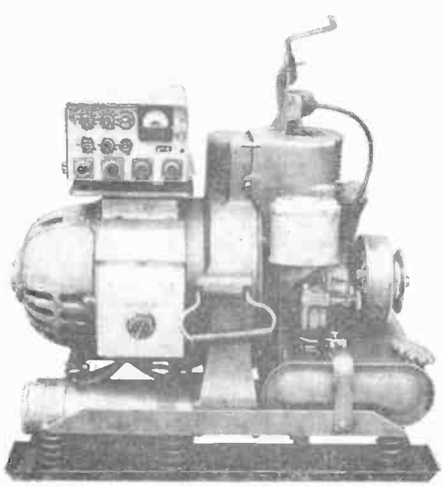
Stunning Effect. Fish are not killed by this device, but merely stunned. The pulsing unit radiates high-voltage d.c. pulses into the water, setting up a charged field



then brings them to the surface

By ROBERT P. HAMMOND

Portable pulsing system developed by the U. S. Fish and Wildlife Service is powered by a 230-volt gasoline generator. Unit employs transistorized circuitry and is less than 2' wide.



that extends about 12 feet from each electrode. Fish coming into this field are captured by the "electrotaxic effect" and herded toward the positive electrode. As they approach the electrode, the increased intensity of the current stuns them and they turn on their sides and float to the surface. Then they are scooped up in nets.

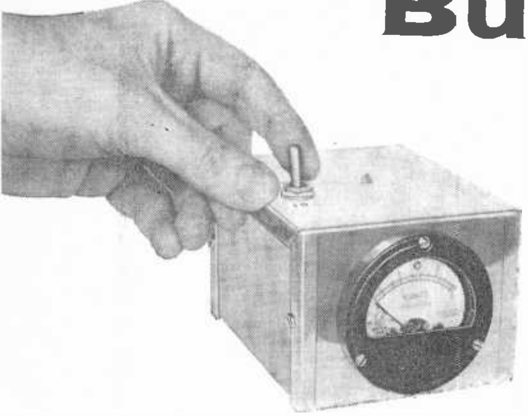
The electrotaxic effect is one of the most interesting features of the operation. It is present only when d.c. current is used, and the reaction of the fish is involuntary. For reasons still unknown, a fish immediately faces the positive electrode when it enters the charged field. Each time the electric pulse is sent, the fish twitches, then swims inexorably toward the positive electrode. Scientists believe this to be strictly a muscular reaction. Fish that have had their heads removed behave exactly the same as live fish, twitching and moving straight toward the positive electrode.

Researchers have found that different

(*Continued on page* 103)

Build an R.F.

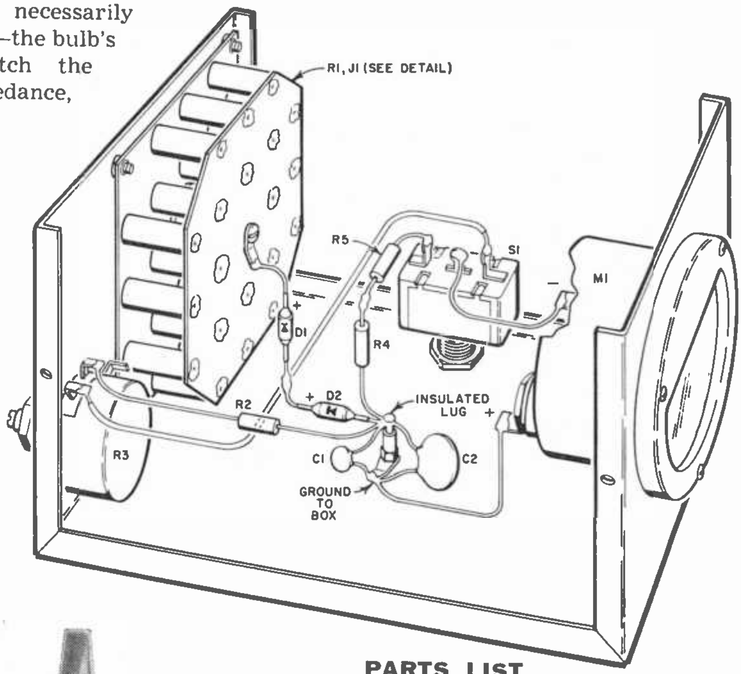
This inexpensive instrument doubles as a



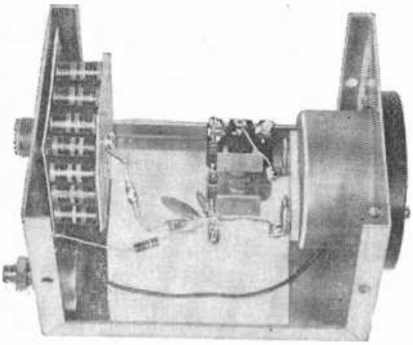
ALTHOUGH many amateurs use an ordinary light bulb to "measure" r.f. power output, this is a hit-and-miss method at best. A 150-watt bulb operating at "half-brilliancy" doesn't necessarily indicate 75 watts output—the bulb's impedance doesn't match the transmitter output impedance, and "half-brilliancy" is little more than a crude guess. The only accurate method of measuring r.f. power output is to use a calibrated r.f. power meter.

Here's a two-in-one unit that's both an r.f. power meter and a dummy load in one compact aluminum case. It's capable of handling 40 watts continuously and up to 100 watts for very short intervals. It can also be used to test a transmitter's low-pass harmonic filter.

This little unit has an effective input impedance of about 50 ohms to match the out-



Standard Minibox serves as chassis for power meter. For best results, use a single insulated tie-point and ground lug when wiring, as shown in pictorial diagram.



PARTS LIST

C1—.001-µf., 600-volt ceramic disc capacitor
C2—.01-µf., 600-volt ceramic disc capacitor
D1, D2—1N38B diode
J1—Coax connector
M1—200-µa. d.c. meter (Triplett 221T, or equivalent)
R1—50-ohm, 40-watt resistor (see text)
R2—330,000-ohm, ½-watt, 5% resistor
R3—250,000-ohm, 2-watt potentiometer, linear taper (Ohmite CLU1041 or equivalent)
R4—33,000-ohm, ½-watt, 5% resistor
R5—100,000-ohm, ½-watt, 5% resistor
S1—S.p.d.t. toggle switch
1—3" x 4" x 5" Minibox
Misc.—Hardware, brass plates, etc.

Power Meter

dummy load in your ham shack

By **JOSEPH TARTAS,** W2YKT

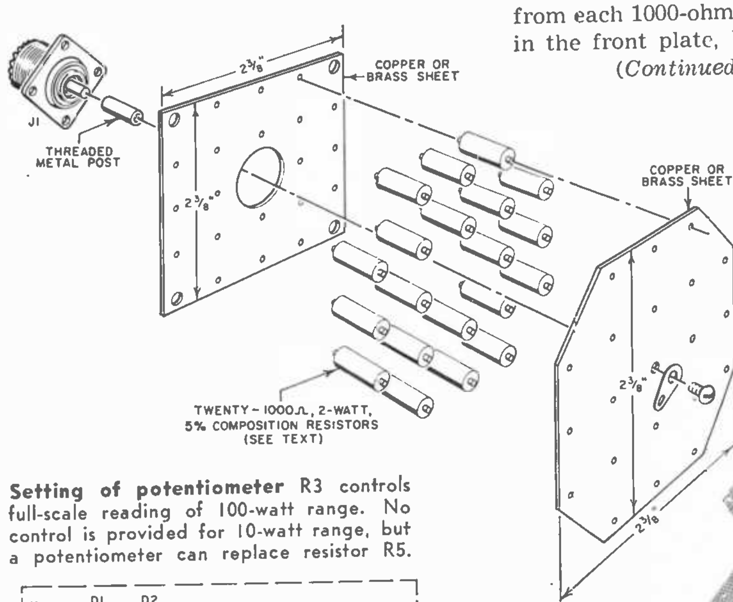
put impedance of most transmitters. It operates on frequencies up to 200 mc. with a voltage-standing-wave-ratio (VSWR) of only 2:1 on the upper limit. Using standard components, you can build it for $20 or less, depending on the meter used.

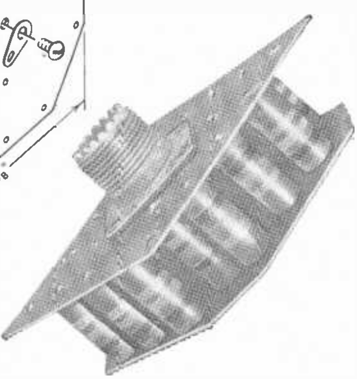
Construction. The 3" x 4" x 5" Minibox which serves as a cabinet also acts as a heat sink for load resistor *R1*. Drill the mounting holes for input jack *J1* and potentiometer *R3* at one end of the box; you'll need a hole for the meter on the opposite end. Switch *S1* mounts on top.

Load resistor *R1* consists of twenty 1000-ohm, 2-watt, 5% composition resistors soldered in parallel to a pair of brass or copper plates as shown in the pictorial detail. Cut the two load-resistor plates at the same time from two copper or brass sheets. Each plate should be 2⅜" square; the thickness isn't important. When the plates are cut, mark one for drilling, clamp them together, and drill both at the same time. This will insure alignment of holes and make assembly easier. Cut off the corners of the back plate to allow access to the nuts on the mounting screws.

To assemble the load resistor, pass a lead from each 1000-ohm resistor through a hole in the front plate, bending over each lead

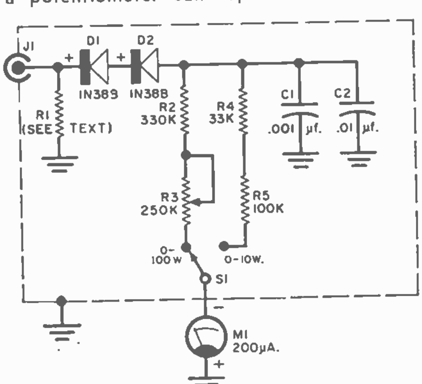
(*Continued on page* 104)

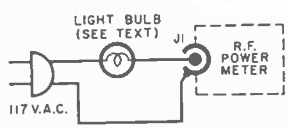




Metal plates for load resistor R1 should be clamped together and drilled at the same time to insure proper alignment of holes.

Setting of potentiometer R3 controls full-scale reading of 100-watt range. No control is provided for 10-watt range, but a potentiometer can replace resistor R5.

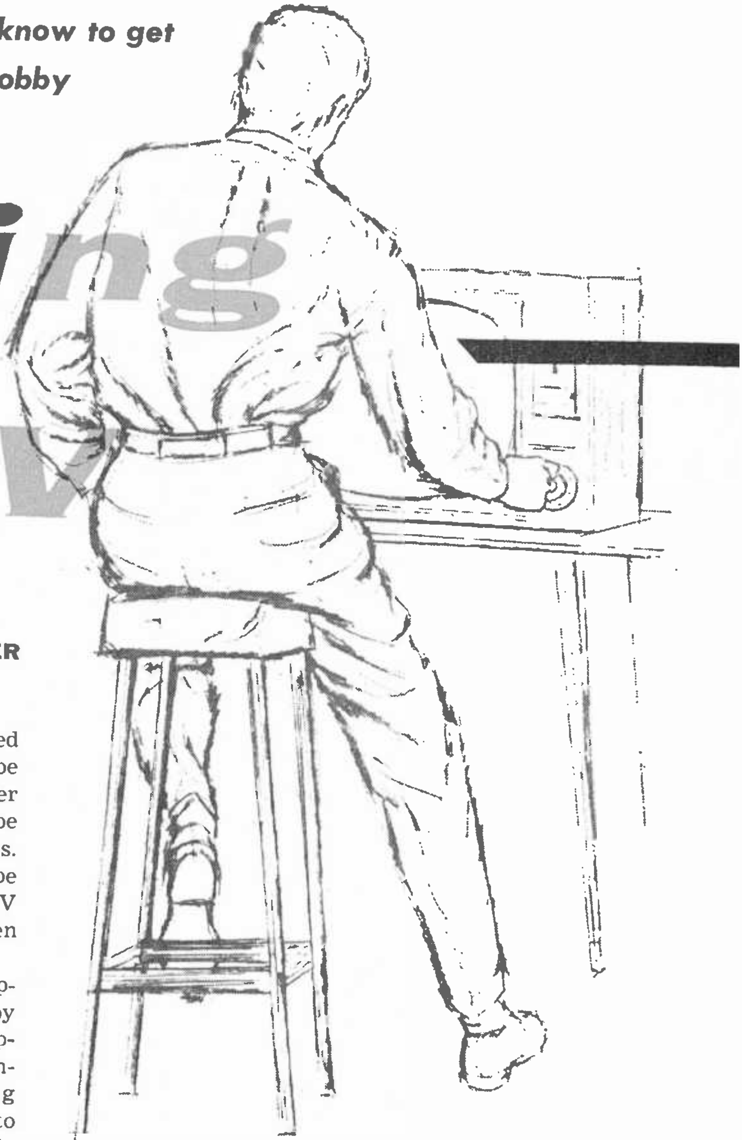




CALIBRATION HOOK-UP

June and July are the peak months for long-distance TV reception. Here's what you should know to get started in this exciting hobby

DX'ing on TV



By KING SCHAFER

THIS June and July, a scattered group of enthusiasts will be watching television screens all over the country. But they won't be viewing regular video programs. Instead, their entire efforts will be directed towards picking up TV stations that are hundreds, even thousands, of miles away!

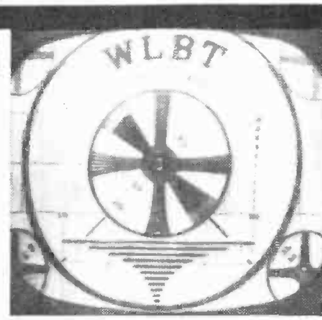
Long-distance television reception (TV DX) is an exciting hobby where the unexpected often happens. A DX'er in Ohio, for example, may come across anything from a Cuban beer commercial to a Texas weather report—all while waiting for an "ID" (station identification). The peak months for this unusual activity—June and July—are just beginning, so a good time for any prospective DX'er to get started is now!

Reflecting the Signal. As you probably know, TV signals tend to go out into space unless they are reflected back to earth. Various types of atmospheric "reflectors" exist at different times of the year. In the early summer, for instance, a section of the ionosphere called the "E-layer" is ionized by the sun. The areas of ionization act as a reflector of sorts to bend the television signals back to earth.

Reception by "E-skip" (DX slang for "E-layer" reflections) is confined chiefly to the low-band v.h.f. channels (2 through 6). The average distance covered is about 1200

275 miles

200 miles



950 miles

700 miles

1000 miles

Long-distance pickups above were logged by author near Buffalo, N. Y. Longest DX was from Pensacola, Fla.

miles, but DX'ers have noted stations as far away as 6000 miles and as close as 450 miles via "E-skip." Reception beyond 2000 miles is probably the result of signals bouncing back and forth between the "E-layer" and the earth's surface.

Many outstanding examples of "E-skip" reception are on record, among them the July 1957 logging by Robert Seybold in Dunkirk, N. Y., of KENI-TV in Anchorage, Alaska, and KFAR-TV in Fairbanks, Alaska. The time duration of the "E-skip" sessions is anywhere from five minutes to several hours.

"Trops." As summer and the "E-layer" begin to fade away, the depressing thought may arise that all those beautiful visions of far-away test patterns will likewise disappear. Not at all, for with early autumn comes what DX'ers call the "Trops" season, named after a lower section of the ionosphere called the "troposphere."

As large weather fronts of high- and low-pressure areas move rapidly across the land, ducts or paths are formed which force television signals down to lower levels. This condition is usually first noticed when stations about 70 miles away begin to increase in signal strength. Later, the reception range may extend a good 300 to 600 miles, or even

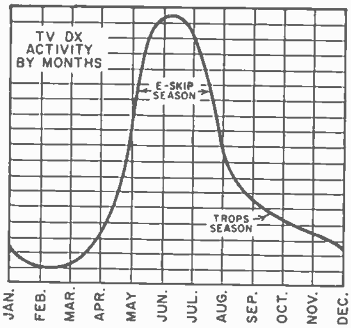


Chart of TV DX activity shows that the months from late Spring to early Fall are the best for TV DX'ing.

1000 miles plus in some areas. As opposed to "E-skip," however, it's the high-band v.h.f. channels (7 through 13) that are affected most by "Trops."

Even channels 14 - 83 on the u.h.f. band produce some amazing results during September and October. Again, the time duration may be several hours, or a scant half hour, with varying degrees of picture quality. A "Trops" record that still stands was set five years ago by DX'er Barney Raunch of Peoria, Ill., when he logged high-band stations from both coasts.

Meteors and Sunspots. With the collapse of the "Trops" season in late October, and the approach of the "lag" period, diligent DX'ers are still not downhearted. Their attentions are merely shifted to a highly elusive form of DX referred to as "MS," the abbreviation for "meteor scatter."

As meteors from outer space enter the earth's dense atmosphere, friction is created which causes them to burn up. Ionization results from this burning action, but it lasts only for a second or two. The ionized areas reflect television signals back to earth, but only in ratio to the duration of ionization. This "on-off" ionization produces the odd effect of "light-switch" reception, where a picture may "burst" in and then out again at the bat of an eye! During peak meteor activity, however, the overlapping effects of numerous meteor burn-ups greatly extend the length of time a signal can be received.

The low-band channels are the ones to watch for "MS," as high-band receptions are rare. Actually "MS" is only one aspect of the scatter-propagation mode, but DX-'ers use it as a general term to cover all burst-type observations. Distances covered by "MS" have ranged all the way from 70 miles to a strapping 3000 miles! DX'er Bill Nieman of Buffalo, N. Y., almost hit the 3000-mile mark when KNXT (Channel 2) in Los Angeles, Calif., flashed on his screen in the spring of 1959.

The most complex and exacting form of TV DX, usually attempted only by experts, is "F2" reception. This refers to the "F2" layer of the ionosphere. Anything observed by "F2" is outstanding because the "F2" layer is activated only intermittently by sunspots. Reception from the "F2" layer is possible from 2000 to 15,000 miles away!

Sad to say, however, there are some difficulties that prevent many U. S. DX'ers from making an "F2" pickup. First, most of the stations from 2000 to 15,000 miles distant are in Europe. Because these stations employ different technical standards than ours, it is necessary to convert receivers to satisfy the differences—a highly involved ordeal. Secondly, with 2000 miles the minimum pickup possible with "F2" reception, the received signal is consequently very weak and exceedingly difficult to tune in.

Station verifications such as this postcard are sought and collected by TV DX'ers as evidence of their skill.

Receiving Equipment. The average person might think that the equipment needed to pull in far-off TV stations would be based around 200' towers and ultra-expensive receivers. Few DX'ers are equipped in this costly fashion, however.

The most important piece of equipment is the television receiver itself. No matter how extensive your antenna installation may be, a receiver that is not operating at top efficiency will severely limit your chances of making any worthwhile DX. It is of prime importance, therefore, to see to it that your TV set is in the best condition

(*Continued on page* 102)

BLACK BOX Magic

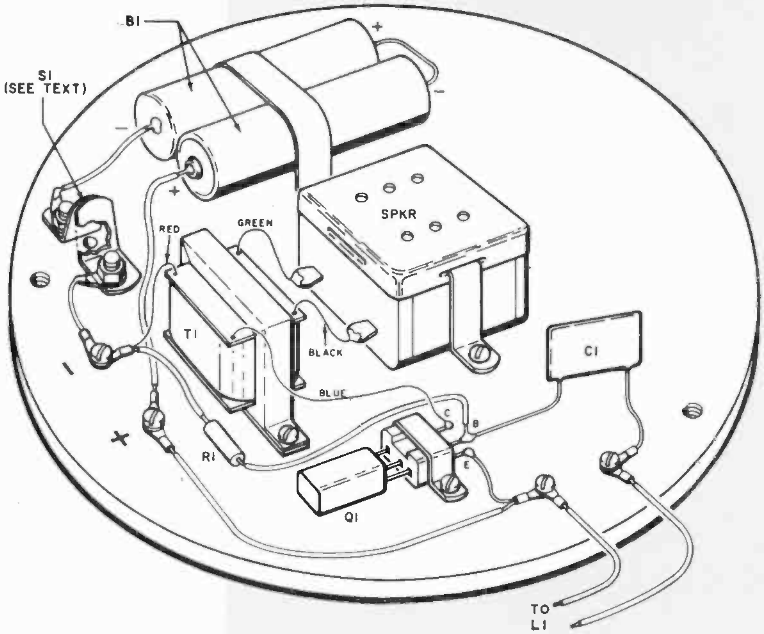
By KENNETH RICHARDSON

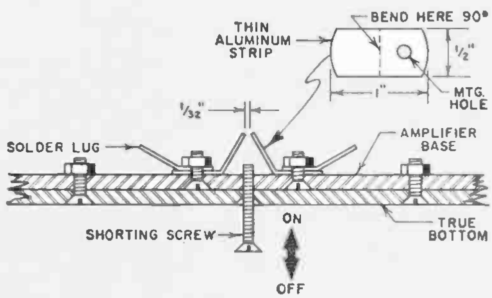
Complete construction plans for a box that talks back

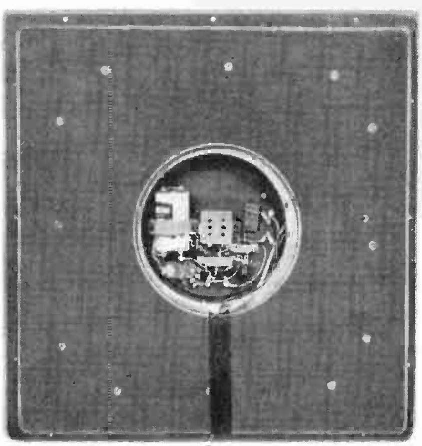
WHAT makes this black box talk? It's a safe bet that guests at your next party will be stumped. Close inspection makes it obvious that the box is empty. Yet it tells fortunes, brings back voices from the past, and asks questions that reveal rare insight and intelligence.

There's some trickery involved, of course. The black box is actually part of a huge air-core transformer. The transformer's "primary" is a large coil of wire hidden under the carpet in the room where your guests are seated. Its "secondary" is a coil of wire hidden in the base of the black box itself.

You'll need an accomplice to make it work, but he needn't be a ventriloquist—the black box is entirely electronic in operation. Unknown to your guests, your accomplice is seated in an adjoining room





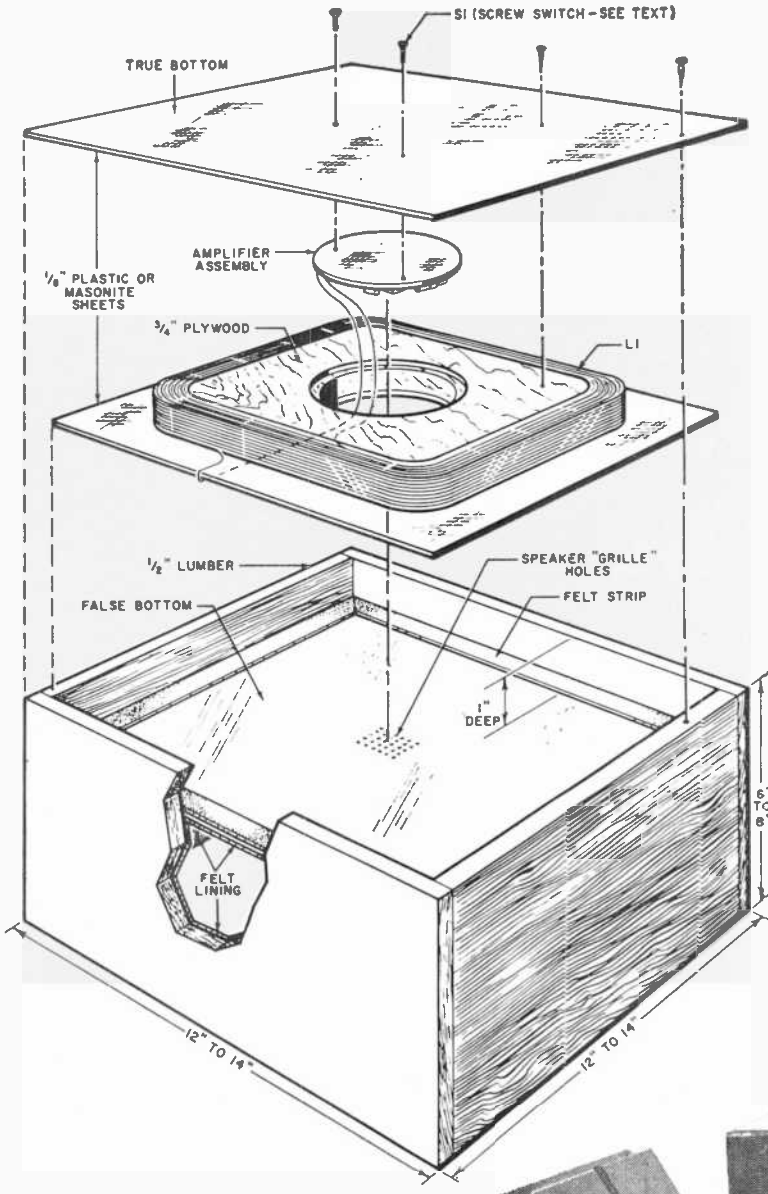


Transistor amplifier for black box is built on disc cut from plastic or Masonite sheet and attached to larger sheet. (See pictorial above and exploded view at right.) "Screw-switch" S1 (detail above) is optional; batteries can be wired permanently into circuit.

with a pair of amplifiers: a "talk" amplifier and a "listen" amplifier. A microphone concealed near your guests brings him their questions through the "listen" amplifier; his answers are returned through a second microphone plugged into the "talk" amplifier. A radio could serve as one of the amplifiers, if convenient.

