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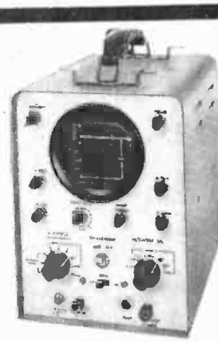

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POPULAR ELECTRONICS

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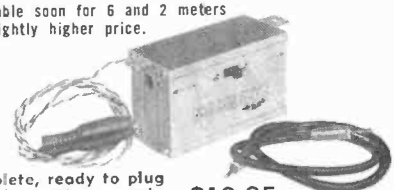

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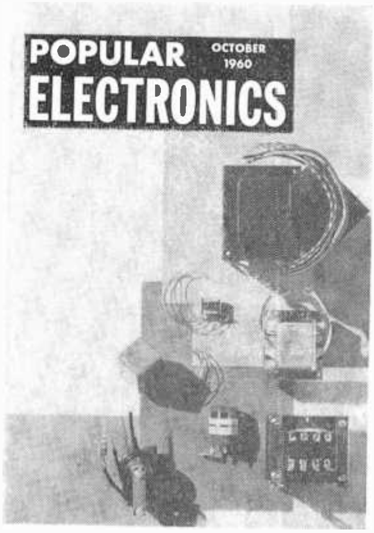

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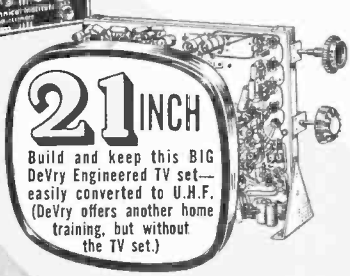

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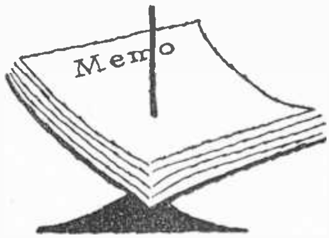


Notes from the Editor

AU REVOIR. There is little doubt that the ultimate objective of the American businessman is to retire--preferably at an early age--and sit back and enjoy life. So it is with editors--and one member of that fraternity who has recently joined the retired ranks is our own Oliver Read.

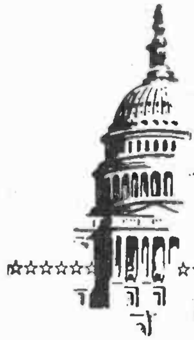
Those of you who have followed POPULAR ELECTRONICS since its inception know that Ollie served as both editor and publisher. Simultaneously, he was publisher of our "big brother" publication ELECTRONICS WORLD as well as HiFi/STEREO REVIEW, the Ziff-Davis magazine in the music and audio field. In all, Ollie was associated with the Ziff-Davis Publishing Company for over twenty-two years.

Acting as publisher of the three largest-selling magazines in their respective fields was no small undertaking. But thanks to Ollie's leadership, a pattern of operation had been established that eventually allowed him to sit back and look fondly at a job well done. Picking this moment as an opportune one, Ollie resigned from his post to go into what some might call retirement --but, knowing Ollie, it means more time for writing, more time to spend in his lab, more time to develop pet projects.

We'll miss Ollie's presence around the office, but his services are far from lost to POPULAR ELECTRONICS. Fortunately for us, he has agreed to a long-term contract as editorial consultant. This means that we here at POPULAR ELECTRONICS and all of our readers will be seeing and hearing more of him as time goes by.

As a direct result of Ollie's retirement, I have returned to POPULAR ELECTRONICS (I was managing editor from 1955 to 1957). In addition, we have lost the services of our feature editor, Furman Hebb, to HiFi/STEREO REVIEW; he has assumed the editorship of that publication. Otherwise, P. E. remains as it has been for the past year in both staff and content. Our only problem—one that most successful magazines enjoy—is just plain growing pains. With Ollie's continued help, our job will be easier.

Oliver P. Ferrell



FCC Report

By ROBERT E. TALL
Washington Correspondent

CB Call Signs

If the FCC has switched call signs on you lately, steer clear of using your former call. That's what the Commission is telling all Citizens Banders who feel they have a sentimental interest in their original call signs and want to continue to use them.

The Commission says it would like to allow CB'ers to keep their original call signs, since they are actually "serial numbers" for station identification purposes. But the "sudden growth" of the service has forced the FCC to cut its paper workload as much as possible. So, to fit into the FCC's current license processing scheme, every license renewal has to be treated as a completely new station application. Therefore, all modified and renewed licenses are automatically given new call signs, the Commission says, and since the former "serial numbers" are thereby superseded, they may no longer be used to identify the CB stations involved.

We haven't as yet run into any FCC enforcement cases involving this point in Washington. But there must be a few kicking around or the Commission wouldn't have gone to such pains to make its position clear.

Treating CB call signs as serial numbers fits into the agency's new call sign plans which are to go into effect on January 1, 1961. Under the new program, a *letter*—between Q and W—will be used for all "serial numbers" issued during each calendar year, with a different identifying letter each year.

The Commission plans to repeat the letters every seven years. For example, all *Q* licenses issued in 1961 will have expired by the end of 1966, and *Q* calls will not be re-

issued again until 1968. This will give the *Q* a one-year vacation (and the other letters as well in succeeding years) and also give the FCC a chance to see if anyone is using a transmitter with an expired license.

According to the Commission, this plan "will further simplify the administration of the service and will add significance to the serial numbers when they are heard on the air."

Applications for CB licenses really are closely examined by the FCC—despite the fact that they are pouring into Washington at a clip of more than 11,000 a month. The Commission caught an application for three CB units filed by a girl in El Paso, Tex., after the FCC had withdrawn the CB license of one of the male members of her family. The license had been revoked after charges that the CB'er was engaging in a type of long-distance communication not intended in the rules; that the station was operating on frequencies beyond the allowable tolerance; and that the El Paso gentleman failed to answer the FCC's letters regarding the subject.

In dubbing the girl's application "unacceptable," the Commission whipped up some language to the effect that it was prohibited from considering her request for a year after the date of the revocation order. The FCC said that it will "not consider a like or new application involving service of the same kind to substantially the same area by substantially the same applicant, his successor or assignee, or on behalf of or for the benefit of the original parties in interest until after the lapse of 12 months from the effective date of the revocation order."

Translating this legal mumbo-jumbo into CB talk, the FCC will not give each and every adult member of a family the opportunity—one at a time—to jam up the band.

A potential axing for Citizens Banders, along with all other types of radio users, was avoided recently when the House failed to act on a bill which would have provided for the collection of fees to cover costs of operating certain government agencies, including the FCC. This bill proposed assessing charges for each application filed with the Commission, including modifications and renewals. It was generally similar to previous attempts to put the regulatory agencies on a pay-for-themselves basis, and is a cinch to come up again in the future. —30—

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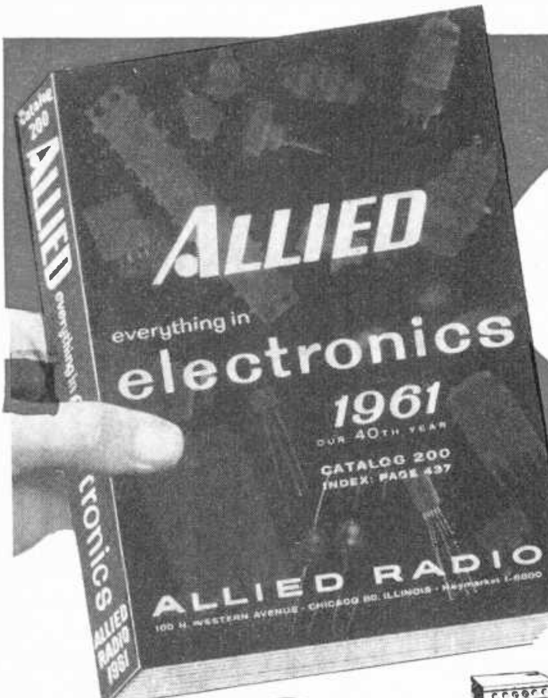

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Letters from our readers

"Supersonic Squawker"

■ I would like to use the "Supersonic Squawker" described in your November 1959 issue at my school's annual science fair. Can you tell me the approximate audio ranges of the squawker as well as what animals will react to it?

GORDON LA BONTE, K1JIJ
Manchester, N. H.

The frequency range of the squawker is from approximately 1000 to well above 20,000 cps. Most creatures will respond to the squawker—for example, dogs, cats, and starlings. A neighbor's dog may be quiet for hours, but he'll start barking as soon as the squawker is turned on.

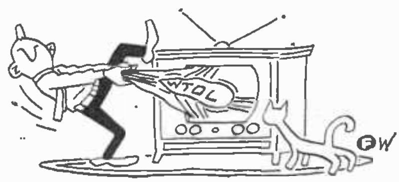
Information Wanted

■ I have recently acquired an old Zenith Model 3-R receiver. It has an all-wood cabinet and weighs about 35 pounds. The Zenith people tell me it was built in 1923 and it's a museum piece. Can any of your readers supply me with a service manual or some information about this receiver?

MARSHALL M. DUES
11499 N. Saginaw Rd.
Clio, Mich.

TV DX'ing

■ I would like to thank POPULAR ELECTRONICS for the fine article entitled "DX'ing on TV" which appeared in the June 1960 issue. After I tried out



some of the hints given in this article, I managed to pull in WTOL, Toledo, Channel 13—over 100 miles. The very next day I again pulled in Toledo, this time WSPD on Channel 11.

JIM KINCAID
Brecksville, Ohio

Drilling Metal Chassis

■ I would like to point out that the gentleman on the cover of your March issue is drilling a metal chassis in a very dangerous way. Rather than holding the chassis in his bare hand, he should have clamped it to the workbench. Lacking a suit-

CARL E. SMITH,
E. E., President

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Letters

(*Continued from page* 12)

able clamp, he should have nailed two blocks of wood to the workbench and placed the chassis between them. Either of these techniques will pay off in a better drilling job and fewer cut fingers.

HERBERT A. GROHMANN
Milwaukee, Wis.

Our thanks go to Reader Grohmann for pointing out the danger in drilling metal chassis without first mounting them securely on the workbench.

BCB DX Clubs

■ In the April 1960 issue, J. D. Leitch spoke highly of broadcast-band DX'ing, and said he wanted to start a club. Mr. Leitch and others like him should be informed about the DX'ers Radio Club and the National Radio Club since both are devoted to BC'ing.

MURRAY C. MANN
Omaha, Nebr.

For information on the National Radio Club and the DX'ers Radio Club—and on BCB DX'ing —see article starting on page 60 of this issue.

Electronic Organ

■ I have been reading POPULAR ELECTRONICS since May, 1955, and in my opinion it is full of clear and well-explained information. In fact, I call it

the "technician's best friend." One thing I would like to see in a future issue is a diagram on an electronic organ—I would like to build one.

ERNEST DI ZAZZO
Montreal, Canada

Thanks for the bouquets, Ernest. It's always reassuring to receive a vote of thanks. As for an electronic organ, it would require considerable expense, construction time, test equipment, and know-how to build one. Even then, the organ probably wouldn't even sound or look professional. In fact, to find a keyboard for a home-brew organ, you might have to chop up your wife's spinet! Your best bet is one of the electronic organ kits now on the market.

Government Books

■ Many of your readers may be unaware of the excellent electronic publications that are available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C. These publications include Air Force manuals, Navy training manuals, and other technical manuals used by the armed forces. Information on such publications can be obtained by requesting a

NEW! LAFAYETTE HE-15A 2-WAY SUPERHET CITIZENS BAND TRANSCEIVER!

- 5 Crystal Controlled Transmitting Positions: Operates at a maximum FCC legal power input of 5 watts fully modulated.
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HE-15A Factory Wired and Tested (less antenna) 5.00 Down .... Net 64.50
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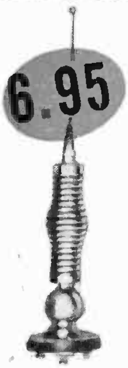

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- 102½" STAINLESS STEEL WHIP FOR OPTIMUM 11 METER PERFORMANCE

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- Chrome Plated
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An outstanding antenna value. This high quality three section telescoping antenna is designed for attachment directly to your citizens band transceiver. Ideal for point to point service over short distances. Molded base loading coil has a threaded stud with a PL-259 plug-connector for vertical or right angle mounting. Shpg. wt., 1 lb.

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10,000 OHMS PER VOLT MULTITESTER

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Convenient pocket size with single range selector switch. First capacity range requires 120V AC, second range requires 6V AC. Durable Bakelite case and panel. Complete with leads and battery. 4½x3½x1⅛". Shpg. wt., 1½ lbs.

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- Provides a Continuous Indication of Transmitter Output
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Measures the RF field generated by any marine, mobile or fixed transmitter. Rear phone jack accepts earphones. Antenna extends from 3¼" to 10¾". Bottom plate magnet allows mounting on any metal surface. Measures 3⅛Wx2¼Hx2"D (less antenna). Shpg. wt., 2 lbs.

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Letters

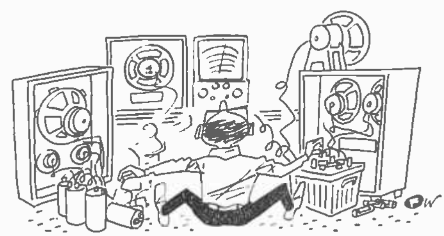
(Continued from page 14)

free copy of Price List 82, RADIO, which also covers electronics, radar, and communications.

EINAR H. MORTERUD, W5FPB
Albuquerque, N. M.

Multi-Speaker Systems

■ In the May "*Letters From Our Readers,*" there was a speaker phasing tip by Christopher Farrell of Lantana, Fla. An alternate method of determining the polarity of the wires in a complicated



multi-speaker system involves only the use of a small battery and a meter. You simply connect the battery across the wires at any point and read the voltage at the other points. The polarity of the wiring can be determined by noting the polarity of the voltage read by the meter.

EUGENE SCHOEN
Baltimore, Md.

Converter Wanted

■ While I would like to put in a word of appreciation for an excellent electronics magazine, I also want to point out one construction project that seems to have been overlooked. Personally, I would like to see plans on a multi-band short-wave converter for use with a broadcast-band receiver either in the home or in the car. I'm sure it would give many of your readers a thrill to be able to listen to Australia as they drive to work in the morning, and to Turkey as they drive back at night. Then, too, it would be a boon for radio amateurs who want to go mobile without spending a lot of money.

STEPHEN R. WILHELM
Great Neck, N. Y.

We agree with you, Stephen. Check the coming issues of POPULAR ELECTRONICS *for a crystal-controlled, battery-operated transistor converter. We just finished running tests on the unit and expect to get the plans into print shortly.*

Happy Ham

■ I added the screen modulator in the February "Across the Ham Bands" to my DX-20 transmitter and am happy to report that it works fine. The voice quality is very good, and the first report I received called the modulation excellent.

CHARLES A. RANKIN, WA2HMM
Westbury, N. Y.

We're happy you're happy, Charles. Watch "Across the Ham Bands" every month for more interesting and useful ham projects. -30-

POP'tronics Bookshelf

"STEREO HIGH FIDELITY HANDBOOK" by Norman H. Crowhurst. Published by Crown Publishers, Inc., 419 Park Ave. S., New York 16, N. Y. Hard cover. 183 pages. $5.95.

A complete commentary on every aspect of stereo high fidelity, this book tells how to achieve maximum pleasure in stereo listening. The author offers detailed information on buying stereo equipment, converting a monophonic system to stereo, and general repairs and trouble-shooting. If you want to get acquainted with high fidelity and get the low-down on stereo, this book is a good investment.

"INTRODUCTION TO ATOMIC ENERGY" by William G. Atkinson. Published by John F. Rider Publisher, Inc., 116 West 14th St., New York, N. Y. 76 pages. Soft cover. $1.35.

An excellent primer for those who would like to learn the fundamentals of atomic energy without getting involved in higher mathematics, this book was written by a man who knows whereof he speaks. He's the chief hull designer of General Dynamics' Electric Boat Division, the creators of our atomic submarines. In fact, the book was originally undertaken in order to instruct personnel at the shipyard in the basics of atomic energy.

"USING AND UNDERSTANDING PROBES" by Rudolf F. Graf. Published by Howard W. Sams & Co., Inc., 2201 E. 46th St., Indianapolis, Ind. Soft cover. 190 pages. $3.95.

The author describes where and how to use probes for testing all types of electronic equipment. In addition to practical data on probes for radio and TV servicing, the book also covers special-purpose probes used in industry, agriculture, medicine, etc.,

Bookshelf

(*Continued from page* 20)

for observing, testing, exploring, and measuring. Seven chapters and over 200 illustrations help the reader to understand direct, isolation, high-voltage, low-capacitance, rectifying, demodulator, signal-tracing, and signal-injecting probes.

"MOST - OFTEN - NEEDED 1960 TELEVISION SERVICING INFORMATION," compiled by M. N. Beitman. Published by Supreme Publications, 1760 Balsam Road, Highland Park, Ill. Soft cover. 192 pages. $3.00.

As an aid to the repair of your 1960 TV set, Supreme has published its yearly manual containing diagrams, alignment data, parts lists, voltage data, etc., for fifteen manufacturers' models. Step-by-step servicing procedure is accompanied by pictorials, schematics, and printed-circuit diagrams for both TV chassis and remote-control tuners. If you have an earlier-model TV set or a radio that appeared in one of Supreme's previous "Most-Often-Needed Servicing" manuals, you'll find it listed by manufacturer and model in "THE 1960 MASTER INDEX TO SUPREME PUBLICATIONS," now available for 25 cents. For example, if you have an old Midwest Radio, Model 16-34, the Index will tell you that the circuit and alignment data appears on page 105 of Supreme's Radio Manual 1926-1938, Vol. 1, and that the volume sells for $2.50.

"UNDERSTANDING MICROWAVES," Abridged Reprint, by Victor J. Young. Published by John F. Rider Publisher, Inc., 116 West 14th St., New York, N. Y. Soft cover. 304 pages. $3.50.

The fundamentals of microwaves—their generation, transmission, and application—are covered thoroughly in this book. Opening with an explanation of electromagnetic and electrostatic fields, it deals with radiation, reflection, Poynting's vector, and Maxwell's equations. Waveguides, coaxial lines, and resonant cavities are discussed in connection with the magnetron, the dynatron,

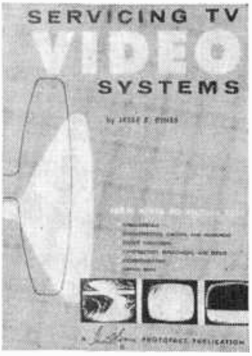
Bookshelf

(*Continued from page* 22)

and the klystron. Microwave antennas are also covered. Recommended as an introduction to the field of microwaves.

"SERVICING TV VIDEO SYSTEMS" by Jesse E. Dines. Published by Howard W. Sams & Co., Inc., 2201 E. 46th St., Indianapolis, Ind. Soft cover. 222 pages. $3.95.

One of the mysteries that confront the average experimenter concerns the fine details of how video circuits operate. This book leads the reader from the television tuner output signal through the video circuits to the electron impact on the screen of the cathode-ray tube. Numerous circuit diagrams, waveforms, block and pictorial diagrams, and photos are used throughout the text to great advantage. The book contains operating data not found in many TV instruction manuals.



Free Literature

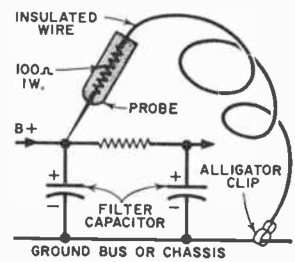
Citizens Banders will be interested in an eight-page catalog, No. AN-61, now available from the GC Electronics Co., 400 S. Wyman St., Rockford, Ill. The booklet describes the company's comprehensive line of Citizens Band equipment—specially designed antennas for fixed station and mobile applications; various antenna-mounting devices for mobile installations; wall, chimney, and tower mounts; adapters, capacitors and suppressors.

A new 28-page catalog describing the complete line of Stancor coils can be obtained from the Chicago Standard Transformer Corporation, 3501 W. Addison St., Chicago 18, Ill. Detailed electrical and physical specifications are given for more than 600 units, as well as complete application information. Some 79 schematics are included, covering every coil type in general use. —30—

Tips and Techniques

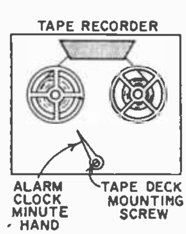
CAPACITOR DISCHARGE PROBE

Before beginning work on a.c.-powered equipment that has just been turned off, protect yourself from filter capacitor shocks by discharging the capacitors. You can make a discharge probe from a two-foot length of flexible, insulated wire; an alligator clip; a 100-ohm, 1-watt resistor; and a test probe. Attach the alligator clip to one end of the wire, and solder one lead of the resistor to the other end of the wire. Then connect the remaining resistor lead to the probe tip. When you have turned off the equipment, fasten the alligator clip to the unit's chassis or ground bus. Then discharge all filter capacitors by touching the probe to their positive terminals for a few seconds—*Clifford Marshall, Edmonton, Canada.*



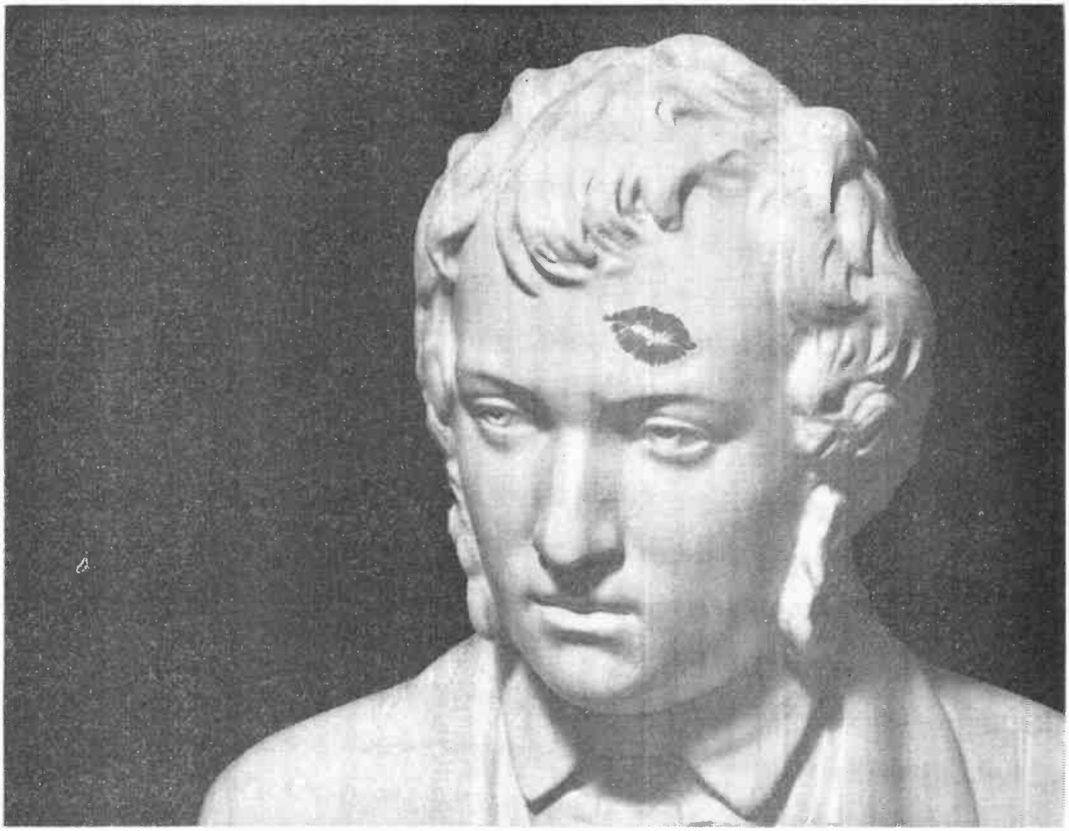
TAPE RECORDING AIDS

Do you ever have trouble remembering which way you were recording on your dual-track tape recorder after you've turned the recorder off? Try mounting an alarm clock minute hand or other wire pointer loosely under a mounting screw on the tape deck as shown. Point the hand toward the take-up reel when you start recording, and point the pointer to the other reel when you start to tape the other way. You'll have no trouble recognizing the take-up reel even if you're in the middle of a reel of tape.—*Art Collins, Buffalo, N. Y.*



EXPERIMENTERS' SCHEMATICS

Experimenters, hams, and hobbyists who build their own equipment should keep a schematic of each project handy—it makes



CLASSICS THAT MADE THE HIT PARADE

DETAILS OF THE PROGRAM

"Classics that Made the Hit Parade" includes these popular symphonic themes:

Borodin	Polovtsian Dances from Prince Igor (Stranger in Paradise)
Tchaikovsky . . .	Symphony No. 5 in E (Moon Love)
Waldteufel . . .	Espana Waltz (Hot Diggity)
Chopin	Polonaise No. 6, in Ab Major (Till the End of Time)
Tchaikovsky . . .	Symphony No. 6 in B (The Story of a Starry Night)
Rachmaninoff . .	Piano Concerto No. 2 in C Minor (Full Moon and Empty Arms)
Chopin	Fantasie Impromptu in C# Minor (I'm Always Chasing Rainbows)
Tchaikovsky . . .	Romeo and Juliet Overture (Our Love)

DETAILS OF THE OFFER

This exciting recording is available in a special bonus package at all Audiotape dealers. The package contains one 7-inch reel of Audiotape (on 1½-mil acetate base) and the valuable "Classics that Made the Hit Parade" program (professionally recorded on Audiotape). For both items, you pay only the price of two reels of Audiotape, plus $1. And you have your choice of the half-hour two-track stereo program or the 55-minute monaural or four-track stereo versions.

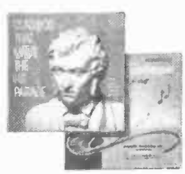
See your Audiotape dealer now.

— a new bonus reel from Audiotape

Some of our greatest popular songs — hits like "Full Moon and Empty Arms," "Till the End of Time," "Stranger in Paradise" — took their melodies from the classics. Eight of these lovely themes—in their original classical setting — are the basis for "Classics that Made the Hit Parade," a program with strength, variety, and, of course, rich melodic beauty.

This unusual program, professionally recorded in sparkling full fidelity on Audiotape, is available RIGHT NOW from Audiotape dealers everywhere. (And only from Audiotape dealers.) Ask to hear a portion of the program, if you like. Then, take your choice of a half-hour of two-track stereo, or 55 minutes of four-track stereo or dual-track monaural sound — all at 7½ ips. Don't pass up this unique opportunity.

"Classics that Made the Hit Parade" makes an ideal addition to Audio's first two bonus reels, "Blood-and-Thunder Classics" and "High Spirits," still available at Audiotape dealers.



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AUDIO DEVICES, INC., 444 Madison Ave., N. Y. 22, N. Y.
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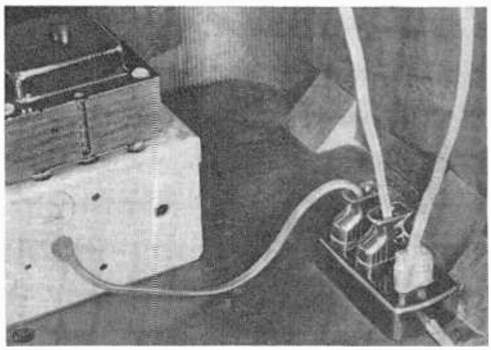
Tips

(*Continued from page* 26)

trouble-shooting easier when some part fails in service. Draw two copies of the schematic as soon as a project is finished and while all the details are still fresh in your mind. Indicate all the normal operating voltages at tube pins, transistor terminals, and other key points. Then file one copy in your experimenter's notebook, and fasten the other copy to the inside of the unit's cabinet where it will be safe from heat generated by the equipment. If the unit doesn't have a cabinet, glue the schematic to the chassis or, better yet, to the chassis bottom plate.—*Jim Kyle, K5JKX/6, Granada Hills, Calif.*

AUXILIARY RECEPTACLE

Mounting a three-way female receptacle at the rear of your console radio as shown can reduce the number of cords and plugs at the radio's wall socket. This will enable you to power other units such as record players, electric clocks, lamps, etc., placed on or near the radio, yet have only one cord running to the wall plug. Mount the receptacle to the cabinet using wood



screws; connect one end of a length of lamp cord to the receptacle, and attach a male plug to the other end. Be sure not to overload the wall socket or receptacle with appliances draining more than either one can handle.—*Art Trauffer, Council Bluffs, Iowa.*

KEEP TV SET'S TEMPERATURE DOWN

Too much heat is public enemy number one to parts in your TV set. To prolong the life of your set, keep the temperature inside the cabinet from reaching dangerous levels. Avoid placing the set tightly against a flat wall; if possible, place it across a corner

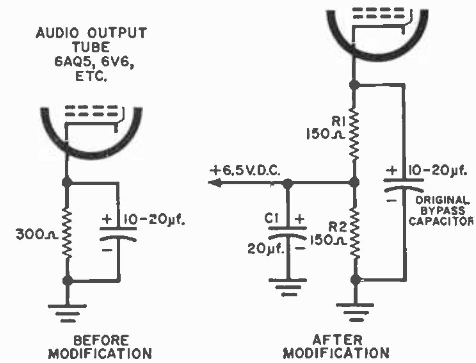
Tips

(*Continued from page* 28)

or at a distance of at least 12" from the wall. In very warm locations, use a small blower fan to ventilate the cabinet.—*John A. Comstock, Wellsboro, Pa.*

POWERING TRANSISTORS

You can easily add a transistorized section to a vacuum-tube amplifier or radio by taking the necessary voltages from the audio output tube's cathode. Modify your set as shown in the schematic and you'll have about 6.3 volts with a negative ground suitable for *n-p-n* transistors. Resistors *R1*



and *R2* serve as a voltage divider, and capacitor *C1* insures that no audio variations will appear in the output voltage. Any cathode-biased output tube can be used, but the output voltage will of course depend on the tube's bias and the ratio between *R1* and *R2*.—*James Romelfanger, Baraboo, Wis.*

TUBE TESTING HINT

Tubes that register "good" on a tube tester often fail to operate in such critical circuits as oscillators and r.f. stages. To weed out these marginally good tubes, simply lower the filament or heater voltage about 10% during testing; set the tube tester's voltage selector to the next lower position, which is usually 10 to 15% lower. If the tube registers "good" with normal voltage but drops into the questionable or "bad" ranges with below-normal voltage, it's nearing the end of its life. This means that it probably won't operate in critical circuits, but it may still provide many hours of useful operation in less critical installations.—*Jim Kyle, K5JKX/6, Granada Hills, Calif.* —30—

The Sounding Board

FOAM CONE: *Engineering Breakthrough for* Better Bass

The "foam cone", just recently introduced in super-quality Electro-Voice low-frequency woofers, represents a major breakthrough in loudspeaker design — and a marked improvement in the delivery of clear, transparent, undistorted bass.

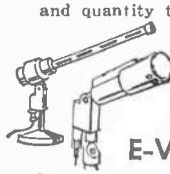
Rigidity of the cone is essential for smooth response. Until the advent of foam, larger woofers were forced into some sort of compromise between acceptable weight and high rigidity. Conventional "paper" cones in smaller diameters can be thickened to the point of inflexibility without undue weight increase, but this is not true of cones with larger diameters — and it is in these larger cones that the resultant "muddy" sound is the most pronounced. Conventional material, in the thickness required for absolute rigidity, would be beyond the weight limitation which is fixed by magnet size and available amplifier power (without expensive re-design of both components).

Exhaustive research turned up "foam". Its correct name is polystyrene (a very hard plastic) — and the word "foam" is related to the form of the material in its final state. Air is entrained in it by agitation while it is liquid. When it cools in the mold, it retains the "foam" structure (internally) — along with its exceptional hardness and stiffness. Thus a thickness — and a stiffness — many times that of "paper" is possible with no increase in weight.

Furthermore, the ratio of stiffness to weight and thickness is completely predictable and calculable. The engineer can specify the proper thickness for the required rigidity. Weight will stay well within limits — and the molding of the cones can be controlled to sub-microscopic accuracy.

The result is a true inflexible cone — which operates as a piston. There is no distortion of shape and none in the resultant sound. It all came about because Electro-Voice is dedicated to achieving perfection demanded by the Audiophile — and has the engineering talent in quality and quantity to solve the problem.

"Accidental" Tests Prove Superiority of E-V Microphones



Electro-Voice conducts many microphone tests to determine durability. Occasionally, though, we hear of a field experience more effective than anything performed in our laboratories. Take, for instance, the time a local engineer, preparing for a game at a high school stadium, accidentally dropped a microphone down a flight of concrete steps. The case was damaged, but lack of time forced him to hook up the one he dropped. His worry about failure proved unnecessary because the microphone performed without the slightest loss in quality.

Such unusual and unexpected circumstances come to our attention because we are asked to ascertain the condition of microphones after mishaps. We were not surprised at the durability exhibited because of our own unique method of testing every E-V microphone model. We drop it, we roast it, freeze it, drench it with salt water, explode guns near it, test for pressure at high altitudes, and subject it to abrasive wear and tear.

