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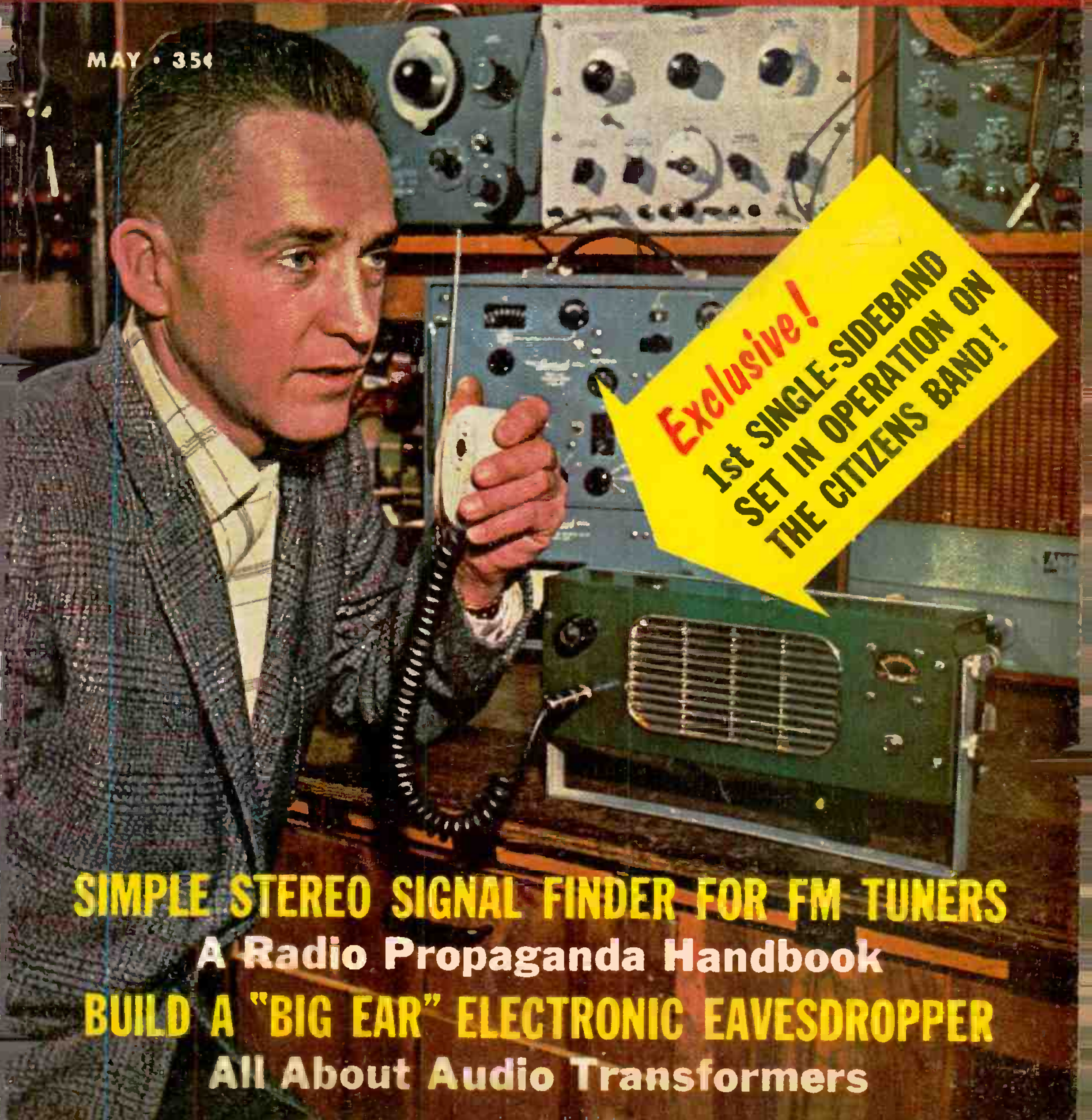

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May 1963 A Fawcett Publication Vol. 6, No. 3

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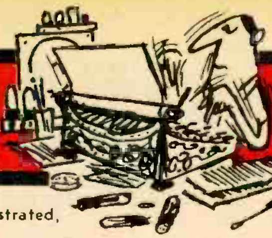
FEEDBACK from our readers



Write to: Letters Editor, Electronics Illustrated, 67 West 44th St., New York 36, N. Y.

Kicking Jock

In your January article LOOK WHAT'S HAPPENED TO RADIO!, it seems to me that Mr. Stanbury made a statement that is without basis when he says disc jockeys are going in for pointless remarks. Most radio stations have disc jockeys, so if the public had this attitude the popularity of radio would not be what it is. Does Mr. Stanbury have some basis for his argument, or just a grudge? A happy dj,

Fred Mirick
Roswell, N. M.

As one of the country's leading broadcast DXers, Mr. Stanbury assuredly does have a basis for his statement and other EI Editors, listening in other parts of the country, agree. You're no doubt an intelligent and intelligible jock, Fred, but did you ever try listening to any of your competitors?

Confidentially

When I read your CONFIDENTIAL HISTORY OF CB (March '63 EI), tears of laughter, to follow your style, flowed like water down a wetback's spine.

Bob Cooper
Brooklyn, N. Y.

Wasn't the Stoner CB transceiver mentioned in CB CONFIDENTIAL once called the Stoner Boner?

Fred Johnson
Boston, Mass.

Yup.

The Diagnosis

I wish to disagree with a couple of statements made in A NEW LOOK IN X RAYS (January EI). It is true that tungsten would cause more X rays to be emitted than copper but the real reason for using it in X-ray tubes is its higher melting point.

Beryllium is used as a window fused to the glass tube, not as a target.

Medical machines give off much more than fractions of a roentgen per hour. The average orthovoltage machine may give off 30 to 65 roentgens per *minute* with average filtration.

Herschel U. Martin, M.D.
Radiologist
Dalton, Ga.

Another Diagnosis

In regards to INVISIBLE ANTENNAS in the January EI, I wonder as to the sanity of the editorial staff. It is hard to believe that we are living in such a backward stage that it is necessary to devote two pages to skillful deception against neighbors and landlords. I wonder if Mr. Bacon is seeking ways of producing TVI without the notice or so-called annoyance of neighbors.

Victor H. Plessner
Springfield Gardens, N. Y.

[*Continued on page* 6]

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FEEDBACK

Continued from page 4

Well, at least you're still wondering, Vic, and that gives us hope for ourselves. As any big-city ham will be glad to tell you, TVI is always the No. 1 problem and most any way of beating it is better than none. You must have extremely understanding neighbors, or perhaps you're not on the air.

● *A Shocker*

Your January article on small, simple test instruments reminds me of an old codger I knew in the late 1930's. He ran a small radio shop and thought no he-man would use a voltmeter. To check voltage in a circuit he simply stuck a finger on a lead. He claimed he was almost as accurate as a meter. Despite predictions, he didn't die of electrocution. A car got him.