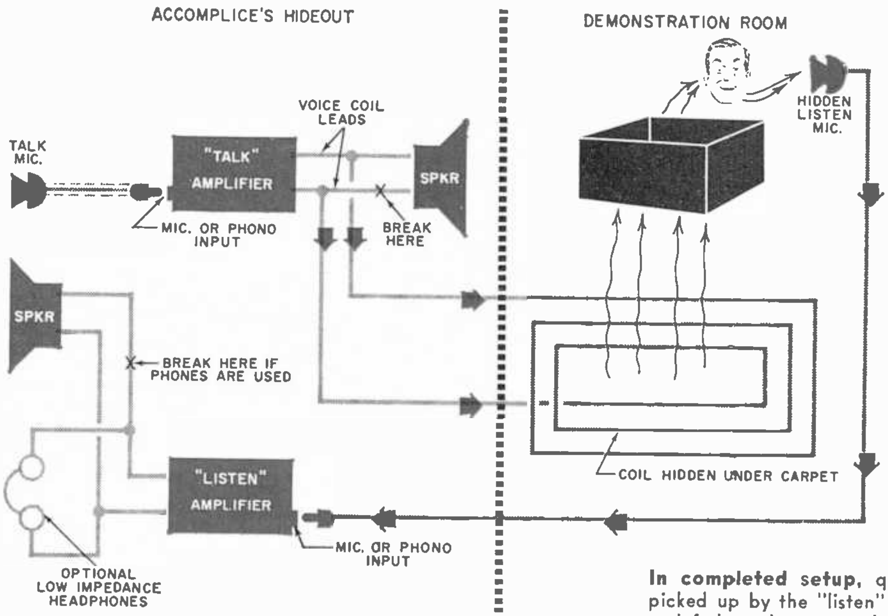
The concealed "primary" coil of wire is connected to the output of the "talk" amplifier. The "secondary" coil in the black box picks up the signal from the "primary" and feeds it to a tiny, one-transistor amplifier and subminiature speaker (also hidden in the box), thus allowing your accomplice's voice to emanate from the apparently empty box.

Construction. Make the black box from ½" plywood. It should measure from 12" to 14" on a side, and from 6" to 8" high.



The box is open on one end and sealed with a false bottom about 1" from the opposite end (see exploded view above). Perforate about 1 sq. in. of the false bottom in its exact center—the holes will act as a speaker grille. The entire inside of the box can be lined with felt or other cloth to conceal the grille holes and to give the box an "empty" look.

Inserted in the false-bottom cavity is a



In completed setup, questions are picked up by the "listen" microphone and fed to the accomplice's hideout. The "talk" amplifier sends his answers back to the demonstration room where hidden coils transfer them electrically to the amplifier in the black box.

"sandwich" made of two ⅛" plastic or Masonite sheets separated by a 11½" x 11½" (for a 14" x 14" box) square of ¾" plywood with rounded corners. Cut the inside plastic sheet the same size as the false bottom; the outside sheet is the true bottom and is cut to fit the bottom of the box. Cut a 5"-diameter hole in the center of the inside sheet and in the plywood.

After assembling the plastic and plywood sandwich, wind pickup coil *L1*—about 700 turns of No. 30 to 34 enameled wire—around the inside of the sandwich on the ¾" plywood. To facilitate winding, mount the sandwich in a homemade jig so it can be turned like a wheel as this "secondary" coil is wound.

The one-transistor amplifier and speaker are mounted on the plastic or Masonite disc cut from the inner sheet of the sandwich. Reduce the disc diameter by about ½" so it will fit in the false-bottom cavity.

A "screw-switch" (*S1*) can be made for the amplifier as shown in the pictorial detail. Simply bend two thin strips of aluminum and mount them about ¼" apart; then bend them until they are 1/32" apart. Drill a hole in the disc between the strips and in the corresponding place in the true bottom. Threading a machine screw through this hole and screwing it flush with the true bottom shorts the strips and closes the switch.

If desired, the switch can be eliminated and battery *B1* wired directly to the amplifier. No-signal current drain is about 2 ma., so the battery will last for some time before replacement is necessary.

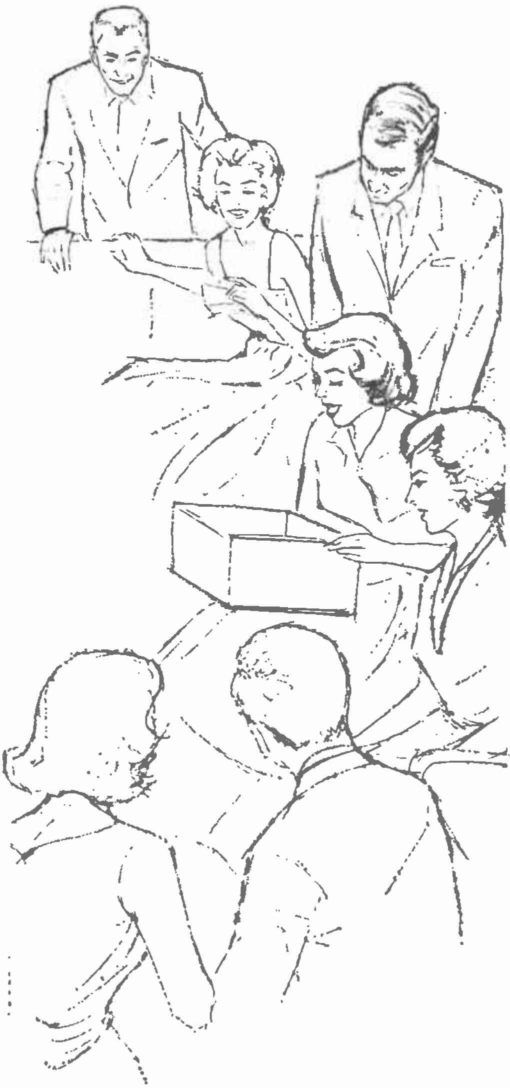
Using the Black Box. The "primary" coil to be hidden under the carpet is made up of several turns of No. 20 to 30 wire. Experiment with the coil diameter and the number of turns for best results.

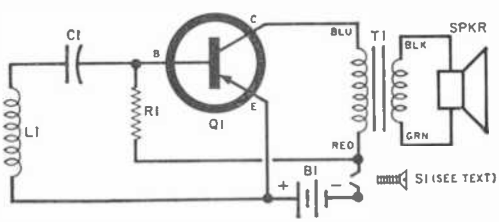
Place the "primary" coil under the edge of the carpet. If your demonstration room has wall-to-wall carpeting, or if the coil proves to be too bulky under the carpet, wind it on the baseboard or ceiling molding instead.

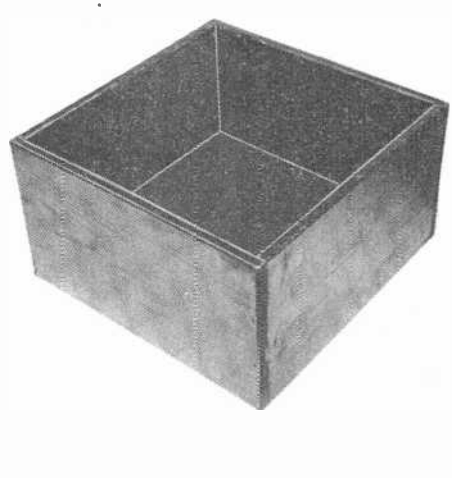
Then disconnect the speaker voice coil from your accomplice's "talk" amplifier and connect the secondary of its output transformer to the "primary" coil. Ordinary lamp cord is ideal for use as interconnecting wire.

Connect the concealed "listen" microphone to the "listen" amplifier, or use a wireless mike if you wish. Your accomplice can listen with headphones or through the loudspeaker of the "listen" amplifier if its level is not too high.

To bring back voices from the past, simply have your accomplice play a suitable phonograph record through the "talk" amplifier at the appropriate time. —30—



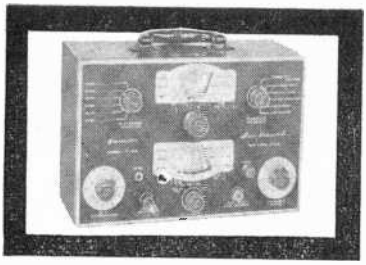


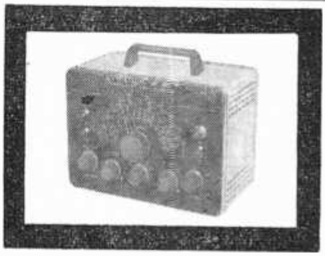


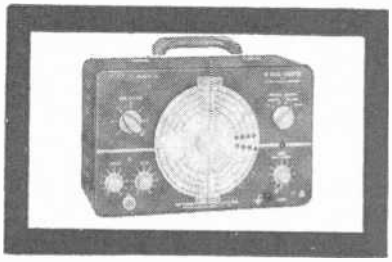
PARTS LIST

B1—3-volt battery (two penlight cells in series)
C1—0.1-µf., 50-volt capacitor
L1—Pickup coil, 2000 feet of #30 to 34 enameled wire (see text)
Q1—CK721 transistor (or equivalent)
R1—47,000-ohm, ½-watt resistor
S1—S.p.s.t. "on-off" switch (see text)
T1—Miniature output transformer; 2000-ohm primary, 11-ohm secondary (Argonne AR-114 or equivalent)
Spkr.—Subminiature loudspeaker (Telex 9155 "Mini-Mike" or equivalent)
1—Length of #20 to 30 covered wire (see text)
2—⅛" plastic or Masonite sheets (see text)
Misc.—½" and ¾" plywood, felt, hardware, etc.

Test Instruments







the Signal Generator

Part 3 Trouble-Shooting and Other Uses

By G. H. HARRISON

TO BECOME better acquainted with the versatile r.f. signal generator, let's put it to work as a trouble-shooter. That five-tube a.c.-d.c. receiver that's been gathering dust in the closet ever since it went on the blink back in 1953 should make a good test subject.

Take the receiver out of its case, plug it in, and turn on the switch. You guessed it: nothing happens! Since the set isn't going to fix itself, let's begin our trouble-shooting by checking first the filaments, then the B+ voltage. (See POPULAR ELECTRONICS, March, 1959, p. 69, for details on this part of the procedure.)

When the set still refuses to produce so much as a squeak even with all the tubes lit and the B+ normal, the time has come to put the signal generator into action. We'll trouble-shoot by working "backwards" through the set, starting with the speaker stage and ending with the antenna.

First, clip the generator's ground lead to the receiver chassis and connect the generator's *A. F. Out* to the grid of the audio output tube (Fig. 1, point *A*). With the receiver volume at maximum, turn the generator's a.f. output control up slowly. If a 400-cps tone can be heard in the speaker, the audio output stage and speaker are working properly.

Next, move the test lead to the grid of the first audio tube (point *B*). If no sound comes from the speaker, the trouble must lie between points *B* and *A*. Either the circuit of *V3* isn't working, or coupling capacitor *C1* is open. To eliminate one suspect, connect the signal generator output to the plate circuit (point *C*). If there is still no sound from the speaker, *C1* must be causing the trouble. Let's replace it with a new one.

Success! When the signal generator is connected to either point *C* or *B*, sound comes out of the speaker. (Note: even with a defective coupling capacitor, a very weak signal will probably be heard with the signal generator connected as above, due to stray capacitances. Under normal conditions, however, the signal from the speaker should be at about the same level regardless of which side of the capacitor is connected to the generator.)

Perhaps the radio will play with the new capacitor in the circuit. Disconnect the signal generator entirely and try to tune in a station. If the speaker remains silent, something else is wrong.

Set the generator to the receiver's intermediate frequency—probably 455 or 456 kc. Turn the signal generator's modulation selector to *Internal* and connect the test lead from the *R.F. Out* terminal to the grid of the i.f. tube (point *D*). Slowly turn up the output level. If nothing happens, the trouble must lie between points *D* and *B*.

Let's narrow down the possibilities. Move the probe to the plate circuit of *V2* (point *E*)—still no sound. Next, touch it to the output of the i.f. transformer (point *F*). Now a signal comes out of the speaker. Obviously, the difficulty is between points *E* and *F*, which means that i.f. transformer *T2* is probably at fault. A quick ohmmeter check will show if its secondary is open. Let's assume that it is.

When the transformer has been replaced, the receiver will have low sensitivity because the new transformer isn't aligned properly. Align it (see May 1960 issue, p. 83). Assuming there's nothing else wrong, the receiver should now operate perfectly. Here's one set that will be doing more than gather dust for a while!

Frequency Response. The signal generator can do more than help put an ailing receiver on the road to recovery. It can also show how efficiently a receiver or tuner is operating. For example, how does the performance of that AM tuner you just added to your hi-fi setup match the rest of the system? Your signal generator—in connection with other test instruments—can tell you.

To measure frequency response, hook up the instruments as shown in Fig. 2. Connect the audio oscillator's output to the *Ext. Mod.* terminals of the signal generator; then connect the output of the generator to the tuner's antenna terminals. Set the audio oscillator frequency to 400 cps and adjust its output to give approximately 30% modulation. (The signal generator instruction book should contain adjustment details.) Set the controls on the signal generator and the tuner to the same frequency —around 1000 kc.—and adjust the output levels to give a moderate indication on the output meter.

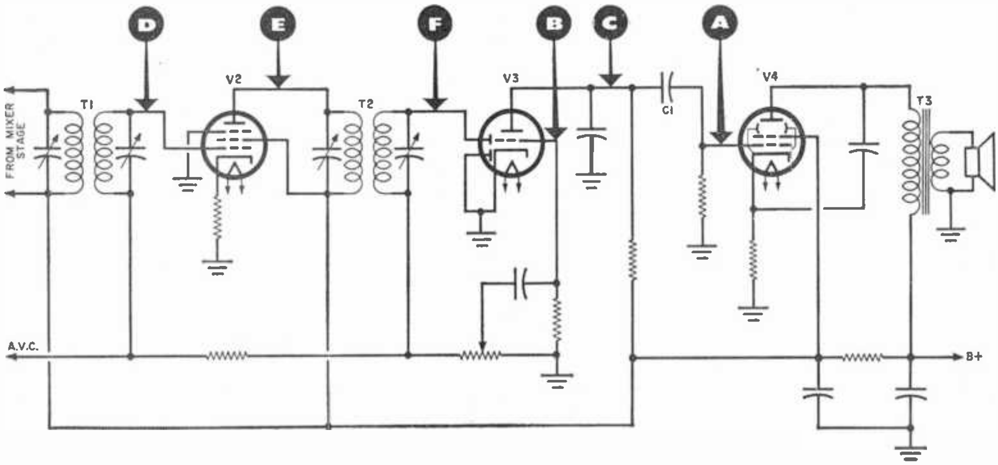


Fig. 1. Trouble-shooting a typical a.c.-d.c. receiver is easy with a signal generator. Injecting generator output at points A through F quickly isolates faulty components.

Jot down the output meter reading at 400 cps. Now tune the oscillator to 300 cps. (Note: Measure the output of the oscillator at point *A* in Fig. 2, and adjust if necessary.) Write down the 300-cps reading. Adjust to 200, 150, 100, 90, 80, 70, 60, 50, 40, 30, and 20 cps, and note each reading.

Now tune back to 400 cps, and start in the other direction. Following the same procedure, take output readings at 500, 600, 700, 800, 900, 1000, 1500, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 10,000, 15,000 and 20,000 cps. Plot the values recorded on graph paper and you will have the tuner's frequency-response curve (see Fig. 3).

Checking Sensitivity. The instruction book that came with your hi-fi tuner or ham receiver probably gives sensitivity

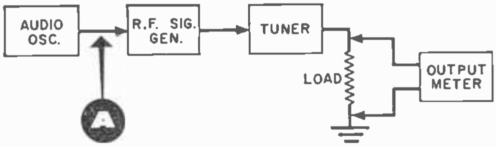


Fig. 2. Setup for measuring tuner's frequency response; "A" is point at which output level of audio oscillator is checked.

specifications. It's a good idea to check them occasionally to insure that the overall operation of the receiver is up to par.

You'll need a signal generator with an accurate indicator to measure the output level. Connect it as in Fig. 4(A). When you work with the broadcast-band frequencies, a simple dummy antenna such as that in Fig. 4(B) can be used; Fig. 4(C) is the recommended Institute of Radio Engineers dummy antenna for multi-band receivers. A

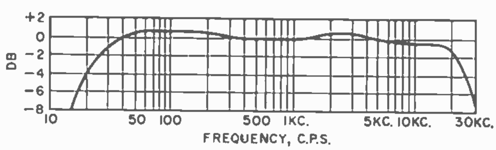


Fig. 3. Frequency response curve of typical tuner. Voltage readings can be converted into decibels and plotted as shown.

dummy antenna *must* be used in making sensitivity measurements to insure accurate input voltage levels.

When you are checking the sensitivity of a tuner, the output meter should be connected across a dummy output load resistor. If you are measuring the sensitivity of a complete receiver, connect the meter across the speaker voice coil or a load resistor substituted for the voice coil.

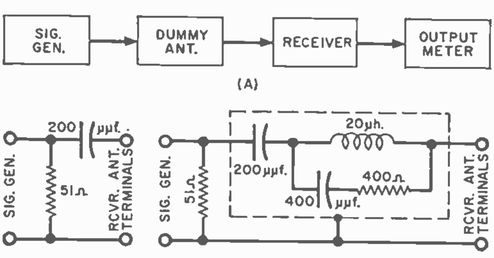


Fig. 4. Hookup for measuring sensitivity (A), simple dummy antenna (B), and dummy antenna recommended by I.R.E. (C).

Now set the signal generator and the receiver carefully to the same frequency. Open the receiver's volume control to its loudest position. Adjust the signal generator's output level until the meter reads the output voltage specified in the instruction manual; then note the output level of the signal generator. The amount of signal required to give a predetermined output is the sensitivity of the tuner expressed in microvolts. A typical tuner may require 100 µv. to produce a specified output—such as 1.0 volt. More sensitive tuners might require only 4 or 5 µv. or even less.

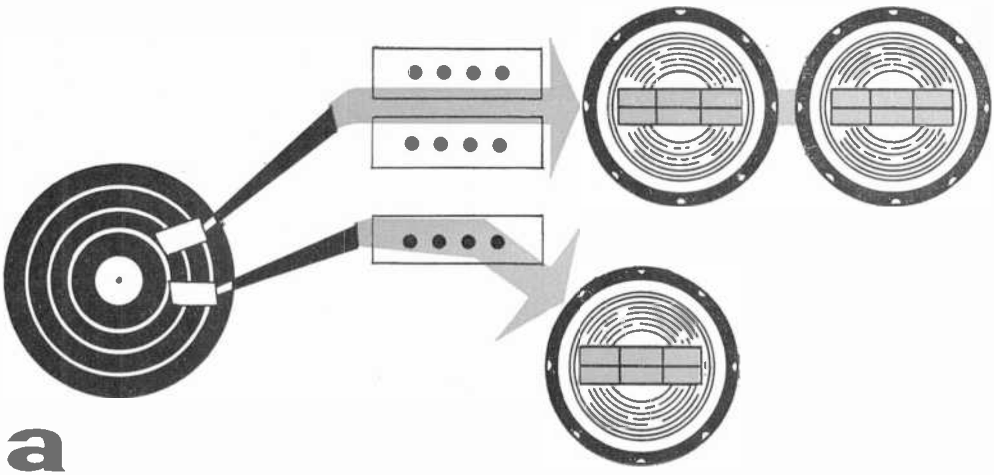
Complete receivers are rated as requiring so many µv. to produce a certain output *power*. If you do not have a meter which reads output power, you can use the formula $E = \sqrt{PR}$ to figure out what voltage reading on the output meter will give the desired power. For example, if your load is a 16-ohm voice coil or load resistor and the receiver's instruction manual specifies that sensitivity should be measured with 1.0 watt of output power, the formula would work out as follows: $E = \sqrt{1 \times 16} = \sqrt{16} = 4$ volts.

Measuring Selectivity. As many receivers and some hi-fi tuners have variable selectivity, the receiver instruction book may give selectivity ratings in such terms as "bandwidth at 10 times down is 18 kc." To understand what this means, consider a typical tuner that produces a one-volt output when 5 µv. are applied to its input at a frequency of 1000 kc. But when the signal generator is tuned 9 kc. to either side of 100 kc., the output drops to 0.1 volt. In other words, with the receiver remaining tuned to 1000 kc., the output at 1009 and 991 kc. (a spread of 18 kc.) is one-tenth as much as it was at 1000 kc., or "10 times down at 18 kc." (see Fig. 5).

To measure selectivity, use the setup shown in Fig. 4(A). Tune the signal generator and receiver very carefully to a frequency about mid-band (1000 kc. or so on the broadcast band). With the signal generator's attenuator set at "X1," adjust the fine control and receiver gain to some convenient reading—say 1.0 volt—on the output meter. Be sure the signal generator output is as low as possible to avoid overloading the receiver.

Turn the attenuator to "X10" and slowly raise the frequency of the signal generator until the output meter again reads

(*Continued on page* 98)



a COMPATIBLE STEREO RECORD

Here is a special report on a new type of record that can be played on either stereo or mono equipment

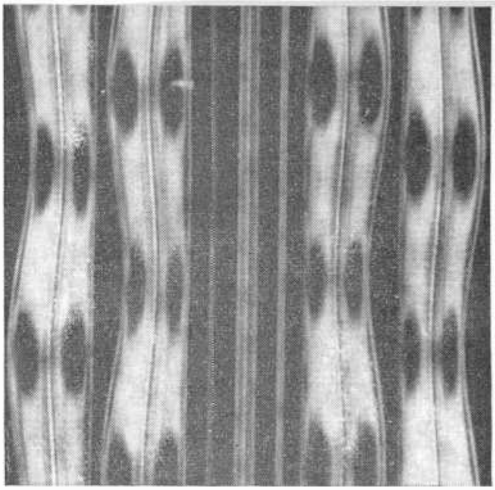
By ROBERT ANGUS

ONE of the most hotly debated subjects among record manufacturers today is a new type of stereo record which its proponents claim is completely compatible. That is, it can be played on either stereophonic or standard monophonic equipment without fear of undue damage to the record grooves.

Design Records, a small company in comparison to the giants in the field, is the force behind this new system. The Design people feel that disappointing record sales are largely traceable to the public's confusion about being offered two different types of records—mono and stereo. If a single compatible record could serve both markets, they maintain, such confusion would be eliminated.

The question of compatibility, it must be remembered, was one reason why the Westrex 45-45 stereo cutting system was adopted in the first place. It featured a V-shaped groove containing a sound channel on each wall. As a needle bumped up and down and from side to side, it picked up parts of each signal—in the lateral plane, the sum of the two channels, and in the vertical, their difference. When a record was played on monophonic equipment, it was argued, the cartridge would pick up only the lateral or sum signal.

Most early stereo disc manufacturers played up the compatibility feature in their advertising, saying that the records would play equally well on monophonic or stereo equipment. Gradually it developed that stereo cartridges would track more satisfactorily if the stylus tip were smaller than the 1-mil tip used for monophonic records. It also became evident that mono cartridges had a tendency to plow right through the groove's vertical modulation, destroying the stereo effect after repeated playings. Soon the experts warned that the compatibility of stereo only went one way—that stereo equipment could be used to play mono



Comparing the grooves of a standard Westrex stereo record with grooves of Design's compatible record (opposite page) shows the compatible record to have less vertical modulation, thereby more closely approximating a monophonic cut.

records. If, on the other hand, you played your stereo records on mono equipment, you were taking their lives in your hands.

Cutting Techniques. The secret of the new compatible record is that there is some "tampering" with the stereo signals before they're fed into the cutter. Instead of producing a sum and difference on the record by cutting the two sound channels at an angle, the new process does the adding and subtracting at a point before the signals reach the cutter. This results in a vertical-lateral cut, with the sum signal engraved laterally and the difference signal contained in the vertical modulation. In playback, a standard stereo cartridge adds and subtracts the vertical-lateral information and recreates the two stereo channels.

In addition to manipulating the two channels before they reach the cutter, the system also reduces the bass response in the vertical component—the "difference" channel—so the dips and rises in the groove will be less sharp.

According to Sidney Feldman of Mastertone Recording Studios, one of the men who has experimented with the new process, the effects of attenuating the bass are less noticeable if you work with sum and difference channels than if you tamper with the left and right channels separately. The result is a record without steep hills and deep valleys, in which the needle rides along in relative serenity.

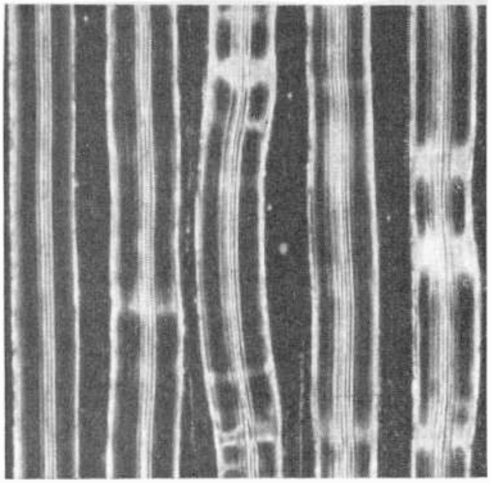
Engineers such as Feldman and John Mosely, who was formerly head engineer at Audio Fidelity Records, explain that it's the vertical modulation that tends to make the regular stereo record non-compatible. Mono cartridges tend to level the hills and valleys, wiping out the "difference" channel. By reducing their amplitude, the engineers reasoned, it should also be possible to reduce vertical wear, and, incidentally, make the records easier to stamp out on pressing machines.