Now, we don't suggest you abuse your E-V microphones as we do when testing. But, should an accident occur, it's nice to know the chances of anything affecting performance are limited.

The cited example is only one of the many requests received to check over field equipment and provide consultation in the field when desired. Lou Burroughs, one of the founders of E-V, and Vice President of Broadcast Engineering, has retained intensive contact with TV and Broadcast Engineers. His on-the-scene consultation has enabled him to help in the solution of many ticklish problems and has kept him abreast of situations which require special microphones.

The 30W — A Woofer for the Wildest Audiophile

The creation of a large, low-frequency speaker is not unique to Electro-Voice, nor is the 30W the largest speaker ever built. E-V, however, did recognize the inherent advantages a woofer could have over a smaller speaker. Such a woofer, because of its ability to reproduce efficiently the lowest bass frequencies without distortion — would offer the ultimate clarity desired by high-fidelity perfectionists.

Electro-Voice, committed for many years to ultra-rigidity in speaker construction, produces a complete line of speakers having rigid, one-piece, die-cast frames. There is no exception to this.

It was inconceivable that an exception could be made with a giant woofer just because of its size. Actually its great size demands extra rigid construction to insure smooth response. Regardless of the extensive and expensive tooling required in shaping the die, core, and die frame, the 30W is now here. It is the world's largest and finest woofer, complete with an absolutely rigid die-cast frame and super bass voice. The die press required to produce the frame is one of the largest in the industrial state of Michigan.

Equal care and design went into all phases of the 30W development. It includes a super-heavyweight (9¼ lbs.) ceramic magnet to increase efficiency and minimize distortion. The new, super-stiff cone of polystyrene foam was originally designed for the 30W. It has almost three times the cone area of an 18-inch woofer and moves an amazing column of air without extra demand on the amplifier. The true-piston performance made possible by the die-cast frame and foam cone enables this speaker to perform beyond the demands of the most confirmed audiophile — absolutely distortion-free to below 25 cps.

Did You Know?

A phonograph needle (stylus) travels and tracks between 500 and 600 yards every time one side of an LP record is played and heat at the tip approaches 1000° F. This high temperature is the basic cause of needle wear. The diamond, with its resistance to heat and abrasive wear and its unequaled hardness, is the ideal stylus to keep record wear at a minimum. It lasts 20 times longer than a sapphire, too. Ask for Electro-Voice Power Point Needles and prolong your record life.

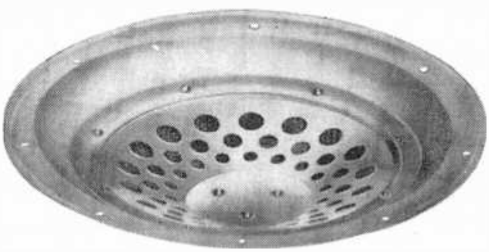
Electro-Voice®

ELECTRO-VOICE, INC.
Dept. 90P, Buchanan, Michigan

NEW products

CEILING SPEAKER

A new "Thin-Line" speaker only 2¼" deep has been announced by *Lafayette Radio*, 165-08 Liberty Ave., Jamaica 33, N. Y. De-



signed to mount in any ceiling, wall, or other baffle, the SK-175 features an unusual construction that places its 12-oz. magnet in front of the cone rather than behind as in conventional speakers. The voice coil is 1" in diameter; frequency response is from 90 to 9000 cps; impedance, 8 ohms. Outside diameter is 9½", including the integrated metal baffle; a 6⅝" wall cutout is required. Price, $5.95.

DYNAMIC CARDIOID MICROPHONE

The new Knight Model KN-4550 dynamic cardioid microphone can be used for all recording and public address applications. Employing a directional, heart-shaped sound pickup pattern to obtain an extremely high front-to-back ratio, the KN-4550 reduces the effects of audience noise and other sounds originating at the back or sides. The microphone is supplied with on-off switch, 18' mike cable, and screw-type connector. Frequency response is 60 to 13,000 cps; output level is −57 db. Output impedance can be

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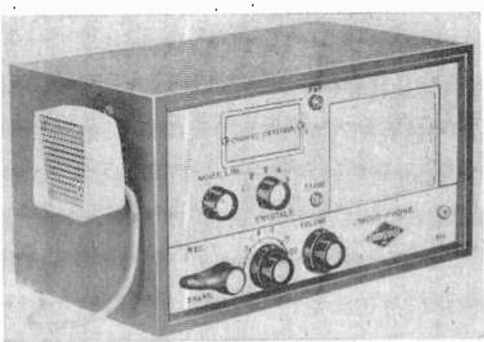
(*Continued from page* 32)

adjusted at the connector for either 150 ohms or hi-Z. Price, $39.95. (*Allied Radio Corp.*, 100 N. Western Ave., Chicago 80, Ill.)

CITIZENS BAND TRANSCEIVER

The Model TR-800 "Radio-Phone," a five-channel Citizens Band transceiver, has recently been announced by *United Scientific Laboratories, Inc.*, 35-15 37th Ave., Long



Island City 1, N. Y. Features of the "Radio-Phone" include a superhet variable-tuning receiver, a crystal-controlled transmitter, and a power pack for operation with either 6 or 12 volts d.c. The unit is furnished with one crystal, a microphone, mobile mounts, and a license application form. Price, $99.95.

GENERAL-COVERAGE SSB RECEIVER

Designed for amateur, commercial, or military SSB operation, the HQ-180 receiver uses single-sideband tuning techniques and provides full dial coverage from 550 kc. to 30.0 mc. It is entirely self-contained, with

its own power supply, requiring only an external speaker or earphones. The HQ-180 features an 18-tube superheterodyne circuit with automatic noise limiter and

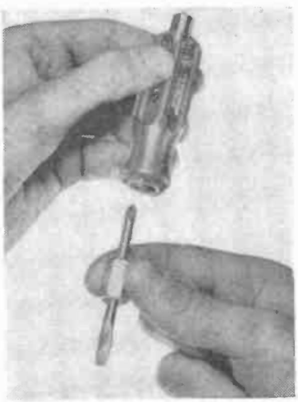
products

(*Continued from page* 36)

uses triple conversion from 7.85 mc. to 30.0 mc., dual conversion from 540 kc. to 7.85 mc. Sensitivity is 0.5 μvolt (c.w.) for a 10:1 signal-to-noise ratio. Price, $429.00, plus $10 for optional clock-timer. (*Hammarlund Manufacturing Company, Inc.,* 460 West 34th St., New York 1, N. Y.)

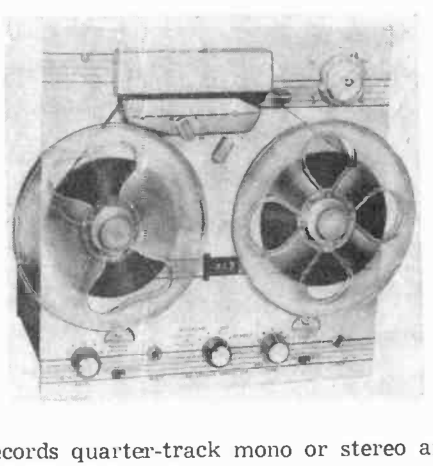
FOUR-WAY POCKET TOOL

A new four-way pocket tool has been introduced by *Xcelite, Inc.,* Orchard Park, N. Y. Television servicemen and all "do-it-yourself'ers" will find the Model 600 handy for a variety of jobs—from removing the backs of TV sets to installing antennas. Readily adaptable for use as a ¼" nut driver, a 3/16" slotted screwdriver, or No. 1 Phillips screwdriver, the tool will fit all standard types of screws commonly applied to the rear panels of TV sets. As a 7/16" nut driver, it can be used for fastening antenna fittings. Price, $2.30.



STEREO TAPE DECK

Stereo enthusiasts will be interested in the Lafayette RK-107 stereo tape deck. It



records quarter-track mono or stereo and plays back quarter-track or half-track mono or stereo. Recording amplifiers are built in; playback is through the tape-head inputs of a stereo amplifying system. Frequency response is from 30 to 17,000 cps at 7½ ips, 40 to 15,000 cps at 3¾ ips; flutter and wow, less than 0.2%; signal-to-noise ratio, 55 db or better. Other features include twin recording-level meters, a digital tape counter, and facilities for recording sound on sound. Dimensions are 13" x 13" x 9½"; price, $239.95. (*Lafayette Radio,* 165-08 Liberty Ave., Jamaica 33, N. Y.)

CAPACITOR REPLACEMENT KIT

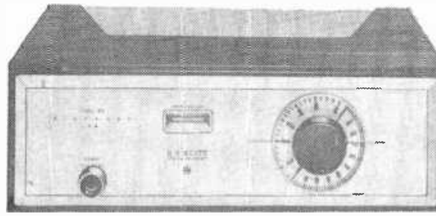
A new compact kit of molded Mylar capacitors is being marketed by the *Cornell-Dubilier Electric Corp.*, South Plainfield, N. J. Called the "Hit Kit," it consists of 35 popular "PM" capacitors in seven most-used values, packed in a sturdy plastic box that can double as a spare parts box when the resistors have been removed. Price, $6.87.

CB MICROPHONES

A line of microphones designed for use in Citizens Band installations has been announced by *American Microphone Mfg. Co.,* Rockford, Ill. Available in either ceramic or crystal types, the "208" series microphones are high-impedance units with frequency response from 40 to 8000 cps. Models with a slide-lock switch are furnished in either closed-mike or open-mike versions for $12.50. If the slide-lock feature is not desired, the price is $10.60.

FM TUNER

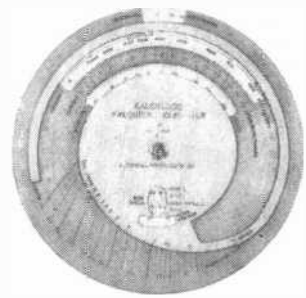
Now available from *H. H. Scott, Inc.,* 111 Powdermill Rd., Maynard, Mass., is a new moderately-priced FM tuner. Featuring 2.5-microvolt sensitivity, the Model 314 has a silver-plated front end to provide optimum performance with even the weakest signals. The manufacturer guarantees the tuner to



be drift-free without the need for conventional a.f.c. Two stages of limiting insure good AM rejection; a multiplex output is included for use with a multiplex decoder. Price, $114.95.

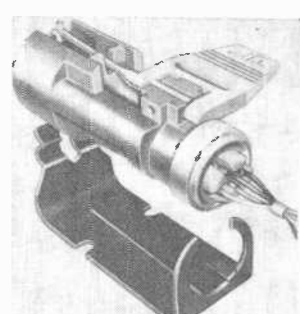
FREQUENCY COMPUTER

Problems involving inductance, capacitance, and frequency can be solved with the "Calculaide Frequency Computer," made by *American Hydromath Corp.*, 24-20 Jackson Ave., Long Island City 1, N. Y. The device covers frequencies from 400 kc. to 3000 mc., wavelengths from .1 to 600 meters, capacitance between 1 and 1000 $\mu\mu$f., and inductance from .05 to 1500 μh. Price, $4.95.

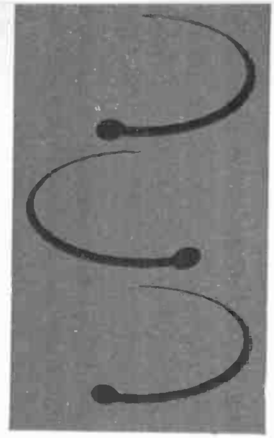


CRYSTAL STEREO CARTRIDGES

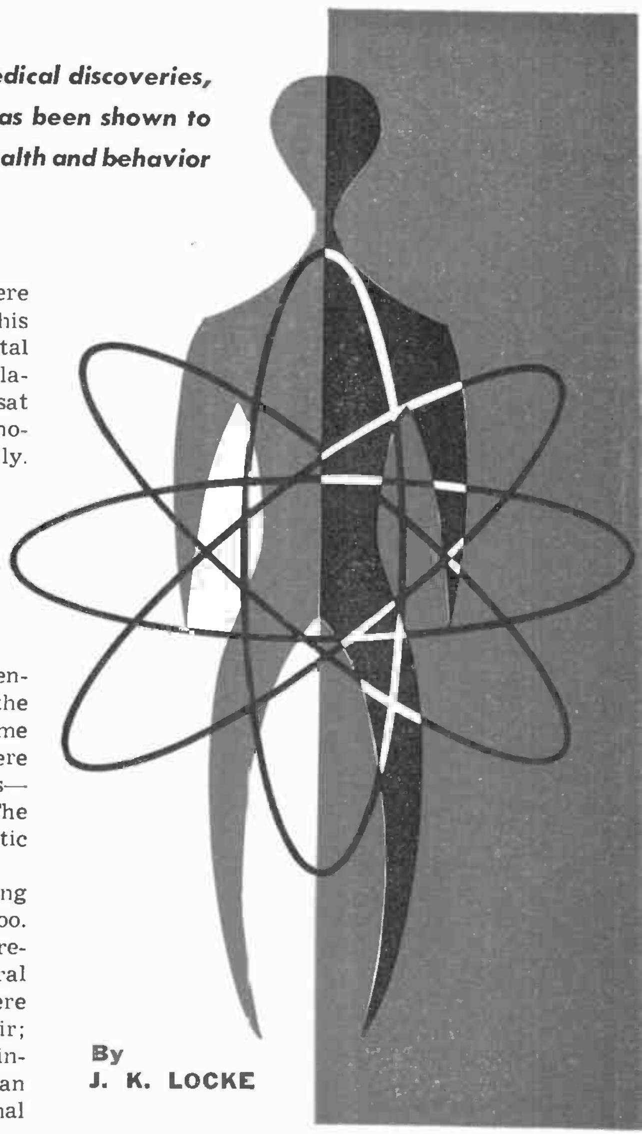
Sonotone Corporation, Elmsford, N. Y., has introduced its new Series "12" crystal stereo turnover cartridges. Made entirely of plastic except for the styli, crystal elements, and mounting brackets, Model "12TH" has an output of 2.5 volts, and Model "12TL" an output of 1.0 volt. Price for each model, $6.45, including mounting bracket, terminal plug, and standard 0.7-mil and 3-mil sapphire styli. —30—



ionized air and human health



One of the most recent medical discoveries, electrically charged air has been shown to have strange effects on human health and behavior

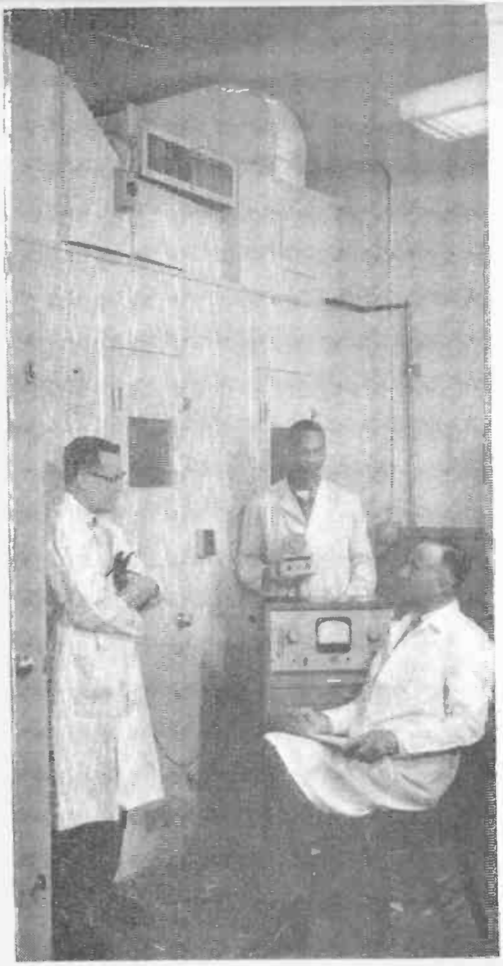


By
J. K. LOCKE

SNEEZING uncontrollably with a severe case of hay fever, the patient made his way to Room 303 of the Graduate Hospital at the University of Pennyslvania in Philadelphia. A few minutes later, as he sat answering the doctor's questions, he noticed that he was breathing more easily. Within twenty minutes his sneezing had stopped completely, his runny nose and watery eyes were drying up, and for the first time in days he was able to breathe normally. As far as he knew, the treatment hadn't even begun—but it had!

A few minutes before the patient entered the room, the doctor had flipped the switch on a small machine. By the time the patient came in, the room's atmosphere was heavily charged with negative ions—electrified air molecules and atoms. The ionized air was responsible for his dramatic improvement.

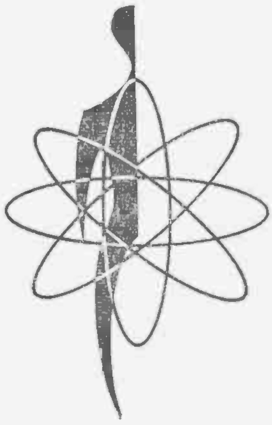
Ionized air is achieving similarly striking results in other types of illness, too. Asthma sufferers get the same kind of relief as those with hay fever. At several Philadelphia hospitals, patients with severe burns are routinely dosed with ionized air; the burns heal more quickly, are less painful, and are less subject to infection than when they are treated only by conventional



Air ion laboratory at the University of California is maintained in collaboration with the Naval Biological Laboratory. Bacteriology professor Albert Krueger is shown seated, while lab assistant Eddy Reed displays a Wesix ion generator. Bacteriologist Richard Smith holds one of the rabbits used in testing the effects of air ions on animals. (U. S. Navy photo)

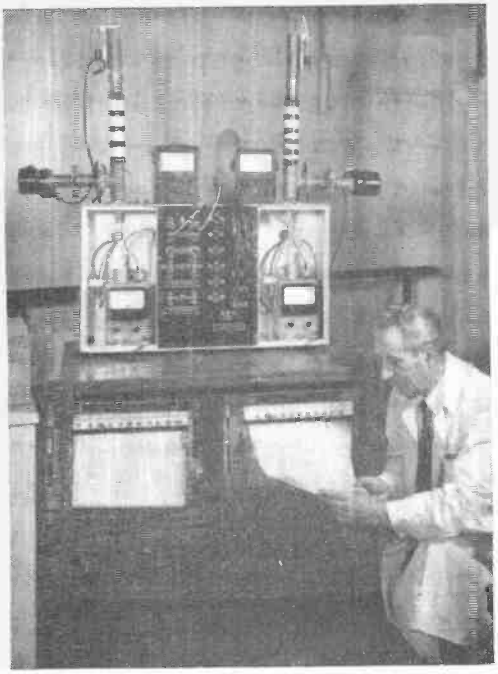
means. In addition, ions seem to speed healing after surgery. And inconclusive results indicate that ions may be effective in still other fields.

Charged Particles. Although scientists are not certain *how* ionized air works many of its near-miracles, there is nothing mysterious about these electrified particles themselves. An ion is simply a molecule or an atom that has an electrical charge. If it has one *extra* electron, its charge is



negative; one *too few* electrons, positive.

Ions of both negative and positive polarity are abundant in the air you are breathing this minute. With each breath, you take in thousands. These natural ions are produced by the weak radioactivity of



Dr. Igho Kornblueh of the University of Pennsylvania is shown with an ion counter and generator developed by the Philco Corporation. This device was used by Dr. Kornblueh in a Philco-supported project, the results of which indicated that negative ionization can be beneficial in relieving symptoms caused by airborne allergies.

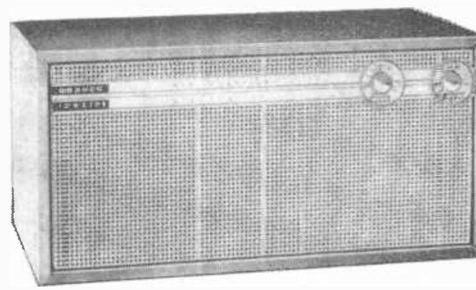
the earth's crust, by ultraviolet radiation from the sun, and by cosmic energy from outer space. Ions are unstable, sometimes lasting only a fraction of a second. But new ones are continuously being manufactured, so the supply is always being replenished. Some places are more heavily ionized than others—mountain tops, for example, where radiation is relatively intense.

The therapeutic use of ionized air is comparatively new, but the fact that ions affect human beings has been known for many years. Back in 1931, Frederick Dessauer, a German scientist, put his subjects—including himself—in small rooms with heavy concentrations of negative or positive ions. He noted that the subjects in the negatively ionized room were generally comfortable, relaxed, and more or less happy. The patients subjected to positive ionization, on the other hand, had quite different reactions. They were cross and irritable, with dry throats, headaches, and nausea.

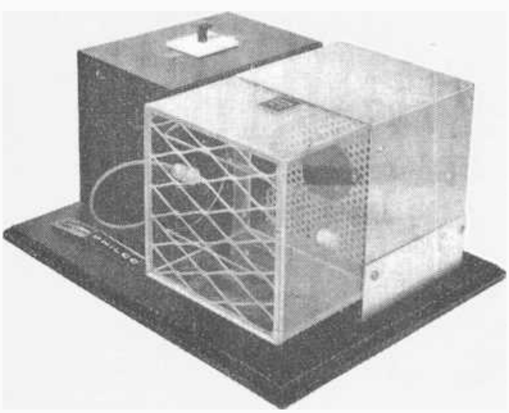
Stimulating the Cilia. Only in the past few years have researchers begun to try to find out why electrically charged air has its dramatic effects. At the University of California, Dr. Albert P. Krueger and bacteriologist Richard F. Smith uncovered one important clue by exposing rabbits to heavy doses of ions. They found that the cilia—tiny hair-like filaments in the windpipe—reacted sharply to ionized air.

Under normal conditions, the cilia wave back and forth about 1400 times a minute. They filter air going into the lungs, removing dust, pollen, and other irritants. Then a flow of mucus washes the foreign matter away.

Experiments showed that when the rabbits breathed air rich in negative oxygen ions, the cilia speeded up to about 1600 beats a minute and mucus flow increased. But when the cilia were exposed to posi-

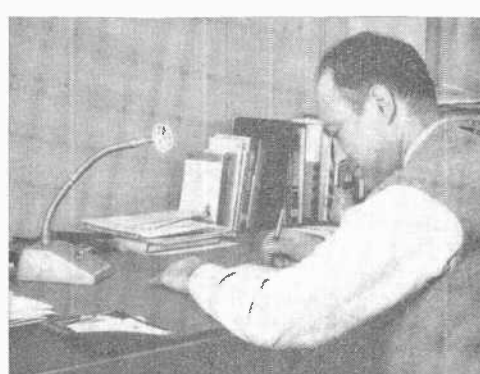


An air-purifying device, the Granco Ionator effectively combines mechanical filtering, electrostatic precipitation, and negative ionization actions.



Clinical-type ionizer made by Philco is used in experimental work to relieve hay fever sufferers and patients with severe burns.

Resembling a microphone, this Wesix ionizer is designed for use at either a desk or a table.



tive carbon dioxide ionization, they slowed down to an average of 1100 beats per minute and the mucus supply tended to dry up. Filtering action was impeded, or even stopped.

The air-cleaning mechanism in human beings works the same way. This explains why most hay fever sufferers get relief from negative ions. With improved cilia action, pollen is trapped and disposed of before it can do much damage.

Other Experiments. Two other researchers—Drs. Igho Kornblueh and Daniel Silverman of the University of Pennsylvania's Graduate School of Medicine—followed different lines of investigation. They subjected patients to large doses of positive and negative ions while recording their brain-wave patterns. They found that either negative or positive ions could change the brain-wave patterns slightly. More interesting, however, was the discovery that the changes brought about by *negative* ions were similar to those caused by tranquilizing drugs.

Other research projects designed to detect the effects of ionized air on blood pressure and other functions have been inconclusive. Consequently, no one knows for sure how negative ions work their beneficial effects. Nor does anyone know why a few patients with rheumatism and arthritis seem at times to benefit from negative ions, while other patients treated under identical conditions show no improvement whatever.

To confuse the situation still further, it appears likely that under some circumstances *positive* ions may be helpful and *negative* ions harmful. A Swiss physician, Dr. Gerhard Schorer, experimented with ion therapy from the early 1930's until his death a few years ago. To the astonishment of other workers in the field, he reported on a number of occasions that positive ions were *beneficial* to his patients.

There have been many attempts to explain this apparent contradiction. Some theorize that since Dr. Schorer was a physician, not an engineer, he simply became confused about the polarity of the ions he used in various experiments. Yet it would seem unlikely that a habitually careful scientist would go through an entire lifetime making such an elementary mistake. In addition, he had engineering help at times from electronic experts who certainly would have detected any such error. So researchers began to look for other explanations.

Hope for Heart Patients. One of those seeking the answer was Dr. Kornblueh, himself a veteran in the field of ionization. He had done much of the early work using ionized air in hay fever and burn cases. Looking through his colleague's records, Dr. Kornblueh noted that many of Dr. Schorer's patients suffered from various types of heart disease.

With this fact in mind, Dr. Kornblueh selected a heart patient whose condition was so serious that he was taking 100 nitroglycerin tablets a week. It was obvious that without some dramatic new treatment

How Ions Are Produced

Heavy concentrations of ions can be produced by several means, including ultraviolet light and spark discharge. But two of the most common methods utilize (1) mildly radioactive substances, and (2) corona discharge.

In the radioactive method, a piece of polonium or tritium foil radiates enough energy to break up and rearrange air molecules near it. Some molecules end up with one electron too many, others come out one short. Thus they become, respectively, negative and positive ions. When they pass a charged electrode, they are either attracted or repelled into the surrounding air, depending on the polarity of the electrode. If, for example, a negative charge is applied to the electrode, the device becomes a producer of negative ions. A device of this type is marketed by the Wesix Electric Heater Co., 390 First St., San Francisco 5, Calif.

The corona-discharge method employs a thin tungsten wire stretched in close proximity to several brass rods. A high voltage—either positive or negative, depending on what kind of ions are to be produced—is applied to the tungsten, while the brass rods remain grounded. The difference in potential causes a corona discharge between the tungsten and brass elements, which in turn produces large numbers of ions. The Ionitron, manufactured by Philco Corp. and designed as an attachment for its current line of room air conditioners, works on this principle.

Using a Keithley electrometer and Beckett probe to detect presence of ionized air. Here, this device will determine if the air conditioner is sending ionized air into the room.

the man could not live much longer. Dr. Kornbluch administered carefully controlled experimental doses of positive ions, and within days the patient was so improved that his need for nitroglycerin tablets dropped to 30 a week! When he breathed negative ions, on the other hand, his discomfort seemed to increase.

Could it be that negatively ionized air has beneficial effects on most people, but heart patients benefit from positive ions? "There are still too many variables, too many unknowns," Dr. Kornblueh says, "to draw any such conclusions at this time." The case simply points up the many mysteries still surrounding the use of ions. But it also furnishes an important clue.

Ions and Human Behavior. Further research promises to answer other baffling questions. Why, for example, do some 40% of all people seem to be completely immune to the effects of ionized air? They feel neither depressed with positive ions, nor happy and contented with negative charges. (As an ironic footnote, Dr. Kornblueh, who has done perhaps as much as any other single human being to advance our knowledge of ionized air, is one of the 40% who cannot feel its effects.)

A better understanding of ionized air also promises to cast new light on certain aspects of human behavior. For instance, any police chief can tell you that there are more murders, accidental deaths, and suicides at some times than at others. Absenteeism in large plants follows mysterious cycles that cannot be correlated with any known factors. Minor crime waves suddenly appear for no apparent reason, to be

A simple device for producing and controlling negative ions in a closed room, the Wesix Ionaire consists of a rectifier and a piece of radioactive tritium foil mounted within a conducting tube.

followed by equally unexplainable periods of unnatural calm.

Could variations in natural ionization—variations which are known to exist—help explain these mysteries? In Philadelphia, the American Institute of Medical Climatology has been founded to try to find out.

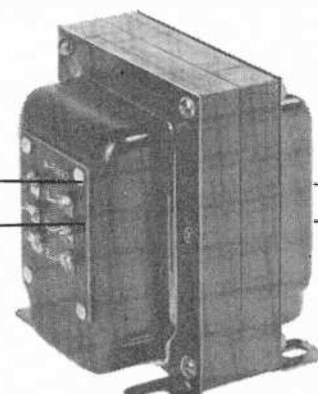
One of the Institute's officers—a high official at Philco Corp.—is supplying extensive records on employee absenteeism, tardiness, accidents, and general behavior of the company's thousands of workers. A Villanova University official is gathering the same information about college students. The Chief of Police in Philadelphia is

(*Continued on page* 112)

AN old-time recipe for a rabbit stew begins, "First catch a rabbit . . ." Similarly, the recipe for a high-fidelity amplifier should begin, "First get a good output transformer . . ." For all the important qualities of an amplifier—frequency response, transient response, distortion, power output, and overall stability—depend to an overwhelming extent on the quality of the output transformer. In fact, the principle reason we have simpler and better amplifiers available at lower prices today is that we have far better output transformers.

The principal tool for attaining genuine high-fidelity performance is inverse feedback. But to obtain a lot of stable feedback over the full audio range, we must have a very flat response—not only within the audio range but for at least an octave or two on each end. This is not a serious problem with tube circuits, but it is a problem with output transformers. Designing a transformer that has flat response and little phase shift between 10 to 50,000 cps, say, is one of the neatest tricks of the trade.

INSIDE the Hi-Fi Output Transformer



Why Use Transformers? Since a hi-fi output transformer is so difficult to design, it might well be asked why we can't get along without one. Why not couple the speaker directly to the amplifier? Actually there are ways of doing this. In the old days, high-impedance speakers were used which could be connected directly to the plates of the tubes. These speakers employed a reed-armature movement rather than a moving coil.

To some extent, the reed armature was like a relay. As an audio current was passed through a coil fixed in a magnetic field, the variation in the magnetic field would vibrate the reed, which in turn would push and pull the cone by means of a lever. The coil had to be large and thus could provide the impedance needed to load the output tubes.

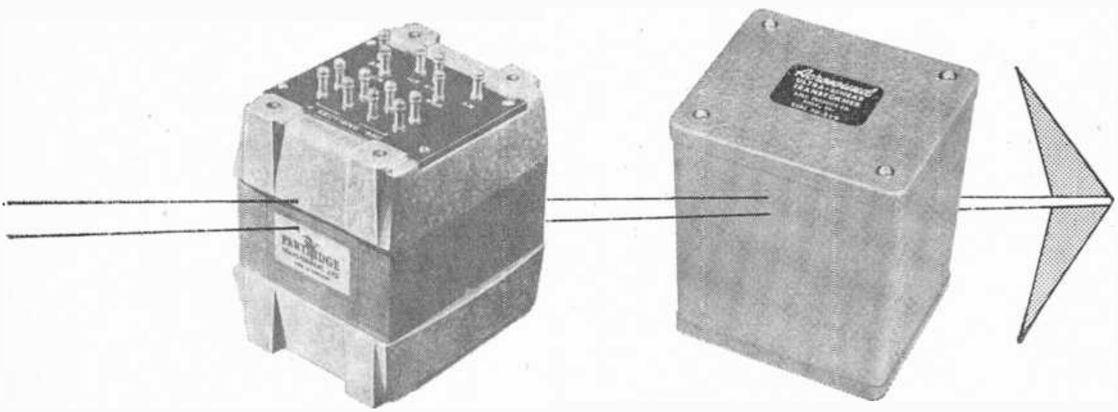
The trouble with this movement is that a very high restoring force is required to keep the reed centered, making it difficult to achieve a speaker free-air resonance below 100 cps. Since we need a response to at least 40 cps and preferably lower for high fidelity, the movement is badly suited for a full-range speaker.

By contrast, the almost universally used moving-coil speaker of today is not well adapted to the high impedances of output tubes. The coil itself must move in the gap, and a high-impedance coil requires a lot of wire. The sheer weight of the wire would make it difficult to get a smooth response, and the resistance of the wire would produce considerable heating and losses. Nevertheless, we have had 500-ohm speakers that can be coupled directly to output tubes in a single-ended push-pull arrangement and other low-impedance circuits. (Stephens produced a combination of an output-transformerless amplifier and 500-ohm speaker of this type a few years ago.)

It is also possible to design amplifiers with output impedances as low as 15 ohms for direct connection to speakers, but such amplifiers have so far been extremely inefficient. Transistors are low-impedance devices and could be matched directly to speakers, but at the moment transistors are not completely satisfactory for high-power output stages. So, on the whole, it has been found simpler to use an output transformer to match the speaker to the tubes.

To understand the problem and its solution, let's take a look at how an output creases as the frequency is lowered. So, if we want to provide a high reactance at 20 cps, we have to have a very large inductance in the primary—well over 50 henrys.