Sam Rice
Los Angeles, Calif.

● *Color Confusion*

In your article about a 79¢ soup-up for Handi-Talkies (January '63 EI) you made a mistake in the last paragraph on page 43. Instead of what you have, the sentences should read: "Connect the *brown* primary lead to the side of the printed wire which leads to the base of the transistor. Connect the *black* lead on the transformer secondary to the speaker side of the break." Misteaks do happen.

John Snyder
Urbana, Ill.

Do'nt they?

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RCA has issued two new publications. One, an enlarged edition of the RCA Receiving Tube and Picture **Tube Manual** (No. 1275K; 50¢), includes a chart that classifies the newer tubes, an application guide for new tubes and a characteristic chart covering 1,050 RCA receiving tubes.

The second is a revised **Interchangeability Directory** of foreign and U.S. receiving electron tubes (No. 1CE-197B; 10¢). U.S. substitutions for more than 800 foreign tubes for AM, FM and TV sets are included. Both publications are available from RCA Commercial Engineering, Electron Tube Div., Harrison, N. J.

If you've read all about stereo FM but have never heard it, you'll appreciate H. H. Scott's off-the-air **stereo recording** of a multiplex broadcast. The record is free from Scott, Dept. P., 111 Powder Mill Rd., Maynard, Mass.

The Story of Patents and Progress is a history of American invention that begins with the first patent issued. The booklet explains how the patent system has contributed to the growth of U.S. technology. Illustrated with original patent applications, the booklet is free from the DuPont Co., Wilmington 98, Del.

A 16-page **Component Catalog** (No. 200), including replacement information on Centralab controls, switches and ceramic capacitors, is available free from Centralab, Electronics Division of Globe-Union, 900 E. Keefe Ave., Milwaukee 1, Wis.

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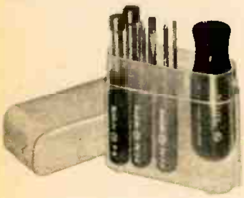

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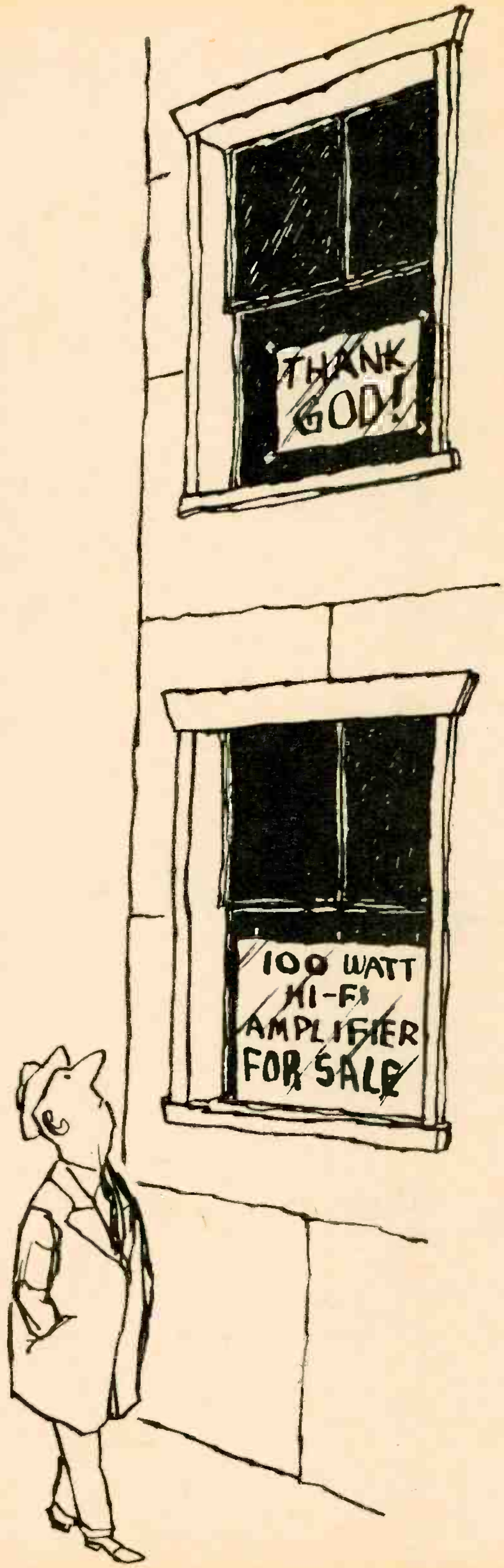

LUNAR LOOKER . . . The odd white ball at right, known as the Roamer, seems destined to be rolling around the moon long before man ever sets foot on the green cheese. Roamer, built by General Dynamics, is designed to move about on the lunar surface, making a variety of investigations on radio command from earth and then transmitting its data as it goes. The vehicle propels itself by displacing its center of gravity or by using a flywheel-clutch system powered by the sun (the black oval in center is a solar umbrella to gather the sun's rays). Our photo shows a 22-inch model of the real thing. Portable command radio is at right.

Moon Man . . . When we finally do make it to the moon, our first live lunar explorers probably will arrive equipped with a belt that does more than hold up their pants. According to the Bendix people, it will be a biomedical radio-pack belt that can monitor its wearer's heart beat, respiration, blood pressure, temperature and so on, transmitting this information to the moon balloon, which our moonauts have parked handily nearby. The vehicle then would relay it to earth for study by physicians. In addition, the belt pack could service for two-way voice communication. A prototype is being worn by the girl in our photo (she's real). Spaceman watching her is a dummy.

Smokeless Cigarette . . . Smoking more now but enjoying it less? Switch to Lucaloxes and taste the difference! There's not a cough in a carload, and no tobacco, either. Lucalox is a tiny new lamp tube developed by General Electric, and it promises a new high in efficiency. The tube is so small you might get one confused with a king-size cigarette. In our photo, model Ellen Downs, looking not a bit confused, holds a Lucalox (left) next to a Brand X filter-tip for size comparison. Laboratory Lucaloxes (GE's trademark) have produced nearly twice as much light per watt as the most efficient current lamp. Actual output runs around 145 lumens per watt. The lamp employs a sodium metallic vapor in its thin tube of synthetic ceramic. When perfected, it will be used for lighting streets, sports arenas and the like, according to GE spokesmen.

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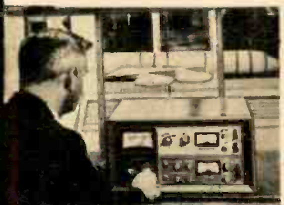

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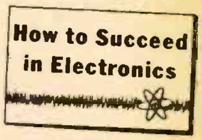

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...electronics in the news

Lo-Fli Radar . . . The gentleman in our photo is test pilot James Bissell and he's looking at a map while cruising in an old B-26 bomber. The trick is that Bissell isn't touching the controls, that those really are mountains ahead and, lastly, that his altitude is exactly 400 feet.