To evaluate the process, the following Design compatible discs were tested: "Porgy and Bess," "Ray Eberle Sings," "Flower Drum Song," and "Ray Bohr at the Radio City Music Hall Organ." In addition, Design supplied mono and conventional 45-45 stereo copies of "Flower Drum Song" for comparison purposes. Equipment used in evaluating the records consisted of a Glaser-Steers GS-77 record changer, a Fairchild SM-1 stereo cartridge (tracking at 3.5 grams) and a General Electric VR-II mono cartridge (tracking at six grams). All listening tests were made with Koss earphones to minimize external distractions.

Test Results. In subjective listening tests, it was discovered that "Flower Drum Song" in Design's compatible version was virtually indistinguishable from the company's regular stereo version. Design's stereo, however, has some peculiarities which most other manufacturers have avoided. On neither the conventional stereo disc nor on the compatible record was there enough bass to tell what sort of low-frequency reproduction the new disc was capable of. Both records featured extreme separation, with a vocalist relegated entirely to one speaker, and the bulk of the orchestra to the other.

When the compatible stereo disc was played monophonically, the reproduction was, if anything, superior to the mono pressing. Both soloist and orchestra emerged more clearly, and there was no audible distortion (except for the weak bass, which appeared on both records).

The next question concerned wear. The GS-77 changer was set up so it would go through its changing cycle every 3½ minutes. Then, the entire last track of a Design compatable stereo record was played over and over again for an eight-hour period with the VR-II mono cartridge. At the



end of that time (approximately 140 plays later), the record was played with the Fairchild stereo cartridge. There were visible and audible signs of wear on the record, but there was no audible loss of the stereo effect.

As a check, the mono version of the same record was put through a similar wear test using the VR-II. Again, the changer went through approximately 140 plays. Although the mono disc showed visible signs of deterioration, it seemed to stand up better under this sort of punishment than did the compatible stereo disc.

Surprisingly enough, conventional 45-45 stereo records don't come off too badly in this sort of testing. A section of a regular stereo record was played over and over with the VR-II mono cartridge, and after every ten plays the record was played stereophonically. After 20 mono plays, there was no audible loss of stereo quality. By 30 plays, however, some highs were lost and distortion was noticeable. After 40 plays, distortion increased markedly and the stereo effect also began to disappear.

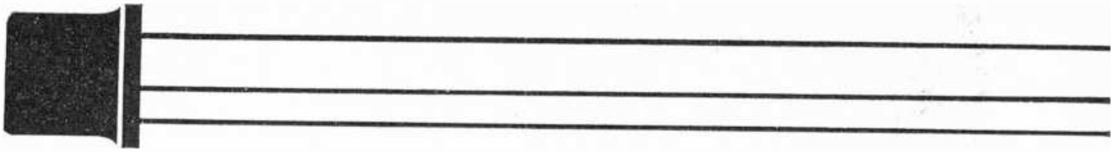
Summing up, it was found that surface noise increases markedly at a point somewhere around 30 plays when a non-compatible stereo disc is played with a mono cartridge. The same amount of surface noise from a mono or a compatible stereo record played with a mono cartridge occurs at about 50 plays. Channel separation tends to be wiped out much earlier in the 45-45 stereo disc, again starting at a point somewhere between 20 and 30 plays. In the case of the compatible disc, channel separation was not lost after 140 monophonic plays. High frequencies—those upwards of 10,000 cycles—tended to disappear somewhere below 20 plays for the conventional stereo record and somewhere under 60 plays with a compatible or a mono record. After 140 plays, both the compatible stereo and the mono discs still reproduced the range from 100 cycles to about 9000 cycles fairly clean.

Evaluation. Does the compatible record work? The answer is yes—at least in the case of these records. Is there a sacrifice in quality? Again, with these records, there is none. Both 45-45 stereo records and compatible stereo versions were checked against master tapes, a test which revealed no more loss of quality than does any disc-to-master-tape comparison. What the test did demonstrate was the superiority of tape over disc.

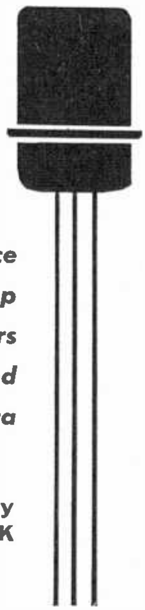
The bass on compatible discs apparently loses its directionality. When asked about this, Don Plunkett, the president of Fairchild Recording Equipment Company, said, "There is serious doubt today regarding the contribution of the lowest frequencies—particularly frequencies below 200 cps—to the spatial feeling so important for stereo reproduction. The reduced separation (at the lower frequencies), caused by reducing the vertical component, permits a higher *lateral* bass level for the same groove space. Thus, when the record is played back with both a stereo cartridge and a mono cartridge, it will produce bass response superior to that possible if full separation had been maintained down to the lowest frequencies."

Objections to the new process have been both loud and heated. One of the leading critics has been Sidney Frey, whose Audio Fidelity label produced the first commercial stereo record. "The customer pays hard-earned bucks for that bass," says Frey. "To deprive him of it would be a crime." In answer, the Design people state that compromises are constantly made in record-making, and that the new record is no more of a compromise than is the RIAA recording curve. Even if, theoretically, there is a slight loss of bass in the compatible method, the supporters of the process say, the record is still quite acceptable psychologically.

Design's compatible stereo records are now on the market. At this writing, however, no other company has indicated that it plans to use the compatible process. It seems logical to assume that if the new technique is practicable, the other manufacturers in the field will gradually switch over to compatible records. If the system is truly an advance, the consumer will reap the benefits. —30—



LOW COST Transistor Tester



Direct-reading device checks both p-n-p and n-p-n transistors for leakage and comparative beta

By MARTIN H. PATRICK

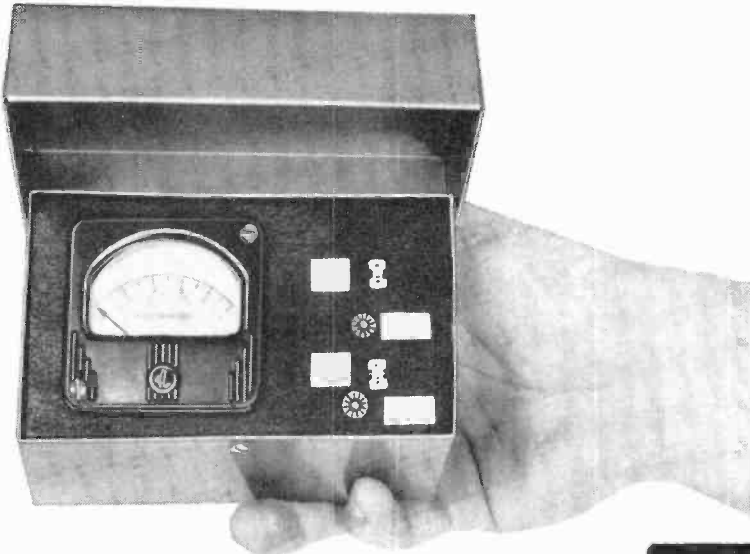
TRANSISTOR leakage and comparative *beta* can be checked in one operation with this direct-reading *beta* comparator. "Creepers" and "leakers" show up quickly, and the problem of matching transistors in push-pull circuits becomes extremely simple. Leakage current can be read immediately by plugging either an *n-p-n* or *p-n-p* low-power transistor into the proper socket. Pressing a button shows the *beta* value on the meter.

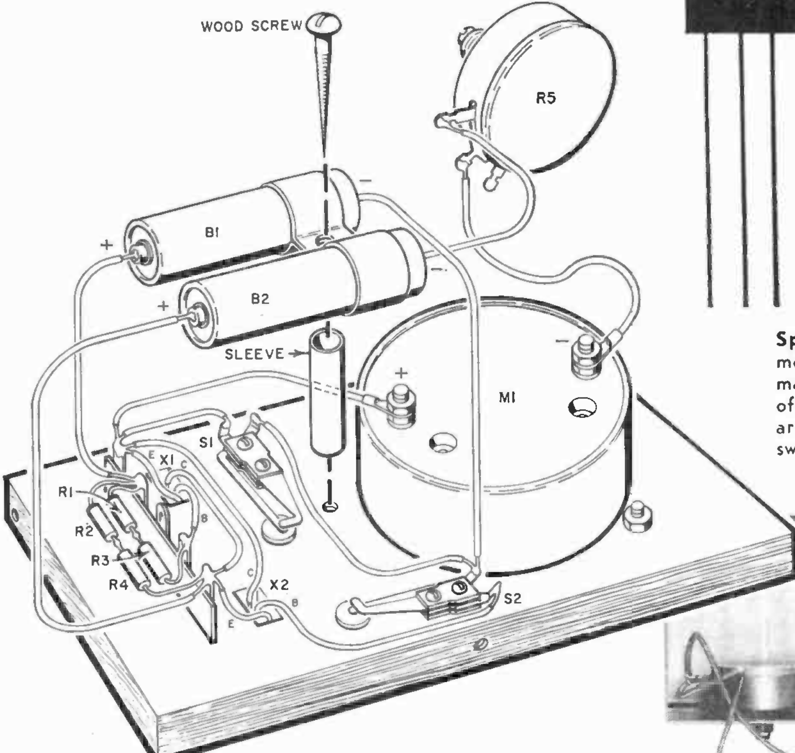
This little device makes use of the fact that many manufacturers recommend transistor emitter-to-collector leakage be no more than 0.125 ma. Most transistors with no more than this amount of static leakage will draw about 10 μa., emitter-to-base, when supplied by a 1½-volt source through a 127,000-ohm resistance. With this unit, it's a simple matter to read the comparative *beta* directly from a milliammeter scale.

Construction. The tester is housed in an ordinary metal filing box, 4" x 3" x 5", with all parts except *R5* mounted on a wooden baseboard which fits snugly into the top of the box (see pictorial). Attach the meter, face up, to the left side of the baseboard; then mount the sockets on the right.

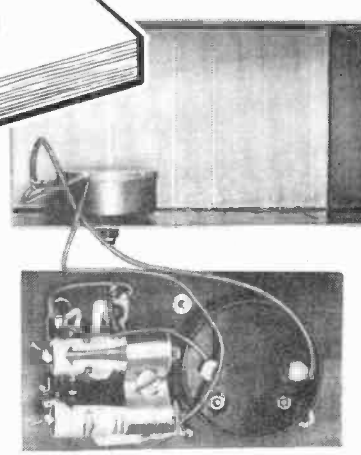
Resistor pairs *R1-R3* and *R2-R4* should be selected so that their values are identical; the parts list recommends ±5% tolerances, but ±1% resistors would be even better. Mount the dry cells on the bottom of the baseboard, or, if space doesn't permit, fasten them to the bottom of the filing box; if you prefer not to solder directly to the batteries, obtain a two-cell battery holder.

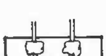
Make the special shorting plug by soldering a small piece of metal to a "U"-shaped length of wire. Two small holes can be drilled in the base to hold the shorting plug when it's not in use, or a third transistor socket can be used as a holder. It's best to wire the sockets before fastening them to the baseboard; note that the collector of one socket is connected to the emitter of the other. Although you can manage without it, spaghetti on the base leads of both tran-



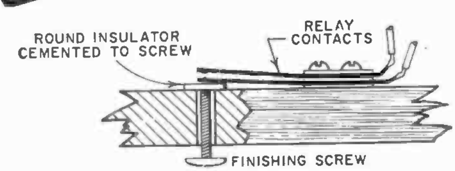


Special switches used in model for S1 and S2 were made from the contact points of an old relay, but standard miniature push-button switches can be used instead.

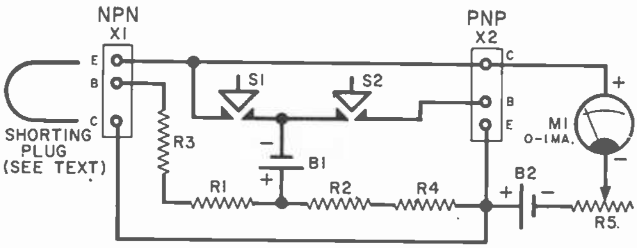




SHORTING PLUG



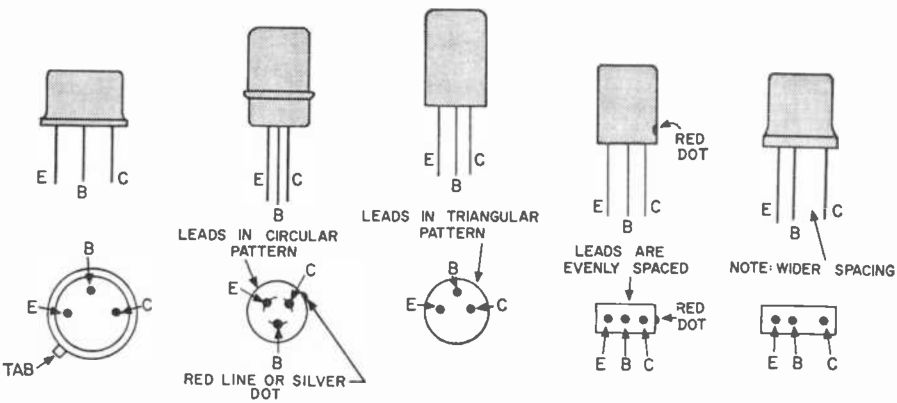
SWITCH DETAIL



Resistor pairs R1-R3 and R2-R4 must be of equal value; use an ohmmeter to check values. Homemade shorting plug is used for adjusting meter to full-scale reading.

PARTS LIST

R1, R2—100,000-ohm, ½-watt carbon resistor, ±5%
R3, R4—27,000-ohm, ½-watt carbon resistor, ±5%
R5—5000-ohm wire-wound potentiometer (Mallory M5MPK or equivalent)
S1, S2—Miniature push-button switch (Lafayette MS-449 or equivalent)
B1, B2—1½-volt penlight cell (Burgess Type "Z" or equivalent)
M1—0-1 ma. milliammeter
1—"U"-shaped wire clip (see text)
1—4" x 3" x 5" metal filing box
1—3" x 5" x ½" wooden baseboard (see text)
Misc.—Five-terminal mounting strip, transistor sockets, wire, screws, etc.



Transistor pin connections vary somewhat with the manufacturer. A colored line or dot rather than additional spacing is sometimes a means of denoting the collector.

sistor sockets is the surest way of preventing accidental shorts when plugging in and unplugging transistors.

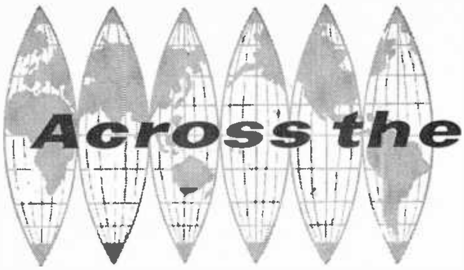
Using the Tester. Adjust the meter to read full scale before using the comparator. To do this, insert the "U"-shaped shorting plug across the emitter and collector terminals on either socket, and adjust *R5*. Once the meter is set, it need be checked only periodically.

Simply insert the transistor under test into the *n-p-n* or *p-n-p* socket, depending on the type of transistor. The meter will indicate the leakage. If it is above 0.125 ma., in all probability it exceeds that recommended by the manufacturer. If you're not certain, check the manufacturer's specification sheets or a transistor manual.

If the transistor has low leakage, press the appropriate push-button switch and note the meter reading. Mentally move the decimal point two places to the right to determine the comparative *beta*. For example, a milliammeter reading of 0.34 is equal to a *beta* of 34, a reading of 0.23 is equal to a *beta* of 23, and so on.

To arrive at a more accurate comparative *beta* reading, subtract the leakage from the final reading. For example, if the leakage is 0.10 and the final reading is 0.45, subtracting the leakage from the final reading and moving the decimal point two places to the right gives a comparative *beta* of 35.

Transistors showing creeping or drift should be questioned, since a good transistor will give the same reading consistently no matter how often the switch is opened or closed. -30-



Across the Ham Bands

By
HERB S. BRIER
W9EGQ

HOW TO PREVENT TROUBLE WITH THE FCC

ONE of ham radio's proudest traditions is its ability to police itself. If one ham violates an amateur regulation, intentionally or not, other hams immediately call the violation to his attention, and the matter is ordinarily settled without official action by the FCC. A perfect example of how this system works occurred only recently.

A Novice friend of mine got up early one Sunday to make a few contacts on 80 meters. He called CQ and raised Rex, W8PCY, Grandville, Mich. Rex gave him an RST599 report.

"You have a very fine signal," said Rex. "The only trouble is that I am listening to you on 7440 kc., the second harmonic of 3720 kc., the frequency you think you are on. You better close down and find out what the trouble is before you get a discrepancy report from the FCC."

Of course, my friend immediately left the air. Later in the day, with the aid of another ham, he discovered that his transmitter was actually tuned to the second harmonic of his crystal frequency. This is easily done with the multi-band output tank circuits incorporated in most low-power ham transmitters, especially when they feed a makeshift antenna.

When Rex's QSL card arrived, it was accompanied by a letter. In it Rex said that he often worked 80-meter Novices with his receiver tuned to their second harmonics and his transmitter on 80 meters. He keeps them out of trouble with the FCC.

Monitoring Harmonics. If other experienced hams would follow W8PCY's example, it would go a long way towards solv-

Ham of the Month

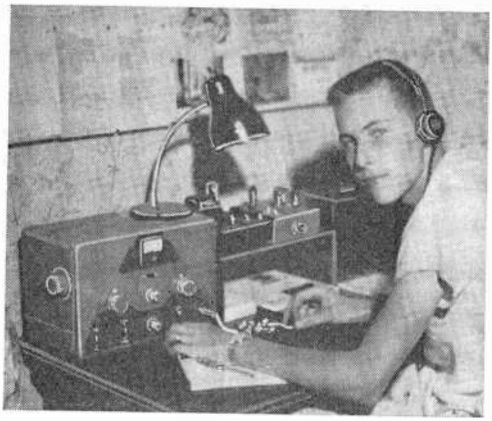
Dr. Henry L. Richter, Jr., W6VZA, is an outstanding ham, scientist, and private citizen. Born in 1927, he obtained his first ham license when he was 16. After service in the Navy, he entered California Technical Institute, earning a B.S. degree in Chemistry in 1952 and a Ph.D. in Chemistry in 1955. He was married in 1947, and he and his wife, Marilyn, have five children.

Dr. Richter joined the Cal Tech Jet Propulsion Laboratories in 1955 and is now chief of its Space Instruments Section. He was active in the development and launching of the "Explorer" series of earth satellites and was instrumental in selecting sites for U. S. space-probe tracking stations abroad. In addition, he was coordinator for U. S. radio participation in the International Geophysical Year satellite tracking program, and a member of the American delegation to the IGY steering committee meeting held in Moscow in 1958.

W6VZA has a six-meter station in his car and a two-meter station in his home. A Johnson "Ranger" transmitter and a rebuilt BC-348 receiver take care of the lower frequencies. He is active in civilian defense work and the San Gabriel Valley Radio Club, a member of both the A.R.R.L. and I.R.E., and an honorary Deputy Sheriff of Los Angeles County.

ing a most difficult Novice problem. The only equipment you need for this kind of monitoring is your transmitter and a receiver capable of tuning the harmonic "shadows" of the 80- and 40-meter ham bands.

Actually, it is frequently easier to hear the harmonics than the fundamental signals. This is due to the longer "skip" and lower interference on the harmonic frequencies. For example, I often hear strong harmonics of east-coast 40-meter hams be-



tween 14,350 and 14,600 kc. when it is difficult to copy their fundamental signals because of the heavy interference from closer stations.

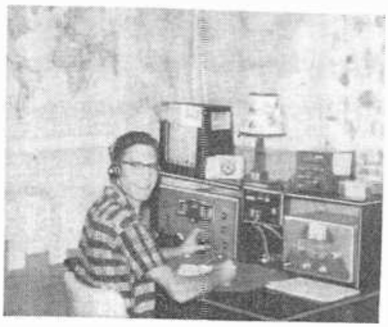
As soon as you tell the average Novice that he is radiating a harmonic, he will install an antenna coupler such as that described on page 133 of December, 1959, POPULAR ELECTRONICS, and a harmonic filter as described on page 93 last month. And don't be too smug about Novice harmonics. A little listening between 7500 and 8000 kc. (the harmonic "shadow" of the 80-meter band) will quickly convince you that General Class hams have their harmonic problems too.

Honest Reports. Less serious than out-of-band radiation, but more annoying to other hams, are the substandard signals put out by a small percentage of all operators. On c.w., such signals are rough and unsteady, chirpy and full of clicks. On phone, they spatter and they drift. They have hum and frequency modulation. Phone or c.w., they occupy more than their fair share of our crowded bands. Consequently, they cause unnecessary interference to the majority of hams, who take pride in emitting clean, sharp signals.

Did you ever stop to think that you may be partly responsible for keeping such signals on the air? How? By following the common practice of giving better reports than their signals deserve to the stations you work.

When was the last time you gave anyone less than T9 on c.w.? Didn't you give a T8 report to that DX station with a signal like a rhinoceros with the colic, for fear he wouldn't send you a QSL card if you gave him an honest tone report? His own mother wouldn't have given him better than T2. And do you add "C" for chirp or "K" for clicks after your RST reports when warranted? On phone, do you give reports like, "Your signals are 30 db over nine," and ig-

Two young Novices, Richard Foster, KN9SBV, of Oxford, Ind. (left), and Dudley Cahn, KN8QEX, Kalamazoo, Mich. (below), both use Heath transmitters. Richard keys a DX-20, and Dudley a DX-40.



nore excessive broadness, hum, distortion, or other signal defects?

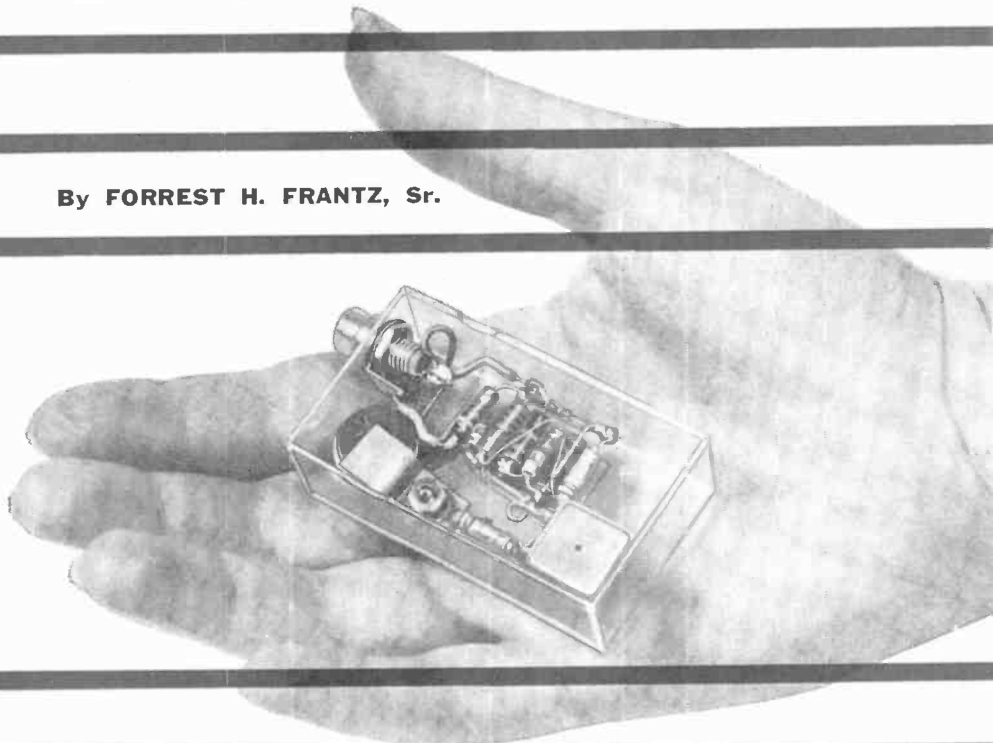
How can you blame a ham with a poor signal for believing that his signal is perfectly okay when the great majority of his reports confirm it? Do you believe the reports you receive? Admittedly, you may feel a little mean when you give an unflattering report to a ham whose signal leaves something to be desired, but what is the value of a dishonest report?

Role of the FCC. Don't get the idea that I recommend cruising up and down the ham bands like a policeman on a motorcycle looking for things to complain about in other hams' signals. Leave that to the ARRL "Official Observers" and to the FCC

(*Continued on page* 108)

LET'S BUILD the "TINY MITE"

By FORREST H. FRANTZ, Sr.



Footsteps on a carpet come through loud and clear

with a peewee amplifier no bigger than a postage stamp

WANT an amplifier that's smaller than a postage stamp? Here are construction details for the "Tiny Mite," one of the tiniest three-transistor amplifiers you'll be able to build for some time to come. The reason? Parts are getting smaller all the time, but those available to experimenters at reasonable prices won't get much smaller than the parts in this amplifier.

The "Tiny Mite" is so compact that it has considerable novelty value. For one thing, you can use it to show your friends just what miniaturization in electronic components really means. You'll also find it handy for surveillance and "eavesdropping" purposes, since it's easy to conceal. An earphone extension cord is all you'll need to listen to conversations at remote locations.