The inductance of an iron-core coil is a function of both the coil itself and the permeability of the core. In other words, we can increase the inductance by having more turns of wire, or more core of higher permeability, or both. In hi-fi transformers where we want to maintain a high impedance to at least 20 cps—preferably 10 cps or less—the only answer is to utilize both means. Therefore, we use a lot of iron in



By JOSEPH MARSHALL

transformer works. Figure 1 is a simplified diagram of a simple transformer. A current flowing through the primary coil induces a magnetic flux in the iron core. We can picture the flux as traveling through the core along the path indicated by the arrows. As the flux passes through the part of the core where the secondary is wound, the flux induces an electric current in the secondary. By choosing the right ratio of turns between primary and secondary, we can obtain any transformation ratio we desire—for example, the ratio to match a 16-ohm speaker to 4000-ohm output tubes.

Low-Frequency Response. The primary of the transformer provides the direct load on the tubes, and it must offer a high enough reactance at all audio frequencies to present an adequate load throughout the full audio range. As we know, the reactance of an inductance de- the transformer core and a lot of wire, too.

A lot of iron of high permeability is necessary for another reason—good transformer efficiency. The core offers a certain amount of "magnetic resistance" to the flux flowing from the primary to the secondary, but this resistance is lowered as the flux density of the core is increased. In other words, the more iron in the core, or the higher the permeability of a given amount of iron, the lower this "magnetic resistance."

Imagine that the core consists of millions of small magnets. If the magnets are neatly arranged in line and parallel to each other, they will produce a much greater magnetic flux. They will also offer less resistance to the passage of the flux from one magnet to the other, just as a well-organized bucket brigade can pour a lot more water on a fire than a disorganized mob. Certain special grain-oriented alloys of iron and steel produce this more efficient arrangement and thereby provide a greater flux density for a given size or weight of core.

The grain-oriented cores have been used in "C"-cores, but with the same amount of core made of the same material, nearly identical performance is obtained from either C-cores or conventional cores. Hence the C-core is seldom used today and is, in fact, available in only one commercial transformer—the British-made Partridge.

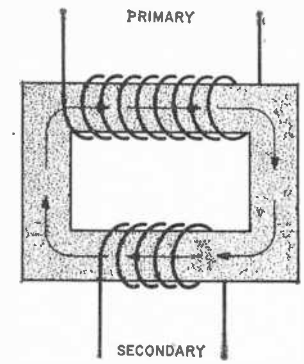


Fig. 1. Diagram of simple transformer. Current in primary winding is induced into secondary.

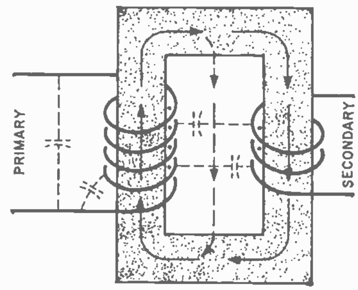


Fig. 2. Capacitances inherent in transformer effectively reduce high-frequency response.

High-Frequency Response. The size of the core has no direct influence on a transformer's high-frequency response, but we run into some other problems here. For one thing, large coils have considerable distributed capacitance between turns, between layers, and between primary and secondary. This capacitance is not significant until we get to high frequencies—especially above 15,000 cps. (See Fig. 2.)

These high frequencies may find the path provided by the capacitance easier to travel than the path provided by the coil. In this case, they will take a short cut through the capacitance instead of taking the long route through the coil. The effect of such bypassing is to short-circuit turns or even layers, with the result that the high frequencies go through fewer turns. This, of course, changes the turns ratio between primary and secondary, which in turn produces a smaller voltage across the secondary and sloping response at the high end.

Another phenomenon at high frequencies is similar to capacitance effects. Not all the magnetic flux produced by the primary in the core travels the desired path through the core to the secondary coil. Some of it strays from the iron path and "leaks" through the air space between the coils as indicated by the dotted line. Since this leakage does not produce any current in the secondary, the secondary voltage is reduced and we again have a sloping response. Worse yet, a sloping response is always accompanied by a phase shift, and phase shifts are the bugaboo of feedback loops. This phenomenon, incidentally, is called "leakage reactance," since it has the same effect as an actual reactance would produce.

Finally, the distributed capacitance and the inductance of a coil form a resonant circuit which produces peaks in the high end of the range. Even if these peaks occur at ultrasonic frequencies above 20,000 cps, they can produce "ringing" or even outright or momentary oscillation when a feedback loop is carried around the transformer. The resonance is unavoidable, but if we want to use a lot of feedback, it is vital that the resonant peaks be moved up beyond the audio range—well above 50,000 cps, if possible. Here, they are not likely to be energized by signals passing through the amplifier and the feedback loop.

One way to reduce "leakage reactance" is to have the primary and secondary adjacent to each other. If the coils are close together, the flux leakage will pass through the secondary coil by mutual coupling and losses will be reduced. For this reason, the simple transformer of Fig. 1 is not suitable for hi-fi use. A better transformer would have the two coils wound over each other or adjacent to each other on the middle branch of an E-shaped core. Although this helps minimize the leakage reactance losses, it tends to increase the losses from distributed capacitance—the close spacing of the two coils increases the capacitance between them. Therefore, the problem faced by the transformer designer is to figure out some way to reduce the leakage reactance and the capacitative losses *at the same time.*

The general principle is to divide both the primary and the secondary into several sections and interleave them in tricky patterns. One of the finest old transformers was the now defunct Amertran which had two equal primaries side by side. Later, the "broadcast grade" transformers of UTC, Stancor, Freed, and others also used interleaved windings. These transformers readily achieved a response flat from 20 to 20,000 cps, and this was good enough for a long time.

But it was not good enough for high fidelity. Invariably, when we tried to route more than about 14 db of feedback around these transformers, we ran into instability at ultrasonic frequencies. To counteract this instability, highly complicated circuits were developed with feedback loops and phase-correcting networks galore.

Williamson's Answer. The designer of the famous Williamson circuit, D. T. N. Williamson, saw that the real problem was in the output transformer. Accordingly, he developed a special transformer with very low leakage reactance. His circuit worked well only with good output transformers, as engineers soon discovered. In fact, for the first few years of commercial high fidelity, audio engineers earned their pay trying to put together a workable and stable combination of the Williamson circuit and the then-available transformers! It soon became obvious that before we could have really first-class high-fidelity amplifiers at a reasonable cost we needed better output transformers. Because of the lack of suitable commercial transformers, Williamson advised constructors to build their own. But manufacturers soon took steps to correct this situation.

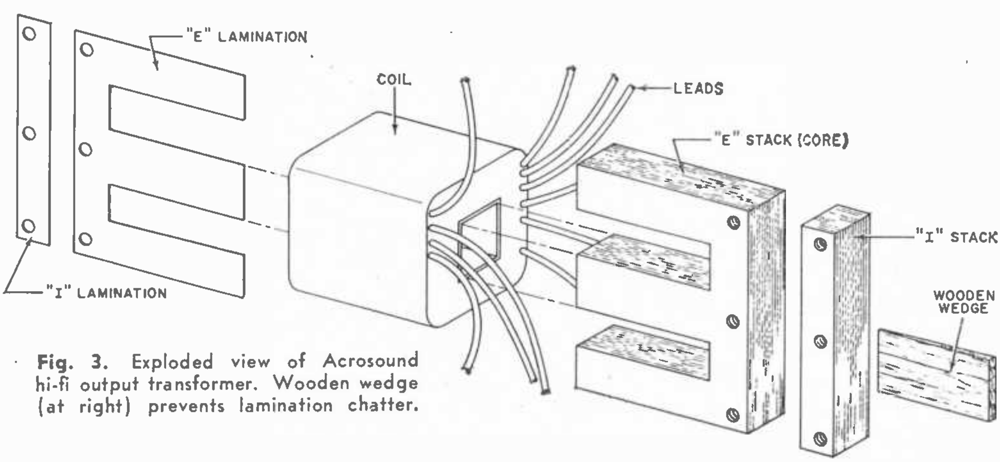


Fig. 3. Exploded view of Acrosound hi-fi output transformer. Wooden wedge (at right) prevents lamination chatter.

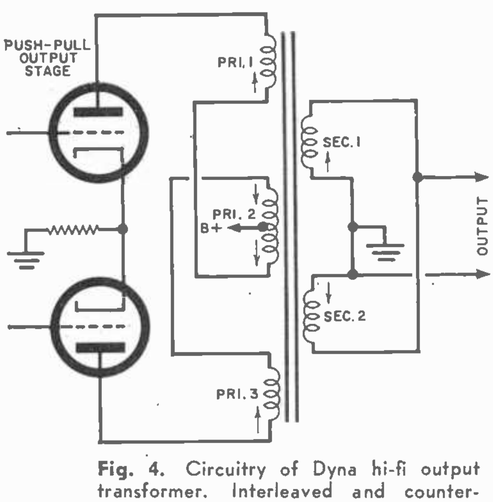


Fig. 4. Circuitry of Dyna hi-fi output transformer. Interleaved and counter-balanced windings help reduce leakage.

Herb Keroes, who patented the Acrosound transformer, did some original thinking to develop his complex and rather subtle design. The basic construction is shown in Fig. 3; the unit uses eight interleaved primary and secondary sections.

As would be expected, the distributed capacitance and the leakage reactance of each of the eight sections is different, and therefore the resonances also differ. Such differences in resonance would result in a very ragged response curve with

(*Continued on page* 108)

POPULAR ELECTRONICS

OVER the past few months, many Class D Citizens Band operators have "adopted" the "10" code devised by the Associated Police Communication Officers, Inc. ("APCO"). CB'ers using this code find that their messages are easily, rapidly, and effectively transmitted over some pretty busy channels. Obviously, on a crowded channel, it's easier to understand someone speaking one or two numbers than a whole sentence.

But the APCO code is a hand-me-down: it's excellent for police departments, but it leaves much to be desired for CB work. While CB'ers can put many of the numbers to good use, signals such as "10-32"—which means "Is drunkometer available?"—are of no value at all to CB'ers.

In response to a considerable number of reader requests, POPULAR ELECTRONICS contacted CB manufacturers, clubs, and indi-

GENERAL STATION OPERATION

11-1	Receiving poorly.
11-2	Receiving well.
11-3	Stop transmitting.
11-4	Okay—acknowledged.
11-5	Identify your station by FCC-assigned call sign.
11-6	Cease operation—signal indicates malfunctioning transmitter.
11-7	Out of service—leaving the air.
11-8	This station is standing by on ________ (*channel number*).
11-9	On which other channels can you transmit and receive?
11-10	Switch to ________ (*channel number*) for transmitting and receiving.
11-11	Unable to copy you because of ______.
11-12	Please repeat your last message.
11-13	Trouble at station because of ______.
11-14	Request licensed radio technician be sent to this station.
11-15	Conducting test—please count to ten slowly.
11-16	Conducting test—please transmit unmodulated carrier for ten seconds.
11-17	
11-18	
11-19	
11-20	What is your location? (My location is ________.)
11-21	
11-22	
11-23	
11-24	
11-25	
11-26	
11-27	
11-28	
11-29	

MESSAGES AND TRAFFIC-HANDLING

11-30	Does not conform to operating rules and regulations.
11-31	Stand by! (*order*)
11-32	Please speak slower.
11-33	Please relay message.
11-34	Busy.
11-35	Confidential information.
11-36	Correct local time.
11-37	Please call this station by telephone.
11-38	Visitors present.
11-39	Is telephone patch possible?
11-40	Advise if ________ is available for radio contact.
11-41	Do you have any messages for this station?
11-42	Any answer on my message regarding ________?
11-43	Is ________ at your station?
11-44	What channel is ________ operating on?
11-45	Your reply is satisfactory.
11-46	I have an urgent message for ________.
11-47	Please clarify your message.
11-48	What is next message?
11-49	Please confirm.
11-50	Telephone ________! (*order*)
11-51	Can you contact ________?
11-52	I have an urgent message for ________. (*NOT for emergency use*)
11-53	
11-54	
11-55	
11-56	
11-57	
11-58	
11-59	

CITIZENS BAND "11" CODE

vidual operators to find out just what they would like to have included in a CB code. We sifted, sorted, reworded, and re-worked hundreds upon hundreds of suggestions, combining many and junking many. The result is the POPULAR ELECTRONICS Citizens Band "11" Code (given below). We hope that you will use it and help cut down on interference caused by long transmissions.

You'll notice that some of the numbers between 11-1 and 11-100 have not been utilized. These omissions are deliberate on our part and allow for additions to the series. All CB'ers are invited to forward their suggestions for new "11" signals. They should be submitted on post cards, one to a card, and should be brief.

Send your suggestions to the "CB-11 Code Committee," POPULAR ELECTRONICS, 1 Park Ave., New York 16, N. Y. —30—

MOBILE AND EN ROUTE

11-60 Reserve hotel room with bath for ________.
11-61 Can you recommend a good local restaurant?
11-62 Can you recommend a good local hotel or motel?
11-63 Please advise weather/road conditions.
11-64 What is highway or best route to ________?
11-65 What is location of nearest service station?
11-66 Will arrive ________ (*time and/or place*).
11-67
11-68
11-69

COMMERCIAL

11-70 Rush—quick action desired.
11-71 Return to base.
11-72 Assignment completed.
11-73 Report in person to ________.
11-74 I will be at your station in ________ (*hours/minutes*).
11-75 Pick up ________ at ________.
11-76 I have ________ with me.
11-77
11-78
11-79

MARINE

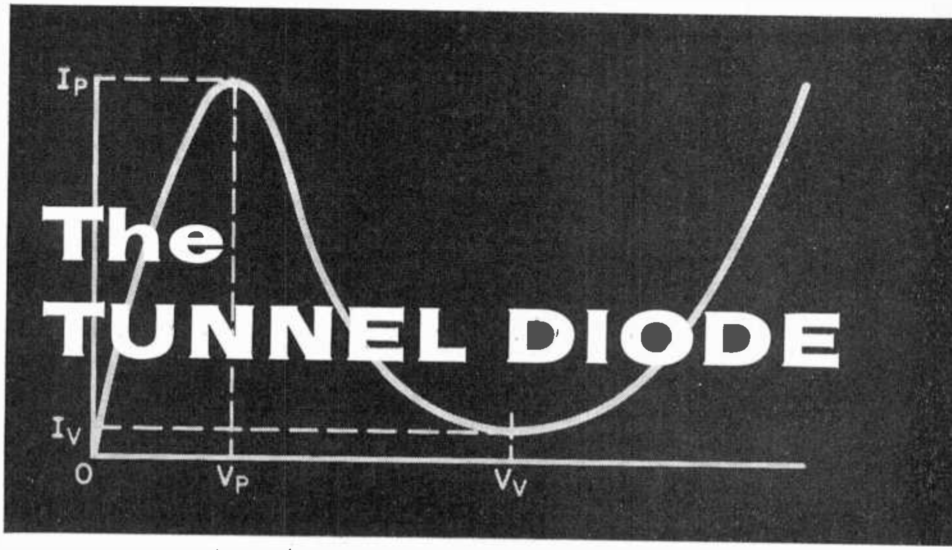
11-80 Please advise sea conditions at ________.
11-81 Do you have dockside moorings available for ________ (*boat type*)?
11-82 Do you have dockside fuel available?
11-83 I will monitor marine channel ________ (*9 or 13*) while under way.
11-84
11-85
11-86
11-87
11-88
11-89

EMERGENCY

11-90 Send police to ________.
11-91 Send ambulance to ________.
11-92 Send fire department to ________.
11-93 Send auto wrecker to ________.
11-94 Send Coast Guard to ________.
11-95 Personal injury due to accident at ________.
11-96 Please summon doctor to your station to give emergency first aid advice by radio.
11-97
11-98
11-99 Emergency conditions no longer exist.
11-100 I have emergency traffic regarding the safety of life and property. Will all stations please give me priority use of this channel until the emergency traffic is completed.

POPULAR ELECTRONICS AFTER CLASS feature

The TUNNEL DIODE



Newest of semiconductors, the tunnel diode is unique in its field. Learn why it's unique, then build a simple transmitter and put it to work

By DONALD L. STONER, W6TNS

BY NOW, just about everyone has heard of the tunnel diode, latest "miracle" from the semiconductor industry. Though related to the tube and transistor, the tunnel diode ordinarily has only two terminals. Yet it differs from other two-terminal devices (resistors, capacitors, and so on) in a very special way. Apply voltage to a resistor, for example, and you can determine current flow by Ohm's law. Increase the voltage across the resistor, and the current flow through the resistor will increase in proportion. But this is not so with the tunnel diode.

The effect which brought about the practical construction of this unique semiconductor was discovered by Dr. Leo Esaki, a brilliant Japanese scientist. Dr. Esaki determined that unusual doping of the germanium-diode junction would cause the current flow to decrease, even though the applied voltage was increased. This effect, known as *negative resistance,* enables the tunnel diode to perform its unusual feats.

Tunnel Diode Theory. To understand the term negative resistance and what causes it, let's study a more familiar object—a tetrode vacuum tube.

Figure 1(A) shows a tetrode vacuum tube with a fixed screen voltage of 200 volts and a plate voltage that can be varied between 0 and 300 volts. The tube's control grid is grounded, since we need no input signal to the tetrode for the purposes of this example.

Let's vary the plate voltage between 0 and 300 volts and record the changes in the tetrode's plate current as shown on the milliammeter—see Fig. 1(B). Note that the plate current *increases* in the normal fashion as the plate voltage is increased until the plate voltage reaches a value of about 100 volts.

At this point a peculiar phenomenon occurs due to the secondary emission from the plate—the plate current *decreases* as the plate voltage increases. This decrease in plate current with increase in plate voltage is called *negative resistance,* which is a well-known characteristic of tetrodes.

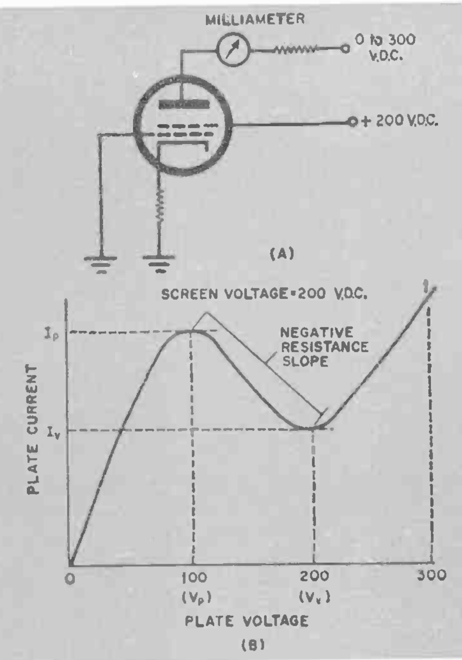


Fig. 1. Tetrode vacuum tube circuit (A) displays curves (B) somewhat like those of a tunnel diode. See text.

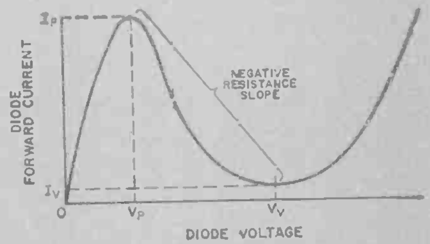


Fig. 2. Tunnel-diode forward characteristic curve. In negative-resistance slope range, current through diode decreases even though voltage across diode increases.

When the plate voltage reaches the value of the screen voltage, 200 volts in this example, the plate current increases as before.

Negative resistance is seemingly contrary to Ohm's law. If we were to apply a steadily increasing voltage across a resistor, for example, the current through the resistor would increase proportionately. If we carried this far enough, the resistor would eventually go up in smoke. But in this case, steadily increasing voltage on the tetrode's plate brings steadily decreasing current. The tetrode in this example actually exhibits a negative resistance at plate voltages between about 100 and 200 volts.

Now that we know what negative resistance is, let's return to the tunnel diode. The slope of the tunnel diode's forward-characteristic curve is very much like the tetrode's plate-characteristic curve. See Fig. 2. Note that as the diode voltage is increased positively from zero to V_p, the tunnel-diode curve is similar to that for any conventional semiconductor or vacuum-tube diode. However, at V_p we reach the peak voltage of the negative-resistance portion of the tunnel-diode slope. Now the tunnel-diode current decreases as the voltage across it increases until the potential V_v, the valley voltage, is reached. At this point, the diode reverts back to type and the current increases as the voltage is increased above V_v. By operating the tunnel diode on the negative-resistance portion of its curve, we can make it function as a negative-resistance oscillator, as will the tetrode above.

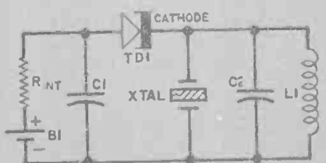


Fig. 3. Typical crystal oscillator circuit using tunnel diode. R_{int} denotes internal resistance of battery.

Typical Circuit. Figure 3 shows a typical crystal oscillator circuit made possible by the development of the tunnel diode. Actually, any negative-resistance device (a tetrode tube, operated at a plate voltage well below its screen voltage as discussed previously, for example) could be used; the ngement is known as a *negative-resistance oscillator.*

One of the greatest advantages of this circuit, known as a Dynatron oscillator in its tube version, is its inherent simplicity—it requires only a power source, a negative-resistance device, and a tuned circuit. Although the circuit is relatively unstable in contrast to other oscillators, its oscillatory properties depend solely on the use of a negative-resistance device between battery *B1* and tuned-circuit *L1-C2*.

Depending on the impedance of tuned-circuit *L1-C2,* the circuit in Fig. 3 will function as an amplifier or an oscillator. To oscillate, the diode's operating point must be in its negative-resistance region, and the impedance of *L1-C2* must be greater than the negative resistance of the diode.

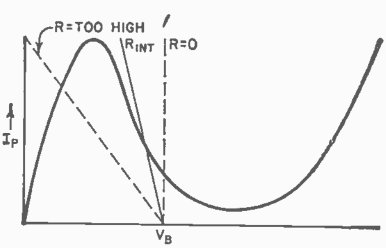


Fig. 4. Load line for typical tunnel-diode oscillator. Load must be as low as possible to restrict diode to negative-resistance portion of curve.

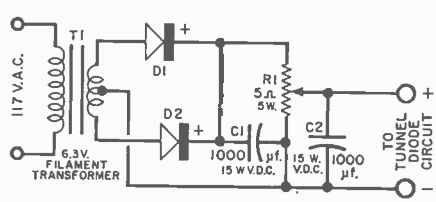
Fig. 5. Low internal-resistance power supply for tunnel diode circuits. Drain through resistor R1 is heavy but unavoidable due to required design.

One factor to consider with the tunnel diode is the internal resistance of the battery, R_{int}. This resistance is equivalent to the plate-load resistor in a vacuum-tube circuit. Figure 4 shows typical load lines that are possible for a tunnel-diode oscillator. Note that all load lines are drawn from point *Vb* which is the power supply voltage. The actual value of R_{int} is important to us. We know that the internal resistance will always be present so that a resistance of zero is impossible in practice. If R_{int} is too high, the tunnel diode will be operating on the positive portion of its slope, which we want to avoid. Hence, it is desirable to have a resistance as close to zero as possible.

Present-day tunnel diodes have negative slope resistance between 20 and 40 ohms, and R_{int} should be on the order of 10 ohms or less for the oscillator circuit to operate. The action of *C1* in Fig. 3 helps to reduce the internal resistance of *B1.* However, a low-value bleeder resistor connected in parallel with *C1* would greatly improve the operation of the circuit.

Figure 5 shows a low internal-resistance power supply that can be used to power tunnel-diode circuits. If you own a low-voltage power supply (one for powering transistors is ideal), it can be used in place of the circuit shown in Fig. 5. Dry cells cannot be used with much success because their voltage and internal resistance are too high. If a bleeder is placed across the dry cell, the large currents passing through the resistor will result in a steadily increasing internal resistance in the dry cell. For experimental purposes, dry cells can be used if they are of the D size or larger and are new. However, they are usable only for a short time.

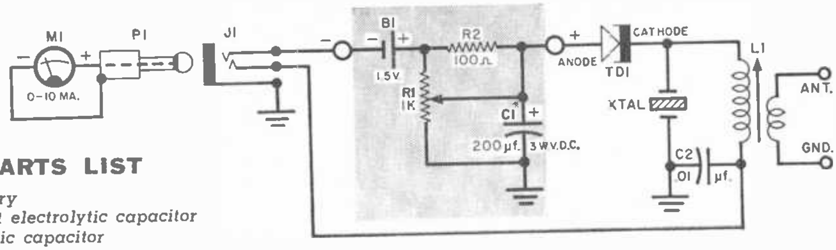
Building a Transmitter. For a better understanding of just what a tunnel diode can do, let's try an experimental hookup



using it in a midget, or "Micro-QRP," 80- or 40-meter transmitter. Even though the tunnel diode is a low-power device, such a transmitter is capable of delivering a usable signal. The "Micro-QRP" tunnel-diode transmitter runs on about 0.6 volt at 1.8 ma., or approximately one milliwatt input. It is crystal-controlled on either the 80- or 40-meter bands, but can be used on any frequency between 3.5 and 10 mc. with the values shown.

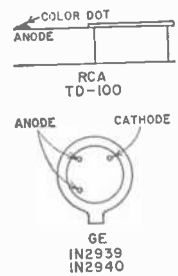
There are only nine working components in the tunnel-diode transmitter—a key jack, a 1.5-volt battery, a 1000-ohm potentiometer, a 100-ohm resistor, a .01-µf. disc capacitor, a 200-µf., 3-volt electrolytic capacitor, the tunnel diode, and a coil and crystal. See Fig. 6.

Mount the components in a 1⅝" x 2¾" x 2⅛" chassis box. The meter jack is mount-



PARTS LIST

B1—1.5-volt battery
C1—200-µf., 3-volt electrolytic capacitor
C2—.01-µf. ceramic capacitor
J1—Two-circuit jack
L1—18 turns of #30 enameled wire, close-wound on 3/8" slug-tuned form
M1—0-10 ma. milliammeter
P1—Phone plug
R1—1000-ohm linear taper potentiometer
R2—100-ohm, 1/2-watt resistor
TD1—Tunnel diode (see text)
Xtal—80- or 40-meter crystal
1—2 3/4" x 2 1/2" x 1 5/8" aluminum chassis
1—Crystal socket
Misc.—Knob, wire, solder, etc.



TUNNEL DIODE CONNECTIONS

Fig. 6. Circuit of tunnel-diode transmitter for operation between 3.5 and 10 mc. Battery power supply (shaded portion) can be replaced with supply shown on opposite page if desired. Note tunnel-diode pin connections shown at left.

ed on the front panel along with the bias potentiometer; the coil, crystal, and tunnel diode are mounted on the top of the chassis; the battery is located under the chassis and supported by leads soldered to the terminals.

A large solder lug should be installed under the coil and used as the common ground terminal for the entire transmitter. It is important that both disc capacitors be returned to this point, with very short leads.

The meter jack is connected in an unusual manner to eliminate the need for an on-off switch. Use a two-circuit jack, with the frame grounded to the chassis. The outer contact connects to the minus end of the battery and the center contact is wired to the coil. When a meter plug is inserted, it shorts the outer pin to the chassis, thereby completing the battery circuit. The tunnel-diode circuit (through the coil) is completed by the meter.

The General Electric 1N2939 and 1N2940 tunnel diodes plug into a standard transistor socket and are therefore easy to work with. The RCA TD-100, on the other hand, will have to be modified by trimming away some of the gold foil lead to make a "pin" of each terminal; be sure to remove sufficient material so that the "pin" will fit snugly in the socket gripper. Once the tunnel diode has been mounted, wire the "Micro-QRP" transmitter as shown in Fig. 6, and you're ready to check it out.

Testing the Transmitter. Connect a milliammeter as shown in the schematic diagram; any meter between 5 and 15 ma. full scale will do. Turn the bias potentiometer to the minimum resistance end of rotation and plug in the meter. The reading should be a little over .01 ma. As the potentiometer is rotated, the current will increase. When the meter indicates 1-3 ma. (depending on what type tunnel diode you use), the reading will suddenly jump to a lower current. The point at which the drop occurs is called the *peak current;* the value to which the meter drops is called the *valley*

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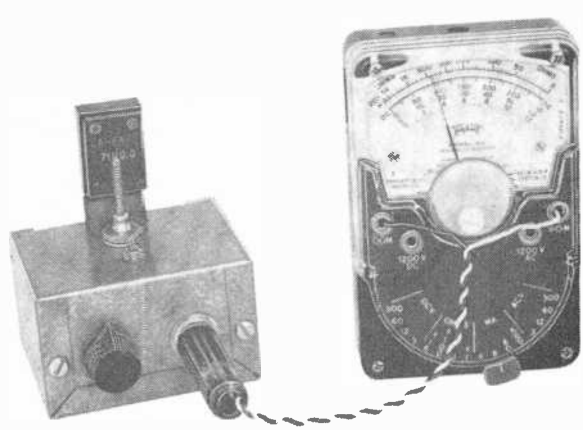
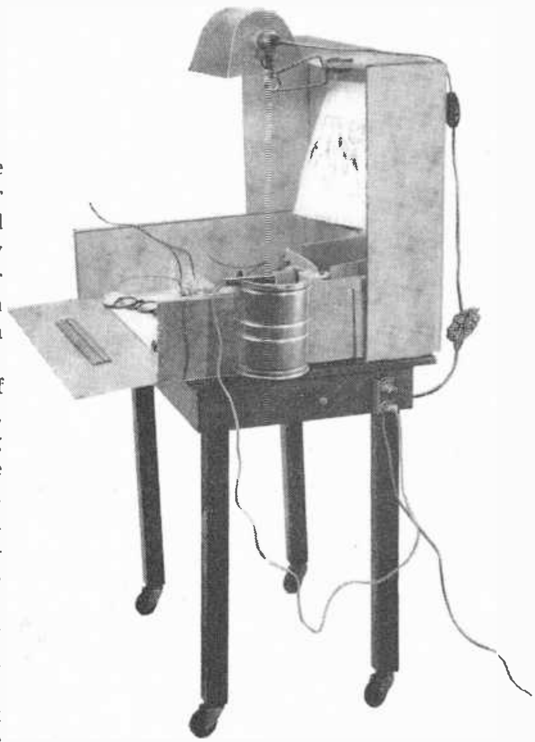


Tunnel-diode transmitter is adjusted with external multimeter to determine the diode's negative-resistance region.

Kit Building in the Parlor

By H. E. McALLISTER



HOW MANY TIMES have you spent the entire evening wiring a new kit in your basement workshop completely removed from the family? Why not join the family group upstairs in the parlor and wire your kit at the same time? All you need is an inexpensive portable table equipped with a few "accessories" for kit building.

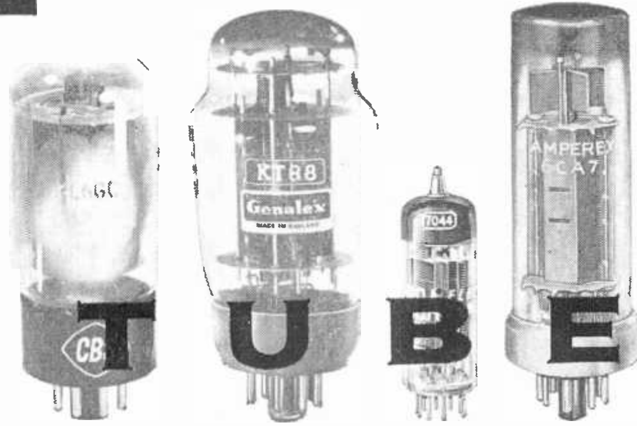
First assemble a table top (a piece of ¾" plywood about 18" x 26" is a good bet, unless you happen to have an old drawing board on hand) on 2" x 2" legs. Cut the legs to about 30", and brace them with 1" x 4"'s under the table top. Use wood screws and apply glue between all joints—Wilhold cement or Elmer's Glue-All, available at your local hardware store, are ideal for the purpose. Apply the glue liberally before screwing the parts together, then wipe away the excess with a damp rag.

While you're at the hardware store, pick up four light-duty plastic casters so your table can be on wheels. (You can wheel it out of the way when it's not in use.) Drill a hole in the bottom of each of the legs to accommodate the casters; then insert the casters with a drop of glue in each hole.

Paint the table a subdued color. Since it's going to be in your living room, at least part of the time, you'll want it to blend in with the color scheme and decor.

A corrugated cardboard carton with a cover lid, the type clothing stores are apt to have in their storerooms, can be used for the top. Affix the carton bottom to the table top with carpet tacks. The carton top is fitted in place but not tacked—it can be dropped down to cover the table top at the end of an evening's work. Slit the front of the carton at its corners as shown above so it will lay flat when the table is in use. The carton can also be painted to improve its appearance.