You might conclude quickly, and rightly, that Bissell either has an ace up his sleeve or that he's now known as the late test pilot of General Dynamics (for that, indeed, is his employer). Luckily for our story, which should have a happy ending, it is the former. The B-26 is being piloted by an automatic electronic system capable of steering the craft on a hedgehopping flight over any terrain.

During flight, a forward-looking radar detects such obstacles as mountains, trees and buildings that appear ahead and feeds this data to a computer, which also gets readings from a radar altimeter. From the combination of information, the computer determines whether the plane should climb or descend to maintain an altitude previously given it by the pilot. Then it feeds climb or dive signals to the autopilot.

Eventual application of the apparatus is pretty clear. If our bombers ever drop their eggs in earnest they are not going to do it from high altitude. Instead, they'll come in just over the trees, so low even radar can't find them.

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- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ SCHOOL INQUIRIES INVITED
- ★ Sold in 79 Countries

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

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

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

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build 20 Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the complete price of $26.95. The Signal Tracer alone is worth more than the price of the entire kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

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

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

Included in the "Edu-Kit" course are twenty Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 20 different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc.

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

FREE EXTRAS

• SET OF TOOLS

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

SERVICING LESSONS

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

FROM OUR MAIL BAG

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

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

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

PRINTED CIRCUITRY

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

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

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

UNCONDITIONAL MONEY-BACK GUARANTEE

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

☐ Send "Edu-Kit" postpaid. I enclose full payment of $26.95.
☐ Send "Edu-Kit" C.O.D. I will pay $26.95 plus postage.
☐ Rush me FREE descriptive literature concerning "Edu-Kit."

Name ....

Address ....

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PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 547AE, Hewlett, N. Y.

. . .electronics in the news

More Time . . . National Bureau of Standards, proprietor of WWV, is ex-

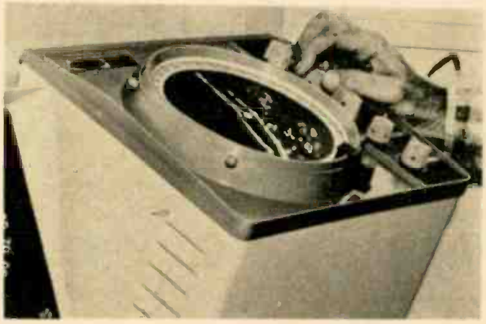
panding its frequency and time transmitting program with new antennas and equipment for WWVB, operating in the long waves at 60 kc, and WWVL, a very-low frequency (VLF) band station. The 400-foot antennas (see cut) are going up near Fort Collins, Colo. Both stations have been on the air several years with flea power. Now WWVL will run a kilowatt, WWVB will have 7 KW. Where WWV's short-wave signals can be picked up at a distance via skip, the beeps from L and B arrive via ground-wave and are more accurate. But expensive equipment is needed to tell the difference.

Tiny TV Taper . . . Video tape recorders may yet make it into the living room.

Ampex's new VR-1500 weighs just 130 pounds, can be wheeled around on a little cart and is friendly to non-technical people with minimal training. It is designed for sports, science and training, as well as for entertainment uses. But you can't yet use it at home.

...electronics in the news

Poor-Man's Radar . . . A new small-boat radar marketed by Raytheon sells



for only $2,000, which is not exactly peanuts but still quite a bargain in equipment of its type. The little set has a 7-inch CRT tube, five controls and smaller dimensions than some table TV receivers. It can distinguish targets as close as 30 yards and is able to discriminate between objects 35 yards apart at a range of half a mile. Maximum range is put at 12 miles by the manufacturer.

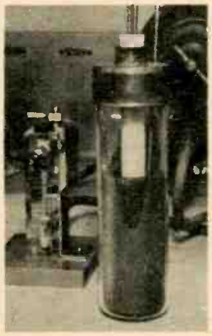
Teeny Tape . . . The thinnest magnetic tape produced to date looks like some stray wisps of carbon paper. Micro-

tape, fabricated by the Ferrodynamics Corp., is a quarter mil in thickness and just .075 inches wide. A reel smaller than a silver dollar (see cut) holds 180 feet, enough for 40 minutes of recording. Two reels are shown in a small jewelry box. The tape is still experimental, being offered only to labs, but one day it may fit in wristwatch-size recorders.

...electronics in the news

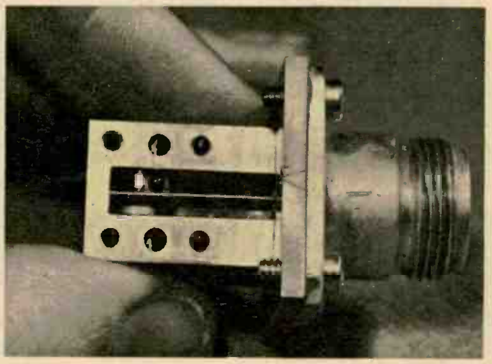
Invisible Intercom . . . Infrared takes the place of radio waves as transmission medium in a lightweight voice communications system developed by Raytheon. The highly concentrated beam must be aimed with telescopic sights (see cut). It has a range of ten miles and could be used for military purposes.

Gas Chamber . . . An experimental fuel cell developed by General Electric operates on such inexpensive fuels as natural or LP gas. Most such cells require more expensive hydrogen. The GE unit has a solid electrolyte of zirconia (white cylinder in the photo). Fed-in gas breaks down into carbon and hydrogen, and the carbon then forms one electrode. The other is molten silver. The second fuel is oxygen, introduced in the form of air. The cell can be self-sustaining when left-over carbon monoxide and hydrogen are burned to heat it to 1,000 degrees C.



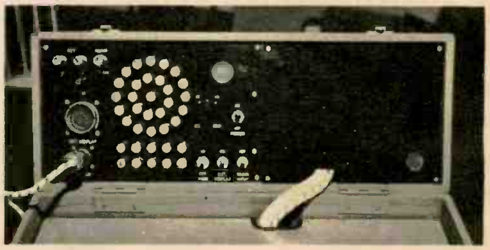
...electronics in the news

Microwave Microfilter . . . A magnetically tunable microwave filter designed at Stanford Research Institute



uses a sixteenth-inch yttrium-iron-garnet (YIG) crystal (see arrow) as tuning element. Tuning is achieved by application of a DC magnetic field. The structure around the crystal is a strip-transmission line coupling. The YIG filter, besides improving receiver performance, speeds up band scanning by a factor of 2,000.