All in all, the "fun" possibilities of this unusually small amplifier are extremely large! Time and money expenditures are pretty much in line with the size of the unit—you can wire the entire amplifier in less than two hours, using parts that should cost you less than $10. For operation, you'll need a microphone and an earphone, but these are components you may already have on hand.

Construction. One of the secrets of the amplifier's size is the construction technique employed. Parts are cemented to a thin plastic strip, then connected to one another by their pigtail leads.

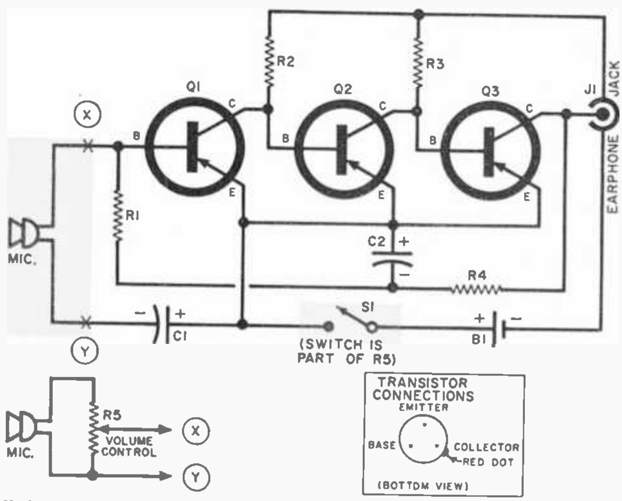
Mount and wire all components as shown in the pictorial diagram, leaving room for have to be unsoldered later when the amplifier is installed in its box. Use clip leads to connect a 50,000-ohm potentiometer into the circuit as *R4*. Adjust the potentiometer for best tone with reasonable volume, then disconnect it and measure its resistance on an ohmmeter. Cement and connect the nearest value fixed carbon resistor into the circuit as *R4*.

If you want to include a volume control, the Lafayette VC-43 or another 10,000-ohm

PARTS LIST

B1—1½-volt battery (RCA VS074 penlight cell, Mallory RM-625RT hearing-aid cell, or equivalent)
C1, C2—1.0-µf., 6-volt ultraminiature electrolytic capacitor (Lafayette P6-1 or equivalent)
J1—Earphone jack
Q1, Q2, Q3—2N207 transistor (Philco)*
R1—5600-ohm resistor
R2—3300-ohm resistor
R3—2700-ohm resistor
R4—10,000- to 50,000-ohm selected resistor (see text)
R5—10,000-ohm potentiometer with switch S1 (Lafayette VC-43 or equivalent—see text)
S1—S.p.s.t. switch (on R5)
Mic.—½" x ½" miniature magnetic microphone (Shure MC-30 or equivalent)
1—Magnetic earphone, 1000-2000 ohms impedance (Lafayette MS 368, or equivalent)
1—Plastic box (see text)

** A low-noise type 2N207B can be substituted for Q1 if desired*



"Tiny Mite" utilizes three transistors in a direct-coupled circuit. Battery can connect directly to Q1's emitter if switch is not used.

resistor *R4* so that it can be mounted later. Keep all leads as short as possible. Be sure to use a heat sink when soldering transistor leads; gripping each lead with a pair of long-nose pliers will prevent soldering-iron heat from damaging the transistor. You'll need a tiny soldering iron for this tiny unit —a soldering pencil is ideal if you happen to have one handy.

The value of *R4* should be determined experimentally; it will probably fall between 10,000 and 50,000 ohms. To find the best value, connect the microphone, capacitor *C1*, earphone and battery *B1* to the amplifier as shown in the pictorial. A temporary soldering job will do, since these parts will potentiometer can be used. The compact VC-43 incorporates a switch that will serve to control battery power; refer to the schematic diagram for circuit details.

The amplifier circuit is now ready for mounting in a small box. In the model, a Walsco plastic hardware box was used—such boxes, full of hardware, are available from local parts distributors for about 33 cents each.

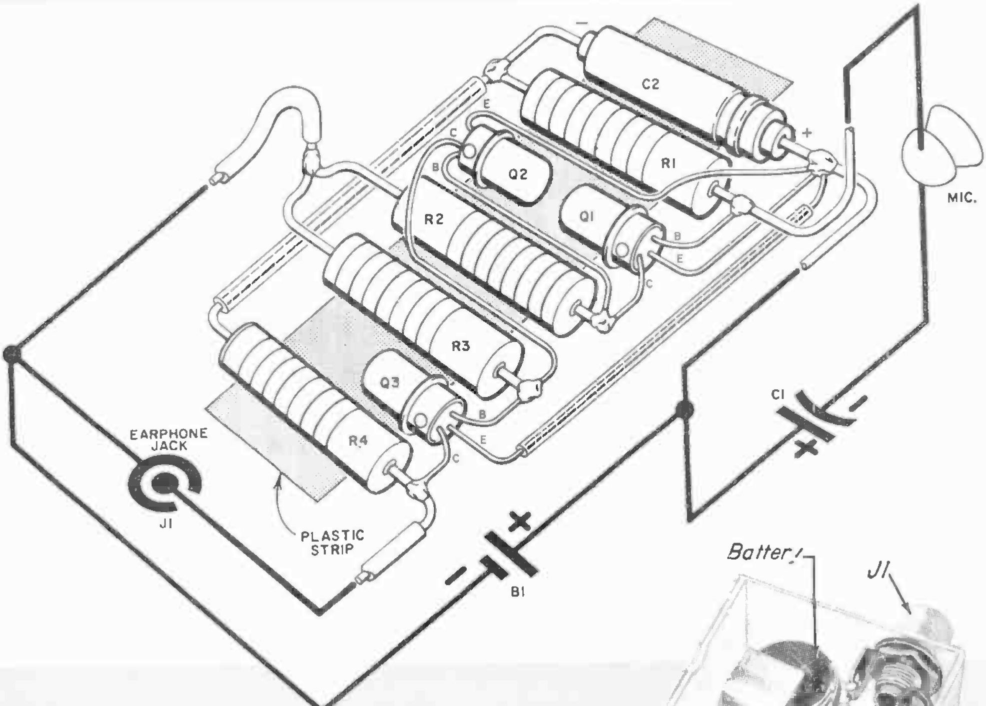
Drill a hole in the box to mount the earphone plug. Mount the amplifier circuit, earphone plug, battery, microphone, and capacitor *C1* in the box, using cement to hold loose parts in place. Wire all parts together and solder. Now slide the box cover in place and scratch an outline of the microphone on the cover. Remove the cover, cut out the scratched section, then slide the cover back in place.

Operation. Plugging in the earphone connects the power supply and energizes the circuit. Current drain on this miniature unit is extremely low: the model draws less than 2.0 ma. Either a 1.5-volt penlight cell or a miniature hearing-aid cell such as the Mallory RM-625RT will power the amplifier

HOW IT WORKS

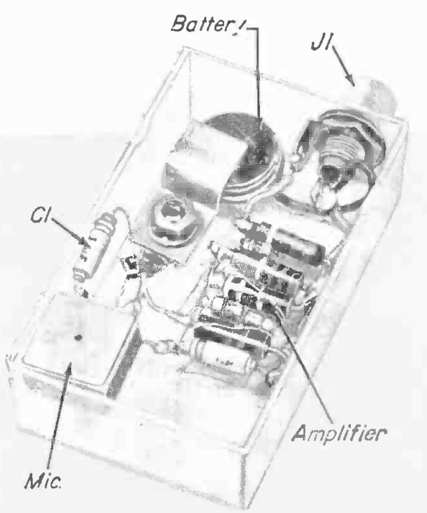
Three 2N207 transistors are employed in an amplifier circuit that is direct-coupled to eliminate capacitors and/or transformers between transistors. Direct coupling permits use of lower operating voltages, with a resulting reduction in the input-stage noise figure.

Resistors *R1* and *R4* furnish base bias for transistor *Q1*. Resistor *R4* is connected to the collector of output transistor *Q3* to provide d.c. feedback to *Q1* and thus insure good temperature stability for all three transistors. Resistor *R2* serves as collector load for *Q1* and base bias resistor for *Q2*; *R3* performs the same functions for *Q2* and *Q3*. Capacitor *C1* isolates the d.c. base bias for *Q1* from the microphone circuit; *C2* bypasses audio that would otherwise be fed from *Q3* to *Q1*.

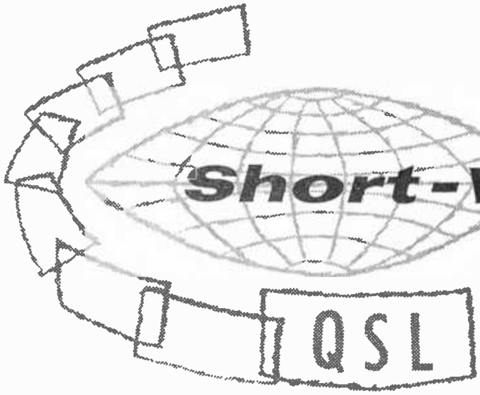


nicely. The penlight cell will furnish power continuously for several weeks, the physically smaller hearing-aid cell for five days or more.

While this is one of the smallest amplifiers ever, it's also a "Tiny Mite" of the first order. In fact, the gain of the unit is so great that you'll be able to hear someone walking on a rug. If you're looking for a practical application, you might try using it as a hearing aid. But bear in mind that it isn't compensated for individual hearing characteristics—hearing-aid sales agencies usually sell standard amplifiers but choose earphones with characteristics to meet individual needs. —30—



Amplifier, microphone, battery, and earphone jack are mounted in a plastic hardware box. Miniaturization can be carried still further through the use of ultraminiature resistors.



Short-Wave Report

By **HANK BENNETT**
W2PNA/WPE2FT

QSL BUREAUS

WHEN listening on the amateur frequencies, especially the higher bands where DX is prevalent, you will often hear a stateside station tell a foreign amateur to "QSL via ARRL." Likewise, you may hear an amateur from the United Kingdom request that his card be sent through the "RSGB." What are the ARRL and the RSGB? And why should cards be sent through those channels rather than to home addresses?

The ARRL is the American Radio Relay League and the RSGB is the Radio Society of Great Britain. These two organizations are the largest clubs devoted basically to the amateur operator. They sponsor their own "QSL Bureaus" whereby incoming QSL cards can be received through a central receiving point. For example, there is one ARRL QSL Bureau for each call area.

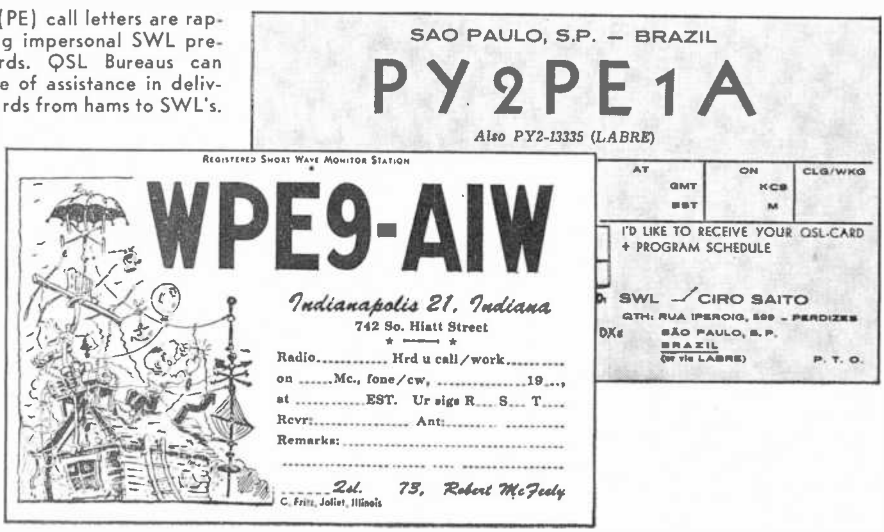
Imagine a ham trying to give his home address on the air to another operator in Afghanistan, New Zealand, or Peru. Errors would probably result. Instead, he simply asks that his card be sent "via ARRL," and the operator on the foreign end has merely to check his Call Book for the address of the proper QSL Bureau.

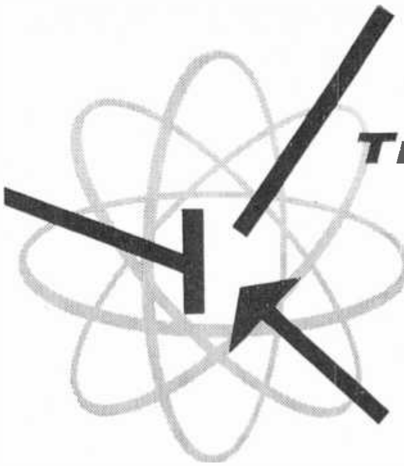
Hams and SWL's send a supply of No. 10 stamped, self-addressed envelopes to the QSL Bureau in their particular call area. When cards come in for them, they are usually filed in one of these envelopes until a certain number of cards are received; then the envelope is forwarded. Few cards are lost in the mails when they are channeled through the QSL Bureaus.

Unfortunately, large-scale QSL Bureaus exclusively for SWL's who want to receive cards from hams do not exist. Usually, a ham will send in a batch of QSL cards to an ARRL QSL Bureau destined for SWL's

(*Continued on page* 117)

Individual (PE) call letters are rapidly replacing impersonal SWL prefixes on cards. QSL Bureaus can sometimes be of assistance in delivering QSL cards from hams to SWL's.





Transistor Topics

By LOU GARNER

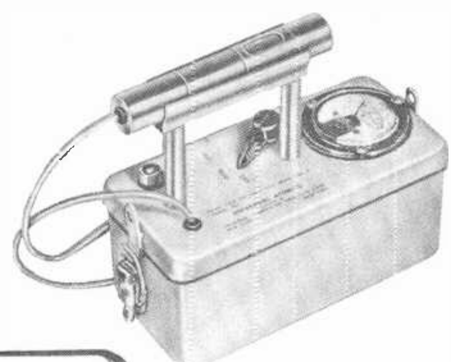
IN a test instrument intended for field or portable applications, the primary advantages of transistorized over tube circuitry are ruggedness, lower weight, and almost minute power requirements. Less obvious, but no less important, are the transistor's other characteristics: smaller physical size, lack of an extended "warm-up" time, and the fact that it develops a negligible amount of internal heat.

This last item is particularly important in test instruments, for excessive heat can lead to a gradual deterioration of capacitors and other components, and it can cause changes in calibration as well. When you use vacuum-tube-operated equipment, for example, it is customary to allow several minutes "warm-up" to permit temperatures and circuit performance to stabilize.

These advantages have resulted in a growing trend towards transistorized test instruments. In some cases, manufacturers have simply "transistorized" older models In others, the transistor has made possible the development of completely new types of test gear.

A few years back, transistorized circuits were adopted by the smaller and newer test instrument manufacturers. Recently, the Cubic Corporation of San Diego, Calif., which started operations in 1951, introduced an extended line of transistorized instruments, some intended for bench as well as field use. Included in this line are pulse generators, waveform generators, and curve tracers. Another relatively new firm, Universal Transistor Products Corporation, New York, N. Y., has specialized in developing instruments for atomic work, such as transistorized Geiger counters, dosimeters, and so on.

Today, more and more "old-line" firms are introducing transistorized test instruments, including such respected names as Hewlett-Packard, General Radio, and Boonton Radio. DuMont is producing a tran-



Test instruments are becoming more and more transistorized. Cubic Corporation's pulse generator and Universal Transistor Products' Geiger counter (top photo) are examples of this trend.

sistorized r.f. frequency meter. The Narda Microwave Corporation produces a transistorized VSWR amplifier-meter. Tektronix has developed a fully transistorized (except for the CRT) cathode-ray oscilloscope. And Motorola has announced a fully transistorized a.c. voltmeter.

Nor is this trend towards transistorized circuitry confined solely to U. S. manufacturers. Firms in Japan, England, Germany, France, and Switzerland are discovering the advantages of transistorized designs. One of the recent developments overseas is a six-transistor colorimeter by Pyror S. A. of Switzerland. If the trend continues, the day may come when most test instruments are transistorized. And that day may be sooner than we think!

Readers' Circuits. The overwhelming majority of small transistorized receiver circuits specify magnetic earphones. Not so the circuit submitted by reader Tom Rehm, KN9PIQ, 2947 N. Farwell Ave., Milwaukee 11, Wis. His circuit (Fig. 1) permits the use of one of the low-cost crystal earsets now offered by major parts distributors.

Referring to the schematic, *L1* is a Superex Type VL Vari-Loopstick and *C1* a 365-μμf. tuning capacitor. Diode *D1* is a type 1N65; *Q1* and *Q2* are G.E. Type 2N107 transistors. Either paper or ceramic capacitors can be used for *C2* and *C3;* values from 0.02 to 0.1 μf. at a working voltage of 25 volts or higher should be suitable. Resistors *R1* and *R2* are 10,000-ohm, ½-watt units. Operating power is furnished by a pair of penlight cells, *B1* and *B2,* controlled by a s.p.s.t. toggle or slide switch, *S1.*

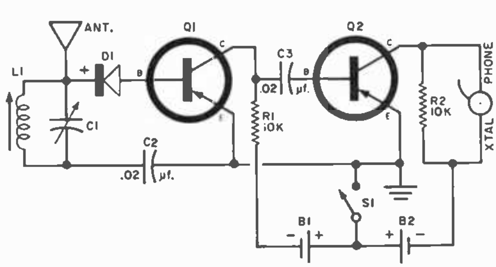


Fig. 1. Transistorized receiver circuit submitted by reader Tom Rehm utilizes inexpensive crystal earphone.

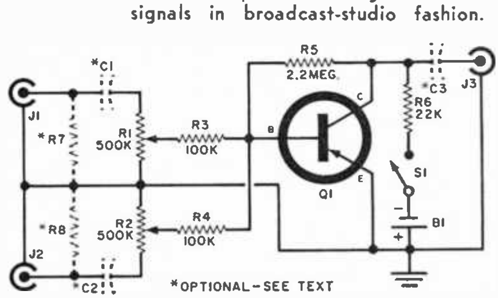
In operation, r.f. signals picked up by the antenna (*Ant.*) are selected by tuned circuit *L1-C1* and detected by diode *D1.* The resulting audio signal is coupled to a two-stage resistance-coupled amplifier, *Q1-Q2,* using *p-n-p* transistors in the common-emitter arrangement. Resistor *R1* serves as *Q1*'s collector load, while *R2* in parallel with the high-impedance crystal earset acts as *Q2*'s output load. Capacitor *C2* serves as a bypass, while *C3* provides interstage coupling. Separate batteries are provided for each stage to minimize coupling through the power supply.

Note that Tom operates his transistors *without* externally applied base bias, relying on their small internal leakage currents to establish optimum operation.

Build the set on either a Bakelite board or a conventional chassis. Mount the chassis in a plastic or wooden case. After assembly, adjust *L1*'s core for 1600-kc. signals with *C1* set at minimum capacity. You may find it worthwhile to experiment with higher supply voltages in some cases—try a 3.0-volt (two penlight cells in series) or a 6.0-volt supply. Tom suggests a 32" whip antenna for reception of strong local stations.

The circuit in Fig. 2 should be of interest to audiophiles and recording enthusiasts. Submitted by Darrel Newell (Beltrami, Minn.), the unit is a transistorized *audio mixer.* He suggests its use for mixing signals from a phonograph and a microphone to simulate broadcast studio operation.

Fig. 2. Audio mixer designed by Darrel Newell permits mixing two audio signals in broadcast-studio fashion.



Jacks *J1, J2,* and *J3* should be chosen to match your other audio gear. Potentiometers *R1* and *R2* are 500,000-ohm carbon units, *R5* a 2.2-megohm resistor, and *R6* a 22,000-ohm resistor; all fixed resistors are ½-watt size. Transistor *Q1* is a Raytheon Type CK722. Operating power is supplied by a 1.5-volt size "D" flashlight cell, controlled by s.p.s.t. toggle or slide switch *S1.*

In operation, *Q1* serves as a single-stage common-emitter amplifier. Input signals are applied through *J1* and *J2,* appearing

(*Continued on page* 100)

Pay TV's First Battle

Pat Boone appears on Canadian pay TV in "Journey to the Center of the Earth." A whole family of six watches for the price of one.

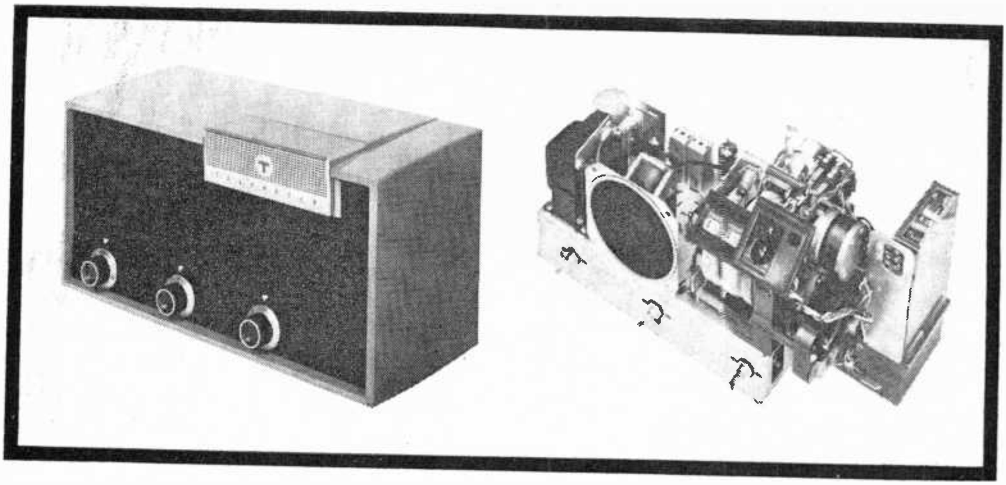
A wired pay-TV system is already in operation in Canada. Since no FCC approval is required, installations will be made in the USA this year

By JOHN D. LENK

THE FIRST major battle of "Pay" vs. "Free" TV started at 7 p.m., Friday, February 26, 1960. Coins began dropping into boxes attached to TV sets in Toronto's suburban community of Etobicoke. Subscription television for Canada was on the road.

Contrary to popular opinion, the Canadians were not paying for something they could previously have had free. For one dollar, subscribers could use their TV sets to watch one of two motion pictures currently being shown in Toronto's neighborhood theaters: 20th Century-Fox's "Journey to the Center of the Earth" and Warner's "The Nun's Story." These films—which will probably not appear on free TV for at least 10 years—were repeated on following days at the same charge. Alternately, a subscriber could pay a dollar for a live telecast of a hockey game between the Toronto "Maple Leafs" and the New York "Rangers" from Madison Square Garden in New York.

Three Channels Added. Three different programs are simultaneously delivered to the TV receiver by means of a compact attachment mounted on or near the set. The subscriber has his choice of which



External and internal views of the Telemeter attachment. It connects to the antenna terminals of a TV set.

program—if any—he wishes to see. The system does not require the approval of governmental broadcasting agencies because the programs are transmitted by wire and thus do not take up valuable frequency space.

After the subscriber pays an initial five-dollar installation charge, it's strictly a pay-as-you-see proposition. There is no monthly service charge or "minimum." Prices for programs vary from "free" to $2.00. Shown during the first month of operation were such films as "North by Northwest," "Room at the Top," "Gigi," and "Cash McCall."

Being wired for the toll system is a residential area which includes 13,000 homes. As of March 1, some 1000 hookups had been completed, and another 3000 subscribers were waiting for the installation crews. By July, a total of 5000 subscribers is expected to be watching first-run movies, sports events, and stage plays in the comfort of their living rooms.

Viewer's Choice. When the subscriber turns on his set, he hears a recording announce the programs being offered and the prices of each. A price window on the attachment also indicates the charge for each program. Assume that Channel A is offering a current motion picture, Channel B is featuring a live stage play, and Channel C has a sporting event. If the subscriber elects to watch the sports event, he tunes the program selector on the attachment to Channel C. When he does this, the price of the program immediately appears in the price window.

After coins are inserted in the coin slot, the attachment feeds the program into the set on an unused channel (because Channels 5 and 6 are not allocated in the same community, one of these channels is always open). Upon receipt of the coins, a magnetic tape recorder in the attachment makes a record of the "transaction." The tape is collected every month or two along with the cash.

Lack of correct change is no problem. The subscriber simply puts in more money than is indicated on the price window. He can then apply the overpayment to a future program. Or, if desired, a refund will be made at collection time.

Should the subscriber decide that nothing is worth paying for that particular night, he simply turns a knob, restoring his normal TV service—without charge, of course. Incidentally, throughout the day, subscribers receive a free bonus in the form of virtually continuous hi-fi background music.

Initial reactions of subscribers to the toll system were enthusiastic. Especially praised was the picture quality of the televised movies. The direct-wire system eliminates any picture defects caused by poor reception—"snow," "ghosts," etc. In addition, because the motion pictures are televised from 35-mm. prints, the larger film size—in comparison with the 16-mm. movie prints now standard on commercial

TV—results in better detail, improved tonal gradation, and generally superior image quality.

Backed by Paramount. Trans-Canada Telemeter, a company backed by Paramount Pictures, is running the Canadian operation. Paramount has invested over ten million dollars in a parent organization, International Telemeter, since 1951 and has more than one million tied up in the Toronto installation. As far as the companies involved are concerned, the installation is not an experiment; it is for keeps.

The basic philosophy behind the Toronto project is to recapture lost movie audiences and to develop new ones. There is considerable evidence that many people do not go to the movies because it is too much trouble; hiring a baby sitter, driving to the theater, parking the car, driving home—all are factors that tend to reduce the movie audience. Telemeter figures that if the people won't go to the movies, it will take the movies to them.