Then install an auxiliary outlet on the side of the table with a line cord long enough to reach a wall outlet in the living room. This auxiliary outlet can be used to power your soldering iron and a desk lamp to light up the table. A No. 10 tin can attached to the side of the carton will hold your soldering iron and serve as a waste bucket. —30—



the TUBE TESTER

More about a popular test instrument and what it can tell you about the vacuum tube

PART 2 — Mutual Conductance and Other Tests

By G. H. HARRISON

ONCE a tube has passed its test for short-circuited elements (see "The Tube Tester," Part 1, in last month's issue), it's ready for a "quality" test. Most tube testers indicate quality on a large front-panel meter, which has sections of its face marked off to read "good," "bad," or "doubtful." But even though most testers *look* alike so far as the front panel is concerned, the circuitry behind that panel divides them into two distinct types. One type measures cathode emission—simply the number of electrons the cathode can supply. The other measures the tube's amplifying ability or *mutual conductance.*

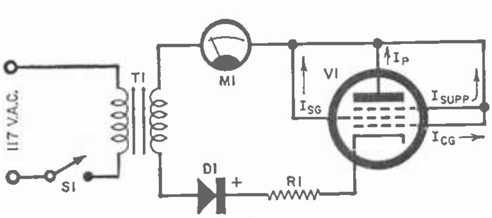


Fig. 1. Emission-testing circuit in Paco Model T-60 tester will also check for open tube elements.

Emission and Open Elements. The simpler kind of tester—and hence the least expensive—is the emission tester. To test a tube, this instrument hooks the plate and all grids together, applies a positive voltage to them, and measures the current between the cathode and the paralleled elements. The amount of current is then compared with standards established for the particular tube under test.

Figure 1 shows a simplified version of the emission-testing circuit of the Paco Model T-60 tube tester. Although the d.c. applied to the plate is pulsating rather than steady, this makes no difference.

ost emission testers, including the Paco - , can also check for open elements—grids, plates, etc., which have become dis-

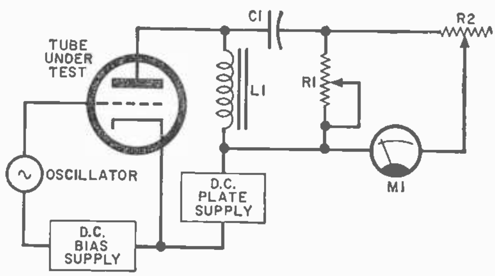


Fig. 2. Dynamic-conductance testing circuit in Heath Model TT-1 tester. Circuit approximates actual operating conditions, and tube is subjected to working test. Meter M1 measures output voltage.

connected from their pins. This test should be run immediately after the emission test just described.

To check for open elements, simply open the switches controlling the elements one at a time. When the control grid switch is opened, the current flowing through it will be interrupted and the meter will show a small drop in total current. The control-grid switch is then closed, and the screen switch opened, and so on, for each element. Although the *amount* of change in total current will vary from element to element, some drop should appear each time a switch is opened. If switching any element out of the circuit fails to bring about such a drop, chances are the element has become disconnected.

Mutual Conductance. Although the emission and open-element tests give an indication of the tube's general state of health, they do not really show how well a tube can do the job for which it was intended—namely, amplifying an electrical signal. Consequently, many testers are designed to measure mutual conductance, the effect of grid voltage on plate current under a given set of operating conditions.

Mutual conductance (*Gm*) can be measured simply by applying the proper voltages to the various tube elements—including the control grid—and reading the plate current. Some testers use this method. But such a test still does not check the tube as an amplifier under operating conditions. Therefore, other testers actually incorporate a small, self-contained signal generator for this purpose.

Such instruments—called *dynamic conductance testers*—apply the proper voltages to all tube elements, then inject an audio-frequency signal (usually around 5000 cps) into the tube's grid-circuit. The output voltage is then measured and compared against standards established for the particular tube under test. Figure 2 shows a simplified version of the Heath Model TT-1 dynamic-conductance testing circuit.

Checking for Leakage. Even the dynamic conductance test does not guarantee that a tube will operate properly in an actual circuit, particularly if the circuit involved is critical. For example, a high-resistance leakage path may have developed between two tube elements. Most conventional tube testers will not detect such leakage during the regular short-circuit test, unless the resistance of the path is relatively low—less than about 250,000 ohms, say. But in many circuits, a leakage path of more than 250,000 ohms can bring on a multitude of troubles.

Consequently, in addition to providing a regular short-circuit test, many modern test instruments can also check for inter-electrode resistances up to 20 megohms or more. Such a circuit is contained in the

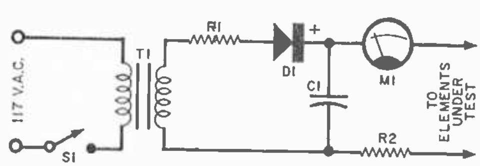


Fig. 3. Inter-electrode resistance measuring circuit in Heath TT-1 tester. Circuit functions as an ohmmeter to measure inter-electrode resistances to 20 megohms; external ohmmeter may be used instead.

Heath TT-1, and is shown in simplified form in Fig. 3. A switching arrangement allows the resistance to be measured between heater and cathode and between control grid, screen grid, suppressor, plate, and all other elements in turn. Sensitive inter-electrode testers are now also available as separate instruments for use by those who already have good tube testers which do not include such a circuit.

Some modern tube testers can even test transistors. The EICO Model 666, for example, has such provisions; Figure 4 (A) is a simplified diagram of its circuit for measuring emitter-to-collector leakage. Note that the emitter is grounded and no

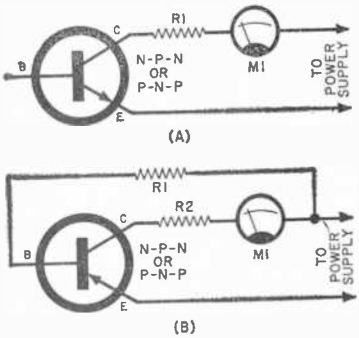


Fig. 4. Transistor-testing circuits in EICO Model 666 tester. Circuit (A) measures emitter-to-collector leakage; circuit (B) measures *beta*.

signal is applied to the base; current flow is determined by the temperature and resistivity of the semiconductor material. Most important, the current flow becomes quite large if there is contamination of the surface of the material, or if the transistor has been damaged by a short circuit.

In Fig. 4(B), a small current is put into the base through a 200,000-ohm resistor (*R1*) to permit the collector-to-base amplification factor (*beta*) to be measured. This can then be compared with the correct value of *beta* for any given transistor. The correct value, by the way, is given on a roll chart contained in the tester. Switching facilities are provided so that either *n-p-n* or *p-n-p* transistors can be tested.

"Life" Tests. Some instruments also have provisions for a so-called "life" test. Such a check indicates roughly how much longer a tube can be expected to operate properly. One such tester simply reduces the filament voltage by 15 or 20%.

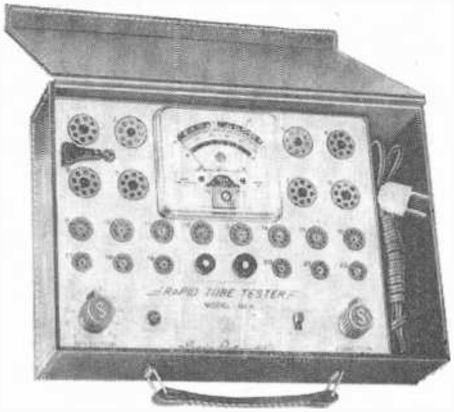
If the filament is still very active, emitting far more electrons than necessary for normal operation, it will generally continue to emit enough electrons even at the reduced voltage to test "good" on the emission tester. On the other hand, if the cathode is emitting at its top capacity and just barely managing to keep the tube operating, chances are it is approaching the end of its useful life. In this case, when filament voltage is lowered, the indicator will probably drop into the "bad" region.

Other testers apply a different kind of life test: they abruptly shut off the filament voltage. If the cathode has a high emission capability, the emission indicator will drop slowly. If the tube's emitting power is weak, the plate current will fall rapidly. Such life tests as these are only the roughest of indicators, but they can be profitably used by an experienced technician in judging whether a tube should be replaced or not.

"Quick" Testers. Although tube testers are generally considered to be time-saving instruments, there are conditions under which their use can be very time-consuming. With today's modern TV sets, for example, a serviceman may find himself with some 20 or more tubes to test on every service job. With a conventional tester, he must locate the tube type to be tested on the chart, set three or four knobs, eight or ten levers, plug the tube in, wait for it to warm up, test for shorts (manipulating more knobs, levers, or switches), then test for quality. Even an experienced technician cannot average much less than two minutes per tube.

To help shorten this time-consuming process, manufacturers have come up with at least three kinds of instruments which make the job of checking large numbers of tubes much faster, frequently cutting the time involved by 50% or more.

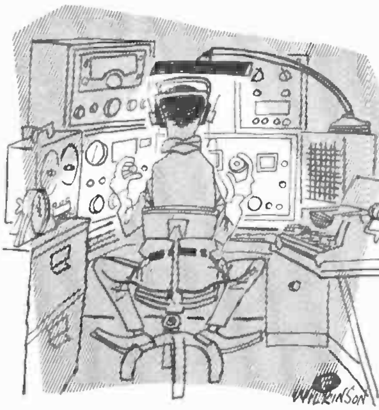
One type of "quick" tester—the general



"Quick" tester manufactured by Superior Instrument Co. has several sockets with pin connections permanently wired to reduce pre-test adjustments.

name applied to such instruments—is illustrated above. Instead of having to adjust many levers to connect the proper voltages to the tube's pins, you simply select the socket which *already* has the proper connections, permanently wired. Then plug in the tube, and start testing.

(*Continued on page* 119)



The World of BCB DX

Beginning DX'ers have the world at their fingertips—right on the broadcast band

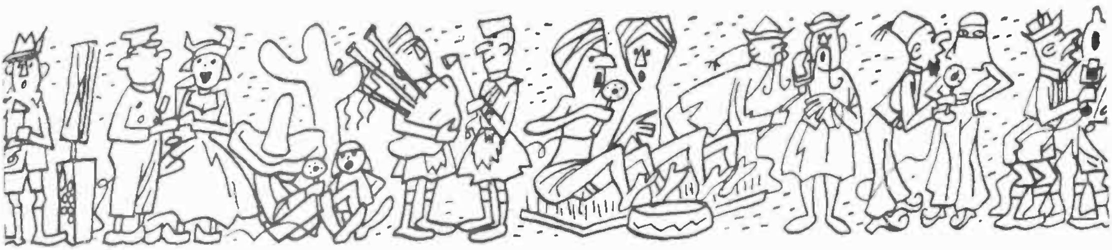
By **GLEN H. KIPPEL,** WØWPO, WPEØNA

WORLD-WIDE DX on the short-wave bands is an old story. Not so well known, but equally exciting for many, is DX on the standard broadcast band (BCB). With fall broadcast-band DX again approaching its peak, why not try *your* luck at it? Over-the-pole reception will be infrequent for a while, since we have just passed the "maximum" of a sunspot cycle. But reception from other areas will be strong, and there are loads of Latin-American stations to be heard nightly.

Equipment Needed. To start your adventure in BCB DX, all you need is a broadcast receiver and a *good* antenna. If you have a communications receiver, so much the better—such receivers are ideal for BCB DX'ing because of the generally superior circuitry and the variety of con-

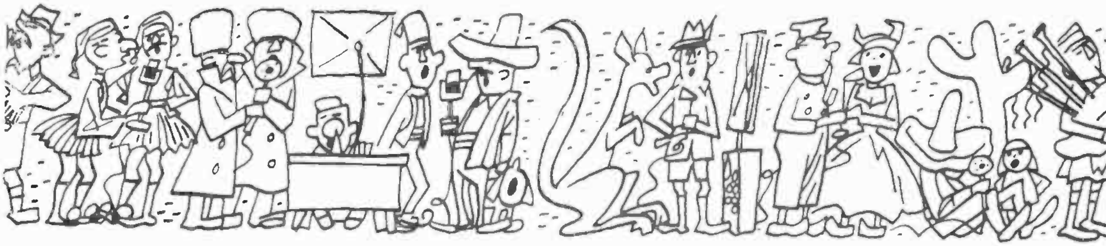
DX BROADCAST

FREQ. (kc.)	CALL LETTERS	STATION NAME (Location) OR SLOGAN
540	XEWA	XEW (San Luis Potosi, Mexico)
550	HON31	Radio Aeropuerto (Panama City, Panama)
550	KMVI	(Wailuku, Hawaii)
550		R. Jamaica and Rediffusion (Galina, Jamaica)
560		Jamaica B/C Corp. (Kingston, Jamaica)
580		R. Jamaica and Rediffusion (Mandeville, Jamaica)
580	WKAQ	(San Juan, Puerto Rico)
590	KGMB	(Honolulu, Hawaii)
590	CMW	Reloj de Cuba (Havana, Cuba)
600	WAEL	(Mayaguez, Puerto Rico)
620	HI3T	La Voz Dominicana (Ciudad Trujillo, D.R.)
620		Jamaica B/C Corp. (Mandeville, Jamaica)
625	TIDCR	Voz de la Victor (San Jose, Costa Rica)
630	4QN	Australian B/C Comm. (Townsville, Australia)
630	CMQ	Radio Centro (Havana, Cuba)
640	CMHQ	Radio Centro (Santa Clara, Cuba)
640	TGW	R. Nacional de Guatemala (Guatemala City, Guat.)
650	TIBAS	Radio Monumental (San Jose, Costa Rica)
650	KPOA	(Honolulu, Hawaii)
655	PJA-10	Voice of Aruba (Oranjestad, Aruba, DWI)
655	YSS	R. Nacional del Salvador (San Salvador, El. S.)
660	KFAR	(Fairbanks, Alaska)
660	2YC	(Wellington, New Zealand)
660	CMCU	R. Garcia Serra (Havana, Cuba)
660	XERPM	R. Programas de Mexico (Mexico City, Mexico)
670	JOBK	N.H.K. Network I (Osaka, Japan)
670	YVQB	Radio Sucre (Cumana, Venezuela)
674		Ici Radio Bretagne, Studio de Rennes (Rennes, France)
675	YND	Union Radio (Managua, Nicaragua)
680	WAPA	Voice of the Caribbean (San Juan, Puerto Rico)



STATIONS HEARD IN THE UNITED STATES

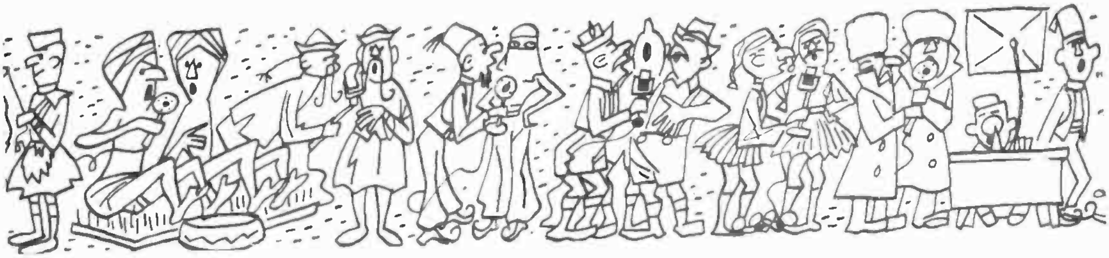
FREQ. (kc.)	CALL LETTERS	STATION NAME (Location) OR SLOGAN
690	KULA	(Honolulu, Hawaii)
690	CMBC	Radio Progreso (Havana, Cuba)
693	TIHB	Radio Reloj (San Jose, Costa Rica)
700		Jamaica B/C Corp. (Montego Bay, Jamaica)
700	YVMH	Radio Popular (Maracaibo, Venezuela)
710	WKJB	(Mayaguez, Puerto Rico)
710	HJCZ	Voz de Colombia (Bogota, Colombia)
715	HRTV	Union Radio Hondurena (Tegucigalpa, Honduras)
720	HJDC	Ecos de la Montana (Medellin, Colombia)
720		R. Jamaica and Rediffusion (Kingston, Jamaica)
720	CMHU	Modesto Radio (Cienfuegos, Cuba)
730	KFQD	(Anchorage, Alaska)
730	VP4RD	Radio Trinidad (Port-of-Spain, Trinidad)
730	CMCA	Radio Mambi (Havana, Cuba)
730	XEX	XEQ (Leon, Mexico)
738V	HJCU	Radio Tricolor (Bogota, Colombia)
740	CMKJ	Radio Centro (Holguin, Cuba)
750	JOIB	N.H.K. Network II (Sapporo, Japan)
750		Jamaica B/C Corp. (Galina, Jamaica)
750	HJAJ	Voz de Barranquilla (Barranquilla, Colombia)
750	YVKS	Radio Caracas (Caracas, Venezuela)
750	YNX	Voz de Paz (Managua, Nicaragua)
751V	TIW	Radio City (San Jose, Costa Rica)
755	CSA3	Emissora Regional (Lisbon, Portugal)
760	CMCD	Radio Voz de la Hora (Havana, Cuba)
760	KGU	(Honolulu, Hawaii)
760	ZFY	Radio Demerara (Georgetown, Br. Guiana)
760	XEWB	XEW (Vera Cruz, Mexico)
770	3LO	Australian B/C Comm. (Melbourne, Australia)
770	HJDK	Voz de Antioquia (Medellin Colombia)
775	TIWW	(San Jose, Costa Rica)
780	4YA	(Dunedin, New Zealand)
780	YVOD	Ecos del Torbes (San Cristobal, Venezuela)
780	4VU	Radio Lumiere (Aux Cayes, Haiti)
782	CSB9	Radio Clube Portugues (Porto, Portugal)
790	4QG	(Brisbane, Australia)
790	XERC	Radio Exitos (Mexico City, Mexico)
795	CMCH	Radio Cadena Havana (Havana, Cuba)
800	IYZ	(Rotorua, New Zealand)
800		Radio Surinam (Paramaribo, Surinam)
800	CMKL	Radio Minuto Nacional (Santiago, Cuba)
810	WKVM	(San Juan, Puerto Rico)
810	TGTO	Radio Internacional (Guatemala City, Guat.)
820	2GL	Australian B/C Comm. (Glen Innes, Australia)
820	HJED	Voz de Rio Cauca (Cali, Colombia)
825	YNOL	Ondas de Luz (Managua, Nicaragua)
830	CMBZ	Radio Salas (Havana, Cuba)
830	JOBB	N.H.K. Network II (Osaka, Japan)
830	TISS	Voz del Tropico (San Jose, Costa Rica)
840	4RK	Australian B/C Comm. (Rockhampton, Australia)
840	HJKC	Emisora Nuevo Mundo (Bogota, Colombia)
845	HROW	Radio Monserrat (Tegucigalpa, Honduras)
850	CMKU	Radio Oriente (Santiago, Cuba)
854	OAX4A	Radio Nacional del Peru (Lima, Peru)
855	TICS	Voz de America (San Jose, Costa Rica)
860	CMBL	Radio Aeropuerto (Havana, Cuba)
860	XEMO	R. Ochocientos Sesenta (Tijuana, Mexico)
865	PJC2	Juliana Zender (Willemstad, Curacao, DWI)



DX BROADCAST STATIONS HEARD IN THE

FREQ. (kc.)	CALL LETTERS	STATION NAME (Location) OR SLOGAN
865	HRUC	Radio Centro (Tegucigalpa, Honduras)
870	2GB	2GB (Sydney, Australia)
880	IYC	(Auckland, New Zealand)
880	JOPK	N.H.K. Network I (Shizuoka, Japan)
880	TGJ	Radio Nuevo Mundo (Guatemala City, Guat.)
882V	TILS	Radion (San Jose, Costa Rica)
887V	HRJN	R. Pinares de Honduras (Tegucigalpa, Honduras)
890	HJCI	Voz de la Victor (Bogota, Colombia)
890	VRH3	(Lautoka, Fiji Islands)
895	OBX4X	Radio el Sol (Lima, Peru)
900	4YC	(Dunedin, New Zealand)
900	KFRB	(Fairbanks, Alaska)
900	KMTH	A.F.R.T.S. (Midway Island)
900	XEW	(Mexico City, Mexico)
908		B.B.C. Home Service (Brookmans Park, Great Britain)
910	WPRP	Voz de Puerto Rico (Ponce, Puerto Rico)
910	CMCF	Union Radio (Santa Clara, Cuba)
914		Radic Surinam (Paramaribo, Surinam)
915	HJCS	Radio Continental (Bogota, Colombia)
920	TIRS	Radio Athenea (San Jose, Costa Rica)
926		Ici Bruxelles, Radiodiffusion—Television Belge (Brussels, Belgium)
930	HJAF	Emisora Fuentes (Cartagena, Colombia)
935	YNW	Radio Mundial (Managua, Nicaragua)
944		Ici Toulouse, Radiodiffusion—Television Francaise (Toulouse, France)
950	JOKR	Radio Tokyo (Tokyo, Japan)
950	LR3	Radio Belgrano (Buenos Aires, Argentina)
950	CMBF	Onda Musical (Havana, Cuba)
965	YNLU	Radio Managua (Managua, Nicaragua)
990	XECL	Radio Mexicali (Mexicali, Mexico)
995V	YVOB	Voz del Tachira (San Cristobal, Venezuela)

FREQ. (kc.)	CALL LETTERS	STATION NAME (Location) OR SLOGAN
1000	XEOY	Radio Mil (Mexico City, Mexico)
1005	HRN	La Primera Emisora (Tegucigalpa, Honduras)
1010	CMBQ	Radio Continental (Havana, Cuba)
1010	PJC7-1	Radio Hoyer I (Willemstad, Curacao, DWI)
1010	JONR	Asahi B/C Co. (Osaka, Japan)
1013V	HJAI	Radio Calamary (Barranquilla, Colombia)
1015	YSC	Radio Mil Vienticinco (San Salvador, El S.)
1020	TGUX	Radio Panamericana (Guatemala City, Guat.)
1030	XEQR	Radio Centro (Mexico City, Mexico)
1034	CSB2	Radio Clube Portugues (Parede, Portugal)
1040	KHVH	(Honolulu, Hawaii)
1040	4ZB	(Dunedin, New Zealand)
1043		Radio DDR (Dresden, East Germany)
1060	CMCX	Emisora Amiga (Havana, Cuba)
1070	IZB	(Auckland, New Zealand)
1070	WMIA	(Arecibo, Puerto Rico)
1075	YSEB	Voz de Latino America (San Salvador, El S.)
1080	HJAT	Radio Reloj (Barranquilla, Colombia)
1088		B.B.C. Home Service (Droitwich, Great Britain)
1090	CX28	Radio Imparcial (Montevideo, Uruguay)
1097		Czeskoslovensky Rozhlas (Bratislava, Czech.)
1110	XERCN	Radio Continental (Mexico City, Mexico)
1120	YVMF	Ondas del Lago (Maracaibo, Venezuela)
1150	XEJP	Radio Variedades (Mexico City, Mexico)
1175	YSCB	Voz del Pacifico (Sonsonate, El Salvador)
1175	TIQ	Radio Casino (Puerto Limon, Costa Rica)
1180		Voice of America (Naha, Okinawa, Ryukyu Islands)
1190	XEWK	XEW (Guadalajara, Mexico)
1195	LR9	Radio Antartida (Buenos Aires, Argentina)



UNITED STATES

FREQ. (kc.)	CALL LETTERS	STATION NAME (Location) OR SLOGAN
1205		Ici Bordeaux, Radiodiffusion—Television Francaise (Bordeaux, France)
1214	HJEM	R. Difusora de Occidente (Cali, Colombia)
1220	XEB	(Mexico City, Mexico)
1223	SBV	Sverges Radio (Falun, Sweden)
1259	HJKN	R. Metropolitana (Bogota, Colombia)
1277		Ici Strasbourg, Radiodiffusion—Television Francaise (Strasbourg, France)
1286		Czeskoslovensky Rozhlas (Prague, Czechoslovakia)
1295		B.B.C. European Service (Norden-Osterloog, W. Germany)
1322		Radio Moscow (Leipzig, East Germany)
1370	JOKD	N.H.K. Network II (Kitami, Japan)
1376		Ici Radio Lillie, Radiodiffusion—Television Francaise (Lille, France)
1380	KPOI	(Honolulu, Hawaii)
1420	XEXX	(Tijuana, Mexico)
1439		Radio Luxembourg (Marnach, Luxembourg)
1440	XELZ	Radio Independiente (Mexico City, Mexico)
1457		B.B.C. Home Service (Clevedon, Great Britain)
1466	3AM2	Radio Monte Carlo (Monte Carlo, Monaco)
1470	XESM	(Mexico City, Mexico)
1480	JORF	Radio Kanto (Yokohama, Japan)
1490	CMOX	Radio Cubano (Havana, Cuba)
1500	XERH	(Mexico City, Mexico)
1540	ZNS	(Nassau, Bahamas)
1560	WENA	R. Metropolitana (Bayamon, Puerto Rico)
1570		N.W.R. (Flensburg, West Germany)
1578	CSB5	Radio Porto (Porto, Portugal)
1578	LKF	Norsk Rikskringkasting (Fredrikstad, Norway)
1580	XEDM	Voz del Pacifico (Hermosillo, Mexico)
1586		N.W.R. (Oldenburg, West Germany)

trols found in these sets. You'll also find a tape recorder a big help with foreign-language broadcasts; by taping the broadcasts, you can decipher the station announcements one word at a time at your leisure.

You'll need a couple of other basic "tools" in addition to your electronic equipment. First of all, you'll need a certain amount of experience in identifying foreign stations, but you're probably already used to listening to foreign languages if you're an SWL. For BCB listening, you should be able to get by with a little Spanish for identifying Latin-American stations; a smattering of French will also be useful on occasion.

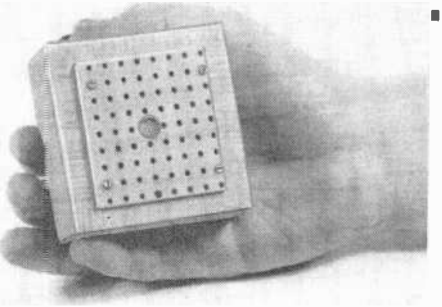
Another important "tool" is a list of foreign BCB stations. Foreign stations heard during the 1959-60 season by DX'ers in the United States and Canada are listed in the extensive table appearing on these pages. Only stations which have been heard during regularly scheduled broadcasts are included; and because of the great number of Mexican and Cuban stations, only a few of the more widely heard ones have been listed. A "V" after the frequency indicates that the station varies slightly in frequency.

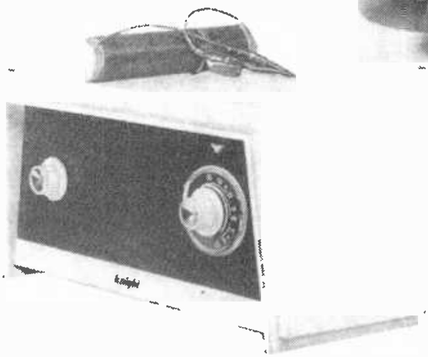
When to Listen. Barring interference, Latin-American stations can be heard almost any time at night during their operating period, but European stations can seldom be heard later than 0300 EST. Trans-Pacific DX comes in only when interfering stations are off, and when ionospheric conditions are favorable.

In addition to the spring and fall "peaks," there are minor BCB DX peaks every June and December. During these lesser peaks, "twilight skip" conditions are in effect and you'll be able to tune in stations up to 1500 miles away. You'll find that a station several hundred miles away often has a signal that can override closer stations. A day or two later, the same station may be weak or inaudible, sometimes with another station taking its place. The best time to

(*Continued on page* 103)

Carrier-Current Sentinel





By

MARTIN H. PATRICK

The Sentinel (above) feeds signal through power line to the pickup unit (coil on top of radio at left).

Low-cost pager uses a. c. power line for inter-station wiring

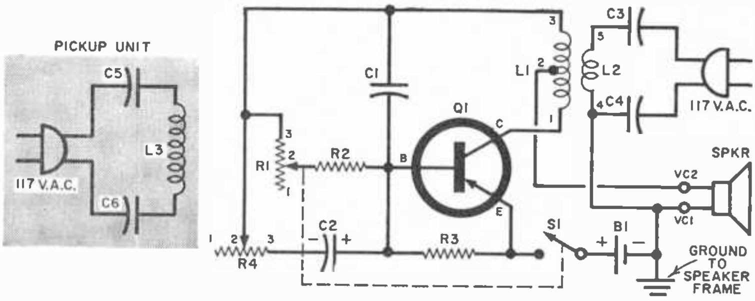
HERE'S a monitoring unit that can keep you in direct contact with other members of your family in various parts of your home. Plug the "Carrier-Current Sentinel" into a receptacle in one room, tune in a small radio in another, and you can keep tabs on calls from the nursery, garage, attic, basement, workshop, or anywhere else nearby.

The Sentinel uses a small PM speaker as a microphone and feeds a modulated r.f. carrier into the a.c. wiring. The signal is passed along the wiring to a pickup unit which plugs into an a.c. receptacle and couples the r.f. signal from the power line to an ordinary AM radio.

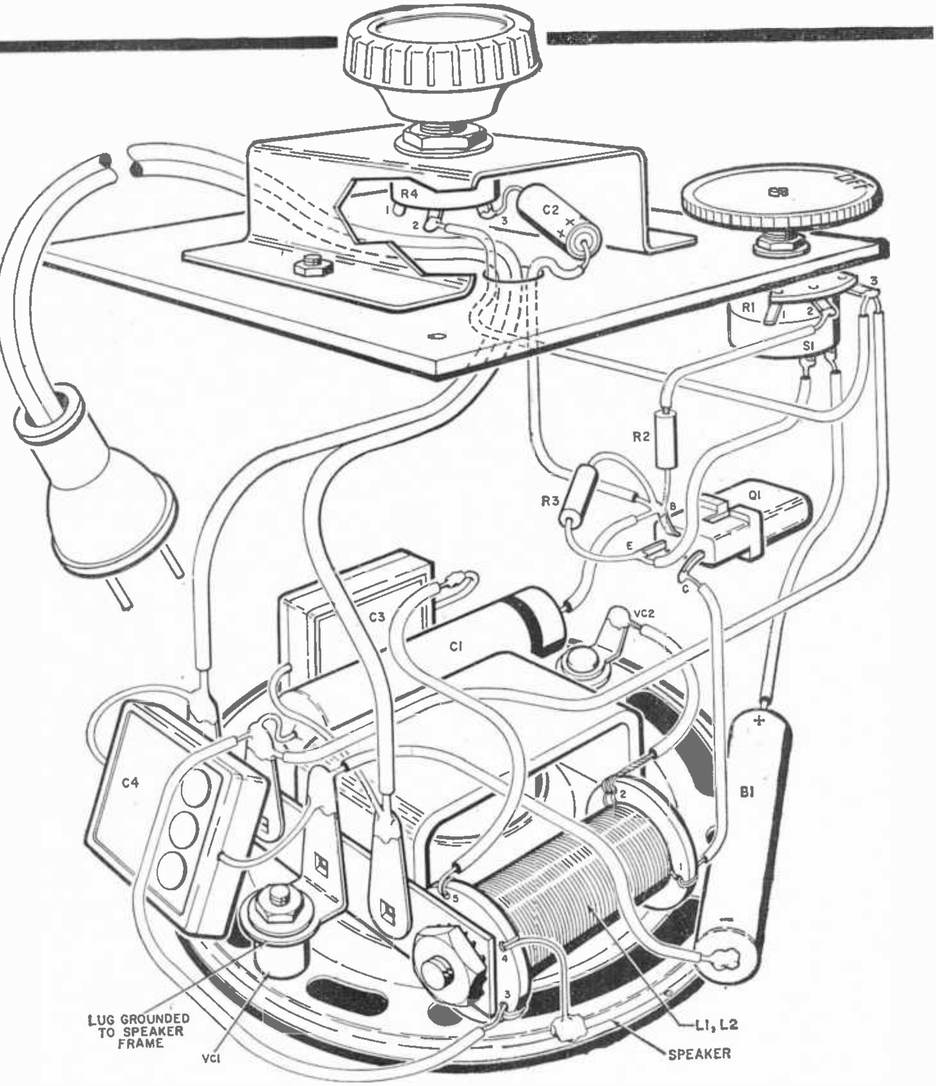
Despite the low power output of the Sentinel, the pickup unit enables even an inexpensive a.c.-d.c. radio to detect any signal the Sentinel will put out. Parts for both the Sentinel and the pickup unit should cost less than $10.00.

Construction. Coils *L1* and *L2* for the Sentinel are close-wound on a No. 8 brass bolt 1¼" long; ¾" fiber washers limit the winding space to ¾".

Start *L1* by winding 300 turns of No. 25 enameled wire on the bolt, tagging the beginning of the winding terminal *1*. When 300 turns have been wound, make a loop in the wire, label it terminal *2*, and wind an additional 300 turns in the same direction. Label the end of the second 300-turn winding terminal *3*, and you have completed *L1*. To hold the windings in place, pass the leads through holes in the fiber washers.



Schematic diagrams for Sentinel and pickup unit. Switch S1 can be on either R1 or R4.