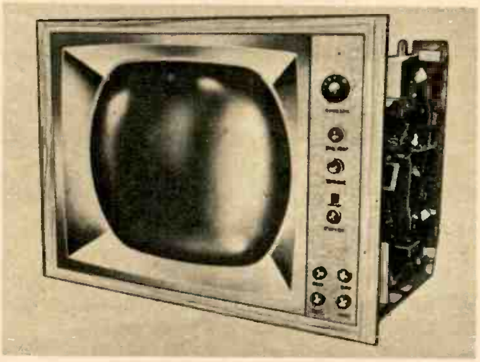
Robot Reader . . . A decoder that takes received Morse code signals and turns



them into lighted letters on a panel—for a typist to copy—may do away with half the operators now required for CW circuits. The RCA device, which is portable, will be particularly useful in underwater and aerospace applications, where automatic radioteletype equipment is not practical. Manual CW telegraphy, usually with extremely low power, still is the workhorse in a good many difficult situations. The size and complexity of RTT equipment rule it out.

Electronic Marketplace

COLOR KIT . . . A color television receiver in kit form has been introduced by Transvision. The firm has been marketing a black-and-white TV kit.

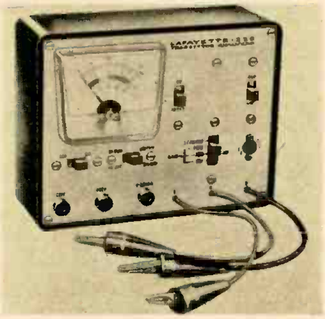


The color job, produced under license from RCA, comes with the critical circuits pre-wired. It has a 21-inch picture tube and can be had either with a built-in 10-watt hi-fi amplifier and speaker system or with a cathode follower circuit for feeding an external amplifier. Kits can be bought in seven separate packages ("pay as you wire") with total price ranging from $419 to $439. Transvision Electronics, Grey Oaks Ave., Yonkers, N. Y.

Mike Market . . . The new Model 575 Versadyne microphone is an omnidirectional dynamic for PA or home recording use. It has a 40-15,000 cps response, comes as a high-impedance ($24) or low-impedance ($21) model; for stand, hand, lavalier use. It's by Shure Bros. of Evanston, Ill.

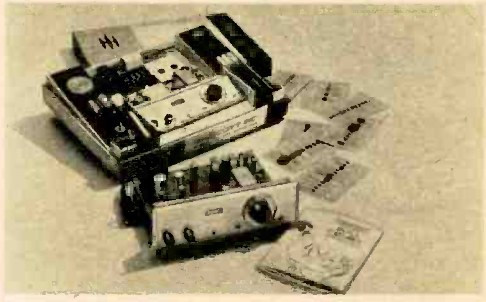
Marketplace

Multi-Checker . . . If you fix transistorized equipment for a living or just for kicks, Lafayette's KT-223 Analyzer can



save time and temper. It functions as an in-and-out-of-circuit transistor checker (with oscillator to test actual performance), a diode and rectifier checker, signal generator (a 5-kc signal with harmonics for AF, IF and RF purposes), a battery tester, a voltmeter and a milliammeter. About $13. Lafayette Radio, 111 Jericho Turnpike, Syosset, L. I., N. Y.

Table-Box . . . Packaging changes in the electronic kit field, particularly the



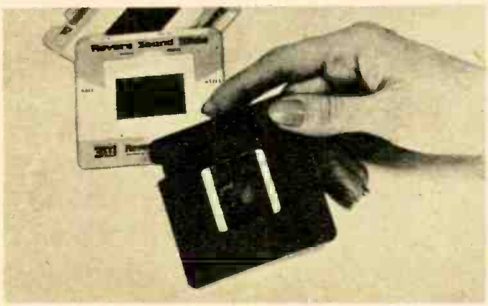
hi-fi end, seem to come along almost as often as Detroit's new models. H. H. Scott has now restyled its famous Kit-Pak container so it becomes what they call a "self-contained work table." The lid comes off the orange-and-black box and the builder goes to work in the bottom section. When he wants to knock off, he merely replaces the lid to keep out prying hands. All parts are blister-packed on cardboard charts. Kit shown in the picture above is the LT-110 stereo FM tuner. H. H. Scott, Maynard, Mass.

Marketplace

Slooooooooowly . . . A new low in magnetic tape speeds has been added to the

old standards in Norelco's Continental 401, a four-track stereo job. In addition to 7½, 3¾ and 1⅞ inches per second, the 401 offers $\frac{15}{16}$ ips, which gives you up to 32 hours of mono recording time with a 7-inch reel. Rated frequency response at the low speed is 60 to 4,500 cps, adequate for non-hi-fi purposes. The all-transistor unit tops out at 16,000 cps at 7½ ips. About $400. North American Philips Co., Hicksville, N. Y.

The Talkies . . . The Revere 435 projector gives you sound along with standard



2x2 slides. Special mounts for the transparencies have a magnetic strip running around the image area in a spiral, and 20 seconds of sound can be recorded on the track. A record/playback head moves around the track as you talk or listen. A second head erases. A transistorized amplifier handles the sound. The machine can project and play a tray of slides automatically. Great for travel and kiddie shots—or sales talks.

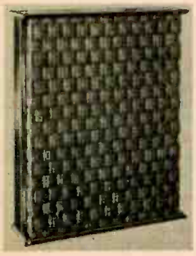
Each unit comes with a detailed, easily followed instruction manual.

Marketplace

Plug Pliers . . . The job of connecting coax cable to an auto-type plug can be a dern nuisance with ordinary tools.

Now there's a special pair of pliers to simplify things. The pliers strip off insulation, crimp the outer braid firmly to the plug body and make contact between the center conductor and the business end of the plug. There's no soldering. Blonder-Tongue Labs, Inc., Newark 2, N. J.

Slender Speaker . . . The Slenderette is just 5 inches deep (24 inches high and 20 wide) but it contains an 8-in. midrange driver plus two 6-in. woofers and two 3½-in. tweeters to give you a robust performance. It can be put on the floor or a shelf, or hung on the wall. Cabinet is hermetically sealed; 20 watts, 8 ohms. The price is $39.95. Lafayette Radio, Syosset, N. Y.



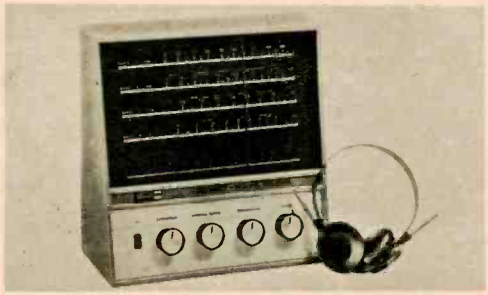
Short Speaker . . . The Sonorama shelf, on the other hand (see above) is only 5 inches tall but 67 inches long, 12 deep.

It has four woofers, two tweeters. $149.95. Rek-O-Kut Co., Corona, N. Y.

80¢ a Watt . . . That's the price of a versatile new ham transmitter offered in kit form by Allied Radio. The T-150

carries a price tag of $119.95 and runs 150 watts AM or CW on 10 through 80 meters. On 6 meters final input drops to 100 watts, either mode. The 28-pound rig is self-contained, has VFO, pi-network for antenna tuning, four-position meter and frequency spotting. A good buy for beginning Generals or for Novices who are moving up to a General ticket.