The economics of the operation are rather interesting. The per-home cost of an installation runs Telemeter about $100. Studies that compare this expense with the per-seat cost of a movie theater indicate that a pay-TV installation is far cheaper. The annual income from a pay-TV installation is also calculated to be more than that from a single theater seat.

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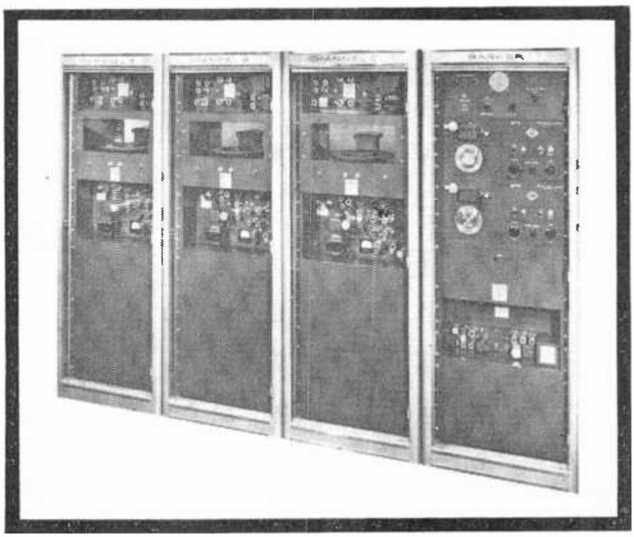
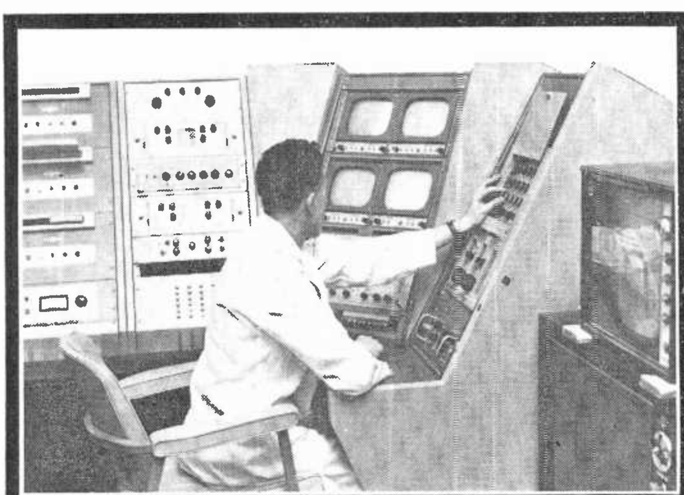
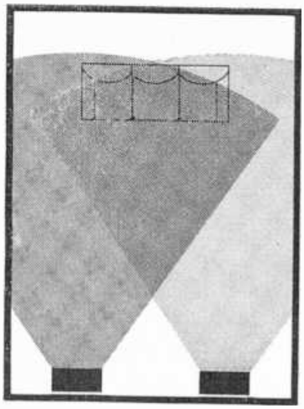


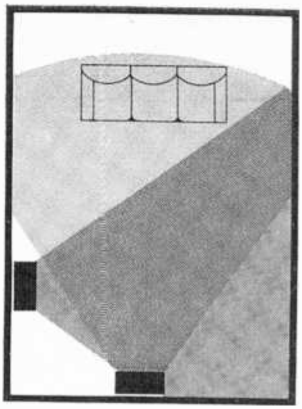
Transmitter racks for the wired pay-TV system. Each of three channels (A, B, and C) carries not only a program, but also the price information and code numbers to identify the program. The fourth ("Barker") transmitter carries a recorded message which announces up-coming programs.

Custom-built control console for the toll-TV operation in West Toronto. The operator can monitor all three channels at once.





Putting the speakers along one of the shorter walls of the listening room is a common and usually successful arrangement.



"Listening corner" placement cannot be recommended because stereo's directionality and overall perspective are lost.

How to place

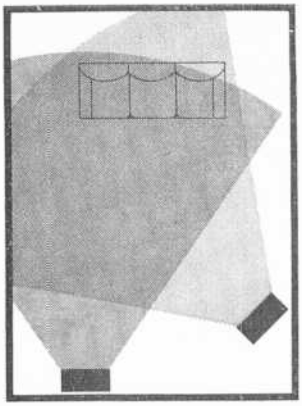
Many stereo systems don't sound right simply because the speakers are placed incorrectly. Here's how to set up your stereo speakers for full effectiveness

WHEN stereo is at its best, it can break down the invisible barrier between the listener and the performer, bringing the Modern Jazz Quartet or the New York Philharmonic into your living room. But despite the tremendous improvement of stereo records and tapes, many stereo systems fall far short of their sonic potentialities.

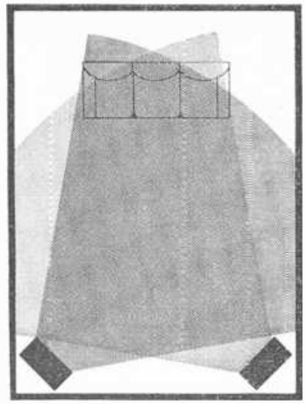
For example, a friend of mine recently invited me over to hear his spanking-new stereo system. One of the speakers was located near the floor in the living room; the other was about twenty feet away, on top of a cabinet in the dining room. Although the equipment was some of the finest available, a good table-model radio would have sounded better. With the speakers located as they were, the system was capable of producing neither good stereo nor good sound of any kind.

Perhaps the most important reason for the disappointing performance of some stereo systems is that their owners seem to have no firm idea of how stereo *should* sound. As long as a cymbal clash comes from one side of a room and the blare of a trumpet from the other, many listeners assume that the full potential of stereo is being delivered. If you are one of those who think directionality is the key to stereo's realism, go to a concert and hear what "real" music sounds like. The purpose of stereo is to duplicate—not exaggerate—an original unity of sound.

Although the ultimate enjoyment of stereo depends on the listener's knowledge of how it should sound (so he can adjust the various controls accordingly), the basic techniques for achieving good stereo sound are not complicated. By paying attention to a few simple rules for the care, feeding,



Placing one speaker near and one far can provide good coverage, but arrival-time differences garble acoustic phasing.



Corner placement provides fair coverage and good bass, but it can create standing waves and excessive channel separation.

Stereo Speakers

By JOHN MILDER

and placement of stereo speakers, you can figuratively invite a jazz combo or symphony orchestra into your living room.

Phasing Problems. The "care and feeding" of stereo speakers involves getting and keeping them in phase with each other. When speakers are correctly phased, the resulting sound seems to come from the space between them, rather than from one or the other. Out-of-phase systems produce sound with a rough or uncertain quality—and an exaggerated directionality that has no relation to the sonic characteristics of a live performance. In addition, out-of-phase stereo usually seems to jump back and forth at random between the two speaker systems.

Putting two speakers in phase initially is usually an easy job—a matter of connecting both pairs of speaker leads so that the cones of both speakers will move back and forth in unison. Many speaker systems have coded terminals that facilitate proper phasing, and others can be put in phase by means of a short listening test with a monophonic source—the sound should seem to originate between the two speakers. A special test record devised by *Electronics World* provides an easy way to check speaker phasing.

After the speakers are initially phased, it's necessary to keep them in phase. This is not as obvious as it may seem. In the long chain of events between the recording session and the playback in your living room, there are many chances for the two stereo channels to move out of phase with each other. Most amplifier manufacturers provide a phasing switch to cope with this possibility. If your amplifier doesn't have a phasing switch, you can install a double-pole, double-throw switch on one speaker to reverse the connection of the wires. In any case, it's always a good idea to try flipping the phasing switch when things don't seem to sound right.

Reversed Channels. In addition to problems of phase reversal, it's also possible for the two stereo channels to become reversed. This makes the right-channel material come out of the left speaker and vice versa. Although this situation isn't as common as phase-reversal, manufacturers of stereo amplifiers supply a channel-reverse switch to take care of it.

Listening to either reversed-channel or out-of-phase stereo material can be a strange experience, but a combination of both can produce a really zany sound. Musical instruments seem to jump back and forth between speakers, and strange reverberations fill your living room. While the overall sound is definitely unlike anything you've ever heard on a monophonic system, don't mistake it for true stereo. On first listening, you might actually like this spectacularly strange kind of sound. After a few hours, however, you'll be much happier if you straighten out the stereo with the phase- and channel-reversal switches.

Speaker Placement. Deciding where to place the stereo speakers for maximum effectiveness is complicated because the recording industry has not standardized stereo recording techniques, particularly with regard to microphone placement. The engineer's understandable willingness to experiment with microphone placement should prompt you to experiment with speaker placement. In practice, this does not mean that you should put your speakers on hand trucks and shift them around the living room to accommodate different kinds of recording, but it does indicate that installing stereo speakers permanently—particularly in walls—is not a good idea because a decision on recording standards could obsolete a custom installation.

Home furnishings magazines give some of the poorest advice for placing stereo speakers. One of the best-known publications suggested the above arrangement. Only the person who sat precisely in the center of the couch would hear stereo.

Experimenting for a few hours with speaker placement will pay big dividends in listening pleasure. Probably within the first few minutes, you will discover that really significant changes in sound quality can result from moving one speaker even a few inches. In the case of "bookshelf" speaker systems, a change from horizontal to vertical positioning will usually produce a very audible difference, and moving the speaker from a bookshelf or mantelpiece to an on-the-floor location will often provide a startling change.

(*Continued on page* 106)

POPULAR ELECTRONICS

AFTER CLASS feature

The Language of VECTORS

Ken and Larry conclude their discussion on vectors this month and uncover more information about the language that engineers use

Part 2

By SAUNDER HARRIS

KEN was deep in the innards of a transmitter when Larry entered his attic ham shack. He put down his still-smoking soldering gun and greeted his friend.

"Hi, Larry. What brings you to the inner sanctum this Saturday morn?"

"My! For an electronic genius you're pretty forgetful," Larry replied with a grin. "Remember our last discussion on vectors? I'm back to have a go at them again . . . by invitation, of course."

Ken laughed. "I do remember the invitation, believe it or not, and I'm chock full of vectors just waiting for you. Pull up a chair while I untangle this mess of wires. Where were we when the last session ended?"

"Well, you had finally gotten it through my thick skull that vectors were lines that had direction and length, and that both their direction and length meant something electrically. In the cases we discussed, the direction of the vector indicated the phase angle of the voltage or current; the length of the vector showed the strength of the voltage or current. Then we drew some curves that showed leading and lagging currents and also the vector diagrams for each curve." Larry stopped for breath.

"I don't mind telling you, Ken," he went on, "that it was a darned sight more interesting than I thought it would be. As a matter of fact, I think I learned a lot in our last session. Now I'm anxious to see how you apply all this vector stuff to actual circuits."

"I'm glad you're interested in the serious study of electronics, Larry. That's the only way you're going to keep up with all the new theories being worked out by engineers."

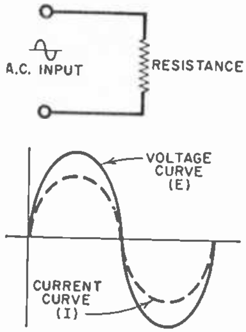
"TODAY, for a start," Ken said, "we'll look at the way circuit elements affect the voltage and current relationships in an electronic circuit. Then we'll express what we learn in terms of vectors. Can you, by chance, rattle off the elements of a circuit in your gay, inimitable manner?"

Larry hesitated for a moment. "When you say circuit elements, do you mean things like coils, capacitors, and resistors?" he asked.

"That's the answer . . . almost," Ken replied. "The electrical elements in any circuit are resistance, inductance, and capacitance. They are put into the circuit by means of resistors, coils, and capacitors."

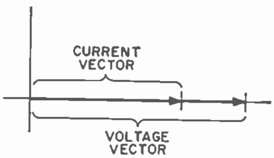
"At least I was close," said Larry.

"Well, let's get down to work with vectors, then. First we'll see what happens to the voltage and current curves of a circuit consisting of a resistance only, plus an a.c. power source." Ken took a pencil and some paper from the work table and made a rapid sketch.



Larry had watched Ken closely as he drew. Finally he blurted out, "I get it, Ken. When there's a pure resistance in the circuit, the voltage and current rise and fall together and there's no phase angle between them. That's why you said a while ago that circuit elements were important. How about letting me draw the vector diagram for this set of curves?"

He took the paper and pencil from Ken and in a moment the diagram was drawn. He passed the sketch back across the table. "How's that, professor?" he asked.



"Swell, Larry. Now, are you sure you understand why you drew the two vectors on one line? Are they really one vector or two?"

"Hey, now, Ken! Don't ask embarrassing questions. But I can answer the first one . . . I think. The two vectors are drawn on the same line because there's no phase angle between them. And they're two separate vectors, all right. I think one is longer than the other because you showed the voltage curve to be higher than the current curve on your drawing . . ."

"Actually, you do understand, Larry," Ken said. "But you're not sure of yourself. While the two vectors you drew—one for the current and one for the voltage—look like one line, in reality they are two lines, one lying on top of the other. It's like the hands of a clock at noon. The two hands seem to be one at first glance, with the minute hand extending beyond the hour hand."

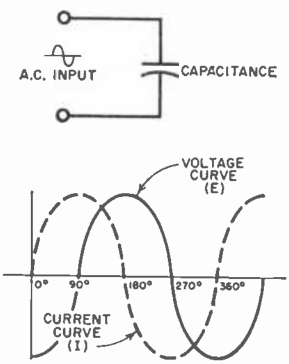
Larry got the point, so Ken went on.

"With regard to the length of each vector, you are the one who sets up the scale for that. It becomes nothing more than a matter of convenience—your drawing has to be easy to work with and not too large or too small. For example, if you're dealing with voltages on the order of 100 volts, it would be murder to let an inch equal a volt. But if you let one inch equal 50 volts, a 100-volt vector would be two inches long and your vector diagram would be in reasonable scale."

Larry nodded. "The way you explain it, Ken, I can set up two scales, one for amperes and one for volts. They don't really have anything to do with each other. Right?"

"You're on the beam, Larry," Ken said. "Now let's look into another case where there is pure capacitance in the circuit."

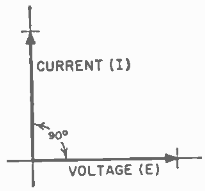
KEN made another drawing and said, "Here's the circuit and the curves involved. Let's see what you can do about translating this into a vector diagram."



This time Larry was a little slower on the uptake. He studied the curves Ken had drawn and scratched his head in puzzlement.

"What's the matter, friend—stuck?" Ken asked. "Here, let me give you a little hint. Study the two curves and figure out which one started first—that's the one that's leading. Then show them that way on your diagram and show the amount of lead in degrees."

"I see it now!" Larry shouted. "This isn't tough at all." He began to draw and talk at the same time. "The curves you drew show that the current starts to flow first. When it reaches the 90° point, the voltage starts to build up. It should look like this in vector form."



"That's 100% correct," said Ken. "You show the current leading the voltage by 90°. That happens in every circuit where there's pure capacitance. See how the use of a vector diagram brings this point out? That's why it's so important to be able to read them, and why they're used so often in engineering texts.

"Let me ask you this question, though, just to see how bright you really are. What's going on in the circuit that causes the voltage to lead the current? See if the diagram can give you any clue."

Larry's jolly look rapidly dissolved into chagrin. "I don't even know what you're talking about, Ken."

"Sure you do, Larry. You're just not thinking along the right lines. Let me ask you this: what sort of a voltage is there across the capacitor before the a.c. input is fed to the circuit?"

"None," Larry promptly replied, perking up a little.

"Right. Now, what's the first thing that happens when the a.c. is applied?"

"Well, I guess the current starts to flow," Larry answered.

"You guess! Current sure does flow. And what is current? Electrons, right? And where do these electrons flow to? And what . . ."

"Whoa there, mighty mentor!" exclaimed Larry. "I've got it. The picture is as clear as a wide-screen vectorscope. The current, or rather the electrons, must flow and pile up on the capacitor plates before a voltage can be built up across the capacitor. That's why the current leads the voltage in this case."

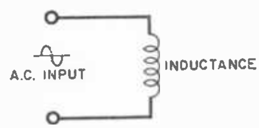
Larry looked proud and continued explaining. "Then, when enough electrons have piled up so that the voltage across the capacitor equals the applied voltage, no more current flows and the current curve drops down to zero."

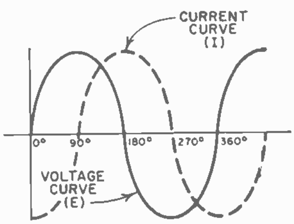
He flipped through the papers to Ken's diagram of the curves for the capacitor circuit. "Here," he said, pointing to the 180° spot on the base line. "This is the point where the capacitor is fully charged to the potential of the applied voltage and the current stops flowing."

"Nice going, Larry," Ken replied. "I think you *have* got it. With the explaining you just did, the next step in vector analysis should be a cinch for you."

ONCE AGAIN Ken took pencil in hand. "This time we'll see what goes on in a circuit that has pure inductance. Then we'll finish up in a blaze of glory with a circuit that combines all three elements."

Ken then drew the curves for the voltage and current flow through a circuit that contained a pure inductance.





"Without getting long-winded about it, Larry, I'll tell you that the inductive circuit acts directly opposite to that of the pure capacitance," Ken said. "The reason for this goes back to the basic laws of magnetism."

"Could you give me a brief explanation?" Larry asked. "Not that I don't know what's what. I just want to see if you do." He ducked as Ken threatened him with a friendly poke.

"Okay, Larry. Here goes. When a current flows through a coil, a magnetic field is built up around the coil. Now, as this current varies—as it has to in an a.c. circuit—the magnetic field also varies and cuts across the coil. When it does this, it introduces a voltage in the circuit that acts to oppose the change in the current. This opposing voltage reaches its maximum value at the same time the current is at a minimum. For this reason it is said to lead the current by 90°. Was the explaining okay, wise guy?"

"Yes, sir, you did very well. I'll see that a good mark is entered for you," snickered

(*Continued on page* 112)

On the Citizens Band

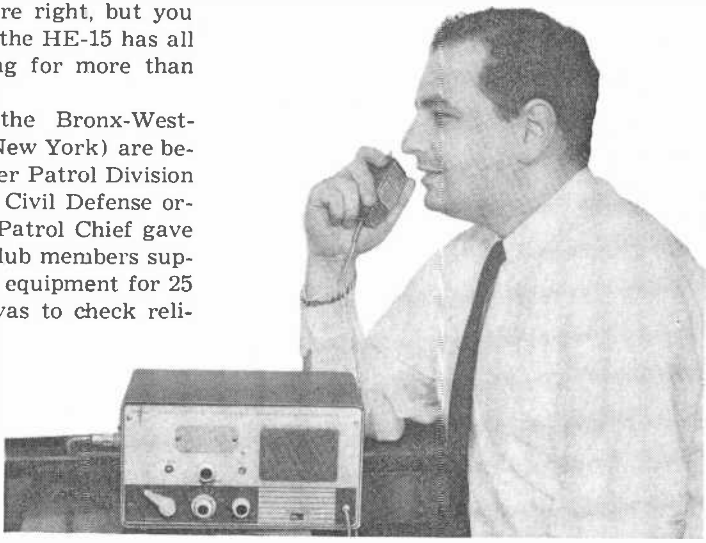
By TOM KNEITEL, 2W1965

ONE of the newest rigs out, the Lafayette HE-15 transceiver shown in the photo below, marks a major breakthrough in the CB price-*vs.*-quality war.

On the "quality" side of the ledger, the HE-15 features a tunable superhet receiver with vernier tuning across all CB channels, an on/off noise limiter switch, r.f. stages in the transmitter and receiver, and five transmit channels. Now, without looking in your Lafayette catalog, take a guess at the price.

If you said $64.50, you're right, but you probably peeked because the HE-15 has all the features of sets going for more than a hundred dollars.

Forty members of the Bronx-Westchester CB Association (New York) are becoming part of the Disaster Patrol Division of the Mt. Vernon, N. Y., Civil Defense organization. The Disaster Patrol Chief gave CB a field test in which club members supplied automobiles and CB equipment for 25 patrol cadets. The idea was to check reliability of CB coverage over wide areas, give the cadets training in reporting to the control, and check the coordination of teams acting under orders from a mobile control center.



Some thirty automobiles with CB rigs will now be made available to the Disaster Patrol as a result of the affiliation with the club. Anybody else hooked up with Civil Defense yet?

If you're thinking about modifying your license, Richie Seidenberg has some interesting news for you. Richie, 2W2933, filed for some additional mobile units and received his license back with the call "2W4887" typed on top. When he asked the FCC about it, they told him that modified licenses receive new calls because it's easier for their records. The old calls are cancelled. Furthermore, Richie was told that when his present 2W4887 license expires in five years a third call will probably replace the second one on his new license.

Several months ago, you may remember, we told you not to assume that any "0.005" crystal would automatically place you "on frequency," because a crystal will only function properly when operating within the circuit for which it was designed. Texas Crystals recently announced that guaranteed-accurate CB crystals can now be delivered for any unit made. Be sure to specify the make and model number of your rig when ordering.

The "Five-Watt Wizards" club, which we discussed in the March column, has had a fantastic number of requests for membership information. Applications have been received from as far away as Hawaii.

As a result of the increasing interest in this club, its members have now decided to solicit membership actively from CB'ers throughout the nation. If *you* want to belong to a national organization for the advancement of CB, drop a card to "The Five-Watt Wizards," 137-27A 68th Drive, Kew Garden Hills 67, N. Y. —30—

By
JOHN T. FRYE
W9EGV

Carl and Jerry

Two Tough Customers

YOU MIGHT HAVE expected to find Carl and Jerry outside on such a wonderful, warm June evening. But they were perched on the workbench of their basement laboratory instead, looking questioningly across at their respective fathers seated side by side on a leather-covered couch.

"No doubt you boys are wondering why we called this conference," Mr. Bishop, Jerry's father, began; "so let me say right off that you can quit looking so serious and guilty. You're not in any trouble—at least none that we've caught you in."

"That's right," Mr. Anderson agreed with a smile. "To end the suspense, boys . . . we've decided it's time you two had a car."

"Yippe-e-e-e!!" Carl shouted as he bounded off the bench and began skipping around the lab. Jerry, who seldom permitted himself to waste any energy, stayed put; but the big grin wreathing his round face showed that he shared his chum's feelings.

"We think you should know how and why we reached this decision," Mr. Bishop continued as Carl settled back on the bench. "Both of us have kept sharp eyes on you as you took drivers' training in school, as you passed your drivers' tests and got your licenses, and as you herded the family buses around these past few weeks. You still have a lot to learn about handling and maintaining a car, but we think you'll learn much faster in a car for which you're solely responsible."

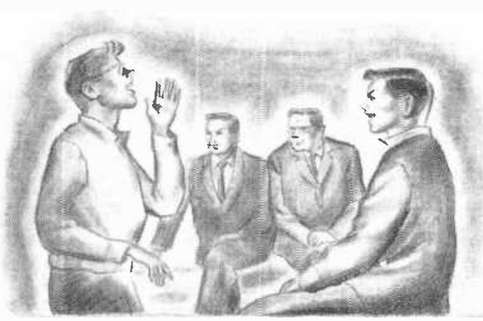
"I might add that your mothers don't agree," Mr. Anderson said with a wry smile; "and you should keep in mind that your old dads have stuck their collective necks way out for you on this one. If you get hurt or hurt anyone else with your car, not only will we be the two sorriest fathers in town, but we're going to hear 'I told you so' for the rest of our lives."

"Along that line," Mr. Bishop went on, "we can't have you buying a worn-out, dangerous junker. But a good, sound used car still costs a sizable chunk of cash. Now that we're preparing to send you two characters through college, neither family has much money to spare—at least not enough to put out the whole cost of a good car."

"That's why we decided to split the expense and buy you two a partnership car," Mr. Anderson chimed in. "We know this arrangement wouldn't work in many cases, but we think you two are an exception. You practically live together, anyway; so we have a hunch you won't mind sharing a car."

"We'd rather!" Carl and Jerry chorused.

"Fine," Mr. Bishop said happily. "Then here's the dope: we looked around quite a



bit and decided a careful shopper can get a good, safe used car for around six hundred dollars. A careless shopper can get an awful stinging for twice that amount. At any rate, we're each putting three hundred dollars into a car-buying fund. You boys are to shop around until you're sure you've found the car you want costing six hundred dollars or less. Then we'll go down and buy it for you. The choice will be solely yours. We're hoping you'll take your time, use good judgment, and get a real bargain; but if you buy a lemon, there'll be no one to blame but yourselves."

FOR A LITTLE WHILE no one spoke. Then Jerry said hoarsely, "Dad, and Mr. Anderson, I want you to know I really appreciate what you're doing. I know you're taking a chance on us, and I'm sure going to try and deserve your confidence."

"Me, too," Carl added; "and maybe we can set your mind at ease on one point. Jer and I have talked it over, and we've decided teen-age drivers fall roughly into three groups. The *Hot-Rodders* are the fellows who try to squeeze every bit of speed and acceleration possible out of a car. They're interested in what we hams would call the automobile's maximum peak power output. A few of them fail to use good judgment about where and when they try out their souped-up 'irons,' and they bring the bad name of reckless drivers to the whole group, which really isn't fair."

"Then there are the *Show-Offs,*" Jerry continued. "These fellows are more concerned with the car's appearance than with its snap or top speed. They are the ones who go in for customizing the body, lowering the silhouette, dual-exhausts, chrome trim, etc. They want their car to be noticed, and sometimes they try to attract attention by childish actions like squealing the tires, using straight pipes, unnecessary blowing of special horns, and so on."