PARTS LIST

B1—1.5-volt penlight cell
C1—0.1-μf., 50-volt capacitor
C2—50-μf., 10-volt electrolytic capacitor
C3, C4—.0015-μf., 500-volt mica capacitor
C5, C6—0.003-μf., 500-volt mica capacitor (for pickup unit)
L1—600 turns of #25 enamel-covered wire, center-tapped; scrambled-wound on 3/16" brass bolt, 1¼" long; length of coil, ¾"
L2—20 turns of #25 enamel-covered wire wound over L1
L3—70 turns of #20 enamel-covered wire wound on broomstick handle (for pickup unit)
Q1—2N1265 transistor (Sylvania) or equivalent
R1—5000-ohm miniature potentiometer with switch S1 (Lafayette VC-27 or equivalent)
R2—470-ohm, ½-watt resistor
R3—10,000-ohm, ½-watt resistor
R4—500,000-ohm miniature potentiometer (Lafayette VC-37 or equivalent)
S1—S.p.s.t. switch (part of R1)
Spkr.—Miniature permanent-magnet speaker
Misc.—Line cords and plugs, fiber washers, wire, solder, etc.

Speaker frame serves as a support for most of Sentinel's components. In the model, voice-coil lug VC1 was removed and replaced with a machine screw and spacer to hold a four-terminal mounting strip.

Coil *L2* consists of 20 turns of No. 25 enameled wire wound on top of *L1*. Label its terminals *4* and *5* respectively, and pass them through additional holes in one of the fiber washers as shown above.

Wire the Sentinel as shown in the pictorial diagram, and be sure to use leads long enough so that the cover of the completed unit can be removed from time to time for battery replacement. When wired, the assembly can be placed inside a 3" x 3" x

(*Continued on page* 110)

Going Mobile with CB

Installing a CB rig in your car is easier than you think. Here's how 12W1906 went about it

By LELAND R. REEDER, 12W1906

IF you're among the thousands about to join the growing ranks of mobile Citizens Band enthusiasts, you may have already purchased a transceiver made by one of the 35 or so manufacturers in the field. Although each manufacturer supplies installation instructions for his particular units, there are a number of general things to keep in mind when installing any CB rig.

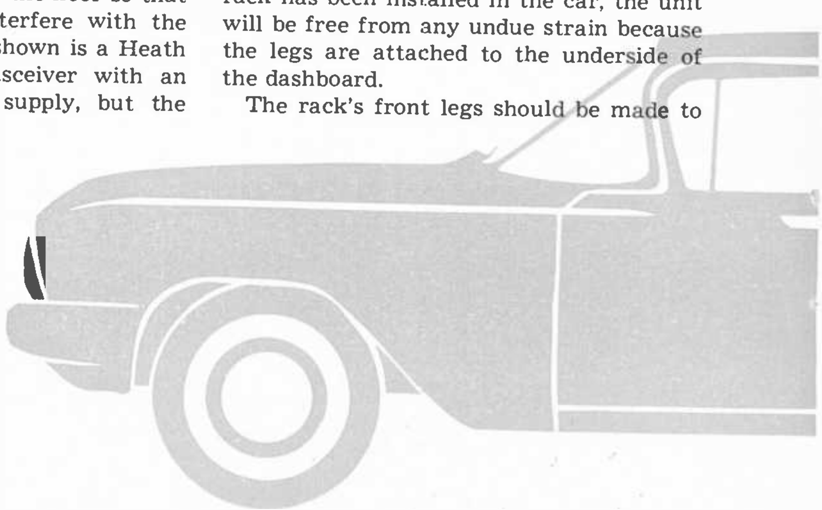
The first problem, of course, is where to put the CB unit. Although the usual place for mounting such rigs is under the dashboard or back in the trunk, both of these locations have their disadvantages. Put the rig under the dashboard, and you're likely to need longer arms than you're presently equipped with. Mount the unit in the trunk, and you'll require some sort of remote control equipment. But there's another way to handle this problem.

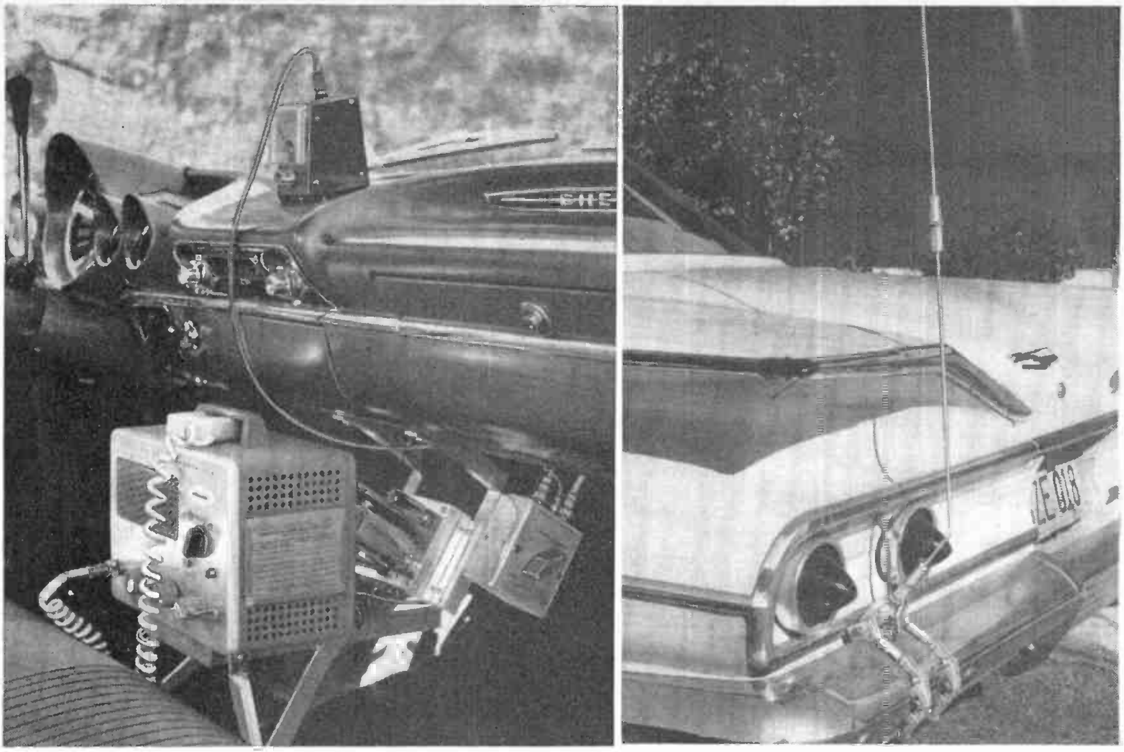
Mounting Rack. The rack described here places the CB unit within easy reach of the driver, yet high enough off the floor so that the front seat doesn't interfere with the controls. The equipment shown is a Heath CB-1 Citizens Band transceiver with an external vibrator power supply, but the rack can be altered to suit almost any equipment. Its total cost shouldn't exceed four dollars.

Standard flat and angle shapes of 1″-thick aluminum, available at most lumber and hardware dealers, are ideal materials for constructing the rack. The main frame pieces, including the side rails, end piece, and legs, are cut from ¾″ x ¾″ x ⅛″ angle; the braces are ¾″-wide strips. The aluminum is easily cut with a hacksaw and holes bored with hand- or power-driven twist drills. Use aluminum bolts and nuts in the assembly; lock washers are essential under each nut.

The dimensions shown in Fig. 1 will be found about right for most domestic cars, although the new compacts and most imports may require some adaptation. The frame is held together at one end by an angle spreader and at the other end by the case of the transceiver itself. Once the rack has been installed in the car, the unit will be free from any undue strain because the legs are attached to the underside of the dashboard.

The rack's front legs should be made to





Rack holds transceiver (above left) at convenient distance from driver; note antenna change-over switch and field strength meter on top of dash. Antenna bumper mount (right) is easy to install.

fit over the bulge in the floor board over the car's transmission. If desired, the legs can be attached to the floor with self-tapping screws, eliminating the front braces. Or, if a less rigid mounting is permissible, the front braces can be installed and the legs left free of any connection to the floor board. To complete the installation, bolt the rack to the underside of the dashboard.

Antenna System. With the rack mounted and the CB unit in place, the next step is wiring the transceiver—simply a matter of running one lead to the antenna and another to the car's battery. A good antenna system is all-important with these little five-watt rigs, and a 102" to 108" whip is about tops.

Although you can mount the antenna on a bumper or on the trunk lid or roof, you may decide on a bumper mount in order to avoid drilling unnecessary holes in your car. The mount can be attached to the bumper with the base of the whip pointing out at about a 45° angle, as shown above. Bend the whip just above the bottom connector to bring the main portion of the whip back to the vertical position.

To run coaxial cable from antenna to transceiver, first drill a small hole through the rear wall of the trunk near the whip and install a rubber grommet in the hole. Feed the cable through the hole, across the luggage space, then down behind the rear seat and under the floor mats to a point near the transceiver. Use solder lugs on the ends of all wires to be connected to screw-type terminals and coax fittings and connectors on all cables carrying radio

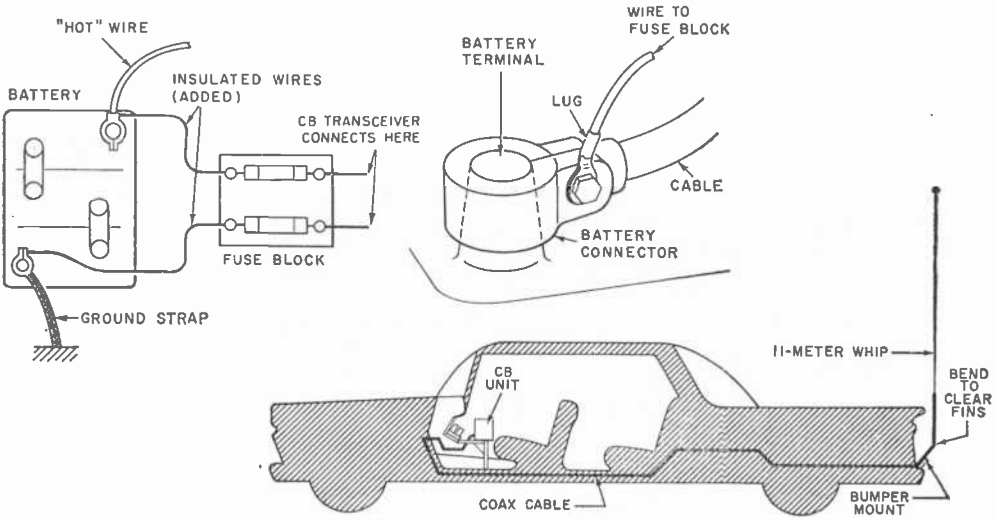


Fig. 2. Fuse block between battery and transceiver will protect the CB rig; one or two fuses can be used, depending on requirements. Use heavy insulated wire for all battery connections, and coaxial cable to connect the transceiver to the antenna.

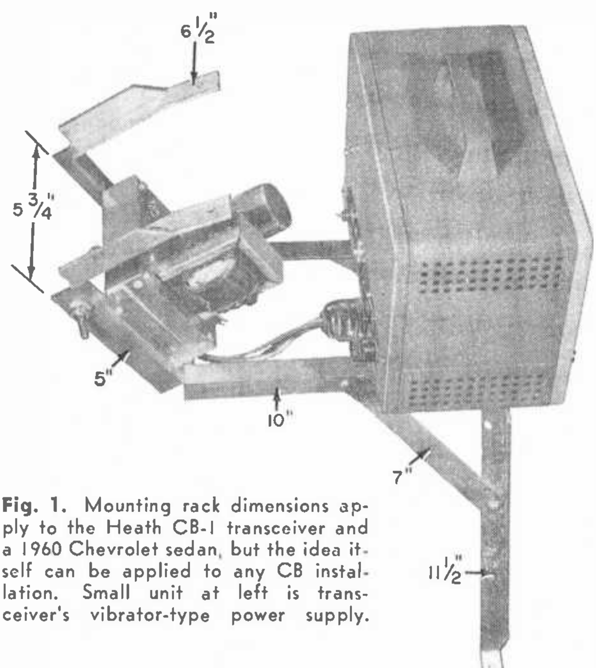


Fig. 1. Mounting rack dimensions apply to the Heath CB-1 transceiver and a 1960 Chevrolet sedan, but the idea itself can be applied to any CB installation. Small unit at left is transceiver's vibrator-type power supply.

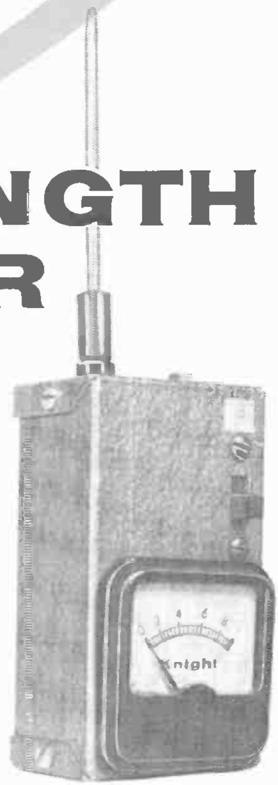
frequencies. For the installation shown, approximately 17 feet of 52-ohm coax between antenna and transceiver gives a satisfactory standing-wave ratio.

Power Supply. Battery voltage can be tapped off almost anywhere, but you'll save headaches by tapping it off at an added fuse block (see Fig. 2). It's a good idea to install a line connector in the hot wire from the battery to the power supply to permit removing the transceiver for checking or repairs. It's also a good idea to have some kind of secret switch in the hot line to keep unauthorized persons from going on the air with your rig. Ground the rack, along with the transceiver, to the body of the car.

A field strength meter is desirable but not mandatory on mobile installations (see article beginning on page 69). If the antenna furnished with the FSM isn't long enough to insure good readings, try connecting the FSM to your auto radio antenna. A s.p.d.t. switch will permit switching back and forth from the auto radio to the meter; use standard cable connectors and plugs for wiring up the switch.

If you pay careful attention to both mounting and hooking up your mobile CB rig, troubles should be few and far between. —30—

Build a FIELD STRENGTH METER



Inexpensive device checks radiation pattern of your CB or ham antenna system

By **RUSSELL KELLER**, K9CZO

ARE you curious about the radiation pattern of your CB or ham antenna? Here's a simple field strength meter (FSM) that will give you an indication of relative field strength on either the 6- or 10-meter ham bands or the 11-meter Citizens Band.

This little instrument is nothing more than a tiny receiver which drives a meter instead of headphones. The meter lets you read the relative signal strength of your signal at various points near your transmitting antenna. Parts should cost less than $10, and total construction time shouldn't exceed a few hours.

Construction. The unit should be housed in a 4¼" x 2¼" x 1½" (or larger) *metal* box; unshielded plastic boxes are not suitable since inductive pickup by the FSM's coil will give a false meter reading. Mount the r.f. portion of the FSM (capacitors *C1* and *C2*, coil *L1*, jack *J1*, and diode *D1*) in the upper half of the box as shown. Insulate antenna jack *J1* from the box with a fiber washer. Keep all leads in the r.f. portion short, and use a heat sink when soldering diode *D1* and transistor *Q1*.

A one- or three-band version of the FSM is possible, the only difference being in the choice of tuning capacitor *C1*. For a three-band model (the 6- and 10-meter ham bands and the Citizens Band), use a 75-$\mu\mu$f. unit (Hammarlund APC-75 or equivalent) for *C1*. If you want only a six-meter FSM, use a 25-$\mu\mu$f. unit (Hammarlund APC-25 or equivalent).

Coil *L1* consists of six turns of No. 18 enameled wire, ½" in diameter. Solder *L1* directly across the terminals of capacitor *C1* and solder the negative lead of diode *D1* to a tap 1½ turns from the ground end of *L1*. Be sure to scrape the enamel from *L1* in the area of the tap before soldering *D1* in place. All other components except meter *M1* are also soldered in place by their leads.

A battery holder is not used since zero-signal current drain is only a few microamperes and penlight cell *B1* should last indefinitely. On-off switch *S1* can also be dispensed with if desired, but the antenna should be unplugged when the FSM is not in use.

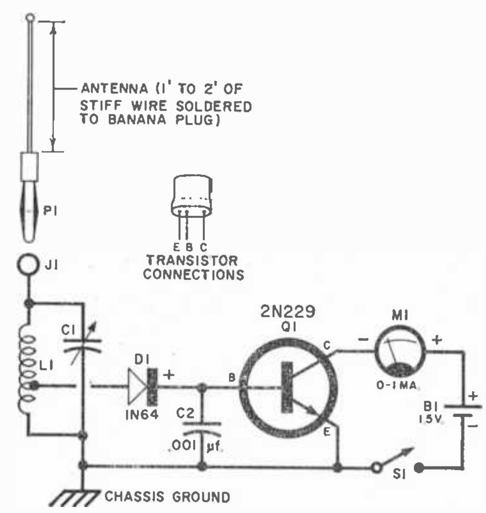
Mount meter *M1* in the lower half of the box. For a more sensitive instrument, use a 500-μa. or 100-μa. meter instead of the 1-ma. unit specified; no circuit changes are needed for either of these meters. With one of the more sensitive meters in the circuit, you can operate the FSM with a shorter antenna and measure r.f. field strength at a greater distance from the transmitter.

Make a short whip antenna, as shown, by soldering a 1' or 2' length of No. 12 or No. 14 busbar to a banana plug. Jack *J1* on the FSM is a banana jack and permits the antenna to be unplugged when the FSM is not in use.

Operation. You can use the FSM to check the radiation pattern around your antenna or to see if your transmitter is improperly shielded and radiating r.f. Before these checks can be made, however, the FSM must be tuned to the transmitter. Do this by inserting the FSM's whip antenna into *J1* and placing it near the transmitter. Then rig a temporary short-wire antenna to the transmitter, and tune up the transmitter. If yours is a CB rig, just switch to "transmit" and use a clear channel. In any case, keep all experiments down to a minimum so that already burdened Citizens Band and ham frequencies are free of unnecessary interference.

Switch on the FSM and adjust capacitor *C1* to the transmitter frequency. The meter will show a sharp rise from the zero mark at the transmitter's frequency. Adjust *C1* for a maximum reading on the FSM. If the meter goes off scale, move the FSM further away from the transmitting antenna. At this point, you'll notice that the FSM pickup depends on its polarization with the transmitting antenna: maximum pickup results when the FSM antenna and the transmitting antenna are parallel to each other.

Once the FSM is tuned to the trans-



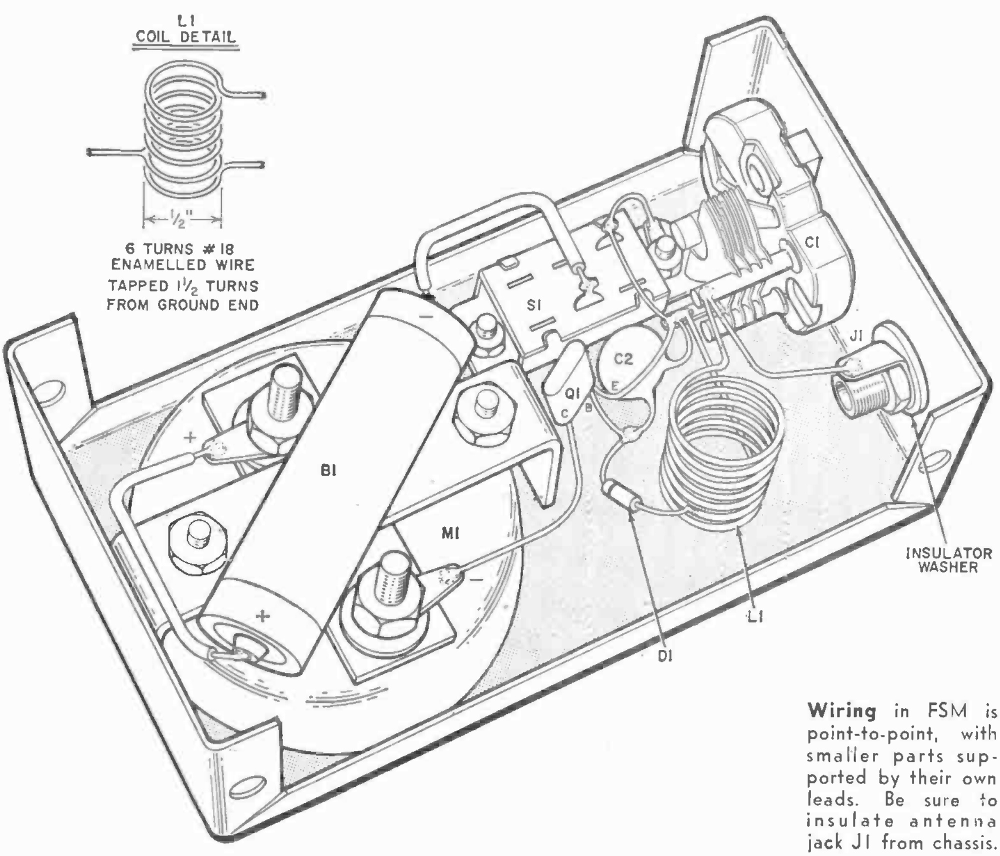
Schematic diagram of field strength meter. Exact values of C1 and M1 will depend on desired range and sensitivity of unit; switch S1 can be omitted if antenna is unplugged whenever meter is not in use.

HOW IT WORKS

Operation of the FSM is similar to that of a receiver using a diode detector followed by a one-transistor amplifier. In this case, the transistor feeds a milliammeter rather than headphones.

When r.f. is picked up by the antenna, it is tuned by coil *L1* and variable capacitor *C1*. Diode *D1*, connected to a low-impedance tap on *L1*, rectifies the r.f. appearing across the *L1-C1* tuned circuit. The rectified signal is filtered by capacitor *C2* and fed to the base of transistor *Q1*, where it is amplified and fed to meter *M1*.

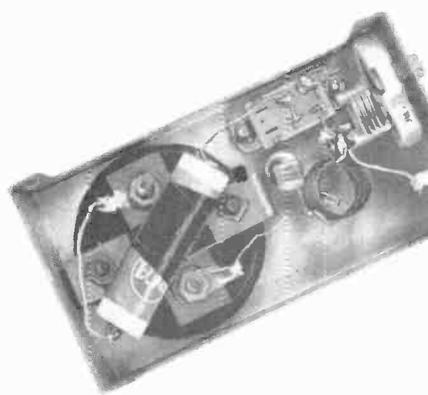
Serving as a visual indicator, *M1* measures the amplitude of the rectified signal, which is proportional to the r.f. field strength. Battery *B1* powers *Q1* through on-off switch *S1*.



Wiring in FSM is point-to-point, with smaller parts supported by their own leads. Be sure to insulate antenna jack J1 from chassis.

PARTS LIST

B1—1.5-volt penlight cell
C1—See text
C2—.001-μf. ceramic disc capacitor
D1—1N64 diode
J1—Banana jack
L1—Six turns of #18 enameled wire, ½" in diameter (see text)
M1—0-1 ma. meter (Lafayette TM-400 or equivalent—see text)
P1—Banana plug
Q1—2N229 transistor
S1—S.p.s.t. slide switch (Lafayette SW-14 or equivalent)
1—4¼" x 2¼" x 1½" box (Bud CU-2116 or equivalent)
Misc.—Hardware, wire, solder, etc.



mitter, disconnect the temporary antenna and connect your regular transmitting antenna. If your transmitter and coaxial transmission line are properly shielded and grounded, you should get no reading on the FSM no matter how close to the transmitter or coax the FSM antenna is placed.

When this check has been made, go outside to your transmitting antenna and turn the FSM until its antenna parallels the transmitter's. Walk around the transmitting antenna with the FSM, taking care to stay at least several wavelengths away from the antenna.

The r.f. field you detect should correspond with the type of antenna you have. If your antenna is directional, the r.f. field will be stronger in one location than in another; this is true of horizontal antennas. Vertical antennas, on the other hand, should exhibit a perfectly uniform field in a 360° sweep. Antennas with reflectors should be most effective on the side away from the reflector. —30—

On the Citizens Band

By TOM KNEITEL, 2W1965

WE SPENT an afternoon with Harry Ashley, 2W3429, a few weeks ago. Harry, as you may know, is no ordinary CB'er—he happens to be the president of EICO; and EICO, just in case you live in a vacuum, is one of the country's top equipment manufacturers—for both kits and wired stuff.

The visit proved quite interesting. We had a chance to talk shop with Harry—and fiddle around with the EICO Model 762 CB transceiver which resides on top of his air-

craft-carrier-sized desk. (That's yours truly in the photo above, looking over the schematic of the 762.) All of the various EICO CB models, including the 762, have the unique feature of being the only kits available today with the complete final oscillator sealed up tight. This means, at long last, that you are free to "pull crystals" to change channels without breaking the law.

Harry, a member of the Five-Watt Wizards, incidentally, is quite active on the band—usually speaking to his home or factory—and sends his 73 to CB'ers throughout the country.

A supplement to International Crystal's 1960 Call Book is now available. It has just about as many calls in it as the main edition (the one issued in February) and costs $3.95. It's complete to June 30. Send your order and check to George Beyers, 1ØW-Ø3Ø6, International Crystal Manufacturing Co., 18 North Lee, Oklahoma City, Okla. Tell George we sent you and he'll rush your copy through.

The first CB group ever to do actual disaster work with the American Red Cross, according to Stanley Tsutsumi, 21WØ3Ø4, is the "Citizen Banders Hawaii" Club. You will recall that there were a bunch of tidal waves thrown at "21-land" recently as a result of the 'quakes in Chile. Well, CBH dug in with more than 12 mobile units and did the CB fraternity proud.

Only a few weeks before the disaster, the Red Cross and the CBH had kicked around the idea of a system for handling disaster work. But the actual disaster hit so soon afterwards that the system wasn't even field-tested. Nice going, CBH!

If you have misgivings about leaving your CB rig in your mobile unit unguarded, here's a silent sentinel to keep watch. It's a very cleverly worded "stay away" sticker

This mobile radio transmitter is under the jurisdiction of the *FEDERAL COMMUNICATIONS COMMISSION*, Washington, D.C.

It is a Federal offense for unauthorized persons to tamper with radio equipment licensed by an agency of the UNITED STATES GOVERNMENT.

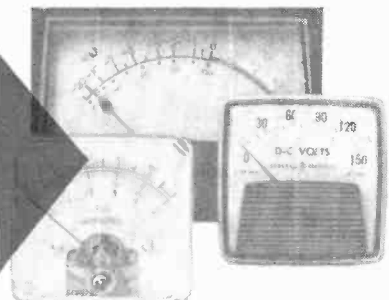
MEDDLERS will be **PROSECUTED** as the **LAW** provides.

for your windshield or dashboard. We doubt if a potential thief would even look twice at your rig after reading it.

The 3⅜" x 6 5/16" sticker is made of anodized (etched) aluminum, with a layer of adhesive material on the back of it. The lettering is done in silver on a black background. It's available for $1.25 through Mahler Research Co., P. O. Box 1159, New York 1, N. Y. —30—

COVER STORY

METERS



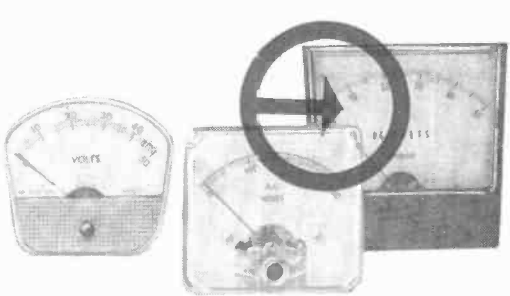
By KEN GILMORE

First developed in 1888, the moving-coil mechanism has held its own through the years as our basic measuring device

THE GREAT English scientist, Lord Kelvin, once said, "When you can *measure* what you are speaking about and express it in *numbers,* you know something about it." Following Lord Kelvin's line of thought, if we are to know something about electricity and electronic instruments, we must have rugged, convenient, accurate instruments able to measure a wide variety of voltages, currents, and resistances. The "meter" is such an instrument.

This most basic of all test instruments has actually not undergone a single change in fundamental theory or design since 1888. It was in that year—almost 20 years before the invention of the triode vacuum tube—that Edward Weston developed the device we now know as the Weston movement.

The Weston Movement. Figure 1(A) shows a single coil of wire suspended between the north and south poles of a magnet. Figure 1(B) is a cross section of this setup; the arrows indicate the direction of the magnetic lines of force. When current begins to flow in the wire, a magnetic field forms around it as shown by the small circles. This field opposes the field of the permanent magnet so that the coil is forced



to rotate as shown. Since the force generated by one turn is very weak, many turns are used in practical meters.

Figure 2 shows such a coil with a needle attached to it; the needle moves along a calibrated scale as the coil rotates. The distance the needle moves is proportional to the amount of current flowing. In other words, if 0.5 ma. generates a magnetic field powerful enough to deflect the needle to half scale, then 1 ma. will cause full-scale deflection. Figure 3 shows the actual construction of a Weston movement—the moving coil (A), a magnet and core (B), and the complete movement (C).

Only one aspect of the Weston movement has changed with succeeding years. (See Fig. 4). Development of better magnetic steels has allowed designers to make a more compact instrument by putting the magnet *inside* the moving coil; the iron shell around the coil completes the magnetic path.

Bear in mind that the Weston movement is a d.c. instrument. If a.c. is applied, the needle will try to follow each reversal of the current. But since it cannot move fast enough, it remains in one place and vibrates. But the Weston movement can measure a.c. currents with the addition of a simple rectifier. Figure 5 shows the basic full-wave circuit commonly used.

This ability of a Weston movement to respond to either a.c. or d.c. current—with the proper circuitry—makes possible one of the most useful test instruments in electronics: the multimeter. (See Fig. 6.) By adding a handful of resistors, rectifiers, and switches to the meter movement, we come up with a versatile instrument that can measure not only a.c. and d.c. current, but also voltage and resistance.

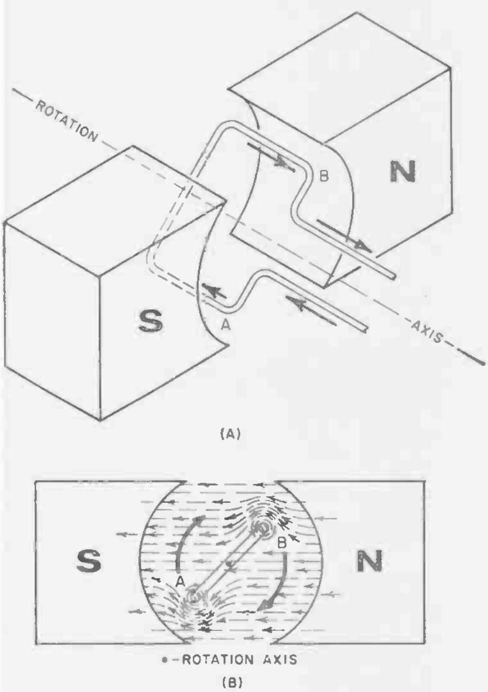


Fig. 1.

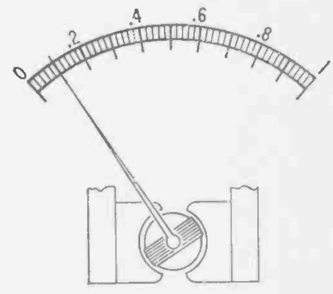


Fig. 2.

Measuring Current. Let's suppose we have a meter with a basic 1-ma. movement. This means that if 1 ma. of current flows through the coil, the needle will be deflected to its full-scale reading. But say we want to measure a current of 2 ma. We can do it by using a "shunt." To our British friends, this word means a railroad siding. In electronics, it also means a siding, but one for electrons rather than trains. In Fig. 7, the resistance of shunt R_{s1} is equal to the resistance of the meter (R_m). Thus, half the current (I_m) will flow through the meter, the other half (I_s) through the shunt, and the full-scale deflection of the needle represents 2 ma.

Shunts are easily calculated if we know the meter's internal resistance (R_m). In this case, let's say R_m = 100 ohms. Thus, R_{s1} in the example given would also be 100 ohms. If the shunt were 50 ohms (R_{s2}), twice as much current would flow through the shunt as through the meter. The meter would conduct only one-third the total current, and its full scale deflection would represent 3 ma. If the shunt were approximately 11 ohms (R_{s3}), nine times as much current would flow through the shunt as through the meter, or, conversely, one-

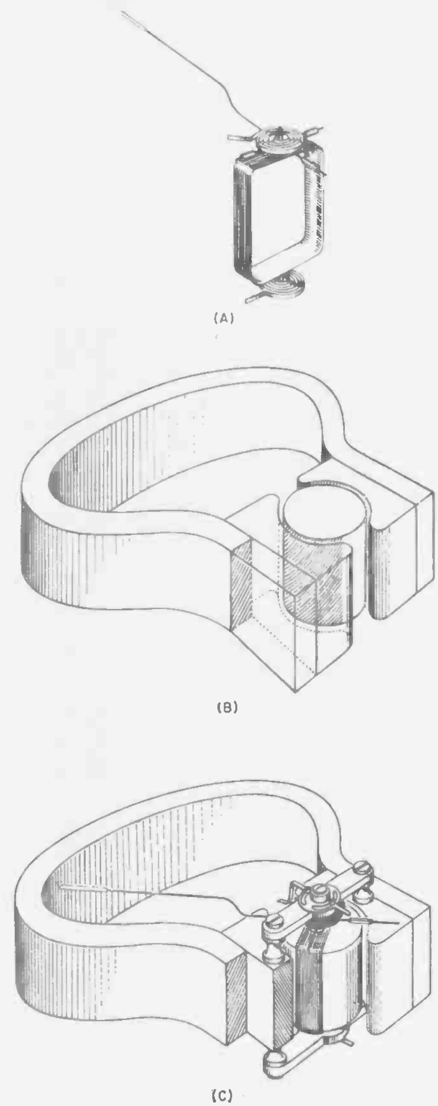


Fig. 3.