A Revell-ation . . . Revell, Inc., long known for its plastic models, has now jumped into the electronic hobby field



with solderless kits for the kiddies. First off the line are a short-wave radio (shown), a flea-power amplifier with stereo conversion kit and a pair of stereo headphones. The kits are put together on a simulated printed circuit with small bolts. The radio tunes the broadcast band and short wave to 30 mc, has four bands and is powered by a 9-volt battery. Output can be fed to the amplifier for speaker operation. Non-technical instructions accompany the easy-to-follow pictorials. The radio costs $24.95. Revell, Inc., Venice, Calif.

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I cannot praise N.T.S. enough. I've just graduated and already I have started repairing radios and servicing TV's . . . At 53, I'm starting a new life and my diploma from National Technical Schools is my proudest possession.

William E. Eckenrod

As field director of Berean Mission Inc., I have complete charge of our radio work. With the expert advice and training I am receiving from you I can do my own repairs on our recorders and P.A. systems, besides keeping our radios going. My training from N.T.S. helps keep us on the air. I feel privileged to be a member of such a fine institution.

Rev. Enoch P. Sanford

Thanks to N.T.S. I have a business of my own right in my home. I have paid for all my equipment with money earned servicing TV sets. Yes, N.T.S. gave me my start in television.

Louis A. Tabat

I have a TV-Radio shop in Yorkville, Illinois, about 4 miles from my home, and it has been going real good. I started part-time but I got so much work that I am doing it full-time. Thanks to National Technical Schools.

Alvin Spera

SEE OTHER SIDE

ALL 8 PHASES IN ONE MASTER COURSE

PHASE 1 TELEVISION INCLUDING COLOR TV
90% of homes have at least one set. Color TV is becoming more popular daily. TV Stations grow in number, need technicians. Maintenance and repair offer big opportunities.

PHASE 2 RADIO—AM & FM
Radios in homes, cars, schools, all need expert upkeep. Stations expand as FM becomes popular. Now transistors boom entire field.

PHASE 3 INDUSTRIAL ELECTRONICS
Computers, Data-Processing machines, Electronic Controls, Guided Missile Systems are new fields where Electronics play a vital role.

PHASE 4 SOUND SYSTEMS
New popularity of Hi-Fi-Stereo, as well as industrial sound systems and business intercoms make this a highly specialized and important field.

PHASE 5 FCC LICENSE PREPARATION
FCC License holders have a wide range of top jobs open to them. FCC License now a requirement for most Communication jobs.

PHASE 6 RADAR AND MICROWAVES
These are the communications systems of the future, already used in tracking and contacting satellites.

PHASE 7 AUTOMATION & COMPUTERS
Automation and Computer electronics are the new tools of industry and commerce. Skilled Technicians in these fields are in great demand at top pay.

PHASE 8 BROADCASTING & COMMUNICATIONS
In the entertainment industry, or in commerce, communications and broadcasting have great importance. Installation and maintenance of equipment requires trained technician know-how.

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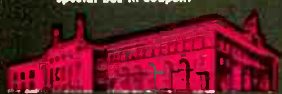

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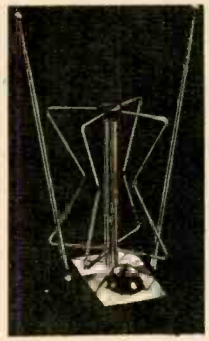
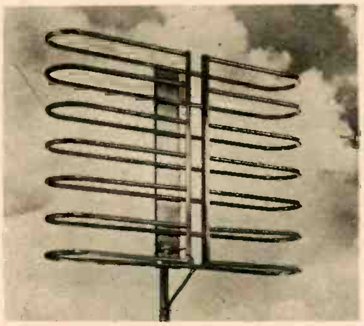
Marketplace

Way-Out Rabbit . . . Latest in indoor rabbit-ears TV antennas, which seem to proliferate like the bunnies they are named after, is the Golden Canaveral by Channel Master. It has a built-in tuning arrangement and separate sections for the high and low VHF bands. The tuning bit is an impedance-compensating circuit which shortens or lengthens the elements electronically. A dipole section has a spread of 8 feet to bring in channels 2 and 3 (a rabbit with an earspan like that would be some bunny). Tuning contacts are of silver. The Fair-Trade price is put at $9.95.



FM Rib Cage . . . B&K's new seven-element FM antenna is designed to feed a stereo tuner, can be used indoors or out.



The Mark Stereo 7 is omnidirectional, horizontally polarized and has aluminum elements. It also has a slight physical resemblance to the rib cage on those biology-class skeletons. The rig measures 5¼x30x22 inches high and comes complete with hardware. The matter of gain seems to be a moot point. We've had some correspondence with the B&K public relations people but the specs eluded us. However, an ad for the antenna says it "doubles the power" of signals, which suggests a gain of either 6db (voltage) or 3db (power). $24.95. B&K Mfg., Chicago 13, Ill.

ELECTRONICS ILLUSTRATED
MAY 1963

OUR SILENT ALLY

By S. David Pursglove

In guerrilla warfare, ingenious electronic gear has proven as useful as the helicopters and guns.

WHETHER they're fighting the Viet Cong in South Vietnam or some equally unconventional enemy in Africa, Latin America, South-Central Europe or the Middle East, one of the big problems for anti-guerrilla forces is communications. Because of thick jungles, rice paddies and its own primitive communications, Southeast Asia dramatizes the situation best.

But U.S. Army scientists now have what they hope is a permanent answer to this need in lands where telephones simply do not exist. To aid our own Special Forces and the guerrilla fighters of our allies, the Army people have come up with a single-sideband radio that is different from any normal military rig seen before. It is "ruggedized, tropicalized and simplified" to meet a variety of battle conditions.

And it's so fool-proof that native troops can both operate and repair it after a few minutes of instruction. To be an expert repairman, you need know only that a red module belongs in a red slot and a green one in a green slot. The SSB radio is transistorized for low power requirements and can be carried by a child. It won't be in the field, however, for another year or so. Meanwhile, the job is being done by the older GRC-109, which performs well under difficult conditions but is a tube set.

The lightweight SSB radio is just one of many new pieces of electronic equipment that, for the first time, are being developed especially for use by anti-guerrilla fighters. In the kind of war that is going on in Vietnam, the only equipment you hear about is helicopters, which ferry the raiding teams about, and the firearms being used. But the electronics gear used by the men can be fully as important in determining success or failure. It doesn't get much publicity because it never kills anyone directly and is as silent as a burning light bulb. Rather than killing, the equipment helps keep the troops on our side alive by providing communications and detecting dangers in advance.