"Finally," Carl concluded, "there are the *Mechs*. These are the boys who pride themselves on keeping their automobiles in tip-top mechanical condition and treating them with respect. Their cars are spic and span, but they put no money into chrome gadgets, dummy radio antennas, or other things that don't contribute to the car's performance. They would as soon kick a dog as abuse their car's mechanism with jack-rabbit starts or tire-screeching stops. They know just as much about what makes a car tick as do the Hot-Rodders, but they're interested in the car's overall, long-time performance instead of its short-burst peak performance. They are just as proud of their cars as are the Show-Offs, but their satisfaction comes from a motor that purrs as smoothly and quietly as a kitten, a body that is tight and free from squeaks and rattles, and a smooth driving technique that wrings the maximum mileage out of every drop of oil or gasoline. Jer and I have decided that, as future engineers, we belong with the Mechs."

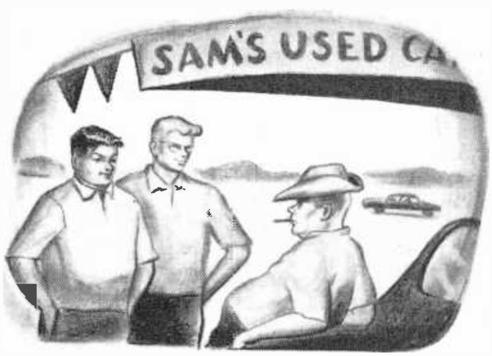
"Well," Mr. Anderson said casually, trying hard not to reveal how pleased he was with what he had just heard, "I know a pair of future Mechs who had better be scampering off to bed so they can get up bright and early tomorrow morning and start car-hunting. Come along, son; let's go home."

LATE AFTERNOON three days later found Carl and Jerry, rather dispirited, standing in front of Sam's Used Car Sales.

"Well, we may as well go in," Carl said. "This is the very last dealer in town."

"I suppose so," Jerry agreed; "but would you have believed it was so hard to buy a car? In the last three days I've been under more cars than a cross-walk, and we haven't found a thing we want at our price."

At this point a short, fat little man wearing a broad-brimmed Stetson hat and puffing at a thin, crooked cigar sauntered out of the office of the car lot. "If you young punks are thinking of trying to sell me



some hub caps you've stolen, you can forget it," he said with a scowl as he flipped the ashes from his cigar with a little finger.

"We don't want to sell you anything, mister," Carl said politely. "We want to buy a car."

"Not from me you don't," the little man asserted. "I've been through that jazz. You want to give me about a bill and a half for a clunker that will run fast enough and hold together just long enough to splash you all over the landscape. Go buy your suicide weapon elsewhere. Plenty of guys will take your money."

"Now, hold on," Jerry said indignantly. "We're not looking for a car to hot-rod. We want a good, sound, safe used car at a reasonable price. We're more interested in how long it will run than in how fast it will go."

Sam cocked his cigar up at a jaunty angle and looked shrewdly at the two boys. "So maybe I went off half-cocked," he said gruffly, "but your pitch is new to me. How much dough you got?" he demanded.

Carl and Jerry exchanged glances. Then Jerry flung caution to the winds and gulped, "Exactly six hundred dollars. Our dads are putting it up."

"How come your folks don't do the shopping?"

"They think if we've got sense enough to drive a car we ought to have sense enough to buy one."

"Hm-m-m, that's an interesting theory most folks prefer to apply in reverse," Sam said with a broad grin that crinkled his eyes almost closed. "Come along and I'll show you something."

The boys followed the waddling little man until he stopped in front of a very clean-looking 1954 model four-door sedan of a popular make. "Now, there," Sam said proudly, "is a real cream-puff if I ever saw one. The guy who owned it had one of those little foreign cars that took almost all the short-trip driving. At least three-fourths of the miles on that speedometer were put on during vacations and other long trips. The rest of the time that car sat in the garage. I've been holding it for my wife's kid brother, but when he found out that the six-cylinder motor only develops 115 horsepower, he lost interest. That bird-brain thinks anything under a couple of hundred horsepower is only for running tinker-toys."

Carl and Jerry had been eagerly going over the car while Sam was talking. He watched them examine the brake and clutch pedals of the straight-stick job for wear. He saw them look at the mileage and date on the door-edge lube sticker and compare this with the 32,000 odd miles on the speedometer. With difficulty he concealed a grin as they solemnly ran all the door windows up and down, opened and closed all four doors, and examined the paint on the door edges for evidence of a repaint job. Then they methodically checked the tread on all four tires and carefully examined the frame for any signs that it had been heated and straightened after an accident. Finally they raised the hood and took out the dipstick. The oil was clean and of a viscosity that checked with the #20 shown on the lube sticker.

"Don't you want to hear it run?" Sam asked curiously. "That's the first thing a teen-ager usually does: start the motor and wind it up before the oil has a chance to circulate. We call this 'tightening the bearings'."

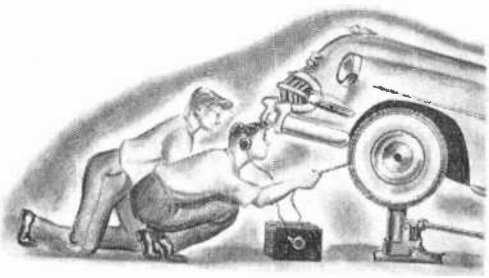
Sam wedged himself under the wheel and started the motor. The starter turned slowly, but once started the motor hummed smoothly.

"What's that little clicking sound?" Carl asked.

"Tappets of the overhead valves," Sam explained as he shut off the motor and got out of the car. "They always make a little noise. But say: I've got to close up now and meander on home. We're having company tonight, and the little woman will flatten me if I'm late. You boys come back tomorrow and finish looking the car over. I won't be surprised if we do business. I like the way you two go at things."

Reluctantly the boys closed the hood and took off for home, excitedly planning further checks.

WHEN Sam unlocked the door of his office the next morning, Carl and Jerry were right on his heels. He had to do some book work, but he gave the boys the keys to the car and suggested they take it for a trial drive. When he walked out of the office an hour later, the boys were back and had the front end of the car jacked up. Jerry was wearing a pair of earphones



plugged into a small black box. He was pressing a little rod sticking out of this box against an exposed front axle as he slowly turned the wheel.

"I think there's a bad bearing in this

wheel," Jerry announced. "I can hear it grinding through this contact mike working into the transistor amplifier. I don't hear it on the other wheel."

"We'll soon find out," Sam said indulgently as he pulled a crescent wrench and a pair of pliers from his hip pocket and started taking off the wheel. "I was a garage mechanic for many years," he explained, "but they kept making cars lower and lower, and I kept getting thicker and thicker. Finally, even with lowering blocks on my creeper, I couldn't slide under 'em any more; so I stopped doctoring them and started selling them. Well! I'll be darned! This bearing *is* a little rough. We'll put in a new one."

"And how about relining the brakes?" Carl asked. "Those bands are almost down to the iron."

"Okay," Sam groaned; "but you boys are going to have me on the street with a tin cup and pencils. Don't forget I'm letting you steal this sweet little buggy for only six bills."

Jerry got into the car and hit the starter. The motor revolved very slowly but did not start.

"Don't tell me I'm going to have to throw in a new battery!" Sam groaned.

Carl picked up the volt-ohmmeter that had been placed for safe-keeping in the rear seat and connected it across the battery terminals as Jerry twisted the starting key again.

"It's not the battery," Carl announced. "The voltage only drops to 5.5 volts with the starter load."

"Better the battery than the starter," Sam said, as he nervously took out one of his crooked little cigars and lit it.

"I've hooked the meter between the grounded battery terminal and the starter case. Hit the starter again," Carl instructed Jerry. "Hold it!" he exclaimed as soon as the starter began its sluggish turning. "That's it. There's a volt or so drop right there. Must be a poor ground connection on the battery cable. Can I borrow that wrench a minute?"

"Be my guest," Sam replied, holding out the tool.

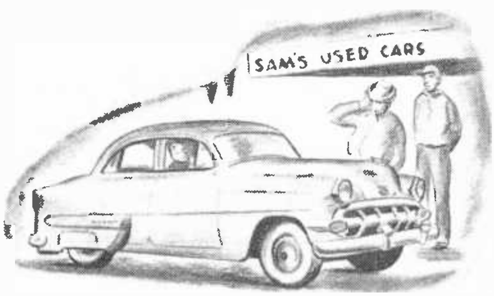
Carl's lanky frame slid easily under the car, and he did some high-powered grunting and wrench-tugging. "Now try her," he called. The starter whirred rapidly, and the motor started instantly.

A pleased smile spread over Sam's face. "Boys," he said impulsively, "I've taken a shine to you; so let's quit horsing around. I like to see a good car go to someone who appreciates and takes care of it. You two have convinced me you will do just that. I'll stake my reputation as a mechanic—of which I'm pretty proud—that this car will give years of satisfaction. It's a real bargain at six bills just as it stands, but I'll put in the new bearing and the brakes and check it all over. You can have it at eight tonight if you want it. What do you say to that?"

Carl and Jerry looked at each other and then said in chorus, "We'll take it!"

IT SEEMED to the boys that eight o'clock would never come, but finally they and their fathers started on foot for Sam's place. Their pride-and-joy, freshly washed and polished, was ready and waiting right in front of the office. They looked it over lovingly as their fathers went into the office with Sam to conclude the deal. As the men came out, Carl flipped a quarter into the air and Jerry called out, "Heads!"

"Tails it is," Carl revealed, and *he* slid



behind the wheel while Jerry got in beside him.

"Pilot to co-pilot," Carl called in a sing-song voice, "ready for take-off?"

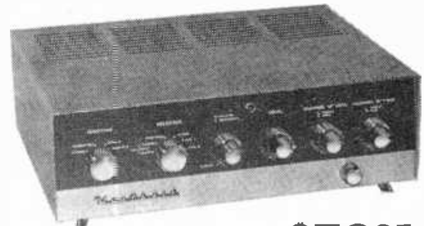
"Blast off," Jerry instructed.

The car rolled smoothly out into the street, and as Sam watched the gleaming tail lights disappear around a corner, he took off his big hat and held it against his chest as he looked up into the star-studded June sky.

"Boss," he said reverently, "there goes my good deed for the day, and I feel real good about it. But if it's not too much to ask, could you maybe send me a few tire-kicking, door-slamming suckers now just to sort of even things up?" —30—

FROM HEATH...

14 NEW KITS



AA-50 $79^{95}

HI-FI RATED 25/25 WATT STEREO AMPLIFIER-PREAMPLIFIER KIT

A complete 25/25 watt stereo power and control center (50 watts mono) . . . 5 switch-selected inputs for each channel . . . new mixed center speaker output . . . stereo reverse and balance controls . . . special channel separation control . . . separate tone controls for each channel with ganged volume controls . . . all of these deluxe features in a single, compact and handsomely styled unit! Five inputs for each 25 watt channel are provided: stereo channel for magnetic phono cartridge (RIAA equalized); tape head input; three high level auxiliary inputs for tuners, TV, etc. There is also an input for monophonic magnetic phono cartridge, so switched that monophonic records can be played through either or both amplifiers. The automatically mixed center speaker output lets you fill in the "hole-in-the-middle" found in some stereo recordings, or add extra monophonic speakers in other locations. Nearly all of the components are mounted on three circuit boards, simplifying assembly and minimizing possibility of wiring errors. 30 lbs.

New Heathkit Stereo Hi-Fi Components . . .

plus Exciting New Kits for the Ham, Technician, Boating Fan and Hobbyist

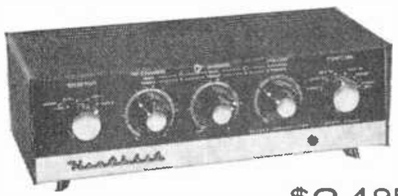
AD-10
$33^{95}

MANUAL STEREO RECORD PLAYER KIT

Made by famous Garrard of England, the AD-10 is a compact 4-speed player designed to provide trouble-free performance with low rumble, flutter and wow figures. "Plug-in" cartridge feature. Rubber matted heavy turntable is shock-mounted, and idler wheels retract when turned off to prevent flat spots. Powered by a line-filtered, four-pole induction motor at 16, 33⅓, 45 and 78 rpm. Supplied with Sonotone STA4-SD ceramic stereo turnover cartridge with .7 mil diamond and 3 mil sapphire styli. Mechanism and vinyl covered mounting base preassembled, arm pre-wired; just attach audio and power cables, install cartridge and mount on base. With 12" record on table, requires approximately 15" W. x 13" D. x 6" H. Color styled in cocoa brown and beige. 10 lbs.

HEATHKIT®

a subsidiary of DAYSTROM, INCORPORATED



AA-20 $34.95

ECONOMY STEREO PREAMPLIFIER KIT

Although these two new Heathkit models are designed as companion pieces, either one can be used with your present stereo system. The preamplifier (AA-20) features 4 inputs in each stereo channel and gives you a choice of 6 functions. It will accommodate a magnetic phonograph (RIAA equalized), a crystal or ceramic phonograph, and two auxiliary sources (AM-FM tuners, TV, tape recorders, etc.) and is completely self-powered. The six-position function selector switch gives you instant selection of "Amplifier A" or "Amplifier B" for single channel monophonic; "Monophonic A" or "Monophonic B" for dual channel monophonic using both amplifiers and either preamplifier; "Stereo" and "Stereo Reverse". 8 lbs.

AA-30 $45.95

HI-FI RATED 14/14 WATT BASIC STEREO AMPLIFIER KIT

Two 14-watt high fidelity amplifiers, one for each stereo channel, are packaged in the single, compact, handsomely styled amplifier (AA-30). Suitable for use with any stereo preamplifier or with a pair of monophonic preamplifiers, it features individual amplifier gain controls and speaker phase reversal switch. Output terminals accommodate 4, 8 and 16 ohm speakers. 21 lbs.

SA-2 $54.95

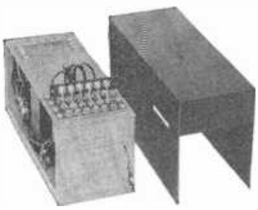
HI-FI RATED 14/14 WATT STEREO AMPLIFIER KIT

A tremendous dollar value in the medium power class, this top-quality stereo amplifier-preamplifier combination delivers full 14 watts per stereo channel (28 watts monophonic) to drive your stereo system with ease, while versatile controls give you fingertip command of its every function. In addition to "stereo" and "stereo reverse" functions, the SA-2 provides for complete monophonic operation. Inputs on each stereo channel accommodate "magnetic phono" (RIAA equalized), "crystal phono", "tuner" and high level auxiliary input for tape recorder, TV, etc. Other features include a speaker phase-reversal switch, clutched volume controls, ganged tone controls, filament balance controls, and two AC outlets to accommodate accessory equipment. Handsomely styled in black with inlaid gold design. 23 lbs.

SA-3 $29.95

UTILITY RATED 3/3 WATT STEREO AMPLIFIER KIT

Your least expensive route to stereo, the SA-3 delivers 3 watts per stereo channel (6 watts monophonic), adequate for average living-room listening. The high level preamplifier has two separate inputs for each channel and is designed for use with ceramic or crystal cartridge record players, tuners, tape recorders, etc. Featured are ganged bass and treble tone controls, clutched volume controls, channel reversing switch, speaker phase reversal switch and mono-stereo function selector switch. Attractively styled with satin-black cabinet. 13 lbs.



AN-10 $19.95

MIXED LOWS STEREO CROSSOVER NETWORK KIT

The AN-10 makes it possible for you to convert to stereo or improve your present stereo system by using just one bass "woofer"; saves buying a second bass speaker, permits using more economical "wing" speakers, improves the bass response of any stereo system. Delivers the non-direction bass frequencies of both channels below 250 cps to a single woofer and passes the higher frequency stereo channels to a pair of wing speakers. Rated at 25 watts per channel. Matches 8 or 16 ohm woofers, 8 ohm high frequency speakers, or Heathkit SS-1-2-3 speaker systems. 10 lbs.

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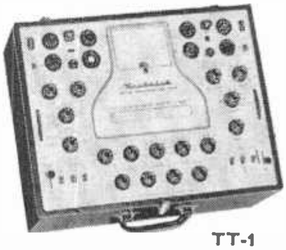

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Test Instruments

(Continued from page 64)

1.0 volt. Write down the signal generator frequency. Turn the output control to "X100" and raise the frequency once more. If the signal generator has an "X1000" position, increase the frequency still more until the meter again reads 1.0 volt.

Reduce the output control to "X10" again and tune the signal generator to slightly *below* the receiver frequency until the meter reads 1.0 volt. Raise the output to "X100" and "X1000," each time tuning lower until the 1.0-volt reading is obtained, and noting the frequency. Selectivity curves can then be plotted as shown in Fig. 5. Incidentally, you can expect selectivity to vary somewhat with frequency, with the lower end of the band tending to be more sharply selective than the upper end.

Examine the typical selectivity curves in

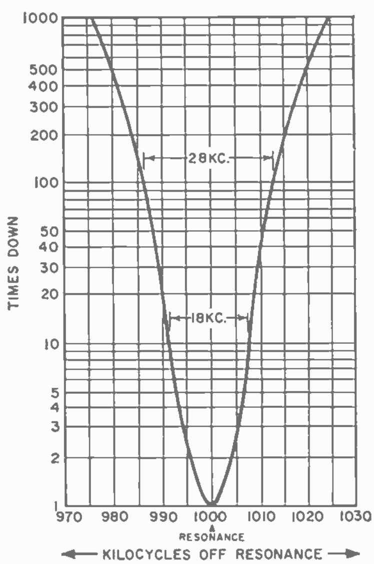


Fig. 5. Selectivity curves of receiver measured with setup in Fig. 4(A). Chart shows receiver 100 times down at 28 kc.

Fig. 5. If the receiver is tuned to 1000 kc., a station broadcasting at 1010 kc. would be approximately 20 times weaker than the 1000-kc. station; a station at 1030 kc. would be more than 1000 times weaker, or completely inaudible.

Maintenance. Signal generators are subject to most of the troubles suffered by other electronic equipment—troubles due to aging, dust, corrosion, and vibration. A regular program of preventive maintenance will assure accurate readings and long service from your generator.

Defective tubes, shorted capacitors, open resistors, and other simple difficulties can be checked and corrected by conventional means. Screws should be tightened from time to time, if necessary.

Signal generators also need occasional frequency calibration. Fortunately, local broadcast stations make good frequency standards. To calibrate a generator, tune in a local station, and set the dial of the signal generator near the same frequency. Place the signal generator's "hot" lead near the receiver antenna and you'll probably hear a high-pitched whistle from the radio speaker. Tune the signal generator so that the frequency of the whistle gets lower and lower. Eventually you'll find a spot where the whistle stops completely—tuning the signal generator in either direction from this spot will cause the whistle to start again. This is known as the "zero beat" point—the point at which the signal generator and radio station are tuned to exactly the same frequency.

You can check high-frequency bands on the signal generator by zero-beating with short-wave and FM stations. If the signal generator dial doesn't read the same as the broadcast-station frequency, adjust the oscillator trimmer until it reads accurately. On signal generators which do not have oscillator trimmers, you may be able to adjust the dial pointer until it indicates the proper frequency. If neither of the adjustments is available, make a calibration chart to show the amount of error on the various bands. It's a good idea to check each band in several places to see if the error is about the same throughout.

One final tip: most signal generator bands overlap slightly. For example, if Band 1 tunes from 100 to 290 kc., Band 2 will probably begin at 280 kc. Since tuning errors are more likely to occur at the high end of any band, use the low-end reading wherever possible.

There are many "tricks" connected with the use of individual generators—no two models are exactly alike, or have precisely similar characteristics. As you become increasingly familiar with your generator, you'll find more and more ways in which it can be helpful in solving your particular problems. —30—

Transistor Topics

(*Continued from page* 78)

across individual "fader" controls *R1* and *R2*. Resistors *R3* and *R4* isolate the input signals. Base bias current is supplied through *R5*, while *R6* serves as *Q1*'s collector load. The amplified output signal is supplied through *J3*.

If you decide to duplicate Darrel's circuit, you'll find it worthwhile to assemble the audio mixer in a small aluminum cabinet to minimize external hum pickup. Use shielded leads for all inter-equipment connections. Note that Darrel has omitted coupling capacitors in order to keep the circuit simple and the cost low; these are needed *only* if the instrument is used with equipment not having built-in d.c. isolation. Where needed, use 0.1- to 0.5-μf., 200- to 600-volt units (*C1*, *C2*, *C3*) for coupling between the equipment and jacks *J1*, *J2*, and *J3*. Proper load resistors (*R7*, *R8*) for the phono or mike cartridges used should also be connected as shown.

Help Wanted! Here are several requests from readers looking for special circuits. If you can help, write directly to the reader.

Ray Henning, Box 1244, Cal Poly, San Luis Obispo, Calif., is looking for an intercom circuit suitable for use in light airplanes.

W. J. Locke, 124 Dillon St., Houston 17, Texas, wants a fully transistorized, low-cost "walkie talkie" circuit with an operating range of approximately one mile.

Richard S. Swain, 13557 Douglas St., Yucaipa, Calif., needs a good circuit for a transistorized recording amplifier.

T. F. X. Carroll, 287 Avenue C, New York 9, N. Y., would like a compact semiconductor power supply suitable for use with a BC611.

Product News. General Motors Research Laboratories (Warren, Mich.) has developed a cadmium sulphide transistor. Although still experimental, this transistor has been used in oscillators, multivibrators, amplifiers, and radiation detectors. It has photosensitive as well as conventional transistor characteristics and thus is suitable for many special-purpose applications.

General Electric (Liverpool, N. Y.) is now producing sample quantities of a gallium arsenide tunnel diode. According to G.E., these new units have performance characteristics somewhat superior to those of the more familiar germanium tunnel diode, although upper frequency limits are a bit lower.

A Swiss firm has developed—of all things—a transistorized pneumatic hammer! In operation, a free-running multivibrator operates the hammer by controlling solenoid valves. A potentiometer permits continuous adjustment of operating frequency up to 17 cps. These hammers, incidentally, are not of the high-power variety for tearing up city streets, but miniature units for use in the watch-making industry!

RCA (Somerville, N. J.) has announced a new semiconductor device designed to improve the sound quality of transistor radios while extending potential battery life. Basically a "compensating diode," the device is used in transistor amplifier circuits to compensate for changes in operating characteristics due to temperature variations.

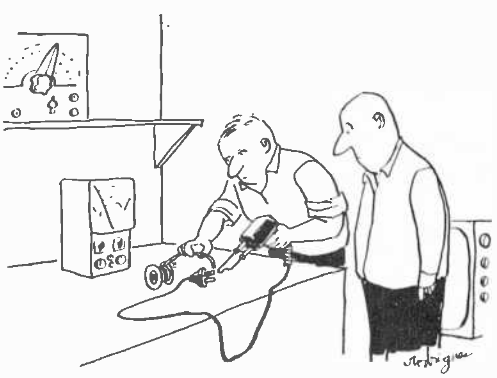
The Lansdale Tube Company (Division of Philco) has announced price reductions for many of its transistors. These cuts range from 15% to 35% on 19 different types, reflecting higher demand and production improvements.

Minneapolis-Honeywell too, has issued a new rate schedule indicating lower prices for several transistors. Cuts range up to 20% for Types 2N538 and 2N538A, both high-quality power transistors designed for general-purpose use in amplifiers, power converters, switching circuits, and voltage regulators.

From International Rectifier Corporation (El Segundo, Calif.) comes news of a Zener diode handbook. Price is $2.00 per copy, and it is available either by mail order or through local distributors.

That does it for now. Looking at the calendar, I see that vacation time is upon us . . . have fun!

Lou



DX'ing on TV

(*Continued from page* 56)

possible. Here are the main considerations:

- The more a television receiver is used, the more its efficiency decreases. If possible, a second set should be used for program viewing, and the DX set employed for hobby purposes only.
- Heat is the set's prime enemy. Always keep it away from heaters and in an area of free air circulation. For best ventilation, the back of the set should be left off (unless small children or pets are about).
- Dust is the side-kick of heat. The chassis should be cleaned by hand or with a blower every three months. Caution: discharge the high-voltage section before cleaning the set.
- Tuner contacts should be inspected and cleaned at least once a year. Constant channel-switching in DX operation makes this necessary.
- All tubes should be tested every four months. Any tube found to be operating at less than 60% of maximum should be replaced.
- High-gain r.f. tubes such as the 6BZ8 and the 6922 are available to soup up the set's front-end performance. Good results can be obtained with them, but you should consult data on their application to your set's circuit before installing them.
- Realignment of the set is usually not necessary. If you feel that the set would profit from realignment, however, have it done only by a highly skilled technician who has considerable alignment experience.

It should be mentioned that some receivers are more successful at DX'ing than others. A model with a high-gain cascode tuner, three or four i.f. stages, and wired circuitry is highly desirable. The Zenith line is popular among TV DX'ers, as are the Du Mont and Andrea receivers.

Snagging the Signal. Almost any roof-mounted antenna can be employed for TV DX'ing, but the higher the gain and the more directional the antenna, the better it is for DX'ing. For v.h.f., a large percentage of DX'ers find that the Channel 2 - 13 Yagi is tops in all-around performance. Cut-to-channel Yagis do provide higher signal pickup for given channels, but installing several of these on one roof or tower is highly impractical (especially when one considers that couplers and switches can attenuate the signals). Stacking any antenna will provide higher gain, but increasing the height is easier and better.