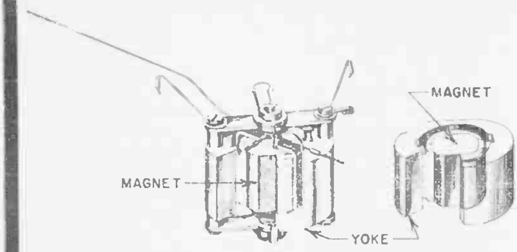


Fig. 4.

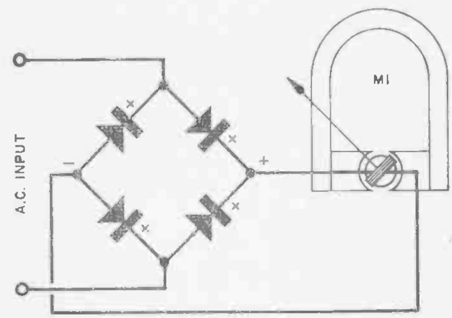


Fig. 5.

Fig. 6.

tenth the total would flow through the meter, and the full-scale sensitivity would be 10 ma.

Modern multimeters have a number of different shunts which can be switched into the circuit to give different current ranges. One typical meter on the market, for example, has scales of 1.5 ma., 15 ma., 150 ma., 500 ma., and 15 amperes. Incidentally, the shunting circuits work the same way in both a.c. and d.c. circuits; the only difference is that a rectifier must be in the circuit for the meter to read a.c.

Measuring Voltage. So far, we have considered only current measurements. But a meter can be connected to measure voltage as well. Let's take that same basic 1-ma., 100-ohm meter movement again and make a voltmeter out of it. By using Ohm's law, we can find the voltage which must be applied across the meter terminals to make a 1-ma. flow: $E = IR$; $E = .001 \times 100$; $E = .1$ volt.

If more than .1 volt appears across the terminals, more than 1 ma. will flow through the meter and damage or destroy

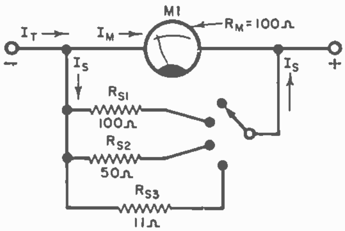


Fig. 7.

it. But suppose we want to measure 100 volts. Again, we apply Ohm's law to find out what resistance the meter would need for only 1 ma. to flow if 100 volts were applied: $R = E/I$; $R = 100/.001$; R = 100,000 ohms.

Since the basic movement is only 100 ohms, we simply add the 99,900 ohms to make up the total of 100,000 in series with

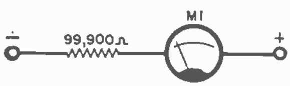


Fig. 8.

the movement as shown in Fig. 8. With various resistances switched into the circuit, one meter can measure a wide range of voltages. One typical commercial meter, for example, has ranges of 1.5 volts, 5 volts, 150 volts, 500 volts, 1500 volts, and 5000 volts. Again, both a.c. and d.c. voltage ranges can be measured by switching in the rectifier for alternating current.

Measuring Resistance. A basic meter movement can even be made to measure resistance, but this requires an additional circuit component—a battery. Let's take our 1-ma., 100-ohm meter movement and connect a 50-volt battery in series with one

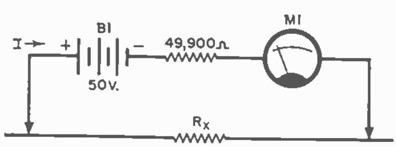


Fig. 9.

of the leads, as shown in Fig. 9. Again, Ohm's law comes into the picture. We know we have 50 volts in the circuit, and the meter movement must not conduct more than 1 ma., so we can calculate the minimum resistance that must be included in the circuit to limit the current to a 1-ma. value: $R=E/I$; R=50/.001; R=50,000 ohms.

Since the meter already has an internal resistance of 100 ohms, we need add only the other 49,900 in series (R_1). Now if we short the two test leads together, 1 ma. of current will flow and the meter will read full scale. Any additional resistance introduced into the circuit will cause the meter to read somewhere between full scale and zero. A relatively low resistance (R_x) between the test leads, for example, would perhaps make the meter read nine-tenths full scale; a larger resistance would make it read half scale; with an infinite resistance, no current at all would flow.

Thus, we see that zero ohms appears on the *right* end of the scale, or opposite from the zero of the volt and ampere scales. Because of the inherent characteristics of the ohmmeter, the needle becomes more and more inaccurate as it approaches the left side of the scale. Therefore, technicians usually try to take resistance readings as near the center of the scale as possible, to obtain the most accurate readings. They do this by switching to various ranges, which, in turn, means switching batteries of different voltages into the circuit. In practice, also, a small variable resistor is usually included in the ohmmeter circuit to compensate for variations in battery strength. The knob controlling this resistor is usually labeled "Ohms Adjust" on the front panel of the multimeter.

Other Uses. The basic Weston movement can be incorporated into still other kinds of circuits containing vacuum tubes. These instruments have certain advantages over the conventional multimeter just described, and are particularly useful for some types of work. (See Test Instruments: The Vacuum-Tube Voltmeter; April, May, July, 1959, P.E.)

Except for certain kinds of vacuum-tube voltmeters, all multimeters have one great shortcoming: they can measure a.c. voltages at relatively low frequencies only—up to about 20,000 cps. But radio and television stations and other branches of communications must measure r.f. voltages and currents up to hundreds of megacycles. This is done with the help of the thermoelement—two tiny chunks of metal, frequently constantan and platinum, clamped

(*Continued on page* 104)

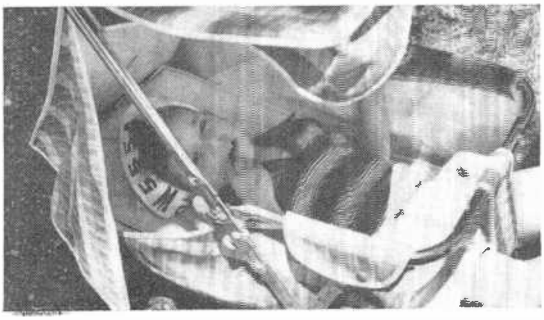
POPULAR ELECTRONICS Goes to a CB Jamboree

Photos by
Tom Burnside
2W7722

The Five-Watt Wizards sponsored a CB Jamboree recently in Riverdale, N. J.; POPULAR ELECTRONICS was pleased to attend. Dealers and manufacturers also visited and helped make the Jamboree a roaring success.

Irv Megeff, 2W1377, "Mr. Essco," ponders one of the thousands of questions that were thrown at him by the more than 500 CB'ers who attended.

Casey Confurius, 2W2182, was typical of the many exhibitors at the Jamboree. He demonstrated equipment, gave loads of free advice, shook hands with the boys, and made many friends for himself.

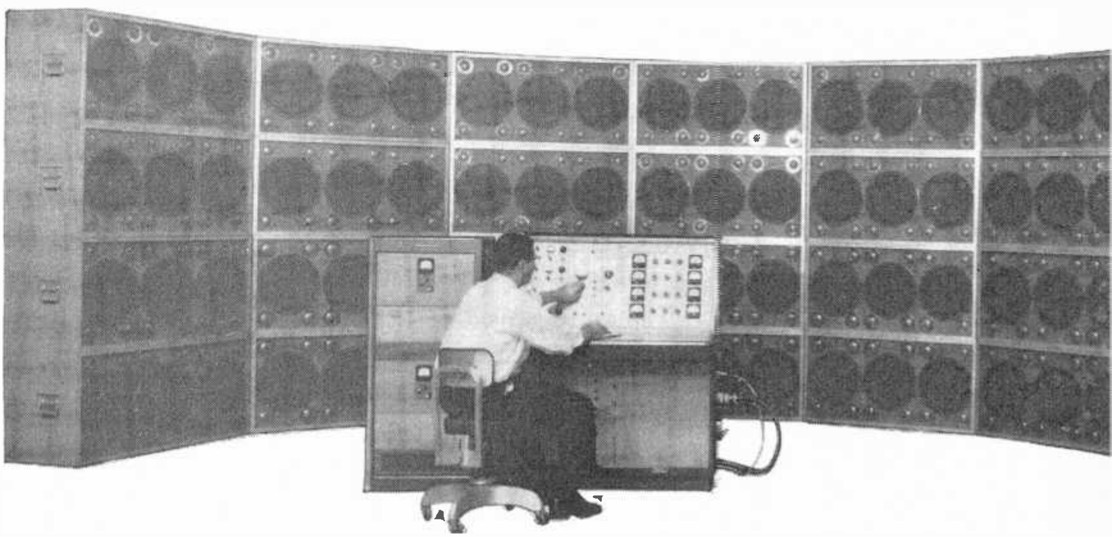


Michael Karp, 2W3811½, son of Sid (2W3811) and Marilyn (2W5554), says that "Ground planes can be fun, but a fella needs his nap."

High-Intensity Hi-Fi

ONE of the world's most unique hi-fi systems is currently in use at the Wright-Patterson Air Force Base in Ohio. Mammoth among hi-fi installations, the system can generate undistorted sound throughout the full 11 octaves of normal audibility; output from the installation ranges from the threshold of hearing to intensities high enough to damage human ears. Developed by Stromberg-Carlson, the system will be used for studying the physiological effects of high-intensity sound.

The "business end" of the system is a huge assembly of loudspeakers—480 in all—mounted in 32 separate baffles for maximum flexibility in arrangement

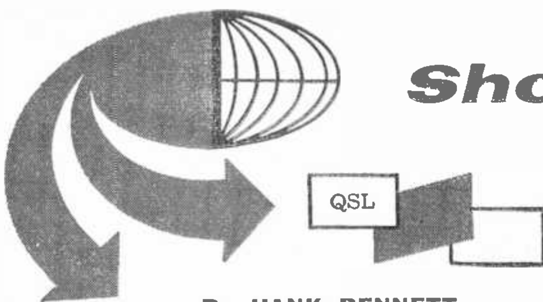


and control. Each baffle contains three low-frequency "woofers" and 12 high-frequency "tweeters." All the transducers are specially designed to deliver high-fidelity sound for sustained periods at high power levels.

The system is controlled from a console which has four possible inputs—sine waves, electronic "white noise," tape recordings (jet engines, missiles, or other noise), or an external source. An adjustment on the preamplifiers establishes a specified line level, which is indicated on a meter. This fixed level is then fed into a mixer, where any of the four input sources can be mixed in any desired combination. The output from the mixer goes to a line amplifier which can also be adjusted to any specified output level.

From the line amplifier, the signal goes through a master attenuator, then into the main audio power equipment consisting of two pairs of audio amplifiers. One pair is for low-power use only, with each amplifier providing an output of 200 watts. The other pair—the real workhorses of the system—are true high-power amplifiers, each with an output of 7000 watts. Frequency response of the entire system is flat from 20 to 20,000 cps.

To avoid unintentional exposure of subjects to high-intensity sound, the control console incorporates a safety device which protects the ears of anyone within hearing range. This device makes it necessary for the operator to place the controls in the low-power position before energy can be supplied by the high-power amplifiers. —30—



Short-Wave Report

By **HANK BENNETT**
W2PNA/WPE2FT

REPORTING TO POP'TRONICS

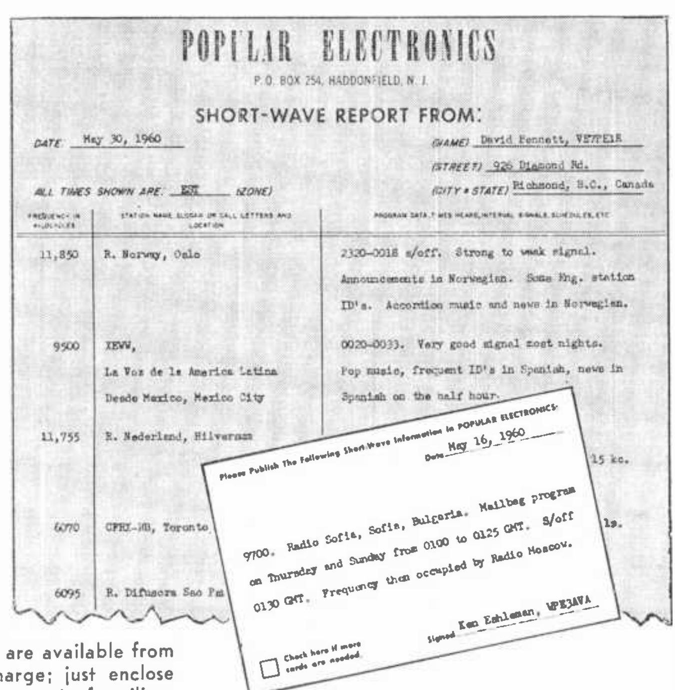
SOME of our newer POP'tronics reporters have asked exactly how they should report to us on the stations they log. They want to know what types of stations to report on, how long a listening period is required, when to submit their reports, and what information to include in them.

Reports can be sent in at any time. They should be written clearly on one side of the paper only—typewritten if possible, and preferably double-spaced. They should be confined to very recent loggings; reports on activities of a month or more previous are of little or no value. Station schedules may be submitted provided that they are up to date.

Any of the short-wave stations that you hear and can definitely identify may be covered. Items concerning other services (amateur, point-to-point, aero, police, FM, TV, etc.) should not be submitted as we rarely have space enough to include these categories. *Unusual* catches can be reported, however, and if space permits they will be printed. Nearly everyone is able to hear the powerhouse stations (London, Moscow, Prague, Sofia, etc.) but relatively few DX'ers try to dig in between the big stations for the more elusive DX. The weaker stations are often the real news-makers!

Your reports should cover listening times of at least 30 minutes per station whenever possible. We receive hundreds of reports each month which appear to be based on only a momentary tuning of stations. Many of these are nearly worthless. The items used in this column are those which feature quality rather than quantity.

The following information should be included: station heard, (by call letters or slogan), location, frequency, dates and times heard (be sure to indicate your time zone—reports are always printed in EST),



POPULAR ELECTRONICS
P.O. BOX 254, HADDONFIELD, N. J.
SHORT-WAVE REPORT FROM:

DATE May 30, 1960
(NAME) David Bennett, VE7TELR
(STREET) 926 Diamond Rd.
(CITY • STATE) Richmond, B.C., Canada
ALL TIMES SHOWN ARE: EST (ZONE)

11,850	R. Norway, Oslo	2320-0018 s/off. Strong to weak signal. Announcements in Norwegian. Some Eng. station ID's. Accordion music and news in Norwegian.
9500	XEWW, La Voz de la America Latina Desde Mexico, Mexico City	0020-0033. Very good signal most nights. Pop music, frequent ID's in Spanish, news in Spanish on the half hour.
11,755	R. Nederland, Hilversum	... 15 kc.
6070	CFRX-RB, Toronto	... ls.
6095	R. Difusora Sao Pa...	

Please Publish The Following Short-Wave Information in POPULAR ELECTRONICS:
Date May 16, 1960

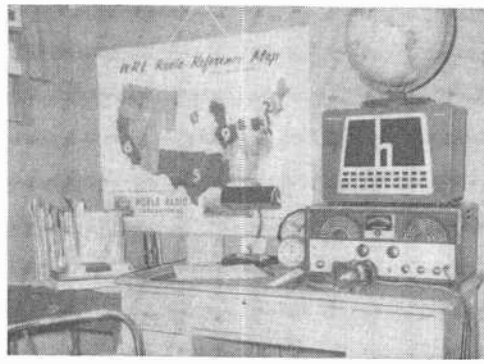
9700. Radio Sofia, Sofia, Bulgaria. Mailbag program on Thursday and Sunday from 0100 to 0125 GMT. S/off 0130 GMT. Frequency then occupied by Radio Moscow.

Signed Ken Eshleman, WPE3AVA

☐ Check here if more cards are needed

Reporting sheets and post cards are available from your Short-Wave Editor at no charge; just enclose a stamp with your request to defray cost of mailing.

James Howard, WPEØEW, of Kansas City, Mo., has heard 42 countries, 36 verified, with a Hallicrafters SX-99 receiver and a 30' long-wire antenna.



The listening post of Al Hovey, Jr., WPE9MS, in Bonduel, Wisconsin. Al also uses an SX-99 and a long-wire antenna which is 150' long, 40' high.

exact program details, languages used (if known), and signal and readability qualities. Let us know of any changes in frequencies and times.

Do not submit information you have found in other publications, as this data is likely to be obsolete. Transcripts of DX programs may be submitted, but the source of your tips should be indicated so that due credit can be given.

Although reports can be submitted at any time, try to mail them so they will reach your Short-Wave Editor by the eighth of each month. All reports should be sent to P. O. Box 254, Haddonfield, N. J.

And remember, you are competing with hundreds of other DX'ers. Space does not permit us to use every good report we receive each month, so don't be disappointed if we don't always print your material.

If you haven't yet registered for your Monitor Certificate and call letters, fill out the form below and mail it to: Monitor Registration, Popular Electronics, One Park Ave., New York 16, N. Y. Please include a dime to help cover handling costs, and a stamped, self-addressed business envelope (two IRC coupons if you live outside the United States).

(*Continued on page* 120)

Short-Wave Monitor Registration

(Please Print)

Name ....

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

Receiver — Make .... Model ....

Make .... Model ....

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

Type of Antenna Used ....

Signature .... Date ....

Across the Ham Bands

By
HERB S. BRIER
W9EGQ

ANTENNA MATCHING

NOW that fall—and its promise of improved radio conditions—is fast approaching, it's time to make sure your antenna system is working at full efficiency. One way to do this is to see that your transmitter and antenna system are properly matched.

Modern ham transmitters are almost always designed to work into 52- to 75-ohm loads. And they work most efficiently when they feed an antenna system of the same impedance. In fact, the output circuit components of some well-known transmitters are not guaranteed by the manufacturers if the mismatch between the transmitter and the antenna system exceeds 2:1. Proper matching involves more than just connecting a 52- or 75-ohm coaxial cable between your transmitter and antenna, too. The coax must also be properly matched to the antenna; otherwise, it simply transfers the mismatch back to the transmitter.

For single-band operation, a doublet antenna cut for your favorite frequency and fed in the center with 75-ohm coaxial cable will usually operate within ±2% of its design frequency before the mismatch goes above 2:1. Multi-band antennas usually work quite well on the bands for which they are designed, but they may develop transmission line mismatches of 5:1 or more on some frequencies. Incidentally, if you're looking for a single all-band an-

Ham of the Month

When Earle, W4FZ, fires up his ham transmitter for a code session on the air, "The Brass" is really "pounding the brass." For Earle is "High Brass" indeed. He is Earle F. Cook, Major General, Deputy Chief Signal Officer, U. S. Army. And radio operators have been "pounding brass" since about 1910, when they actually pounded huge brass keys to set off old-time spark transmitters.

Earle has been an avid ham since 1926, the year before he went to West Point. He first got on the air as 8BVX in Cleveland, Ohio. In all, he has held no less than ten ham calls, including K5AK, Panama Canal Zone; D4AFR, Germany; and KH6AAX, Hawaii. Since 1958, he has operated as W4FZ in Arlington, Va.

Fifteen meters is the General's favorite band. His duties prevent him from getting on the air as much as he would like, but he tries to make a contact or two every day, often early in the morning before he heads for the Pentagon. Imagine the surprise of some of the army operators when they discover that "Earle," whom they have been addressing so familiarly as W4FZ, is a real general and deputy chief signal officer to boot!

tenna, you'll find a good one for the 3.5- to 29.7-mc. range on page 144 of POPULAR ELECTRONICS, October, 1959.

Fortunately, with any practical antenna, you can use an antenna coupler to obtain a near-perfect match between your transmitter and your antenna system. Construction data on two practical antenna couplers are given in the October 1959 (page 97) and in the December 1959 issue (page 133) of POPULAR ELECTRONICS.

How can you tell if your antenna system is properly matched? A standing-wave ratio (SWR) bridge is the answer. It analyzes the r.f. currents flowing at any point in a transmission line and indicates the quality of the match on a calibrated meter. Build the one described below and see how useful it will be in helping you keep your antenna system at peak efficiency.

Tony Bodo, KN9UEN, 4725 Pennsylvania St., Gary, Ind., (left) recently started his hitch with the Army. As a Novice, Tony built up an impressive log of some 30 states, including Hawaii on 7198 kc.

Mike Gilmore, K7CLO, 528 Daley Ave., Layton, Utah, (right) worked WAS as a Novice. Now a General, Mike is an avid DX fan and has been the first Utah contact for many hams, both in the United States and abroad.

SWR BRIDGE

The standing-wave ratio bridge shown here is simple to build and to operate. On frequencies up to 30 mc. and at power levels up to 1 kw., it compares favorably with topnotch SWR bridges now on the market.

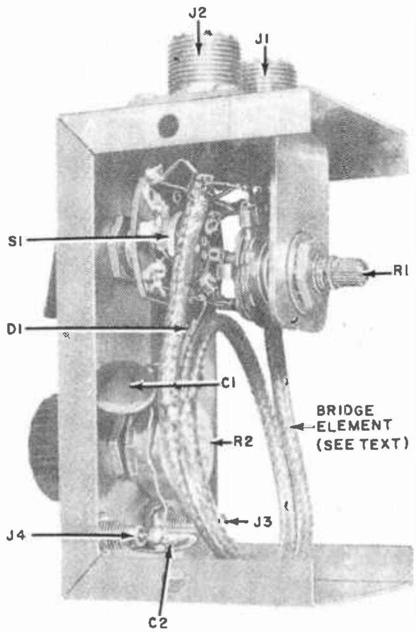
This bridge is designed to be connected permanently in the nominal 52-ohm or 75-ohm coaxial feedline of your antenna system. For economy, you can use your multimeter set to its lowest direct current range as the indicating meter. Or you can use any available d.c. meter with a full-scale sensitivity of 1 ma. or better.

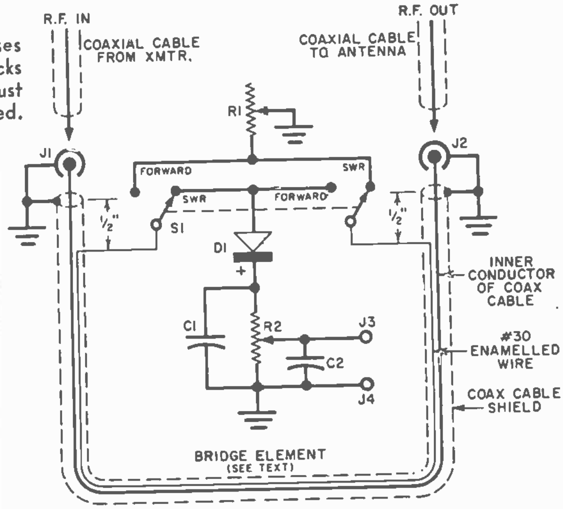
Construction. Mount coaxial connectors *J1* and *J2* on one end of the 4" x 2¼" x 2¼" aluminum box (Bud CU3003A or equivalent), and mount potentiometer *R2*, switch *S1*, and tip jacks *J3* and *J4* on the front of the box. If your box is painted, scrape the paint from around the mounting holes for *J1*, *J2*, and *J3* for good electrical contact. However, insulate *J4* from the case with extruded fiber washers. Mount potentiometer *R1* behind *S1* on a small aluminum bracket, after removing the pot's metal shell to reduce possible capacitance effects to a minimum.

The most difficult part of the bridge to construct is the coaxial-cable bridge element. It is made from a length of coaxial cable which has an additional wire passed between the cable's braided shield and the inner polyethylene insulation around the center conductor.

To make a 52-ohm, 500-watt element, strip the outside vinyl coating from a 16" length of RG-58/U coaxial cable. To make

Standing-wave ratio bridge uses external 0-1 ma. meter across jacks J3 and J4. Potentiometer R1 must be a composition unit as specified.





PARTS LIST

C1, C2—.005-μf. ceramic disc capacitor
D1—1N34A diode (or equivalent)
J1, J2—Coaxial connector (Amphenol 83-1R or equivalent)
J3, J4—Phone tip jack
R1—250-ohm potentiometer, composition element (Centralab AB-2 or equivalent)
R2—25,000-ohm potentiometer
S1—D.p.d.t. rotary wafer switch (Centralab 1462 or equivalent)
1—Length of RG-58/U, RG-59/U, RG-8/U, or RG-11/U coaxial cable (see text)
1—4" x 2¼" x 2¼" aluminum box (Bud CU3003A or equivalent)

a 75-ohm, 500-watt element, use RG-59/U cable. If you want a 1-kilowatt element, substitute a 10" length of RG-8/U for a 52-ohm system or RG-11/U for a 75-ohm system.

Make a small hole in the cable's shield braid a half inch from each end of the cable. Then thread a length of No. 30 enameled wire in one hole, under the braid, and out the other hole. This operation can be made simpler if you carefully slide the braid off the insulated inner conductor and then replace it after the wire is threaded through the braid. Be careful not to scrape the enamel off the No. 30 wire where it comes in contact with the braid.

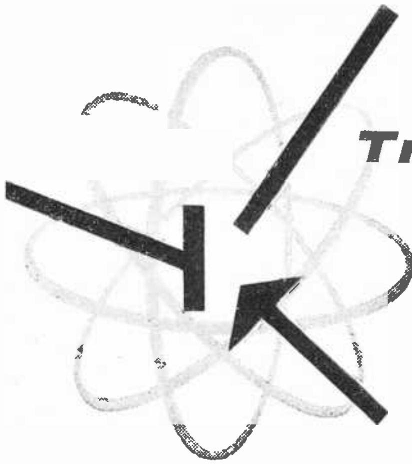
Wind the completed bridge element in a 1½-turn loop if you are using RG-58/U or RG-59/U coax. With RG-8/U or RG-11/U, wind the coax in a single-turn loop. Connect the ends of the element's inner conductor to jacks *J1* and *J2*, and ground the braid to solder lugs under the jack's mounting screws. Solder the bottom loop of the bridge element braid to a lug at the bottom of the box to keep the element from flopping around. These connections should be made quickly to avoid melting the inner polyethylene insulation.

Next, connect the ends of the No. 30 wire to the center terminals of *S1*, keeping the leads short. Join together the two top terminals of *S1* with a wire jumper, and connect the center of the wire to one end terminal of potentiometer *R1*. Ground *R1*'s center terminal; the remaining terminal on *R1* isn't used.

Join together the remaining two terminals of switch *S1* with another jumper and connect diode *D1* from the center of the jumper to the left terminal of *R2*; grasp the leads of the diode with a pair of long-nose pliers when soldering it to prevent heat damage. Now connect the center terminal of *R2* to *J3* and ground *R2*'s remaining terminal. Bypass the two ungrounded terminals of *R2* with .005-μf. ceramic disc capacitors. Finally, connect a short jumper from *J4* to *R2's* grounded terminal.

Calibration. To calibrate the bridge, connect a 52-ohm dummy load to *J2*. Plans for a 40-watt load are given on page 53 of

(*Continued on page* 113)



Transistor Topics

By LOU GARNER

SOME TIME AGO we asked for suggestions on a good "handle" for transistor experimenters—something comparable to *ham* for amateur radio operators, *SWL* for short-wave listeners, or *audiophile* for high-fidelity enthusiasts. A flood of names came in—typical ones included *transibug, transifan, semiphile, tram* (cross between *tr*ansistor and h*am*) and *tex* (short for *t*ransistor *ex*perimenter). None really rang the bell, though.

Now we have a new name to consider. Reader Arthur F. Miles (1324 30th St., San Diego 2, Calif.) suggests that we call ourselves *semicon-men,* or perhaps *semicons* for short. Sounds good, but it might be misinterpreted by the lay public. After all, a semicon-man could be a part-time con-man—or worse yet, a convict on parole!

While we're on the subject of new names, have you noticed the tendency on the part of individual transistor manufacturers to coin words and letter symbols to identify their particular construction techniques? In case you find these a little confusing, here's a quick run-down on the more popular designations and their meanings.

SB—Surface-Barrier. A type of construction developed by Philco's Lansdale Tube Company in which the base electrode is thinly etched.

SBDT—Surface-Barrier Diffused Type. Similar to the SB type, but with the emitter and collector electrode materials diffused into the base alloy.

MADT—Micro-Alloy Diffused Type. Another Philco technique for manufacturing high-frequency transistors using diffusion methods.

MESA—A name, not a letter combination, referring to transistors manufactured under a technique which etches a microscopic table or "mesa" into the semiconductor alloy.

PADT—Post Alloy Diffusion Technique. A manufacturing technique developed by Amperex that combines features of alloy and diffusion processes—it's used in the manufacture of very-high-frequency transistor types.

PC—Point-Contact. A symbol which refers to the now virtually obsolete point-contact transistor.

Readers' Circuits. Although summer is pretty much over, there are still lots of warm, bright days left. And there'll be many more pleasant nights for sitting by the patio barbecue or camp fireside. So this month we're featuring another pair of interesting circuits designed primarily for out-of-doors use.

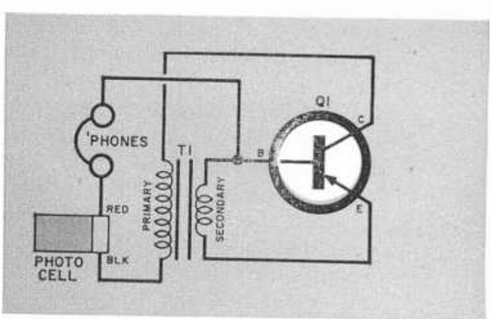


Fig. 1. This audio oscillator, submitted by reader Steven Brattman, works as long as the sun shines. It's a good code-practice unit for out-of-door use.

The circuit in Fig. 1, which was submitted by reader Steven Ronald Brattman (1664 S. Crescent Heights Blvd., Los Angeles 35, Calif.), can be used for assembling a code-practice oscillator or a tone source. Basically, it is a self-contained audio oscillator powered by a "battery" with an almost infinite life—as long as the sun shines!

A single *p-n-p* transistor is used as a "tickler-feedback" audio oscillator. Audio transformer *T1* has a dual function: it provides the feedback needed to start and sustain oscillation, and it matches the relatively high impedance of the collector-emitter circuit to the low-impedance base-emitter circuit. Operating power is supplied by a small, self-generating photocell.

All components are standard and readily available through regular parts outlets. Transformer *T1* is a UTC Type SO-3 "subouncer" (10,000- to 25,000-ohm primary, 200- to 500-ohm secondary) or equivalent. Transistor *Q1* is a G.E. Type 2N107, but similar *p-n-p* units (CK722, GT-222, 2N109 or 2N1265) should work as well. An International Rectifier Type B2M sun battery serves as a power source, and standard 2000-ohm magnetic headphones are used.

Neither layout nor lead dress is critical. You can assemble the unit in a plastic or metal case, or even on a fiber breadboard if you wish—just make sure the sensitive surface of the photocell is exposed. For code-practice use, a standard handkey can be inserted in either the *black* or *red* photocell lead. If the device refuses to oscillate, reverse *either* the primary *or* secondary transformer leads (not both). Best results are obtained, of course, in full sunlight.

Reader Richard A. Mauro (2326 Powell Ave., Bronx 62, N. Y.) submitted the circuit of the three-transistor phonograph amplifier shown in Fig. 2. This battery-powered instrument should be just right for music under the stars on pleasant fall nights. Although at first glance Dick's circuit appears to be a common design, it really isn't —he's come up with several noteworthy innovations.

In all three stages, *p-n-p* transistors are used in the common-emitter arrangement. The input signal, obtained from a high-output crystal pickup, is applied through *Gain* control *R1* to *Q1*. Resistor *R1* is used as a *rheostat* rather than as a conventional potentiometer, with control achieved by means of a voltage division between *R1* and *Q1*'s base-emitter impedance.

The amplified signal appearing across *Q1*'s collector-load resistor, *R3*, is coupled through capacitor *C2* to *Q2*. After amplification in the second stage, the audio signal appearing across *Q2*'s collector load, *R5*, is coupled through *C3* to the power amplifier, *Q3*. Transistor *Q2*'s base bias is provided through *R4*, *Q3*'s through *R6*. An adjustable inverse-feedback network, *C4-R7*, serves as a *Tone* control. The output from *Q3* is coupled to the PM loudspeaker by impedance-matching transformer *T1*. Operating power, supplied by conventional dry batteries, is controlled by s.p.s.t. switch *S1*.