Another new special-type radio is the TRC-77, a lightweight CW code outfit with extra long range. It is designed for deep-penetrating patrols, enabling them to keep in touch with home base, and for stay-behind elements which remain when a country is overrun by an enemy. The stay-behinds would use the rig to send out intelligence information and to receive mission assignments.

Well over half the $100 million a year being put into special guerrilla and anti-guerrilla equipment is going into electronic gear.

A big problem right now concerns communications between local residents and field troops. If a village mayor in Vietnam suspects that a guerrilla raid is imminent he can get help in only one way—by sending a runner to the nearest military post. Too often, the runner never makes it. The obvious answer is radio. But the set would have to be low in cost, for there are thousands of villages to protect, and a new low in simplicity is required. The Army has toyed with the idea of just two buttons: push No. 1 to signal an attack by a few Viet Cong; push No. 2 for many Viet Cong. But what is a "few" and how many are "many?" Voice radio, it became clear, was the only practical answer.

U. S. Special Forces team using a hand-operated generator to power a knee-key CW transmitter.

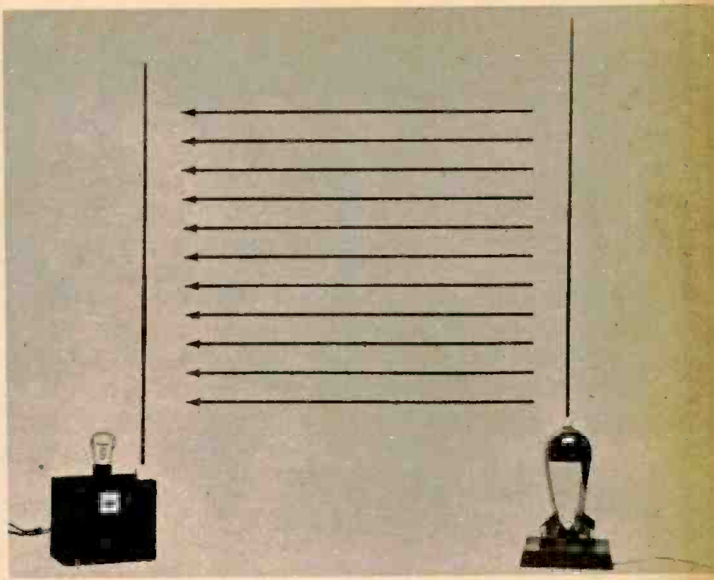
Transistorized mine detector for anti-guerrilla forces is fraction the size of the WW II model.

There are a few other special requirements. The set must be maintenance-free. Villagers who have difficulty learning how to turn a radio on and off would not be able to service any kind of set. And 24-hour operation would be necessary (the Viet Cong don't send word that they're about to attack) in areas with no local power supply. The right radio still has not been designed, but a compact, simple, solar-cell-fed battery rig is under development. It may fill the bill.

Power, where there are no electric lines or battery counters, can be a monstrous headache. Gasoline generators might supply enough juice for a particular job but they're noisy, giving away your location, and they need fuel. Hand-cranked generators are heavy and require an extra man. Now in the research stage is a *silent* engine that may be steam-powered, using sticks, leaves and dry grass. The fuel cell also looks promising, but it must have canisters of fuel to keep going in its current state of development.

A favorite Communist guerrilla weapon is a crude anti-personnel mine that consists of nothing more than a

Tiny Manpack radio has phone-type dial, scrambles signals for secrecy.



People-detector sets up electronic fence (represented by arrows) which rings alarm when man comes between antennas.

barbed nail projecting through a piece of wood buried in a muddy path or rice paddy. It's called a panji, and when you've found one the nail usually is already through your foot. The old mine detector of World War II may prove to be the answer. A new transistorized version of that monster weighs only half as much and the controls have been simplified to the point where no special training is needed.

One of the more bizarre projects afoot is aimed at developing a hugely simplified, two-electrode lie detector. Little training and less interpretation would be required by this unit, designed to get a quick yes or no on whether a local citizen is a guerrilla by night. The readout would be a green light for innocent, a red one for guilty. The plan is not for execution on the spot, however. The detector would be merely a first screen to determine which persons would get a full-size grilling.

A majority of guerrilla fighters and infiltrators in Southeast Asia are likely to come in from a neighboring country across a border that is impossible to seal with troops. If the border *could* be sealed, our side would have a much easier job. The research people have experimented with radar but the cost would be high.

A more promising people-detector is a simple device that uses a low-frequency radio signal (see photo). The apparatus has a tiny oscillator in a bomb-shape base support (right in photo) and a wire or rod antenna that can be 12 to 15 feet high. The receiver is a small black box with a matching antenna and a bell or other alarm.

The transmitter sends out a signal from 10 to 100 kc, forming an invisible barrier between itself and the receiving antenna, reaching as high as the two wires or rods. When anything intrudes the signal dies and the alarm sounds.

Though the rig can be built for about $10, it is not as simple as it sounds. A bogus signal of the right frequency might keep the alarm silent while an intruder passed. So there is a safeguard. A portion of the signal which hits the receiving antenna bounces back and is picked up by the transmitter. The oscillator continues to operate only so long as this radar-like echo comes in. If the echo dies, the transmitter shuts down and the alarm goes off.

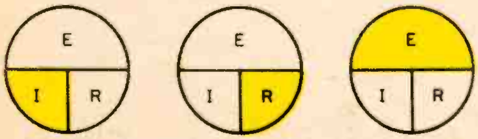
$I = E/R$

A new look at the most basic electrical principle: Ohm's Law.

By Ernest M. Deutsch

WE'RE STILL in the dark as to the basic what and why of electricity but we are able, nevertheless, to generate it, use it and measure it with great accuracy. The reason lies in electricity's extreme predicability. Under a given set of conditions we know exactly what an electric current will do. The tool we use to make our predictions is Ohm's Law, most basic of all principles relating to electricity.

Ohm's Law is attractive to the electronic hobbyist because it is so simple to use. But this simplicity got its formulator, German physicist Georg Simon Ohm (1787-1854), into a lot of trouble. A mathematics professor at Cologne and Nuremberg, Ohm enjoyed a high reputation until it came to his paper on Die Galvanische Kette Mathematisch Bearbeitet (free translation: The Galvanic Chain Worked Out Mathematically). The piece said simply that current in an electrical circuit is directly proportional to applied voltage and inversely proportional to resistance. But in light of scientific thinking in those days, the answer was *too* simple and too pat.



$I = E/R$ $R = E/I$ $E = I \times R$

Ohm's contemporaries thought he'd slipped a gear. He resigned his post and lived in obscurity. But after 14 years it was discovered that the physicist *did* know what he was talking about and, an old man now, he was given a medal.