No matter what type your antenna, use a good grade lead-in such as the popular v.h.f. / u.h.f. foam variety. It's also wise to take your antenna down once a year for a thorough cleaning and check-up.

Another important aid to TV DX'ing is a good rotator. Since most antennas deliver the best signal when "pointed" directly toward the sending station, the advantage of 360° coverage is obvious. And for critical u.h.f. - DX, a rotator is a must.

A good signal booster can be used in every DX rig. Boosters come in two general types: the antenna-top and the set-top model. Both can pep up weak signals, but the antenna-top unit has the edge because incoming signals are amplified *before* transfer to the lead-in. Although the set-top unit amplifies noise collected in the lead-in process, most DX'ers use it because of its lower cost. Various models are available, and any receiver can be equipped with a set-top booster in a matter of minutes.

The cheapest "booster-like" device is a 7" x 4" sheet of metal foil. You wrap the foil on the lead-in about three feet from the receiver's input terminals, tune to a weak high-band or u.h.f. station, and slide the foil about six inches in either direction until the best picture is obtained. When changing channels, the adjustment is repeated. This impedance-matching technique is helpful to FM DX'ers also.

Why TV DX? There are two questions the layman usually asks a TV DX'er. First: why do you do it? Second: what proof is there you've actually seen the stations you claim to have seen?

The second question is not so hard to answer. Proof of reception is established by a photograph, by a "veri" (verification) card or letter from the station, or even by a tape recording of the station's "ID."

The first question is tougher. Why people will sit for hours in front of a TV set, switching from one blank channel to another is beyond me. But they do. And I do. And chances are, once you get started, you will, too! —30—

Readers who would like further information about TV DX'ing should write to the American Ionospheric Propagation Association, c/o Art Collins, 68 Amber St., Buffalo, N. Y. This TV DX club publishes a monthly bulletin with reports and data of interest to serious DX'ers.

New Angle to Angling

(*Continued from page* 51)

pulsing rates affect fish of various sizes differently. Pulse rates of from 45 to 50 pulses per second are most effective on fish from 4" to 7" long and rates from 85 to 90 pulses per second work best with larger fish. A compromise rate of 50 pulses per second is adequate for most operations, however.

By the way, don't start getting any ideas about building your own electronic fishing system. Electronic fishing by other than scientists is illegal on most waterways in the United States.

Foreign Experiments. Europeans have done considerable work in developing commercially practical electronic fishing gear. Dr. Konrad O. Kreutzer, a German, has been especially active in this field. In one of his early experiments, he adapted a German minesweeper for the purpose, using a 60' span between electrodes. More recently, the efficiency of his system has been increased sufficiently to pay development costs.

Dr. Kreutzer also experimented with an electrical fish hook. A fish would be shocked and knocked unconscious when it bit the hook, and the fisherman could then pull in a dead weight rather than a fighting fish. This device was designed with the tuna industry in mind because the average tuna weighs more than 100 pounds and fights the line with great vigor. It has never had wide application, however.

The Russians, too, have experimented with electronic fishing gear, combining it with a giant vacuum cleaner that sucks the fish into the boat when they come near the positive electrode. As an added touch for night fishing, the Russians suspend lights over the vacuum pump inlet.

A similar system that operates in salt water has recently been announced by a West German electronics company, International Electronics Laboratories of Hamburg. Because of salt water's high conductivity, it was thought that electronic fishing in sea water would not be practical. However, tests indicate that this new system is quite satisfactory for sea-water applications. A 3'-wide flexible tube with an electric light to attract the fish is lowered into the water. As the fish approach the lower end of the tube, they are drawn up it toward the positive electrode at the upper end of the tube. Then the vacuum pump sucks the fish out of the water. This system is said to take in as many fish in eight minutes as a trawler does in a day.

Scientific Applications. The U.S. Fish and Wildlife Service has used its electronic fishing gear to study make-up of the fish population in various inland streams and rivers. A study done on the Yakima River in Washington has revealed that scrap fish outnumber the commercially important salmon 90 to 1. This means that there is terrific competition for the available food and habitat area. And while the study suggests that the river can be made more productive by reducing the number of scrap fish, cautious fishery scientists are slow to move. They feel that they might upset some "biological balance" which might be present and are waiting until they can complete more extensive investigations.

So if you should see some men paddling about in an aluminum boat and stirring around in the water with an electrode, don't think that they are chefs busily engaged in mass-producing fish chowder. More likely they're fishery biologists collecting a few specimens. —30—

R.F. Power Meter

(*Continued from page* 53)

as close to the plate as possible. Stand the plate on edge and insert the remaining leads in the back plate, bending over only the leads of the "corner" resistors. Squeeze the plates gently against the resistors and solder the leads from the "corner" resistors to each plate. Finally, solder the remaining leads and clip them off next to the plates. File down any leads that prevent the assembly from being mounted flush against the rear of the box.

Calibration. Since meter *M1* is calibrated in microamperes, it must be recalibrated to read in watts. To do this, switch *S1* to the 100-watt range, and connect electric light bulbs to *J1* as shown on the calibration schematic. Start with any combination of light bulbs totaling 400 watts—for example, two 150-watt bulbs and one 100-watt bulb; then decrease the wattage of the lamps to 300, 200, 150, 75, and 40 watts. The three higher wattage combinations should be left connected only momentarily. In each case, measure the voltage across *R1*.

Using 117 volts a.c. in the calibration

setup, calculate the power for a given meter reading as follows:

$$\text{Power (watts)} = \frac{\text{Voltage}^2 \text{ (across } R1\text{)}}{50}$$

This formula is valid only if the voltage scale on the VTVM is calibrated in r.m.s. Use *extreme caution* when calibrating, since one side of the 117-volt line is connected directly to the power meter case.

The full-scale reading on the 100-watt range can be changed to read approximately 20% higher or lower by adjusting pot. *R3*. The 10-watt range need not be calibrated and should read 10 watts full-scale with the values of *R4* and *R5* shown. If desired, the 100,000-ohm resistor used for *R5* can be changed to a 2-watt potentiometer of the same value. This would allow you to vary the full-scale reading with switch *S1* in its "10-watt" position.

Operation. To operate the unit as a power meter, connect *J1* to the output jack of the transmitter under test. Set the range switch to the 100-watt position to start. If the meter reads 10 watts or less, you can safely switch *S1* to the 10-watt range for a more accurate reading.

To test a transmitter's low-pass harmonic filter, connect *J1* to the output of the filter with the transmitter output connected to the filter input. Record the wattage at the filter output jack. Next, remove the filter and connect *J1* directly to the transmitter output. A much higher reading without the filter indicates that the filter elements need readjustment or that the transmitter has a high harmonic output.

As a dummy load, the r.f. power meter can be operated continuously at 40 watts or less. Higher transmitter outputs should be applied only momentarily to prevent damage to load resistor *R1*. —30—

HOW IT WORKS

The r.f. power meter determines the power output of a transmitter by measuring the voltage across fixed load resistor *R1*, which is connected to the transmitter output. Meter *M1* is calibrated in watts according to Ohm's law.

In operation, diodes *D1* and *D2* rectify the r.f. voltage across *R1*. The rectified voltage appears across resistors *R2*, *R3*, and meter *M1* in the 100-watt range, and across resistors *R4*, *R5*, and meter *M1* in the 10-watt range. In each range (selected by *S1*), a current flows through the meter in proportion to the rectified voltage present.

Two bypass capacitors (*C1* and *C2*) are used to maintain the linearity of the meter. At self-resonance, each capacitor becomes ineffective as a bypass device. But since the two capacitors are self-resonant at different frequencies, one always functions as an r.f. bypass.

How to Place Stereo Speakers

(Continued from page 84)

In any room it's necessary to strike a balance between the best stereo illusion and the most comfortable overall sound. The optimum positions for each purpose sometimes don't coincide. The best listening coverage for stereo is usually attained when the speakers are positioned along one of the shorter walls of a room. Corner placement generally provides the best bass response, but the space separating two corner speakers will often be too extreme for effective stereo.

After you outgrow a possible mania for ping-pong effects, your main consideration will be listening ease. In your first hour of experimenting, you will find that certain locations produce reflections and concentrations of sound (standing waves) which amplify one particular frequency range tremendously. At almost any point in the frequency scale, standing waves make for extreme listening fatigue, and at very low frequencies they produce a general feeling of uneasiness which is hard to pinpoint at first. Square rooms are usually the worst offenders in standing-wave production, particularly when speakers are positioned in corners.

Because of the variations in recording techniques, there are no rigid rules about how far the speakers should be spaced apart, although today's stereo speakers are usually not placed as far apart as in the earliest days of stereo. The ideal, of course, is to duplicate the original separation of the microphones used in recording. This is an elusive goal at the moment, still waiting for the last word from the recording engineer. In general, though, a bottom limit of three to four feet of speaker separation is necessary even in the smallest listening room to allow sorting out the separate impressions which give stereo its impact.

As you test speaker locations in your living room, the problem of speaker phasing reappears in another form. This time the consideration is acoustical—rather than electrical—phasing. For maximum stereo effect, the sound from both speakers should reach your ears at precisely the same instant. This means that both speakers should be approximately the same distance from your listening position. While it's not always possible to be exact in placing speakers for this purpose, putting one significantly closer than the other to your favorite listening spot will partially destroy one of the most carefully calculated aspects of stereo sound.

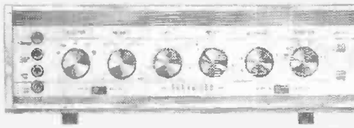
The Decor Conflict. While you have considerable choice in the positioning of speakers, a few things are (or should be) taboo for the true stereophile. Almost all of them are related to room decor. Many wives, encouraged by pictures in home furnishing magazines, are adept at placing stereo speakers to score a decorative triumph. Unfortunately, sound values are usually lost in the esthetic shuffle.

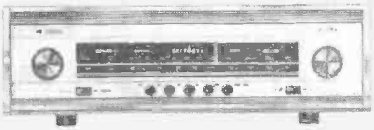
A favorite decorative gambit is the placing of speakers in a "listening corner" at right angles to each other. While speakers can often be placed facing slightly toward or away from each other, the ninety-degree placement usually means misery for the stereophile. Carefully planned phase relationships disappear and the perspective which stereo offers—both in directionality and depth—is largely lost. Less serious but even more common is the installation of bookshelf speaker systems at staggered distances from the floor. The alert stereophile should be prepared to cope with his wife's decorative instinct and keep it within bounds.

Interior decorators are to be regarded with particular caution—some will stop at nothing in their efforts to "harmonize" decor and stereo. One of the more outrageous concepts involves the use of a circular rug to match the "round" sound of stereo.

Also to be avoided is the intrusion of a piece of furniture directly between you and either of the speakers. If high frequencies are obstructed and muffled by a well-stuffed sofa inherited from Aunt Minnie, much of the impact of stereo will disappear. Highs are responsible for supplying most of the subtle details in the make-up of musical instruments, and their absence leaves you listening to unsatisfactory reproduction.

Finally, it's worthwhile to remember that stereo was intended to supply the depth and perspective you feel at a live performance, rather than a super-directionality of sound which you seldom notice at a concert. If you concentrate too much on hearing the drums from the left and the trumpets from the right, you may wind up with out-of-phase or otherwise inferior sound which is a long way from the realism that stereo, at its best, can offer. —30—





Across the Ham Bands

(*Continued from page 72*)

monitoring stations. Instead, try to give true reports to the stations you work to the best of your ability and equipment. And if anybody disputes their accuracy, don't waste your time in fruitless argument. Simply admit the possibility that you might be wrong.

In turn, if you receive an unflattering report, don't argue with the ham who gives it to you. If your signal is bad, why be the only one on the band not to know it? When you know it, you can do something about it.

A local ham called a short time ago to tell me that he had just received an official FCC discrepancy report. Although his carrier frequency was 2.1 kc. inside the 20-meter phone band, he was cited because his *sidebands* extended 2 kc. into the c.w. band. The FCC *does* monitor the ham bands.

News and Views

You've heard about "cooking on the front burner." Well, **Nick, W9YQP,** Springfield, Ill., beats that. His wife cooks on that burner and the rest of the burners on her electric stove, but she listens to Nick on the front burner. That's the one he comes out of "loud and clear" when he's on the air. Can anybody explain it? . . . **Arnaldo Coro, Jr., CO2DL,** 62 #3310 Marianao, Cuba, works 50.1 and 50.4 mc., running 15 watts to a 6146 feeding a five-element beam. He and CO2's MW, ZX, XZ, RR, GX, and QY would like to arrange skeds with U.S. six-meter hams for propagation research. Arnaldo is interested in working 40-meter Novices, but he needs a 40-meter Novice crystal, which is not obtainable in Cuba—currency restrictions. . . . . **Joe Burch, KN3JLS,** 556 Continental Rd., Hatboro, Pa., started his ham career with an old Stromberg-Carlson receiver, minus BFO. After chalking up a record of two contacts, he decided to give his Heathkit DX-20 transmitter a little help and got a Hallicrafters S-85 receiver and a Heathkit QF-1 Q-multiplier. His antenna is a Windom, fed through balun coils. With this combination, he has 18 states worked, 16 confirmed. Joe will help prospective hams get their licenses.

Larry McKay, K5RRG, P.O. Box 98, Madison, Miss., uses a Heathkit DX-40 to feed 10- and 40-meter dipoles, both 40′ high, and receives with a Hammarlund HQ-110C. He has worked 50 states and 18 countries, but moans because he cannot pry a QSL card out of Hawaii. His country total is 18. Check with Larry if you need a Mississippi card. Forty-meter c.w. and 10-meter phone are his favorites. . . . . **Larry Aldrich, KN3HJQ,** RD #3, Corry, Pa., works 40 and 80 meters, using a Globe Scout 680-A transmitter. Its r.f. leaps into space from a 125′ "long-wire" antenna, and his signal trapper is a converted "surplus" ARC-5. In fact, he must have two of them to work both 80 and 40. In four months on the air, his total is 101 contacts. . . . . **Donald E. Lampkin, WV2HMB,** 187—29 Mangin Ave., St. Albans 12, L. I., N. Y., passed his Technician exam in December and plans to take his General exam this summer. He uses a home-built 6L6 transmitter running 25 watts and receives with a Hallicrafters S-40A receiver. . . . . **Don Lewis, KN4MQT,** 1860 Audubon Dr., N. E., Atlanta 6, Ga., also sticks to home-built transmitters. His 40-meter rig runs 35 to 40 watts, and he has a 25-watter for 15 meters. He receives on a Hallicrafters S-38B. Don's record is 19 states, 14 confirmed, but he works under a dire handicap: if his school grades drop to "C," he goes off the air until they come back up again.

Dave Grant, WL7DEM, P.O. Box 190, Nome, Alaska, has heard many Novices miss choice DX stations calling them because they don't tune off their own frequencies. Being only 150 miles from UAØ (Russia), Dave rates as pretty good DX for most other U.S. hams himself—really "far out," in fact. In eight months, he has worked 12 states, plus Russia, Midway, Guam, Okinawa, Japan, and New Zealand. . . . . **Richard Stewart, Jr., K3ITH,** 2504 Prescott Rd., Haverton, Pa., uses his 40-meter dipole antenna on all bands from 10 to 80 meters, feeding it with a DX-20. He uses a separate antenna for his Hallicrafters S-38E receiver. QSO's with 26 states prove that he gets out. Dick is president of the Haverford Junior High Radio Club and a member of the Rag Chewer's Club. . . . . **Gordon Pastor, KN8RMN** (17), 3090 Hillier Rd., Barberton, Ohio, likes 15 and 40 meters. In three months, he has worked 10 countries on five continents. A three-element 15-meter beam, 45′ high, helps his DX-40 do the job, and an RME DB-22A preselector assists his old Hallicrafters SX-28 receiver. Gordie grinds his own crystals for the transmitter. Between 15 and 40 meters, he has worked 45 states.

Don Wright, VE6AAM, 4707 Coronation Dr., and **Brian Credico, VE6EX,** 1928 29 St., S.W., both in Calgary, Alberta, Canada, make a joint report. Don prefers 15-meter c.w. but drops down to 80 meters occasionally. His EICO transmitter feeds a five-element G4ZU beam. He has two receivers—a Hallicrafters SX-99 and a Hammarlund HQ-100. He has worked all states but needs cards from New Mexico and Montana. DX: 38 countries, 18 confirmed. Brian, VE6EX, needs Utah, Vermont, and South Dakota. He has 23 countries, 13 confirmed. His transmitter is "home-brew," running 45 watts on phone and 80 watts on c.w. Twenty meters is his favorite phone band, but he works a lot of c.w. on 15, 20, and 40 meters. Brian has a three-element 20-meter beam, a "ground plane," and a 40-meter dipole. His receiver is a Hammarlund HQ-110. Both boys work as many Novices as they can and QSL 100% on receipt of cards.

Until next month, when I hope to have *your* letter, picture, and suggestions, 73,

Herb, W9EGQ

Eavesdropping on Outer Space

(*Continued from page* 45)

logical system to represent natural physical constants, such as the speed of light. Our computers would make quick work of breaking a code based on such logical concepts.

But deciphering signals is just one problem to be encountered in this, man's strangest adventure in communications. Even if signals come from the nearest stars, the distances involved are so great that it would take almost 20 years to answer a single question. If, as is more likely, life is found at a distance of 50 light-years, it would take 100 years to get our first answer.

Elaborate Installations. The equipment now being used in radio astronomy would seem like a dream-come-true to Karl Jansky. Today's receivers can detect signals millions of times weaker than could his home-built rig. Masers and other supersensitive devices are actually capable of hearing signals that are a millionth of a millionth of a millionth of a watt!

Ingenious devices isolate, identify, and measure minute signals completely buried in the cacophony of squeals, crackles, and wails that fill the ether. Where yesterday's radio astronomer listened on a headset, or watched a moving pen scratch a wavy line on a graph, today's scientist sits in his office figuring out new exercises for his giant telescope to run through.

The telescope itself, meanwhile, peers into its assigned sector of the heavens, translates what it sees into digital form, and feeds the result into an electronic brain for analysis and evaluation. Like the Venus radar contact mentioned earlier, today's received signals are far too complex for a human operator to recognize, let alone analyze. So computers have moved in to do the job.

Certainly the most eye-catching feature of any modern radio telescope is its antenna. It may take any one of a weird variety of forms. The University of Ohio telescope, for example, looks like a giant upside-down rake with each 12' tooth wrapped in a steel coil. Near Sydney, Australia, there is a space ear in the form of a giant cross with arms a third of a mile long. A Russian instrument at the University of Leningrad looks like a huge board fence, with each board individually adjustable.

Today's largest radio telescope is at Jodrell Bank, not far from Manchester, England. It is a giant dish, 250′ in diameter, as tall as a 30-story building. It is tilted by battleship gun turrets and mounted on locomotive wheels riding a circular track.

Future Telescopes. The world's most impressive telescope—and the largest scientific instrument ever built—will be the U. S. Navy's 600′ dish telescope already under construction at Green Bank, W. Va. This mammoth space ear will tower 66 stories. Its giant dish will be as big as Yankee Stadium, yet the entire seven acres of its aluminum-mesh reflecting surface will be accurate to within a fraction of an inch. Since thermal contraction and expansion—and distortion caused by wind pressure and gravity—would normally stretch the reflector out of shape by several inches, engineers have worked out a scheme to keep the surface absolutely true at all times. They've arranged this by dividing the face into a number of small sections and installing individual servo motors on each one. In the finished dish, each section will adjust automatically for the slightest misalignment.

Bigger and more powerful radioscopes are coming. Not long after the 600′ antenna goes into operation in 1962, Cornell University's 1000′ giant in Puerto Rico is expected to be ready for action. This monster will not be steerable—its huge bowl will be hollowed out of a mountain valley. But its great range will push back the frontier of space still further.

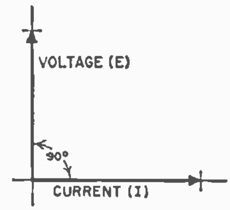
Even this huge reflector will suffer from limitations that no earthbound telescope can overcome, however. Radio noise created by the decay of radioactive substances in the earth's crust has long been a source of trouble. Unavoidable, too, is the interference generated by the layer of ionized gas that covers our planet several hundred miles above its surface.

But radio astronomers think they already have the answer: a telescope in space! Not only would such a telescope get away from the earth's noise, but it would also be free from gravity, wind, and changing temperatures. When will such an instrument be built? Not for a long time, surely. But when it is, it will be another valuable tool in man's never-ending quest for knowledge of outer space—a quest that began with Karl Jansky's startling discoveries less than 30 years ago. —30—

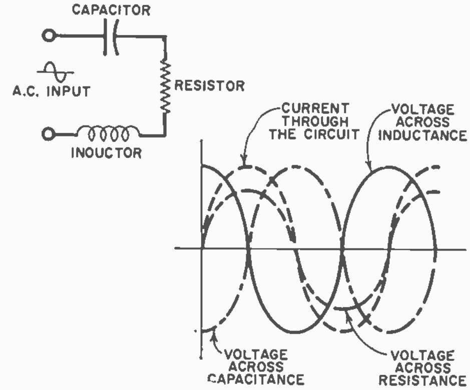
The Language of Vectors

(*Continued from page* 87)

Larry. "Now let me draw the vector diagram for an inductive circuit." Larry made a rapid sketch.



"That's it," said Ken approvingly. "Now let's get serious, Larry, and put all the things we've discussed together in one piece. I'm going to draw a very simple circuit that has all three elements—resistance, inductance, and capacitance. Then I'll draw the complete set of curves for the circuit. When you see it, I think you'll really understand why vectors are important. Remember, what I'm drawing is just about as simple a situation as you can find in an electronics circuit."



"Wow!" Larry smacked his hand loudly against his forehead and stood up. "That does it, pal. You said it would be a *simple* circuit. I'm leaving. See you around."

"Steady, old boy," said Ken with a laugh. "This is the test that will separate the man vectors from the boy vectors. Actually, all you have to do is plot each curve as its own vector on a set of coordinate axes. Draw the coordinates, take the curves one at a time, and see how you make out."

Note to the reader: This can be your test as well as Larry's. Before you read on, why not try and draw the vector diagram for

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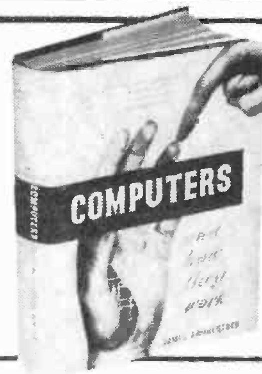

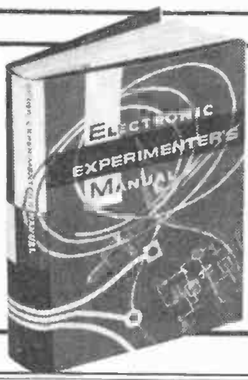

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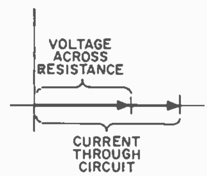
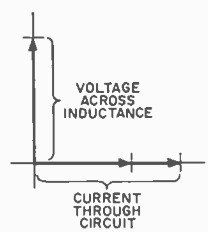
these curves yourself? Remember Ken's advice: take the curves one at a time and set up a vector for each one. If one vector falls on top of another, that's okay—just think each curve out for itself.

LARRY began to draw with some hesitation. "First I'll draw in the vector for the current because it's the same for the whole series circuit," he said. "Then I'll draw the vector for the voltage across the resistor. Say . . . these two are in phase with each other, so they would come out on the same line . . . like so. How's this, Ken?"



"That's the way to use the old noggin, Larry. Now you have two more curves to consider, the voltage across the inductance and the voltage across the capacitance—which leads which, and by how much. Draw that in and there's your vector diagram."

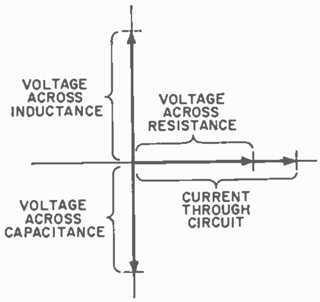
With sudden inspiration, Larry began to pencil in the two additional vectors. "First off," he said as he drew, "the voltage across the inductance is at a maximum point when the current curve is at zero. That means it leads the current by 90°, so I'll show it this way."



"Good boy," said Ken enthusiastically. "Now finish it off."

"Lemme see, now," murmured Larry. "The only vector left to put in is one to represent the voltage across the capacitor. From what I know, and from the looks of the curve, that voltage is 90° behind the current, so its vector would fit in here." Larry drew in this final vector. "Double-checking against your curves, Ken, I can see that the capacitor voltage is at a minimum at the points where the current curve crosses the base line of the coordinate axis. That means I must be right when I show this vector lagging behind the current vector by 90°."

He passed his complete drawing across to Ken.



"That's it, Larry. The diagram is right and you've done a fine job. Now, if you'll look at the mess of curves that represent the same circuit as the vector diagram you just drew, I'll bet you can see why engineers like to work with vectors."

"Boy, do I ever get the point, Ken! The vector diagram sure does simplify things . . . once you understand what it means. I really want to thank you for teaching me all about using vectors."

"Wait one sec, chum. Did I read you right? Do you think you know all about vectors?" When Larry nodded, Ken started to laugh.

"All I've done, Larry, is show you the ABC's of the subject. Remember this: vector algebra takes up a full college course and gets pretty deep. If you remember what we did discuss, though, you'll be able to understand enough about vectors to follow most discussions you come across in technical books and articles.

"If I were you I'd get a text on the mathematics of electronics — *Mathematics for Electricians and Radiomen,* by Nelson M. Cooke, is a good one. Study the sections on vectors in it and you'll be surprised how much you can learn in a short time. All you need is high-school math, and you'll be on your way.