The volume-control arrangement, of course, is rather unique. Other innovations include a *power* transistor with a resistive load in the second stage (*Q2*), and a relatively high power-supply voltage—Dick suggests using a 22½- to 30-volt battery. The battery voltage actually exceeds the

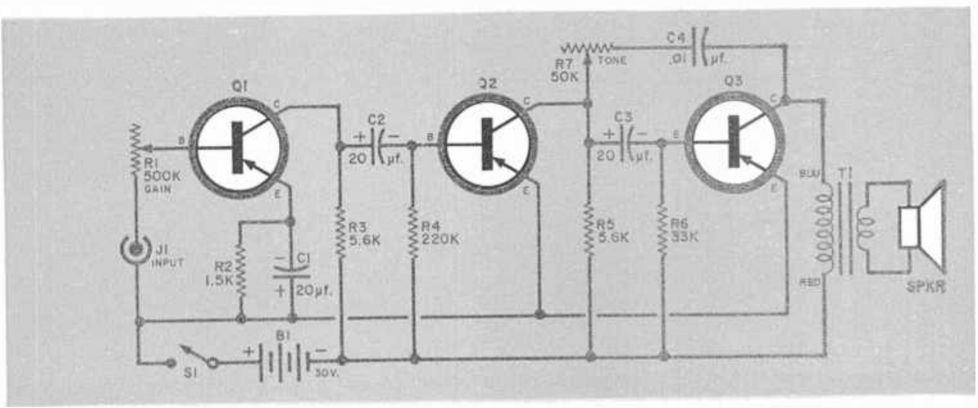


Fig. 2. Battery-powered phono amplifier developed by reader Richard A. Mauro is somewhat unconventional in design but should present no problems to the experienced builder.

maximum ratings of the transistors, but the comparatively large load and bias resistors serve to limit the electrode-to-electrode voltage applied to each transistor to safe limits.

As in the previous circuit, standard components are used. Capacitors *C1*, *C2*, and *C3* are 50-volt electrolytics; *C4* is a 200-volt tubular paper capacitor. Resistor *R2* is a ½-watt unit, and all the other resistors—except for the two controls—are 1-watt units. Transistor *Q1* is a G.E. Type 2N107; *Q2* and *Q3* are CBS Type 2N256 or Motorola Type 2N554. Transformer *T1* is a low-cost vacuum-tube output transformer (1500-ohm primary, 3.2-ohm secondary), and any toggle, slide or rotary switch will serve for *S1*. Operating power can be obtained from any combination of batteries supplying up to 30 volts at moderate currents; for long life, use a pair of Burgess TW2 12-volt batteries in series.

In spite of Dick's somewhat unusual circuitry, the construction of this amplifier should be a straightforward operation for the average hobbyist. Neither layout nor lead dress is especially critical, as long as good practice is followed. The only real problem you may encounter is that of providing a suitable phonograph motor and turntable; a standard low-voltage d.c. motor can be used, or you can adapt a surplus spring-wound phonograph if you prefer.

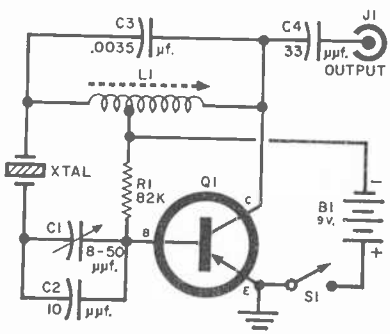


Fig. 3. Circuit of Heath Company's Type HD-20 crystal-controlled calibration kit. Device will check frequencies from 100 kc. to 54 mc.

For Hams and SWL's. Primarily designed for hams, a transistorized crystal-calibrator kit recently introduced by the Heath Company (Benton Harbor, Mich.) should be equally appealing to SWL's wishing to check the calibration of their short-wave receivers. Battery-powered, the HD-20 is adjusted against a standard frequency source (such as WWV at 2.5, 5, or 10 mc.) and provides accurate "check-points" at 100-kc. intervals from 100 kc. to approximately 54 mc. It measures only 2½" wide by 4½" high by 2⅝" deep, and will give up to six months intermittent service on its self-contained battery.

As shown in Fig. 3, an r.f. type *p-n-p* transistor, *Q1*, is used in the common-emitter arrangement as a modified Hartley oscillator. Tank circuit *L1-C3* serves as *Q1*'s collector load, with a tap on *L1* providing the feedback needed to start and maintain oscillation. The frequency of oscillation is controlled by a special quartz crystal (*Xtal*) in the feedback path. Base bias is supplied through resistor *R1*, with operating power obtained from a single 9-volt battery, *B1*, controlled by s.p.s.t. rotary switch *S1*. Feedback trimmer capacitor *C1*, shunted by a small fixed capacitor, *C2*, provides a fine adjustment over the operating frequency. The 100-kc. output signal, rich in harmonics, is obtained through blocking capacitor *C4* from jack *J1*.

In operation, the 100-kc. signal and its harmonics are "beat" against a receiver's internal BFO or known stations to establish calibration points at 100-kc. intervals across each tuning band. This enables the receiver operator to check dial tracking and possible misalignment. The instrument is also useful for checking the calibration of various laboratory units, such as signal generators, monitor receivers, tuned signal tracers, and so on.

Help Wanted! Reader David H. Knight, 35 Cornelius Parkway, Toronto 15, Ont., Canada, would like to hear from other readers interested in *electronic music*. Specifically, he's looking for a simple one-

(*Continued on page* 111)

By
JOHN T. FRYE
W9EGV

Carl and Jerry

Tick-Tach-Dough

"BOY, that uncle of yours sure comes through with some neat presents," Carl said enviously, as he drove slowly along the river road not far from town. He shot a quick sideways glance at the ultra-compact portable tape recorder Jerry was holding on the seat beside him. "You say that thing weighs less than five pounds, and yet will do anything a big recorder will do? Why, it's no bigger than our English lit book!"

"Well, now, I didn't put it quite that way," Jerry demurred. "It's not a hi-fi job, but it's plenty good enough for voice recording and will record for a full hour at 1⅞ inches per second. Because it's transistorized, it's easy on the self-contained batteries.

"But let's get on with our test," he continued. "This shielded lead from the microphone jack is connected to the tachometer, and the tachometer is connected to a spark plug. That means that every time the spark plug fires, it puts a tick of sound on the tape. We'll drive the car at different speeds with different loads on the engine, and then we'll take the recorder back to the lab. When we play the tape into our 'scope, we'll be able to see if the pulse-amplitudes fed into the meter-indicating circuit of the tachometer stay the same at all engine speeds and loads as they should."

As he finished speaking, he switched on the recorder, placed it in the glove compartment, and closed the door. At this exact instant, Carl abruptly swerved the car off the road, braked to a stop, cut the engine, and jumped out. "Come on!" he shouted. "Let's catch that baby coon!"

Jerry was right behind him. The two boys dashed into the thick bushes growing beside the road in hot pursuit of the cute little masked, ring-tailed animal that had scurried across the road in front of their car. But Mr. Coon was no easy catch. Every time they stopped, the boys could hear him scurrying through the dry leaves. A couple of times they actually caught glimpses of him as he lured them deeper and deeper into the thick underbrush. But

finally they lost him—or he lost them—altogether. They gave up and started back toward the road.

"Oh, well," Carl sour-graped as he ruefully inspected a shirt sleeve ripped on a thorn bush, "we couldn't have kept him anyway without a special permit. Say . . . where's our car?"

It was gone! Parked near where they had left it was an empty, later-model car with the motor still running. As the puzzled boys stood by, bewildered, a state police car with its red roof-light flashing rounded a curve and screeched to a halt. Three armed men burst from its doors and trained

(*Continued on page* 94)

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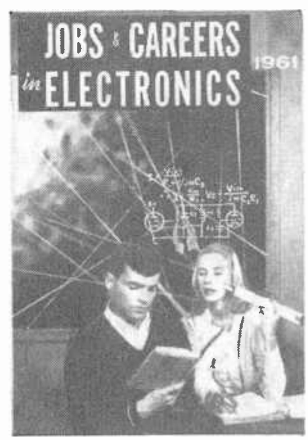

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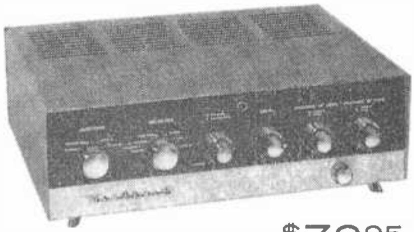

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HI-FI RATED 25/25 WATT STEREO AMPLIFIER-PREAMPLIFIER KIT

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.

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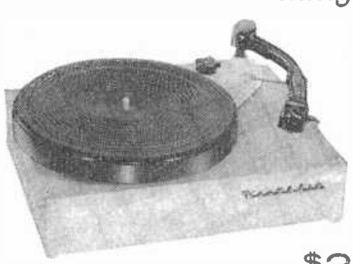

AD-10 $33^{95}

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.

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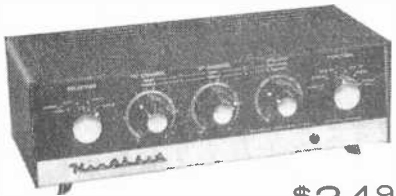
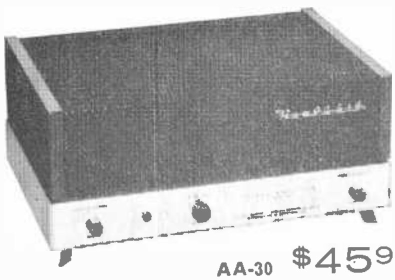


AA-20 $34.95

ECONOMY STEREO PREAMPLIFIER KIT

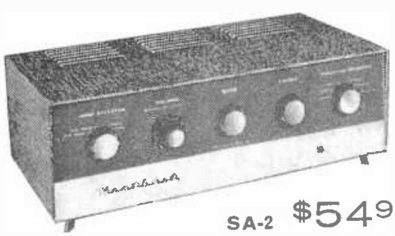
Although these two new Heathkit models are designed as companion pieces, either one can be used with your present stereo system. The preamplifier (AA-20) features 4 inputs in each stereo channel and gives you a choice of 6 functions. It will accommodate a magnetic phonograph (RIAA equalized), a crystal 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

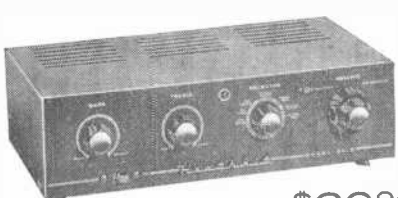
Two 14-watt high fidelity amplifiers, one for each stereo channel, are packaged in the single, compact, handsomely styled amplifier (AA-30). Suitable for use with any stereo preamplifier or with a pair of monophonic preamplifiers, it features individual amplifier gain controls and speaker phase reversal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

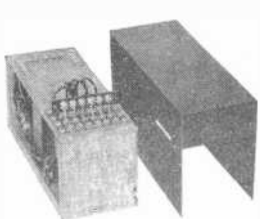
A tremendous dollar value in the medium power class, this top-quality stereo amplifier-preamplifier combination delivers full 14 watts per stereo channel (28 watts monophonic) to drive your stereo system with ease, while versatile controls give you fingertip command of its every function. In addition 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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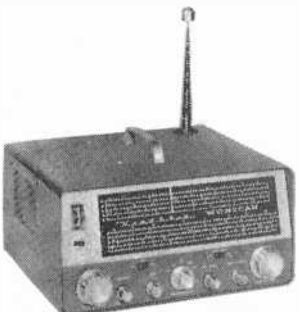

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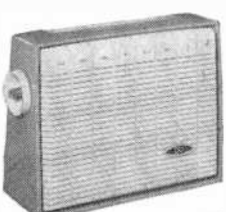

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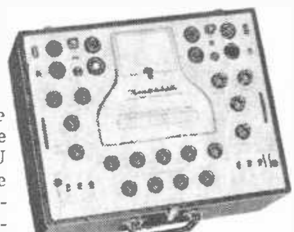

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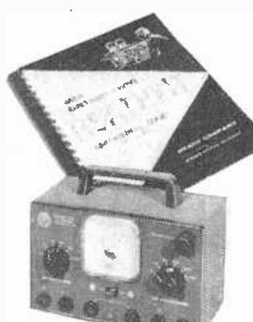

EK-1

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Carl and Jerry

(*Continued from page* 88)

their guns threateningly on Carl and Jerry, who quickly raised their hands.

"Halt—I mean, we surrender—don't shoot!" Jerry stammered nervously as he looked into the yawning gun muzzles.

Before the men could say anything, another car bearing a huge star on its side came roaring around the curve and barely managed to stop without ramming the state police car. In it was the sheriff, whom the boys knew fell, and two of his deputies. He rushed out of the car and ran toward the state policemen.

"They're not the bank robbers" he shouted. "I know these kids. Carl, Jerry, did you see where the two men in that car went?"

"No, but I'm afraid they went in our car," Carl quavered. He told the sheriff how, in the excitement of trying to catch the coon, he had neglected to take the keys from the car.

"Two men robbed the First National Bank a few minutes ago," the sheriff explained then. "A cashier managed to set off the alarm, and they took off in this car with us just a few seconds behind them. Since a description of their car was broadcast to all police units, they needed another one bad. Finding your car with the keys in it was a great stroke of luck for them. Now I need a description of *your* car to put on the radio. I don't suppose you know your license number?"

"Yes, I do," Carl said bitterly. "It's ST2242. It's funny I can remember that when I don't have sense enough to take out the keys."

IN A FEW SECONDS the sheriff had broadcast a description of the boys' car. The state police car had already taken off in pursuit of the thieves. Before the sheriff started after them he leaned out of his car window and said, "You boys stay here until the fingerprint crew arrives, and don't touch that car or let anyone else touch it until they get here. You can ride back to town with them. Don't worry too much about your car. We'll get it back."

"Or what's left of it," Carl muttered as the officers drove away. "I get sick to my stomach when I think of those jokers clashing the gears, burning rubber off the tires, and maybe getting a lot of holes shot

through the body. If I were you, I wouldn't speak to a concrete-head like me."

"Oh, it's not that bad," Jerry said, managing a grin. "I think we can depend on the robbers doing their best to keep the police from shooting holes through our car—at least while they're in it. And quit feeling so guilty. I didn't think about the keys either. *We* let our car be stolen—you didn't."

Carl didn't reply, but there was a lot of unspoken thanks and appreciation in the look he gave his understanding pal. In a few minutes a couple of men from the police department arrived and started dusting the car for fingerprints and lifting off the ones that looked promising. Ordinarily Carl and Jerry would have taken a very keen interest in this highly-developed technique. But they were so upset over the loss of their pride and joy that they spent the time pacing up and down the road waiting impatiently for the men to finish so they could get back to town for news of the car thieves. (To them, the bank robbery was secondary!)

Finally the fingerprint men were through, One of them drove the abandoned car, while the other took Carl and Jerry back to town in the police car. The boys were

too anxious about their car to listen to the man talking about the robbery.

As the boys walked into the shadowy coolness of the police station, the hearty voice of Police Chief Morton greeted them; "Well, now! The only place I remember seeing faces as long as yours is on watches painted by Dali. But you deserve to have long faces. How many times have I told you that leaving keys in an empty car is not only an invitation to a hardened criminal but is also a good way to start a reckless teen-ager on a life of crime?"

"Aw, Chief, don't rub it in," Carl said miserably.

"Okay, I won't," Chief Morton relented. "In fact, maybe I can change the looks on your faces. The sheriff just told me on the radio that they nabbed the bandits five minutes ago without firing a shot. Your car doesn't have a scratch on it, and it should be pulling up outside right about now."

For a split second the boys stared at their friend to make sure he wasn't joking. Then their faces lit up and they bolted for the door leading to the police station parking lot. The sheriff and a couple of deputies were getting out of the lead car of a regular caravan. They hustled two surly, handcuffed men into the station. Three

state police cars and a couple of city police cars filed into the lot and parked. Finally, bringing up the rear, was a state patrolman at the wheel of Carl and Jerry's beloved car. He parked it, stepped out, and handed the car keys to Carl with a flourish.

"I don't think I need tell you to keep the keys of this sweet-driving little car in your pocket from now on," he said with a teasing grin. "You boys better stick around for a while. You may be able to give us some more information."

He went into the station where the prisoners were being questioned, and Carl and Jerry started looking over their car inch by inch to make sure it had suffered no abuse at the hands of the thieves. They couldn't find a thing, and they were just sitting happily side by side in the front seat when Chief Morton opened a back door and got in.

"Well, boys, we have the robbers, but we don't have the forty thousand dollars they stole," he reported wearily. "They must have hidden it between the time they picked up your car and the time we caught them, a period of about forty-five minutes. They could have cached the money in any of a thousand different places along the river bank or in the woods that border most of the criss-crossing back roads they were traveling on. Both men are long-time criminals, and I'm convinced we could sweat them until Doomsday without getting anything out of them. I just wish this car of yours could talk."

In the silence that followed, Jerry noticed a faint ticking sound coming from the dash. "Holy cow," he gasped, "the tape recorder!" He opened the glove compartment door and switched off the motor that had been flipping the loose end of the tape on the full pickup reel.

"You mean you had a tape recorder going in the car while those men were in it?" Chief Morton asked eagerly. "Maybe we could tell from what they said . . ."

"Uh uh, Chief," Carl interrupted. "All we've got on that tape is pulses from the tachometer." He told the police chief about the experiment they were making with the tape recorder.

"Well, that's that, then," Chief Morton said as he opened the door. "I guess you can't help us. . . . You can go along home whenever you wish."

"Wait a minute!" Jerry suddenly exclaimed. "I believe I know a way we can make the car tell us where the bank robbers drove it. If you'll come along, I'll explain on the way."

Chief Morton got back into the car without a moment's hesitation. "Take off, kids," he directed. "You two haven't given me a bum steer yet."

JERRY drove to his home and ran into the electronic laboratory he and Carl had in the basement. In a few seconds he came back out carrying a pair of expensive-looking earphones and a tiny transistorized amplifier.

"First," he explained as he worked, "I hook this transistorized amplifier to the lead coming from the tachometer so I can amplify the pulses fed to the meter circuit. These earphones are intended for stereo listening, which means the inputs to the two earphones are separate. I connect one earphone to the output of the amplifier, like so; and the other to the output of the tape recorder. When I start the tape playing, I hear the recorded pulses from the tachometer in my right earphone. Now, with the motor running, I hear the pulses from the tachometer as a note in my left earphone. By adjusting the volume controls, I can make the two sounds equal in volume. When I accelerate the motor until they are identical *in pitch,* I know the motor is running at precisely the same speed it was when the recording was made. Do you see what I'm thinking?"

"*I* do!" Carl said admiringly. "By listening to the tape, we can start right where the bandits picked up our car, keep it moving at the same speed they drove it, and retrace their course."

"That's the idea, although I'm afraid it won't be *quite* that simple," Jerry said as he started the car again. On the way to where they had seen the coon, he practiced driving the car in synchronization with the sounds from the tape recorder. This was a little tricky at first, but he was soon driving "by ear" with little difficulty. He parked the car exactly where he and Carl had left it to chase the coon, and the tape was rewound. After the short recorded portion at the beginning, there was a lengthy blank section marking the interval between the time when they had stopped the motor and the bandits had started it.

As the sounds from the tape recorder started coming through, Jerry let out the clutch and followed through the gear changes in exact step with the recording. He had to drive faster than he and Carl usually drove to bring the pitch of the note heard in his left earphone up to that heard in the right; but as he approached the first sharp turn in the road, he was relieved to hear the pitch in the right earphone dropping as the bandit-driver slowed the car.

"Hey, how do you know they didn't turn there?" Chief Morton demanded as Jerry zipped through a crossroad.

"Motor never slowed down," Jerry yelled, so he could hear himself through the muffling earphones. But when they approached a T-road a few minutes later, there was no way of telling from the sound of the recorder whether the car had turned right or left. "We'll try it right," Jerry decided as he turned in that direction. But when they came near the first sharp turn, he knew he was wrong. The note from the tape recorder did not lower in frequency to indicate a slowing car.

They returned to the intersection, backed up the tape, and took off in the opposite

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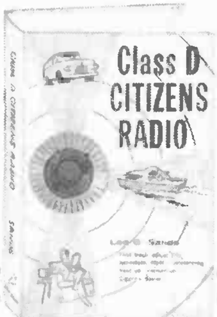

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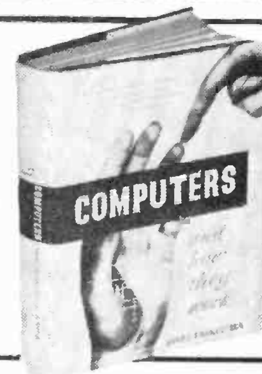
by James Fahnestock



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direction. This time the motor speed on the tape matched the road exactly. Twice more in the next quarter of an hour they had to use this technique to find the proper turn. Then, as they were driving along a perfectly straight stretch of road between open fields, Jerry began to slow the car in step with the recording, and finally he

stopped altogether just short of a bridge across a little creek.

"They were here for quite a while with the motor idling," he announced.

"Wonder why," Chief Morton muttered, looking out across the bare fields. "There's no place to hide anything around here."

"The bridge!" Carl exclaimed, and he jumped from the car and started scrambling down the creek bank. Jerry and the chief were right behind him. Carl walked under the bridge, reached up, and pulled an oilcloth-wrapped package from where it had been shoved far back between the ends of the bridge girders. Quickly the chief unwrapped it to disclose several neat packages of bills.

A QUICK COUNT revealed that the entire forty thousand dollars was there. "Sure makes a beautiful salad of government lettuce, doesn't it?" the chief asked as they stood on the creek bank looking down at the piles of currency spread out on the oilcloth.

"Yeah," Carl agreed. "And since ticks from the tachometer led us to it, you might call it 'tick-tach-dough.'"

Jerry and Chief Morton exchanged pained expressions. Then, with one accord, each of them grasped one of Carl's arms and thrust his curly head, glasses and all, into the clear water of the little creek.

"Only a fevered brain could come up with that bad a pun," Jerry said as his friend emerged spluttering. "Maybe the cool water will help." —30—

The World of BCB DX

(*Continued from page 63*)

listen to stations riding on twilight skip is around sunrise and sunset.

DX Literature. For a complete listing of foreign stations, with schedules and addresses, the 1960 *World Radio Handbook* is almost a necessity. It can be purchased from Gilfer Associates, Box 239, Grand Central Station, New York 17, N. Y. for $2.70.

As the *World Radio Handbook* lists the BCB stations outside of the European area by country only, a handy adjunct is the government log, *Broadcasting Stations of the World, Part II,* which lists stations outside of the United States by frequency. It can be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for $2.00; be sure to ask for the latest issue. Other logs in this series are *Part I,* which lists stations by country and city ($2.00), and *Part III,* which lists them by letters and station name or slogan ($1.50).

An excellent log is also available for $1.00 from the Vane A. Jones Co., 3749 N. Keystone Ave., Indianapolis 18, Ind. It lists over 4000 BCB and 2000 s.w. stations by frequency, country, and state or province.

BCB DX Clubs. One of the main problems that beset BCB DX'ers is keeping track of the many stations which seem to be continually changing frequency, power, etc. A radio club is a great help in this respect, and will also enable you to get acquainted with other DX'ers.

Foremost among the clubs for BCB DX'ers is the National Radio Club, Box 63, Kensington Station, Buffalo 15, N. Y.; a 20-page bulletin is issued weekly during the DX season and monthly during the summer months; dues are $4.00 a year. The Newark News Radio Club, 215 Market St., Newark 1, N. J., devotes a section of its monthly bulletin to BCB; dues are also $4.00 annually. The DX'ers Radio Club, ℅ Jim Ernst, Mahone Bay, Nova Scotia, Canada, is 100% BCB and issues a bulletin every month with the exception of July and August; dues are $2.00 in Canadian or $2.10 in U. S. currency. Write to the clubs for further information and sample bulletins.

The author wishes to thank DX'ers Bob Foxworth and Larry Godwin for their assistance in preparing the station list which begins on page 60. —30—

Meters

(*Continued from page* 76)

together. When the metals are heated, they generate a small voltage across the junction between them. Thus, a circuit can be designed so that r.f. voltage flowing through a separate conductor will heat the junction, which then generates a voltage proportional to the amount of heating. This current is measured by a Weston movement, calibrated in terms of r.f. current.

Designers, using the Weston movement as the basic indicator, have come up with an astonishing bag of tricks over the years. With the addition of a light-sensitive selenium disc, for example, as shown in Fig. 10, the device becomes a commercial photographic exposure meter—the brighter the light on the disc, the more current generated. A small generator, on the other hand, transforms the meter into a tachometer for measuring rpm. In another application, two meters in one case can be connected to the electronic receivers in an aircraft instrument landing system and arranged so that they show the pilot whether he is on or off course (Fig. 11). Such meter applications are virtually endless.

Fig. 10.

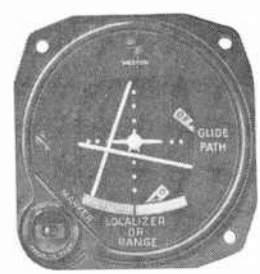
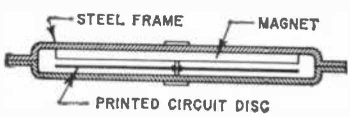


Fig. 11.

New Developments. Although the basic Weston movement has not changed in principle or basic design for 72 years, there are many striking new developments in meters. One of the newest is a printed-circuit meter recently introduced by the Parker Instrument Division of Interlab, Inc. As shown in Fig. 12, the meter's coil is printed on a thin disc and mounted parallel to a ring magnet. When current flows through the printed-circuit coil, a magnetic field is created which reacts with the field of the magnet, and makes the disc rotate. A soft iron shell (not shown) encloses the magnet and disc, furnishing a return path for the magnetic lines of force.

The entire printed-circuit meter is only ½-inch thick. And since it weighs only a fraction as much as conventional meters of similar sensitivity and range, it will undoubtedly find widespread use where size

Fig. 12.



and weight are important—in airborne equipment, for example. Another important advantage of the new movement is its ability to handle overloads that would instantly burn out the relatively delicate Weston movement. The manufacturer claims that an overload of 1000 to 5000% will not damage these movements.

Another relatively new development is the meter which triggers a relay. Here, the indicating needle is fitted with a contact. A matching contact is fastened to an arm which is adjustable from the front panel. When the current in the circuit under measurement causes the needle to deflect to where the adjustable arm has been pre-set, the two contacts come together and set off a sensitive relay which can then be used to control some other circuit. By far the most sensitive relays available, these instruments can be made to operate on as little as one or two microamperes. Units of this type, by the way, can be used in any kind of control circuit—battery charging, tube overload protection, etc.—anywhere fast, accurate control is needed.

But developments such as these only scratch the surface. As the science of electronics advances into new realms, scientists and engineers are constantly finding new ways to make the basic meter—oldest of all electronic test instruments—more and more useful.
—30—

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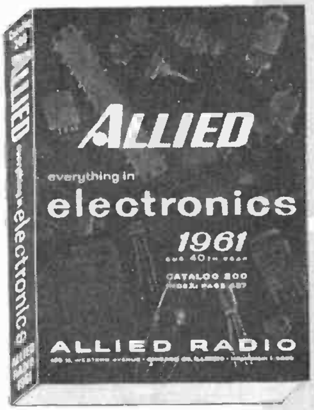

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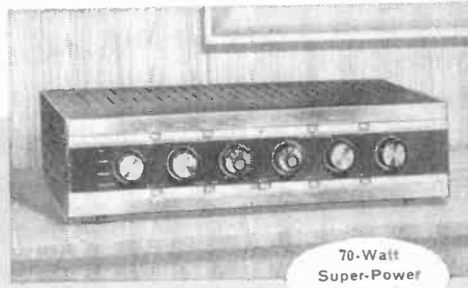

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Inside the Hi-Fi Transformer

(*Continued from page* 49)

peaks and valleys, but the parallel connection corrects this effect to some extent. The different resonant frequencies of the various sections set up uneven patterns of leakage flux, but the parallel connection sets up a reverse flux which tends to cancel out the flux differences and thus wipe out the primary resonant peaks. Practically all modern output transformers now use some form of paralleled secondaries, although a similar result can be achieved with paralleled primary sections.

David Hafler, who was associated with Keroes in both the commercial development of the Acrosound tranformers and the distributed-load circuits, achieves roughly comparable performance through a simpler patented arrangement of windings used in the Dyna transformers and shown in Fig. 4. The *Pri. 3* winding is next to the core and the others are wound above it, exactly in the order shown in the diagram. Here the two coils are not only divided into several sections, but some of the sections are wound in opposite directions to buck out leakage fluxes. Although this pattern is relatively simple, it has resulted in units flat from 7 to 70,000 cps.

Secondary Taps. The use of high feedback factors has brought on another complication. It is desirable to provide several taps on the secondary to match speakers of 4, 8, or 16 ohms. It is also desirable, of course, to have exactly the same performance regardless of which speaker tap is used. In fact, if the performance is not the same, each amplifier would have to have its feedback loop trimmed to suit the response of the tap being used.

The easiest way to provide the proper match for speakers of different impedances is simply by tapping the secondary at the proper point, regardless of where that may be. This is still common practice. However, if the tap is made at any point other than the end of a layer, the leakage reactance will be high. Thus a 4-ohm tap in the middle of a layer would have a higher leakage than an 8-ohm tap at the end of the layer; and the feedback loop would work quite differently with 4-ohm and 8-ohm speakers.

To correct this condition, Keroes uses a very ingenious method. The two inner sections of the secondary are wound with from two to four parallel wires bifilarly (side by side). These separate wires can be connected in various ways at the outside of the layer to achieve just about any turns ratio desired. Figure 5 shows one way of connecting three bifilarly wound wires to make a single coil so the taps on the Acrosound secondary are always taken at the end of a layer.

In other transformers, the secondaries are space-wound so that each section between taps occupies at least one full layer. In still others, multiple secondary sections—each covering a full layer—are connected in various series, parallel or series-parallel combinations, to achieve the right turns ratio.

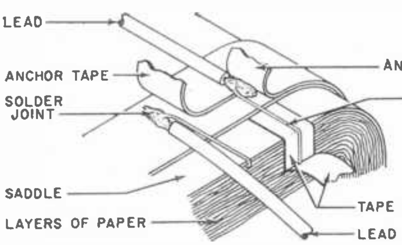

Fig. 5. Method of tapping secondaries in Acrosound transformer for identical leakage reactances.

Current Trends. Interestingly enough, the modern hi-fi output transformer has led to a virtual redesign of hi-fi amplifiers. Triodes were favored over pentodes at one time, partly because triodes present a far lower load and therefore require less inductance in the transformer primary, which in turn simplifies the capacitance and leakage problems. But with better output transformers, a large amount of feedback can be used. Such high feedback gives the pentode a low output impedance so that its inductance requirements are much like those of a triode. Even more important, the pentode requires less drive and therefore one or two stages can be eliminated.

The distributed-load arrangement improved the situation even more for pentodes. The development of better pentodes, too, such as the EL84 and the EL34, further simplified amplifier circuitry, which in turn reduced phase shifts and lessened the stringent demands on the output transformer. Today, the relatively simple Dyna and Mullard circuits are justly renowned —thanks in part to the modern wide-range output transformer. —30—

Carrier-Current Sentinel

(*Continued from page* 65)

1½" plastic or wooden box and the cover screwed in place; if size isn't too important, a small cigar box or similar wooden container will do.

The coil for the pickup unit (*L3*) is wound on a dowel stick ⅞" to 1" in diameter and approximately 5" long; an old broomstick was used in the model. Wind 70 turns of No. 20 plastic-covered hookup wire on the form, and pass the ends of the winding through two holes drilled through the ends of the dowel. Connect capacitors *C5* and *C6* in series with the leads, and solder the free ends of the capacitors to a line cord. House the pickup unit in a suitable wooden box.

Operation. Place the pickup unit on top of a broadcast radio in the listening room; to insure maximum pickup, make certain that the coil of the pickup unit is parallel to the loop antenna in the radio. Turn on the radio and tune it to the lowest unused frequency on the dial.

Now plug the Sentinel's line cord into an adjacent receptacle and turn the unit on. Set the modulation control about midway, whistle into the loudspeaker "mike," and turn the frequency control until you hear yourself on the radio. Talk into the Sentinel and adjust the modulation control for best sound. Next, unplug the Sentinel and plug it into a receptacle in the room you want to monitor, taking care not to upset the control settings.

Your Carrier-Current Sentinel is now set for receiving calls. Just talk into its miniature "mike," and the Sentinel will do the rest. —30—

HOW IT WORKS

The heart of the Sentinel is a Hartley oscillator circuit (coil *L1*, capacitor *C1*, and transistor *Q1*) which develops an r.f. carrier. The center-tap of coil *L1* would ordinarily be connected directly to ground, but in this case the ground connection is made via the speaker voice coil. As a result, the output from the speaker collector-modulates (i.e., plate-modulates) the r.f. carrier.

Potentiometer *R1* adjusts the feedback to the transistor base and thus controls the carrier frequency; potentiometer *R4* controls the modulation level in the circuit. The oscillations in *L1* are induced in *L2* and coupled to the a.c. line through blocking capacitors *C3* and *C4*.