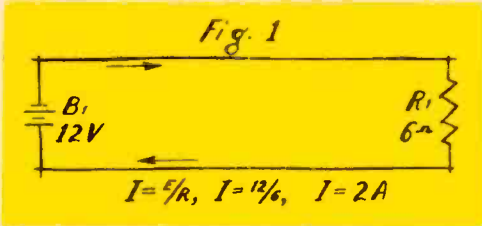
No involved mathematics is needed to use Ohm's Law. If you can add, subtract and divide simple numbers you can be an Ohm's Law expert. This is not to say that complex circuits don't present complex equations. But the complexity lies in the circuits, not the law.

Understanding Ohm's Law is facilitated if we visualize what happens in an electrical circuit. There are just three ingredients: voltage, current and resistance. And an electric current is a flow of electrons through a conductor.

Voltage, symbolized by the letter E for electromotive force, provides the force or pressure of electric power. Everything that happens in a circuit stems from the fact that it is subjected to a voltage stimulus. The unit of measure is the volt.

Current, symbolized by I for intensity, is a measure of the amount of electrons flowing through the conductor under pressure of the voltage. The unit of measure is the ampere.

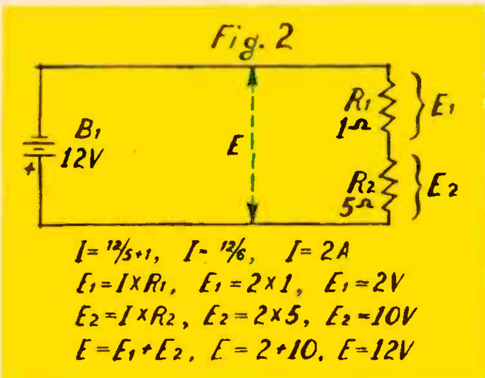
Resistance, tagged by the letter R, is a measure of the opposition to the flow of an electric current offered by a conductor. The unit of measure is the ohm.



There are a dozen or so ways to memorize Ohm's Law. To our mind, Ohm's Law Circle (see first illustration) is easiest. E, I and R are arranged in alphabetical progression in a circle as shown. To find any of the three, you simply cover that letter and work out the remaining symbols. If you cover E, you find I and R on the same level, so you multiply them. Covering I or R puts the E over the remaining symbol so you divide the upper one (E) by the lower (I or R).

There are just two other simple principles to remember: voltages in a parallel connection are the same; current in a series connection is the same.

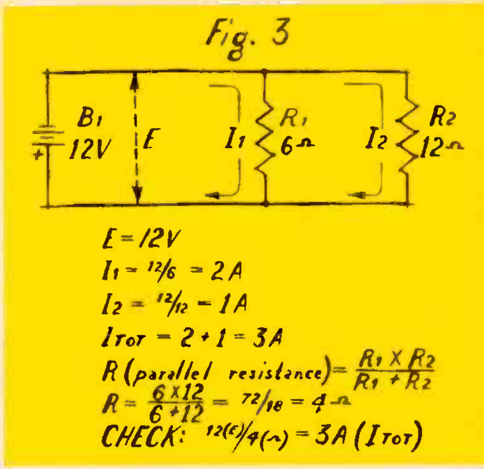
Let's get to the equations that are scattered through this article. In all of them we've shown a battery as power source, though it could just as well be a generator, and the E, I and R quantities are in simple numbers. In actual circuits



you're likely to find such quantities as the milliampere (a thousandth of an ampere). Only thing to remember is that all must be converted to decimals in using Ohm's Law (10 milliamps becomes .010, etc.).

In Fig. 1 we show the most basic of all circuits—an electric current flowing through a single resistance (disregarding the resistance of the conductor). If battery B1 applies 12 volts to the circuit and resistor R1 presents a resistance of 6 ohms, how much current will flow? Substituting numbers for the symbolic letters in the Ohm's Law Circle, we find that I is equal to 12 divided by 6. The current, then, is 2 amperes.

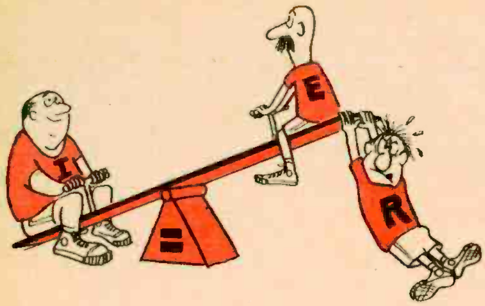
In Fig 2 we have a series-connected circuit. It's the type of problem we



might have if R1 represented the resistance of the connecting wires and R2 were a load resistance, such as a light bulb. Or R1 and R2 might represent two tube filaments. Since current flow is dependent on the *total* resistance "seen" by the voltage source, we must determine what that resistance amounts to. The answer is obtained simply by adding 1 ohm and 5 ohms—or 6 ohms. Voltage (E) again is 12 volts, so I equals 12 divided by 6, or 2 amperes. Since this is a series circuit, the current is the same throughout.

To find the voltage drop (E1) across R1 we cover E in the circle and find we must multiply I (2A) and R (1 ohm), which gives us 2 volts. The same formula gives us 10 volts for E2. Total voltage drop must equal applied voltage (12V), so adding 10 and 2 shows us that our answers were correct.

In Fig. 3 we have a parallel-connected circuit. R1 might be the horn in a car and R2 the cigarette lighter. In a parallel circuit we know the voltage drop across both resistors must be 12V (volt-

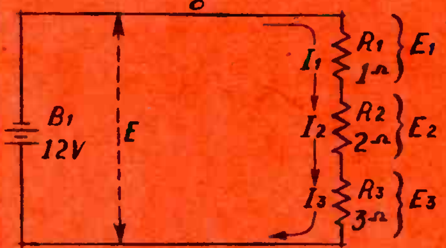


ages in parallel connection are the same). To find the current flowing through each resistance, we divide 12 (V) by the value of each, finding I1 is 2A and I2 is 1A. Total current drain equals the sum of currents through all branches, or 3A.

Determining the parallel resistance of the circuit requires a special formula: R1 times R2 divided by R1 plus R2. Working this out, we find that the total resistance "seen" by B1 is 4 ohms. To check our total current (3A) we can divide E (12V) by R (4 ohms).

Figure 4 is a duplication of Fig. 2, except the circuit has become a little more complicated with three resistors, and Fig. 5 is like Fig. 3, but again more complicated. With the basic understanding you now have of Ohm's Law, you should be able to follow the equations with ease. When you have gone through

Fig. 4



$R_{TOT} = R_1 + R_2 + R_3 = 6\Omega$

$I_{TOT} = 12(E)/6(\Omega) = 2A$

$I_1 = I_2 = I_3 = I_{TOT} = 2A$

$E = 12V$

$E_1 = I_1 \times R_1 = 2 \times 1 = 2V$

$E_2 = I_2 \times R_2 = 2 \times 2 = 4V$

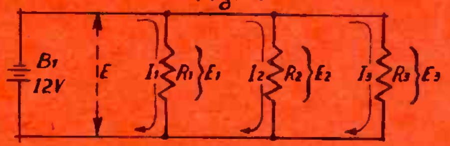
$E_3 = I_3 \times R_3 = 2 \times 3 = 6V$

TOT VOLTAGE DROP(E): 12V

these examples, change the circuit values—and then the circuits—to give yourself some practice.