"Speaking of being on your way," Ken added, "it's time for me to close up shop here."

"Thanks loads, Ken," said Larry. "I really appreciate the help. From now on vectors will hold no fears for me, and I'm sure going to dig into them a little deeper as you suggested." —30—

Inside the Tape Recorder

(*Continued from page* 48)

tion. The most common equalizer uses a feedback loop from the output of the second triode to the cathode of the first. A combination of resistors and capacitors in the feedback loop achieves the equalization.

Commercial tapes will provide a flat response if equalized with an NAB equalizer, the curve of which is given in Fig. 4. This curve was originally worked out for 15-ips tapes, but Ampex has modified it by adding more treble boost in the recording curve to make it effective at 7½ ips. All commercial 7½-ips tapes are recorded to produce a flat response to 10,000 cycles or more when played back with NAB equalization.

Although there is no official standard for 3¾-ips tapes, Ampex has developed an equalization which is similar to the NAB curve except that the turnover is 2 octaves lower—at around 800 cycles. The recording curve requires a boost of about 14 db at 7500 cps and a low-end boost similar to that of the 7½-ips standard. At the moment, the Ampex curve appears to be the one most widely used for 3¾-ips tapes.

Recording Amplifiers. Recorders must have preamplifiers to amplify the weak input of a microphone and amplifiers to drive the recording head. The preamps generally follow usual hi-fi circuitry, although one or two professional types use the cascode arrangement for the input stage of the microphone preamp in order to assure the best signal-to-noise ratio. To attain a noise figure of 55 db or better, noise and hum must be minimized; therefore, in the highest-quality recorders, d.c. heater supplies and low-noise resistors are employed.

While the simpler home-type recorders often make one amplifier do double duty in playback and in record, the more elaborate recorders have separate record and playback amplifiers. By using the playback amplifier in conjunction with a separate playback head, it is possible to monitor the tape as it is recorded.

Naturally, the more elaborate and costly the unit, the better it will be able to approximate ideal performance. Home-type recorders, although they are modestly priced in comparison to professional machines, generally are good values. They are far superior to their ancestors and deliver very acceptable performance. —30—

Short - Wave Report

(*Continued from page* 76)

as well as for other hams. The ARRL Bureau then forwards the SWL cards to those who have provided a self-addressed, stamped envelope, or they send them to a local SWL club, such as the Newark News Radio Club. Most SWL clubs also forward QSL's, but only to their members. When they receive cards for SWL's who are not members, they classify them as "undeliverable" after a reasonable attempt to locate the addressees.

One of the large SWL clubs reports that many QSL cards are being received from hams addressed only to WPE call signs. Naturally, the SWL club must, in turn, contact POP'tronics to obtain the addresses before the cards can be forwarded. Should the recipient not be a member of the club, the club is under no obligation to forward the cards to him.

Of course, you have a much better chance of receiving the QSL if you include your name and address as well as your WPE call when you request a card. (There is no reason why you should not do so since QRM on postcards is quite low.) If you wish, you can also include return postage, and the ham can send your QSL direct to you. Check with your postmaster for information on International Reply Coupons so you will not have to enclose currency.

For the time being, your Short-Wave Editor is willing to assume the duties of a QSL Bureau for "undeliverable" SWL's, but only for clubs and not for individuals. Clubs wishing to use this service should send me

The listening post of Donald House, WPE3KA, Lancaster, Pa. His equipment includes a Zenith Trans-Oceanic portable, a Hallicrafters S-38E, and a broadcast-band receiver. Don has collected 70 cards from amateurs, with six countries confirmed.

a list of club members and their WPE calls. Operators of SWL club QSL Bureaus may then send undeliverable cards (only those bearing a WPE call sign) directly to me, and I'll do my best to forward them. Individuals are specifically requested *not* to ask for addresses of call-sign holders.

At a later date we hope it may be possible to organize a full-scale WPE QSL Bureau. However, it takes a lot of hard work to get such a bureau organized, and continuous effort to maintain it in good order. It is pretty much of a thankless job. On the other hand, it might be an interesting project for those who handle it. Only time will tell. In any case, you can rest assured that the SWL QSL Bureau is coming—now that the SWL is being recognized more and more, and now that we have our own call signs.

Current Station Reports

The following is a compilation of current reports. All times shown are Eastern Standard and the 24-hour system is used. At time of compilation all reports are as correct as possible; stations often change schedule and/or frequency with little or no advance notice. Please send all reports to P. O. Box 254, Haddonfield, N. J., in time to reach Your Editor by the eighth of each month.

Afghanistan—Kabul is noted on 9703 kc., dual to (but not heard on) 4750 kc., with an Eng. xmsn from 1030 to 1059 and from 1415 to 1430 s/off with pop and classical recordings. (*WPE3NF, WPE8BGF*)

Algeria—*Algeria Renaissance* (*Voice of Free Algeria*) is heard on 8220A kc. with Arabic chanting at 0045-0100 followed by talks in French; Arabic music resumed at 0111. (*WPE3AGZ*)

Brazil—ZYR96, Sao Paulo, 17,710 kc., has been heard well at 1940-2100 with music and Portuguese anmts. (*WPE4BC*)

Bulgaria—Sofia is heard well on 9700 kc. with Eng. to N.A. at 2000-2030 and 2300-2330. A mailbag program is given on Thursdays and Sundays and a DX program on the first Friday of each month. Other Eng. xmsns are noted at 1430-1500 and 1635-1705 (the latter is dual to 7670 and 7255 kc.) to the United Kingdom. A daily concert is scheduled at 1835-1900 on 9700 kc. to N.A. and England. A new outlet on 11,850 kc. is heard at 1900 in Spanish and at 1930-2000 in Bulgarian. (*WPE2ACO, WPE2BAT, WPE3AJC, WPE4ASH, WPE4DZ, WPE5CN, WPE8BEU, WPE9KM, WPE9DN, WPE9NY, WPEØABI, VE3PE5S, HJE, JK, JR*)

Chile—CE1515, *R. Corporacion de Santiago*, Santiago, is noted with a strong signal on 15,150 kc. from 2130 with programs of American and L.A. music. (*WPE3HP*)

England—The European Service of the BBC has German at 2345-0015 on 3952.5 kc. and English-by-radio at 0000-0015 on 3975 kc. Both channels carry a program in Czechoslovakian at 0015. (*WPE2ACO*)

Finland—OIX4, Pori, 15,190 kc., is heard very well at 0630-0800 with programing in Finnish, pop and classical music. A DX program is aired on Saturdays at 0630-0700. A xmsn in Swedish/Finnish to Europe is noted at 1100-1330, dual to 17,800 and 6120 kc. At 1100-1120 on alternate Fridays, there is an Eng. DX session. A new Eng. program is planned for 15,190 and 17,800 kc. at 1730-1800 on Mondays only. (*WPE1BM, WPE2ACO, WPE2BMO, WPE8HF*)

Gabon Republic—*R. Gabon*, Libreville, has moved from 5025 to 4774 kc. and is quite strong until 1600 s/off (Saturdays to 1700). (*WPE3NF*)

Germany (East Zone)—*R. Berlin International*, 11,765 kc., has an Eng. test program at 1130-1200 to the Middle East and another Eng. xmsn at 1230-1300. The new Arabic Service is heard at 2305-2335. (*WPE8MS, WPE9AWO, WPE9KM*)

Ghana—Accra, 3366 and 4915 kc., has Home

New Stations

The *Voice of America* will shortly begin construction on two mammoth transmitting sites and a receiving station around an 18-mile triangle near East Greenville, N. C. With a total power of nearly 5 megawatts, there will be six 500-kw. units, six 250-kw. transmitters, and 10 lesser-powered stations. The antennas involved will include nearly 100 curtain, rhombic, and log periodic types with 400 towers ranging from 50′ to 375′ high. Several presently scattered *VOA* installations will be concentrated at this new site. (*WPE8-AD, DG*)

A new short-wave station is to be constructed at Forney, Texas, and will operate somewhere between 15,100 and 15,450 kc. with a power of 50,000 watts. The owners, Global Broadcasting Co., plan broadcasts in Spanish and English beamed to Peru, Ecuador, Colombia, Venezuela, British Guiana, Surinam, and parts of Brazil and Bolivia. No call letters have yet been assigned. (*WPE5AC*)

From Monaco you can expect to pick up the signals of *Trans World Radio*, a new 100,000-watt transmitter of the *Voice of Tangier*. Complete information on this station, regarding frequencies and schedules, is unavailable at the moment and it is possible that this is only a medium-wave station. (*AS*)

Mr. I. C. Griggs, Chief Engineer of the *Sierra Leone Broadcasting Service*, writes that they are hoping to increase the power of their short-wave outlet to 10,000 watts and may, in addition, operate on a different frequency during daylight hours. The new outlet is not expected to be in operation until after 1960. (*WPE8MS*) news at 0100, "Radio Newsreel" (from the BBC) at 0115, Eng. language lessons to 0130, and recorded music to 0200. The IS is African drumbeats. (*WPE1AAC, WPE1KW, WPE2TA, WPE3HP, WPE4JP, WPE8MS*)

Gilbert & Ellice Islands—*R. Tarawa,* VSZ10, 6050 kc., has been tuned at 0230-0300 with music and talks in native language, and an Eng. ID. (*WPE8BGF*)

Guatemala—*R. Nacional de Quetzeltenango,* 6118 kc., is noted from 0039 to 0102 s/off with news and ID in Spanish. Sunday is the best day. (*WPE3DS*)

India—Eng. broadcasts from Delhi are as follows: 2330-2340 to E. Africa on 21,620 and 17,810 kc.; 1045-1100 to E. Africa on 17,840 and 15,225 kc., 1930-1950 to Burma on 11,895 and 15,280 kc.; 2130-2145 to S.E. Asia on 17,830 kc.; 0830-0930 to S.E. Asia on 21,605 and 17,705 kc.; 0500-0600 to Australia and New Zealand on 17,795 and 21,690 kc.; 0500-0600 to N.E. Asia on 21,615, 17,705, and 15,205 kc.; 1445-1545 to Europe and England on 11,710 and 9675 kc.; and 1445-1545 to W. Africa on 17,790 and 15,105 kc. (*WPE1CE, WPE8MS*)

Iraq—The Eng. xmsn from Baghdad was recently rescheduled to 1600-1630 on 6030 kc. (*WPE1AGM, WPE1BY*)

Israel—*The Voice of Zion,* Jerusalem, 9009 kc., is beamed to W. Africa at 1615-1645 in Eng., and to 1715 in French. Other xmsns are broadcast at 1530-1600 in Eng. and at 1430-1500 in French, both beamed West. A dual outlet on 9727 kc. is not announced but carries Eng. at 1545-1600. (*WPE1AGM, WPE-1ANK, WPE4KB, WPE8MS, WPE9AGB, WPE9KM*)

Japan—Tokyo has replaced 9525 kc. with 17,825 kc. to N.A. and Hawaii. (*WPE6EZ*)

Liberia—ELWA, Monrovia, is good on 21,-515 kc. at 2015-2152 on Tuesdays only in Eng., and on 11,980 kc. at 0030 to past 0115 with Eng. until 0100. A new outlet on 11,825 kc. has been noted at 0030 beamed to West and Central Africa; French from 0100. (*WPE9KM, WPEØEW, WPEØVU*)

Monrovia's 4770-kc. outlet is heard very well during their late afternoon xmsn with the signal peaking around 1630; Eng. religious programing. (*WPE2FT*)

Luxembourg—*R. Luxembourg* carries German religious services at 0000-0030 on 6090 kc. (*WPE5AG*)

Malaya—The BBC Far Eastern Station, Singapore, 11,955 kc., is tuned at 0433-0445 with pop music followed by the General Overseas Service sports results, and at 1125-1141 with classical music and commentary. (*VE7PE1R, RB*)

Netherlands New Guinea—*RONG (Radio Omroep Niew Guinea)* Bosnek, Biak, 6072 kc., is fair on this new outlet at 0724 with choral music and anmts in Dutch. (*WPE3NF*)

New Guinea—VLT6, Port Moresby, 6130 kc., is noted with dance music at 0315 and ID at 0330. This station has only 2000 watts power. (*WPEØVB*)

Nigeria—Lagos is noted on 4990 kc. with Eng. news at 1600. After a native language period, English at 1634 with recordings. (*WPE1AGM*)

The Kaduna outlet on 3326 kc. has Eng.

news at 0030 with a BBC news relay at 0100. (*WPE8MS*)

Portugal—Lisbon is noted in Eng. on 17,895 kc. at 1215-1300 (news at 1245) to S. Africa and at 0845-0930 on 21,495 and 17,880 kc. to India, Pakistan, and the Persian Gulf area. Their usually excellent musical programs and all-Portuguese anmts can be heard at 1300-1600 on 17,895 kc. to S. Africa; at 0930-1215 on 21,700 kc., 1630-2045 on 17,895 kc., and 1645-2100 on 15,125 kc. to Brazil; at 1900-2145 on 15,125 kc. to N. A. and Canada; at 2100-2300 to Pacific Coast areas on 11,840 kc.; and at 1630-1930 on 15,100 kc. to the Portuguese fishing fleet off Eastern Canada. (*WPE2TA, WPE7CB, WPE7UQ, RY*)

Rhodesia & Nyasaland—Here is the latest schedule from Lusaka. African "A" Service: 2300-0100 (weekdays) on 4826 and 7285 kc.; 0500-1030 (Sundays from 0600) on 11,882 and 7285 kc.; 1030-1300 on 7285 and 3955 kc.; and 1300-1400 on 7285, 4826, and 3955 kc. African "B" Service: 0900-1300 on 4826 kc. English and Commercial Service: 2300-0000 (daily), 0900-1900 (Saturdays), 0000-1805 (Monday through Friday) and 1000-1500 (Sundays) on 4911 and 6018 kc.; 0000-0230 on 6018 and 7220 kc., and 0230-0700 (Sundays from 0100) on 6018 and 9505 kc. Reports go to Federal Broadcasting Service of Rhodesia & Nyasaland, Engineering Division, P. O. Box R. W. 15, Ridgeway, Lusaka, Northern Rhodesia. (*WPE2BXD*).

Senegal—*R. Senegal*, Dakar, 4893 kc., has Eng. news (relay from Brazzaville) at 1730 and returns with French at 1739. (*WPE3NF*)

Sierra Leone—Freetown has local news in Eng. at 0145 on 3316 kc., local language news at 0150, and a BBC relay of news at 0200. (*WPE1AAC, WPE8MS*)

Tahiti—*R. Tahiti*, Papeete, 6135 kc., has French news at 0100 and is noted with a good signal until 0230/close. Programing consists largely of French recordings and anmts. (*WPE1AAC, WPEØVB*)

Tanganyika—Dar-es-Salaam has been noted on a new frequency, 4785 kc., from 1300 to 1415 s/off with the "Second Program." (*RY*)

Thailand—HSK, Bangkok, 15,385 kc., has Eng. at 2315-0015. (*WPE1BY*)

Tunisia—*R. Tunis* has been found on 6105 kc., from 1530 with Arabic chants, talks, and news; s/off at 1902. ID is *Huna Tunis*. (*WPE3NF*)

Another outlet on 9630 kc. has been heard fairly well in Arabic at 1300-1400 and also around 0000. (*WPE1BY*)

United Arab Republic—Cairo is scheduled as follows: 0130-0200 on 7050 and 11,670 kc. with dictation news; 1200-1400 on 17,690 kc. to W. Africa with Eng. news at 1300; 1015-1215 and 1245-1330 to E. Africa on 17,915 kc.; 1400-1730 on 11,990 kc. with French news at 1402, German news at 1515, Italian news at 1602, and Eng. news at 1645 (European beam); 0000-1830 on 9585 kc. in the Home Service. Dual to 9585 kc. is 15,390 kc. at 0000-0200, 0400-0600 (Fridays), 0930-1200 (except Fridays), 0945-1200 (Fridays), and 1200-1830. (*R. Cairo Engineering Staff, WPE1BD, WPE1BY, WPE2CD, WPE5ABD, WPE9DN, WPEØAE, SH, BS*)

(*Editor's Note:* Despite a personal letter from *R. Cairo*, several of our Monitors have positively found Cairo on 12,030 kc. rather than 11,990 kc. during the scheduled English period.)

Windward Islands—Grenada has been relaying cricket games to the United Kingdom on 21,680 kc. from 1130 onwards and has been noted as late as 1545. (*WPE2ACO, WPE5XX, WPE7CB, BB*) —30—

SHORT-WAVE CONTRIBUTORS

Stanley Schwartz (*WPE1AAC*), Bridgeport, Conn.
James Silk (*WPE1AGM*), Madison, Conn.
Dave Swedock (*WPE1ANK*), Meriden, Conn.
Anson Boice (*WPE1BD*), New Britain, Conn.
Jerry Berg (*WPE1BM*), West Hartford, Conn.
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Johnny Chane (*WPE1KW*), Winchester, Mass.
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Dan Metro (*WPE3DS*), McKeesport, Pa.
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Bruce Skogen (*BS*), APO, New York, N. Y.
Ron Young (*RY*), Chelmsford, England

SHORT-WAVE ABBREVIATIONS

A—Approximately	kc.—Kilocycles
anmt—Announcement	kw.—Kilowatts
BBC—British B/C Corp.	L.A.—Latin American
Eng.—English	N. A.—North American
ID—Identification	R.—Radio
IS—Interval signal	s/off—Sign off
xmsn—Transmission	

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—30—

POPULAR ELECTRONICS

Advertisers' Index

JUNE 1960

Pay TV's First Battle

(*Continued from page* 81)

Telemeter is aiming for a goal of 40,000 subscribers in the Toronto area. The break-even point is said to be 10,000, a figure that the company hopes to have in the fold before the year is over.

Next Target: the USA. The Canadian installation is only the beginning, according to Telemeter. Since FCC approval is not required for a wire system, the company promises that four or five communities in this country—probably on the East Coast—will be wired for toll TV this year. The densely populated upper-middle-income sections in the suburbs of New York City are the most likely spots.

Negotiations are already being made for programs to supplement motion-picture fare. And in the eventuality that the FCC should okay the use of the airwaves for pay TV, Telemeter has a system ready to go.

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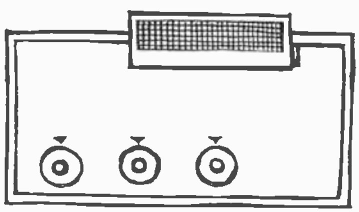
Perhaps the most important facet of the Canadian toll-TV installation is that pay TV is here, ready and willing to compete with movies and sponsored TV. Neither the government nor the networks can stop it. Now, it's up to the public—you and me—to decide its fate. –30–



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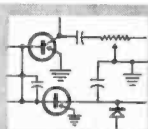

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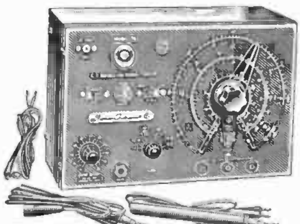

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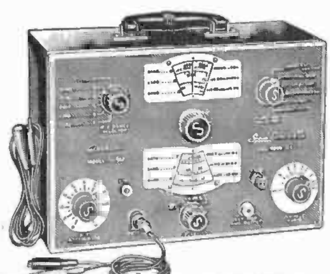

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- √ *Cross Hatch Generator*
- √ *Color Dot Pattern Generator*
- √ *Marker Generator*

This versatile All-Inclusive GENERATOR Provides ALL the Outputs for Servicing:
A.M. Radio • F.M. Radio • Amplifiers • Black and White TV • Color TV

Model TV-50A GENOMETER . . .
Total Price $47.50
Terms: $11.50 after 10 day trial, then $6.00 monthly for 6 months if satisfactory. Otherwise return, no explanation necessary.

CROSS HATCH GENERATOR: The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines interlaced to provide a stable cross-hatch effect.

R. F. SIGNAL GENERATOR: The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics.

VARIABLE AUDIO FREQUENCY GENERATOR: In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal.

MARKER GENERATOR: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency).

BAR GENERATOR: The Model TV-50A projects an actual Bar Pattern on any TV Receiver Screen. Patterns will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars.

DOT PATTERN GENERATOR (FOR COLOR TV): Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. Only **$47.50**

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

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

Superior's New Model 82A

A truly do-it-yourself type TUBE TESTER

Model 82A—Tube Tester

Total Price $36.50

Terms: $6.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

TEST ANY TUBE IN 10 SECONDS FLAT!

1. Turn the filament selector switch to position specified.
2. Insert it into a numbered socket as designated on our chart (over 600 types included).
3. Press down the quality button —

THAT'S ALL! Read emission quality direct on bad-good meter scale.

FEATURES:

• Tests over 600 tube types. • Tests OZ4 and other gas-filled tubes. • Employs new 4" meter with sealed air-damping chamber resulting in accurate vibrationless readings. • Use of 22 sockets permits testing all popular tube types and prevents possible obsolescence. • Dual Scale meter permits testing of low current tubes. • 7 and 9 pin straighteners mounted on panel. • All sections of multi-element tubes tested simultaneously. • Ultra-sensitive leakage test circuit will indicate leakage up to 5 megohms.

Production of this Model was delayed a full year pending careful study by Superior's engineering staff of this new method of testing tubes. Don't let the low price mislead you! We claim Model 82A will outperform similar looking units which sell for much more—and as proof, we offer to ship it on our examine before you buy policy.

Model 82A comes housed in handsome, portable, Saddle-Stitched Texon case. Only.... $36.50 Net

SUPERIOR'S NEW MODEL 83

C.R.T. TESTER

Model 83—C.R.T. Tube Tester

Total Price $38.50

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

Tests and Rejuvenates ALL PICTURE TUBES

ALL BLACK AND WHITE TUBES

From 50 degree to 110 degree types —from 8" to 30" types.

ALL COLOR TUBES

Test ALL picture tubes—in the carton—out of the carton—in the set!

● Model 83 is not simply a rehashed black and white C.R.T. Tester with a color adapter added. Model 83 employs a new improved circuit designed specifically to test the older type black and white tubes, the newer type black and white tubes and all color picture tubes. ● Model 83 provides separate filament operating voltages for the older 6.3 types and the newer 8.4 types. ● Model 83 employs a 4" air-damped meter with quality and calibrated scales. ● Model 83 properly tests the red, green and blue sections of color tubes individually—for each section of a color tube contains its own filament, plate, grid and cathode. ● Model 83 will detect tubes which are apparently good but require rejuvenation. Such tubes will provide a picture seemingly good but lacking in proper definition, contrast and focus. To test for such malfunction, you simply press the rej. switch of Model 83. If the tube is weakening, the meter reading will indicate the condition. ● Rejuvenation of picture tubes is not simply a matter of applying a high voltage to the filament. Such voltages improperly applied can strip the cathode of the oxide coating essential for proper emission. The Model 83 applies a selective low voltage uniformly to assure increased life with no danger of cathode damage.

Housed in handsome portable Saddle Stitched Texon case—complete with sockets for all black and white tubes and all color tubes. Only $38.50

We invite you to try before you buy any of the models described on this page, the preceding page and the following pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate.

NO INTEREST OR FINANCE CHARGES ADDED!

If not completely satisfied, you are privileged to return the Tester to us, cancelling any further obligation.

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MOSS ELECTRONIC, INC.

Dept. D-749 3849 Tenth Ave., New York 34, N. Y.

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Superior's New Model 70 UTILITY TESTER®

FOR REPAIRING ALL ELECTRICAL APPLIANCES and AUTOMOBILE CIRCUITS

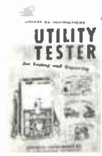
As an electrical trouble shooter the Model 70:

- Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents Switches, Thermostats, etc.
- Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakages, etc.
- Will measure current consumption while the appliance under test is in operation.
- Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc.
- Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).

As an Automotive Tester the Model 70 will test:

• Both 6 Volt and 12 Volt Storage Batteries • Generators • Starters • Distributors • Ignition Coils • Regulators • Relays • Circuit Breakers • Cigarette Lighters • Stop Lights • Condensers • Directional Signal Systems • All Lamps and Bulbs • Fuses • Heating Systems • Horns • Also will locate poor grounds, breaks in wiring, poor connections, etc.

Model 70—UTILITY TESTER
Total Price...$15.85—
Terms: $3.85 after 10 day trial, then $4.00 monthly for 3 months, if satisfactory. Otherwise return, no explanation necessary.



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Just read the following partial list of contents: What is electricity? • Simplified version of Ohms Law • What is wattage? • Simplified wattage charts • How to measure voltage, current, resistance and leakage • How to test all electrical appliances and motors using a simplified trouble-shooting technique.
• How to trace trouble in the electrical circuits and parts in automobiles and trucks.

Model 70 comes complete with 64 page book and test leads

Only $15^{85}

SUPERIOR'S NEW MODEL 80

20,000 OHMS PER VOLT ALLMETER

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

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

SPECIFICATIONS:

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

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

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

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

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

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

Model 80 ALLMETER...........
Total Price.............$42.50
Terms: $12.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

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

Model 80 Allmeter comes complete with operating instructions, test leads and portable carrying case. Only .... $42^{50}

TRY FOR 10 DAYS

BEFORE you buy *THEN* if satisfactory pay in easy, interest free, monthly payments. See coupon inside.

We invite you to try before you buy any of the models described on this and the preceding pages. If after a 10 day trial you are completely satisfied and decide to keep the Tester, you need send us only the down payment and agree to pay the balance due at the monthly indicated rate. (See other side for time payment schedule details.)

NO INTEREST OR FINANCE CHARGES ADDED!

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