Coil *L3* in the pickup unit concentrates the signal on the line near the radio's antenna. The radio in turn detects the signal and broadcasts it over its speaker.

Transistor Topics

(*Continued from page* 86)

transistor oscillator circuit that is stable and capable of operating over a wide frequency range. Dave points out that both Columbia University and University of Toronto are setting up workshops devoted to a study of this field. He also notes that a full day was devoted to electronic music at the recent World Composers Conference in Stratford, Ontario.

Product News. With fall approaching, most manufacturers are readying new lines and new models of their older products. Here's a quick review of items to watch.

Motorola is now producing a large-screen transistorized TV set. Equipped with a rechargeable silver-cadmium cell, it uses a 19AEP4 picture tube, 23 transistors, and 12 diodes.

Telex, Inc. (St. Paul, Minn.) has introduced a hearing aid which does away with ear tubes and dangling cords. Consisting of two parts, the unit includes a high-gain amplifier and short-range transmitter (200 kc.) in eyeglass frames. A self-contained 200-kc. receiver is housed in a subminiature assembly which fits entirely within the ear. Six transistors are used—five in the basic amplifier and transmitter, one in the receiver. Overall acoustical gain is 45 db.

General Electric has expanded its already large line of semiconductor rectifiers with a series of 16 medium-current units. All are stud-mounted silicon devices in the 2- to 8-amp. range. Continuous peak inverse voltage ratings of the various models range from 50 to 600 volts; type numbers are 1N1341A through 1N1348A.

The Autolite-developed transistorized ignition system has now been applied to tractors. Engineers of the Electric Autolite Company recently demonstrated the system to officials of Minneapolis-Moline.

For a long time, the only transistorized AM-FM portables available to American consumers were imports, with Sony perhaps the best known. But Zenith has just introduced an American-made AM-FM set to major market areas throughout the United States.

That's the picture for now. We'll be back next month with more news.

Lou

Ionized Air and Human Health

(*Continued from page* 45)

compiling hour-by-hour reports on major crimes; doctors are collecting daily data on over 3000 hospital patients; and the city medical examiner will contribute figures on natural deaths, suicides, and homicides. To the Institute goes the gigantic job of correlating all of these facts with variations in natural ionization, atmospheric electricity, barometric pressure, and other climatological factors.

Other cities have similar, though less extensive, programs under way. For example, the U. S. Weather Bureau now has two full-time bioclimatologists on its New York staff who investigate, among other things, air ionization. Several European cities are also running experiments.

Continuing Progress. Where might these far-flung investigations lead? As is usually the case with scientific research, the results will probably be more revolutionary than we can guess. Already, there are these developments:

- The Central Bureau of Meteorology in Hamburg, West Germany, issues a daily Medico-Meteorological Bulletin which advises against surgery on days when natural ionization and other climatological factors are unfavorable.
- Dr. Kornblueh recommends that emergency civil defense centers which might handle large numbers of burned patients be supplied with massive ionizing equipment. With such equipment, he says, there would be less pain and suffering, less need for narcotics, and more rapid recovery.
- Other authorities suggest that submarine crews and others who must work for long periods in cramped quarters might feel better and operate more efficiently in a mildly ionized atmosphere.
- Armed Services space-medicine scientists—aware that extremely high ion levels will be generated in space vehicles by cosmic radiation—have launched an intensive program to learn more about ionization and its effects. Dr. Albert Krueger's work in California, for example, was done under a U. S. Navy grant.
- At the recent political conventions, the ABC network had special "rest-haven" rooms with negatively charged air; the idea was to relax and exhilarate the political figures before they went on the air.
- Ionizers may find widespread use in the

home—to make you feel better, more relaxed, contented. At least two companies, Wesix and Philco, have ionizers on the market suitable for home use, and other companies are known to be studying the possibility of marketing similar devices.

Thus, ionized air, though its effects on the human body are still only hazily understood, is already making worthwhile contributions to the health and comfort of thousands. Although not all medical authorities accept ion therapy in its present state as a useful medical tool, and while further research is proceeding at a snail's pace compared to other branches of medical investigation, progress continues to be made. Work now under way in connection with our space-medicine program may provide the boost needed to transform ion therapy from medicine's neglected stepchild into its newest "wonder cure."

Dr. Kornblueh said recently, "I think we are well over the experimental stage. From now on, it is only a matter of time and money until ionization becomes an integral part of physical medicine." —30—

Across the Ham Bands

(*Continued from page* 83)

the June 1960 POPULAR ELECTRONICS. Or you can make a temporary 4-watt load by connecting a pair of 2-watt, 100-ohm composition resistors in parallel.

Next, connect a 1-ma. meter to *J3* and *J4* (the "+" terminal on the meter to *J3*) and set *S1* in the *Forward* position. With *R2* at the ground end of its rotation, feed a few watts of r.f. into *J1* on the 28-mc. band.

Then adjust *R2* for full-scale deflection on the meter. With a 16" length of coax in the bridge, five watts of r.f. will "pin" a 1-ma. meter at 28 mc. with *R2* "full on." If less power is available, a 50-ma. meter will probably be required for adequate deflection at lower frequencies. If the terminals on your meter are not labeled and the meter reads backwards, reverse its connection to *J3* and *J4*. Turn *S1* to the SWR position, and adjust *R1* for minimum meter reading. If the bridge is built correctly, this minimum will be very close to zero. Once *R1* is adjusted, its setting should not be changed.

Using the Bridge. Connect the bridge in series with the coaxial cable between your transmitter and antenna or antenna

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Now switch *S1* to the *SWR* position and note the new meter reading. If the meter reads "0" in the *SWR* position, you have a perfect (1:1) match; one-fifth the reference reading indicates a 1½:1 mismatch; one-third the reference reading, a 2:1 mismatch; one-half the reference reading, a 3:1 mismatch; three-fifths the reference reading, a 4:1 mismatch; and two-thirds the reference reading, a 5:1 mismatch.

To improve the match, readjust your antenna coupler. If you do not use a coupler, check to make sure that the impedance of your feedline matches the feed-point impedance of your antenna. In addition, you might check the length of your antenna for proper resonance at your operating frequency.

News and Views

Starling "Max" Glass, KN4GNJ, Rt. 4, Rome, Ga., is winding up his Novice career after having worked 31 states and British Columbia. He has passed his General exam and is waiting to bury the 'N'. Max uses a home-brew 50-watter to feed a dipole antenna on 7159 kc., and he receives with a National NC-60 aided by a Heathkit QF-1 Q-Multiplier. . . . . **Eddy Pacyna Jr., K1 - - -,** 86 Neanda St., New Britain, Conn., came through with all the dope on his station except his call letters. Eddy started his ham career as a Novice, and has never run more than 50 watts to his transmitter. But he has WAS and WAC and 40 countries on 40 and 20 meters. He will sked you on these bands to help you get your Rag-Chewers Certificate or for any other reason. Eddy's present transmitter is home-built and runs 35 watts to feed a combined 20- and 40-meter dipole; his receiver is a National NC-88 helped along by a QF-1 Q-Multiplier. Over 600 SWL cards wall-paper his ham shack. . . . . **Steve, K4NGK,** Lexington, N. C., was pleased to see the mention of his Cuban ham friends, including CO2DL, in the June "News and Views," and immediately shipped CO2DL the 40-meter Novice crystal he hadn't been able to get. Mission accomplished!

Sherman Stanley Jr., WV6IRN, 2412—29 St., Sacramento, Calif., is in the "hot seat" waiting for his General Class license to arrive. But he's not sitting with his arms folded—he's putting together a new Heathkit Apache transmitter. Sherman's Heathkit DX-40, running 75 watts, still works fine though. With it, and his Hallicrafters SX-111 receiver and folded dipole, he has worked 34 states, 32 of them confirmed. . . . . **Bob Mann, Jr., KN5ZOX,** and his dad, KN5ZOW, 6020 Ponder Drive, Ft. Bliss, Texas, use a DX-40 transmitter matched up to a 40-meter dipole antenna. They receive on a National NC-183 receiver. Their record is 37 states worked and 27 confirmed in four months. . . . . **Glenn Hamilton, KNØYPY,** 531 Ottawa Street, Leavenworth, Kansas, has worked 34 states in a month on the air. His only crystal frequency is 7173 kc., however, so that is the frequency to look for him on if you arrange a sked with KNØYPY to work Kansas. Glenn pushes his DX-40 to 75 watts to agitate a 40-meter dipole antenna which is 25′ high.

Arthur Morrison, KN4PBE, 1350 Bell St., Riviera Beach, Fla., is helping to keep the Morrison family on the air while his brother Eddie, K4TPP, is in the Army. Art spends about 75% of his time on 40 meters and 25% on 15 meters. He uses a Globe Chief 90 transmitter and an old Hallicrafters S-20R receiver. If everything goes right, he hopes to swap the S-20R for an SX-110 soon. KN4PBE's antenna is also a 40-meter dipole. . . . . **John Chapin, KN3JWJ,** 1235 Shackamaron St., Philadelphia 25, Pa., got a slow start on the air after receiving his license, but in the past month he has made over 100 contacts in 24 states. He operates on 80 and 40 meters, using a Knight T-50 transmitter and a Hallicrafters SX-42 receiver. . . . . **Tommy Morgali, K7IUF,** Moneta, Wyo., is going to be a very popular ham. He offers to work anybody on phone or c.w. who wants Wyoming on 10, 15, 20, or 40 meters. And that appears to be almost everybody! Tommy uses a DX-40 to excite a multi-wire dipole and another 15-meter dipole. He slips into the holes in the interference with a Heathkit VF-1 VFO; a National NC-188 receiver equipped with a Q-Multiplier helps him find the holes.

Paul Schumacker, KN9TRB, 2591 Beaumont Ave., Green Bay, Wis., worked only one "7," who did not QSL, and he was beginning to doubt that there were any more. But he now knows about K71UF! Paul works the 80-, 40-, and 15-meter Novice bands with equal pleasure. His Johnson Adventurer transmitter excites an "all-band" antenna; a Hallicrafters SX-28 receiver takes the incoming signals from the antenna. Thirty states, 29 of them confirmed, and Canada make up Paul's "brag" list. . . . . **Robert McGraw, KN4TAY,** 401 Main St., Martin, Tenn., tried three different antennas and two transmitters in his first two months on the air before finding the winning combination. Now, with a T-50 transmitter exciting a ½-wave doublet, the picture is a lot rosier. He has made 75 contacts in 15 states on 3710 kc. Bob receives on a Hallicrafters S-38 receiver, to which he has added a preselector and a Q-multiplier, both of his own design.

Mail your "News and Views," pictures, and comments to: Herb S. Brier, W9EGQ, C/O POPULAR ELECTRONICS, One Park Ave., New York 16, N. Y. 73,

Herb, W9EGQ

The Tunnel Diode

(*Continued from page* 55)

current. In between these two points is the unstable or *negative resistance region* where the diode oscillates.

By tuning a communications receiver to the crystal frequency, you should be able to hear the signal generated by the "Micro-QRP" transmitter. Place a hank of wire from the receiver antenna terminal near the transmitter, and you should be able to "peg" the "S" meter.

By winding a 5-turn link of hookup wire around the coil, the transmitter can be loaded to an antenna. No claims for transmitting distance are made for the little unit, since this is almost entirely up to the skill of the experimenter.

Some tunnel diodes will not "take off" as easily as other types. Depending on your diode, you may find it necessary to touch the cathode terminal at some point between the diode and coil through a small capacitor, while adjusting the bias potentiometer. The static electricity on your body will *shock-excite* the transmitter circuit and start it oscillating. Once you have the circuit oscillating properly, you can adjust the coil for maximum signal.

Experiments. You can also use the tunnel diode to demonstrate computer switching techniques. You will find that at one particular setting of the bias potentiometer the diode will switch back and forth between the peak and valley whenever you shock-excite the anode (between the diode and potentiometer arm). Your body's static electricity acts much the same as the information fed to the diode in a computer.

Although the meter moves quite slowly, the diode switches from one state to the other as fast as a bolt of lightning. In fact, the switching characteristic of this unique diode occurs almost at the speed of light—186,000 miles per second! In computers, the tunnel diode is capable of making a "decision" in less time than it takes the light to travel from this page to your eyes!

While a tunnel diode may cost you between \$5.00 and \$15.00 right now, it will last a lifetime (unless you step on it) and can be used each time a new circuit is brought out. —30—

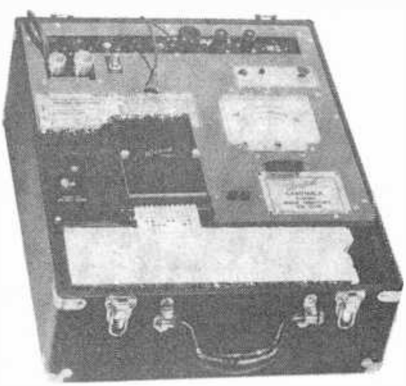
Test Instruments

(*Continued from page* 59)

The chart enclosed with this tester tells which socket to use for each tube type.

Another type of quick tester has as many as five sockets of each type, into which up to five tubes of any one kind may be plugged at the same time. After a 30-second wait, during which all five filaments heat simultaneously, the five tubes can be tested in rapid succession.

A third, and even more revolutionary, type of tube tester on the market uses



Revolutionary tester by Hickok Co. applies modern computer principles to tube testing. Punched card corresponds to particular tube under test.

punched cards, much like a computer. You simply select the stiff card corresponding to the tube to be tested and slip it into a slot on the front of the instrument. The tester makes connections through holes in the punched card, and applies the proper voltage to the various tube elements.

In the final analysis, however, the ultimate tube test is made when you plug a new tube into the equipment in which it's intended to work. In some cases, especially in equipment operating at very high or ultra-high frequencies, you may find that a tube refuses to operate properly, even though it has checked out perfectly on a tester. If so, don't throw the tube away; it may work well in another circuit.

Like any test instrument, a tube tester has its limitations. But used with judgment, and with a full understanding of its capabilities, it can be an extremely useful aid to electronic servicing, experimentation, or construction work. —30—

Short-Wave Report

(Continued from page 80)

The following is a resume of the current reports. All times are Eastern Standard and the 24-hour system is used. At time of compilation all reports are correct, but bear in mind that stations often change frequency and/or schedule with little or no advance notice.

Afghanistan—A QSL from Kabul was received after 142 days via registered surface mail in the form of a pictorial postcard. It stated that the reported xmsn of 0810-0830 was actually directed to Japan and that they expect eventually to open regular service to that country. (*WPE9KM*)

Australia—VLA15, Melbourne, 15,160 kc., was noted at 0200-0300 in Eng. to Asia and to the S. Pacific dual to 25,735 and 21,600 kc. Home news was given to 0215. This country can be heard well broadcasting to Eastern N.A. at 0714-0815 and to Western N.A. at 1014-1115 on 11,710 kc. *R. Australia* is scheduled to begin a Japanese program daily at 0500-0600 on VLB11, 11,760 kc., and also on a 9-mc. channel still to be determined. (*WPE4BFY, WPE8MS*).

Belgium—Brussels operates as follows: xmsn I at 1730-1800 to N.A. on 15,335 kc. and to S.A. on 11,855 and 6000 kc.; xmsn II at 1930-2000 to N.A. on 11,855 and 9655 kc. Both xmsns are broadcast daily except Wednesdays (on Mondays, only xmsn II is aired). The Saturday program runs from 1815 to 2000. Reports go to ORU, Box 26, Brussels. (*WPE1ARV, WPE6EO, WPE8BEU, VE3PE5T, LL*)

Bolivia—*R. Guavira*, Santa Cruz, 9198 kc., is a good DX catch for anyone. This station has been noted infrequently at 1900-1930 in Spanish, with many announcements and L.A. music. It has been noted drifting as high as 9204 kc. The ID is given at 1910, 1915, and 1925. (*NNRC*)

Brazil—*R. Nacional de Brazilia*, 11,720 kc., is now announcing as being in Brasilia, the new capital city. It was noted well between 1830 and 2000 with Portuguese. (*WPE3NF, WPE9KM*)

Canada—English from *R. Canada*, Montreal, is broadcast at 2000-2045 to U.S.A. on

15,190 and 9585 kc.; at 2200-2300 to Northern Canada on 11,720 and 9585 kc. (2300-2345 Sundays); at 0330-0415 to Australia on 11.945 and 9630 kc.; at 0645-0745 to Canadian Forces on 21,600 and 17,820 kc. (0650 to 0730 Saturdays); at 0730-0745 with "Alouette" on 21.600 and 17,820 kc. (Saturdays only); at 1245-1300 with music on 15,190 kc.; at 1245-1300 with news for ships at sea on 17,820 and 15,190 kc.; at 1530-1600 to Europe on 17,820 and 15,190 kc.; and at 1700-1730 to Caribbean areas on 21,600 kc. All xmsns are daily except where noted. Reports go to *International Service*, Box 6000, Montreal. (*WPE2AHZ, WPE4BFY, WPEØATG*)

Chile—CE960, *R. Presidente Balmaceda*, 9600 kc., Santiago, was noted from 1851 to 2150 with classical music, followed later by pop music and songs. CE1515, 15,150 kc., Santiago, was also noted at 1815-1840, with pop music to 1830, then a play. All xmsns mentioned were in Spanish. (*WPE8ACA, WPEØVB*)

Colombia—HJEV, *La Voz de Valle*, Cali, 6135 kc., long silent, has returned to the air and was noted testing at 0230-0330 with a new xmtr. No regular programing is on the air as yet but this station will probably become active shortly. (*NNRC*)

Czechoslovakia—Prague has Eng. to the United States and Canada at 1930-2000 on 9550, 11,990, 15,285, and 15,410 kc.; at 2200-2300 and 0000-0030 (on the same channels plus 11,840 kc.); also used on the 1930-2000 segment only is 17,775 kc. Broadcasts to Australia, New Zealand and Japan are at 0300-0400 on 11,990, 17,755, and 21,450 kc. (*WPE1AJH, WPE1ARV, WPE2ANW, WPE2BXO, WPE2CNX, WPE3EX, WPE6EZ, WPE8WH, WPE9BR, WPE9GD, WPE9KM, DA, BB, CG, DP*)

Dahomey—*R. Cotonou* has moved back to 4870 kc. and puts out a good signal at 0050 in a native dialect; French is heard at 0100. (*WPE3NF*)

Ecuador—HCJB, Quito, carries "Southern Cross Salute" at 0130-0530 on 15,115, 11,915, 9745, and 6050 kc.; "Quito Calling" at 1400-1815 and "Caribbean Call" at 1830-1900 on 17,890, 15,115, and 11,915 kc.; and "Morning In The Mountains" at 0900-1000 on 17,890 and 15,115 kc. (all daily except Mondays). Their colorful QSL card, in white with green and brown printing, bears a tribal design of the ancient Inca Indians. (*WPE1ARV, WPE2BVP, WPE4AUU, WPE9ADW, DG, RP*)

Ethiopia—The Lutheran World Federation has worked out an agreement with Emperor Selassie for a 60-year lease and established headquarters for two new outlets for missionary broadcasting, one of which will be a 50-kw. short-wave outlet. No frequencies have yet been determined; however, languages to be used include English, Swahili, Zulu, Arabic, and others. (*WPE9KM*)

Fiji Islands—VRH, Suva, has been noted on 5980 kc. at 0115-0150 and 0250-0300 with pop tunes; at 0300-0304 with news and weather in English. (*WPE1AAC, WPE1BY, WPE3NF*)

Finland—Helsinki carries Eng. to Europe at 1300-1330 on Mondays and at 1100-1130 on Fridays on 6120, 15,190, and 17,800 kc.; and to N.A. at 1730-1800 on Mondays and at 1530-

1600 on Fridays on 15,190 and 17,800 kc. Broadcasts on other days are in Finnish and Swedish. The DX program is heard on the first and third Fridays of the month. (*WPE1AGM, WPE4BJV. WPE5AG*)

Germany—*Radio DDR, R. Berlin International*, Leipzig, has Eng. at 1300, 1500, and 1700 on 9730, 7300, and 6115 kc., and at 1130-1200 on 11,755 kc. An Arabic segment begins at 0600 on 11,755 kc. (*WPE1AGM, WPE1BM, WPE8HF*)

Ghana—Accra is scheduled at 0030-0300 and 1130-1715 on 3366 and 4915 kc., and at 0700-1130 on 4915 and 9640 kc. Reports go to Ghana Broadcasting System, Box 1633, Accra. (*WPE-2TA, WPEØVB*)

SHORT-WAVE ABBREVIATIONS

anmt—Announcement	QSL—Verification
Eng.—English	R.—Radio
ID—Identification	S.A.—South America
kc.—Kilocycles	s/off—Sign-off
kw.—Kilowatts	s/on—Sign-on
L.A.—Latin America	xmsn—Transmission
N.A.—North America	xmtr—Transmitter

Accra was noted testing recently on 9545 kc. at 0125 with native music and a definite ID at 0130. (*WPE9KM*)

Guatemala—*R. Nacional de Quetzeltenango*, Quetzeltenango, is heard very well on 11,700 kc. from 0800 s/on to 2300 s/off, all Spanish, and much marimba music. A late report indicates that they may also operate on Sundays. (*WPE3DS; WPE4BC, WPE6EZ, WPE8FV, WPE9BR, WPE9KM*)

Iran—Teheran broadcasts its External Service as follows: at 1230 in Kurdish and at 1330 in Arabic on 7288 kc., at 0700 in Urdu, at 1500 in Russian, at 1515 in Turkish, at 2030 in French, and at 1545 in Eng. on 9680 kc. All xmsns are non-directional and the power is 100 kw. (*WPE8MS*)

Israel—The Overseas Service of *Kol Zion* has changed its Eng. period from 1530-1600 to 1515-1545 on 9009 kc. The 9725-kc. channel has been dropped. (*WPE2AXS, WPE3AVA, WPE8MS*)

Kenya—The report of last month relative to Nairobi swapping its 4934-kc. and 4885-kc. channels was in error. The 4885-kc. channel has again been noted with English. It is possible that this channel alternates with 4934 kc. on certain days. Further checks are being made. (*WPE3NF*)

Monaco—The new 100-kw. xmtr of *Trans-World Radio* in Monte Carlo may be on the air earlier than the 1961 target date, possibly as early as September or October, 1960. The channels to be used include 9705, 11,765, 6035, and 7140 kc. Tentative target areas include the British Isles, Scandanavia, the Near East, and Russia. Reception reports should be sent to *Trans-World Radio, The Voice of Tangier*, 354 Main St., Chatham, N. J. (*AS*)

Morocco—The new outlet of Rabat is being noted on 9505 kc. around 1500; it carries the same type of program usually noted on the 7115-kc. outlet. (*WPE1BM*)

Netherlands—Hilversum broadcasts to the United States and Europe at 1615-1705 on 17,775, 15,220, 11,730, and 6020 kc., and to N.A.

only at 2030-2110 on 11,730, 9590, and 6025 kc. The *Happy Station* program is beamed here on Sundays only at 2100-2230 on 9590 and 6025 kc. *R. Nederland* is offering a seven-page antenna booklet which describes single and folded dipoles, "L," Windom, and rod-type antennas, as well as information on grounds and lightning arresters. Reports and requests go to Box 222, Hilversum. (*WPE1AOG, WPE1ARV, WPE2BRH, WPE2CYY, WPE3BCU, WPE4BAJ, WPE4FMR, WPE7OD, WPE8BEL, WPE8QX*)

New Zealand—*R. New Zealand,* ZL4, Wellington, 15,280 kc., is scheduled daily at 1400-0045 and is heard best from 2230 to s/off relaying the Home Service to Australia. Reports for this 7500-watt station go to Box 2396, Wellington C1. (*WPE8TU, KN*)

Norway—Oslo carries "Norway This Week" in Eng. to N.A. on Sundays at 2105-2125 and on Mondays at 0005-0025 on LLM, 15,175 kc., LLK, 11,850 kc., LLG, 9610 kc., and LKJ, 6130 kc. (*WPE1SD, VE2PE1H, VE7PE1R*)

Peru—The International Service of *R. Nacional de Peru* (OAX4T) broadcasts on 15,150 kc. to Europe on Monday, Wednesday, and Friday at 1600-1700 in Eng. (1600-1615), French, German, and Spanish; to the Orient on Tuesdays at 1700-1730 in Japanese and Eng.; to N.A. on Thursdays at 2100-2130 in Eng. and Castilian. Regional outlets include OAX4R, 9562 kc., and OAX4Z, 6082 kc., Lima; OAX8C, 9610 kc., Iquitos; OAX6L, 9530 kc., Tacna; and OAX1Z, 9550 kc., Tumbes. (*WPE1BM, WPE2AXS, WPE8ACA, VE7PE1R*)

OBX4V, *R. America,* Lima, is noted on 3239 kc. at 1935 in Spanish dual to the 9452-kc. channel. OBX4Y, *R. Junin,* Huancayo, 3299 kc., is heard after Belize s/off at 2315 with Spanish vocals. (*WPE3NF*)

Philippines—DUH5, Manila, 11,840 kc., was noted testing at 1215-1300 with recorded light music and anmts in English. The power is 250 watts. (*NNRC*)

Portuguese Guinea—An attractive QSL Card from CQM, Bissau, lists their power as 500 watts, the frequency as 7948 kc., and the schedule as 1600-1800 daily. (*WPE1BD*)

Senegal—*R. Mali,* 11,895 kc., Dakar, is noted at 0200-0300 in French with news at 0215. The 7210-kc. outlet is not being heard at present. (*NNRC*)

R. Senegal, 4890 kc., Dakar, has moved here from 4893 kc. and is fair at 1715 with French news. (*WPE3NF*)

Sudan—The new outlet of *R. Omdurman,* 7200 kc., is noted from 1730 to 1819 s/off and again from 2315 s/on with mostly Arabic language. Listen carefully for the ID *Huna Omdurman.* (*WPE1BM, WPE3NF, WPE8MS*)

Sweden—Stockholm carries Eng. to Eastern N.A. at 0900 and 2045 and to Western N.A. at 2215 on 11,810 and 17,840 kc. The DX program is broadcast Mondays. (*WPE2CNJ, WPE4BFY, WPE7LX, WPE8HF, GI*)

Switzerland—Berne's DX program is aired on Tuesdays to N.A. at 2100 and 2345, with amateur and short-wave news alternating. (*WPE1BM, WPE2CGG, WPE5KJ, WPE5ML, WPE8BCU, WPE9KM, CG. RR, PS*)

USSR—Eng. from Tashkent is broadcast daily at 0700-0730 and 0900-0930 on 11,690 and 9600 kc. Reports go to *R. Tashkent*, Tashkent, Uzbek Republic, USSR. (*WPE5AFU*)

Vatican City—The Vatican's current schedule for Eng. reads: 1000-1015 daily on 9646, 11,685 and 15,120 kc.; 1100-1115 (Monday, Wednesday, Saturday) on 21,515 and 17,840 kc.; 1315-1330 daily on 9646, 11,685, and 15,120 kc.; and 0530-0545 (Monday, Wednesday, Friday) on 17,735 and 21,740 kc. (*WPE5SH, WPE8MS, KN*)

—30—

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Peter Fredette (*WPE1AOG*), Springfield, Mass.
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Albert Mencher (*WPE2BRH*), Bayside, N. Y.
John Freiberger III (*WPE2BVP*), Northville, N. Y.
Peter Collins (*WPE2BXO*), Elmira, N. Y.
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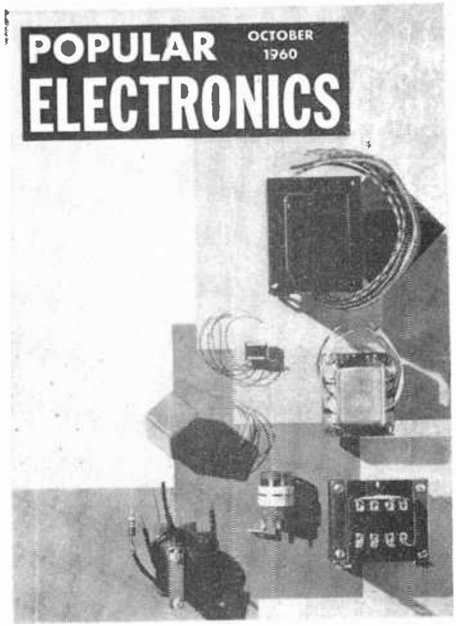

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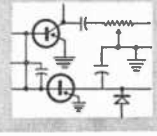

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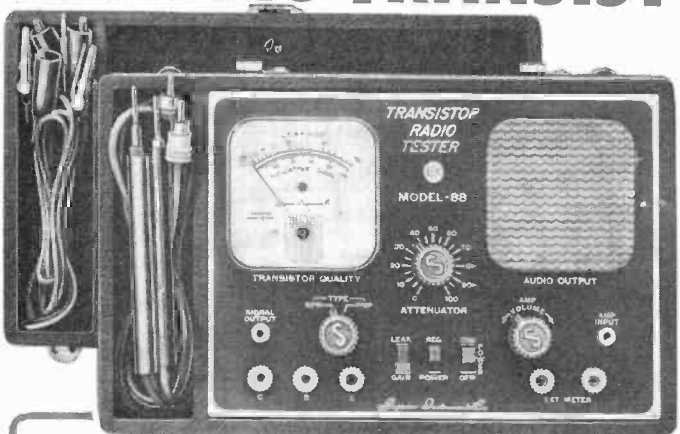

The Model 88 is perhaps as important a development as was the invention of the transistor itself, for during the past 5 years, millions of transistor radios and other transistor operated devices have been imported and produced in this country with no *adequate* provision for servicing this ever increasing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

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

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Superior's New Model 77

VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER

Compare it to any peak-to-peak V. T. V. M. made by any other manufacturer at any price!

• Extra large meter scale enables us to print all calibrations in large easy-to-read type.

• Employs a 12AU7 as D. C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability. • Meter is virtually burn-out proof. The sensitive 400 micro-ampere meter is isolated from the measuring circuit by a balanced push-pull amplifier. • Uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

AS A DC VOLTMETER: The Model 77 is indispensable in Hi-Fi Amplifier servicing and a must for Black and White and color TV Receiver servicing where circuit loading cannot be tolerated.

AS AN ELECTRONIC OHMMETER: Because of its wide range of measurement leaky capacitors show up glaringly. Because of its sensitivity and low loading, Intermittents are easily found, isolated and repaired.

AS AN AC VOLTMETER: Measures RMS values if sine wave, and peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers are easily read.

SPECIFICATIONS

• **DC VOLTS**—0 to 3/15/75/150/300/750/1,500 volts at 11 megohms input resistance. • **AC VOLTS (RMS)**—0 to 3/15/75/150/300/750/1,500 volts. • **AC VOLTS (Peak to Peak)**—0 to 8/40/200/400/800/2,000 volts. • **ELECTRONIC OHMMETER**—0 to 1,000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms. • **DECIBELS:** −10 db to + 18 db, + 10 db to + 38 db, + 30 db to + 58 db. All based on 0 db = .006 watts (6 mw) into a 500 ohm line (1.73v). • **ZERO CENTER METER**—For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

Comes complete with operating instructions, probe leads, and streamlined carrying case. Operates on 110-120 volt 60 cycle. Only. $42.50

Model 79—Super Meter
Total Price $38.50
Terms: $8.50 after 10 day trial, then $6.00 monthly for 5 months if satisfactory. Otherwise return, no explanation necessary.

SUPERIOR'S NEW MODEL 79

SUPER-METER

WITH NEW 6" FULL-VIEW METER

A Combination VOLT-OHM MILLIAMMETER
Plus CAPACITY, REACTANCE, INDUCTANCE & DECIBEL MEASUREMENTS
Also Tests SELENIUM & SILICON RECTIFIERS, SILICON & GERMANIUM DIODES

The model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development. It includes not only every circuit improvement perfected in 20 years of specialization but, in addition includes those services which are "musts" for properly servicing the ever-increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes — components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

SPECIFICATIONS:

• **D.C. VOLTS:** 0 to 7.5/15/75/150/750/1,500. • **A.C. VOLTS:** 0 to 15/30/150/300/1,500/3,000 • **D.C. CURRENT:** 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes • **RESISTANCE:** 0 to 1,000/100,000 Ohms, 0 to 10 Megohms. • **CAPACITY:** .001 to 1 Mfd., 1 to 50 Mfd. • **REACTANCE:** 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms. • **INDUCTANCE:** .15 to 7 Henries, 7 to 7,000 Henries. • **DECIBELS:** −6 to +18, +14 to +38, +34 to +58. The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings. All Electrolytic Condensers from 1 MFD to 1000 MFD. All Germanium Diodes. All Selenium Rectifiers. All Silicon Diodes. All Silicon Rectifiers.

Model 79 comes complete with operating instructions, test leads, and streamlined carrying case. Use it on the bench—use it on calls. Only $38.50

TRY FOR 10 DAYS

BEFORE you buy! THEN if satisfacto[ry]

pay in easy, interest free, monthly payments. See coupon inside.

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

NO INTEREST OR FINANCE CHARGES ADDED!

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

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