Even our complicated circuits admittedly are on the simple side when you compare them to what you find, for instance, in an AC/DC radio. And the values we've given are easy-to-figure round numbers. But using more representative numbers would have proven nothing except how to be devious in an explanation. Remember that most important fundamental: Ohm's Law works exactly the same regardless of

Fig. 5



$E = E_1 = E_2 = E_3$

$I_1 = E/R_1,\ I_2 = E/R_2,\ I_3 = E/R_3$

how complicated the circuit is or how odd the values.

In hobby electronics you normally deal with fairly down-to-earth voltages, such as 1½, 6, 12, 117 and 350 volts, the last being a typical B-plus supply. Resistance is likely to run into good-size numbers, such as 2,700 or 500,000 ohms. Your current values normally are low, often stated in milliamperes, which must be converted to decimal ampere values: 100 ma (.100 amps), 50 ma (.050) and 5 ma (.005).

When you get to the practical and especially the theoretical engineering level you're likely to run into some whoppers. Kilovolts (thousands of volts) are common and current readings run up to where the non-professional begins to wonder when the fuses are going to go. Resistance spread is as wild.

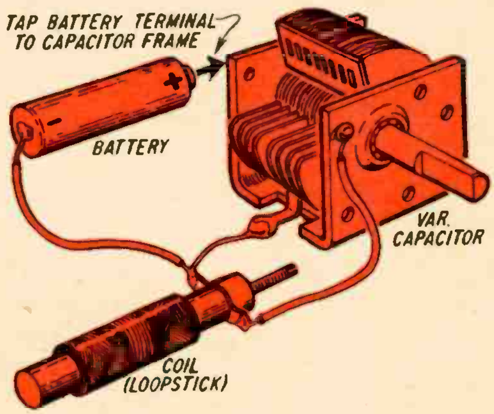
For instance, consider a case where a theory book gives you a resistance of .00017 ohms and a current of 74,117.6A. In the end, you'd come up with a voltage that isn't at all spectacular. But you scarcely could say the same for the other parts of the equation.

You wouldn't be fazed by such figures, however. Remember, you're now an expert on Ohm's Law.

BEGINNERS PAGE

RADIO WAVES

WITH three components—coil, capacitor and battery—you can create a radio wave. The parts form a simple transmitter (see drawing) whose signals are tunable on a broadcast receiver. Use a variable capacitor of the BC-radio type (if you have a two-section unit, hook up the side with the most plates). An old loop antenna or a Vari-Loopstick is the coil. The battery is 1.5-volt dry cell. After the circuit is assembled as shown, place it about a foot from a broadcast receiver and you're ready to transmit.



Set the BC receiver dial near the middle and adjust the volume to normal listening level. Tap the positive end of the battery against the capacitor frame. You should hear clicks in the speaker. Next, begin tuning the variable capacitor. At some point the clicks grow louder, then softer as the tuning changes.

The transmitter produces a radio signal through shocking action in coil and capacitor. When battery voltage is applied electrons pour onto the capacitor plates and charge them. Although the battery is removed, the charge is retained. Notice, however, that electrons have a path through the coil. They rush through the turns of wire and set up an electromagnetic field. This invisible field of energy exists as long as the capacitor has electrons to discharge into the coil. When the capacitor is exhausted, the field collapses. Remember that when a moving field cuts across turns of wire it causes electrons to flow. Just so, the coil's collapsing magnetic field sends a new surge of electrons back to the capacitor. The whole process now begins again in give-and-take between coil and capacitor.

The origin of the signal is at the coil. Its electromagnetic field moves so rapidly that a portion does not have time to collapse entirely and this fragment escapes into the surrounding space, where it is picked up by the receiver.

Unlike normal transmitters, this one cannot sustain radio-wave output more than a fraction of a second. The resistance of the wires dissipates power quickly in the form of heat. Thus the battery must be applied repeatedly to replace lost energy. If continuous output were required, a tube or transistor would be coupled to the tuned circuit to inject a power pulse each time electrons flow from coil to capacitor. Such action sets up CW, or *continuous-wave* operation. This transmitter generates a short-lived *damped wave.*

The speed at which the electrons bounce back and forth determines the frequency of the radio wave. If the variable capacitor is rotated to full capacity (plates meshed) the loudest clicks will be found near the low end of the broadcast band. A coil with more turns has the same effect. In both cases the part's storage ability increases and electrons take more time to go back and forth.—*H. B. Morris*

FM STEREO FINDER

By Fred Blechman, K6UGT

DIAL ACROSS the FM band with a multiplex tuner and you'll be hard-pressed to distinguish stereo signals from mono programs by sound alone. The newer tuners tell you when you've hit a stereocast with a beep or a glowing light. But older multiplex rigs, tuners with add-on adaptors and the table-top sets have no such provision. Fortunately, you can upgrade your equipment with one simple circuit. EI's Stereo Finder, which can be built for about $5, sends an audible tone through the speakers when the tuner receives a stereo FM transmission. It's a sensitive device that won't interfere with your system's normal operation.

The unit operates on the beat-note idea. As shown in the block diagram, a stereo signal entering the multiplex adaptor contains a 19-kc pilot signal, in addition to the usual right-and-left channel information. The Finder injects an additional signal and the resulting mixture of pilot and Finder signal falls into the audio range. With the Finder tuned to generate 20 kc, the beat note sent to the speakers is an audible 1 kc (20 kc minus 19 kc = 1 kc).

Construction. The unit is a 1-transistor oscillator whose low operating frequency calls for no special wiring precaution. Follow the illustrations if it's to be used externally, or you can devise your own layout if the unit is to be tucked inside existing equipment. Just be sure that the on-off switch is easily accessible.

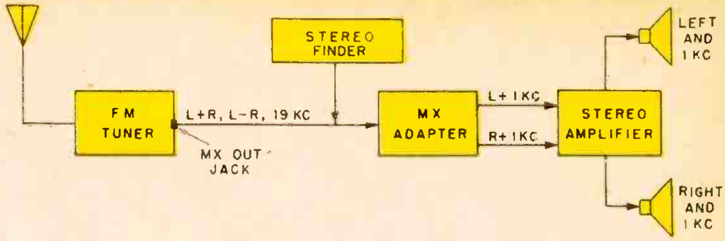
Only problem likely to be encountered lies in the variety of multiplex adaptor circuits; some might kill the oscillator action of the Finder. If the completed model doesn't work properly, try installing an additional ½-watt resistor of approximately 27,000 ohms. The resistor may be tried in parallel with (across) capacitor C4, or in series with it (between capacitor and center lead of the output jack). If this doesn't improve performance, raise the battery voltage to a maximum of 9 volts. If the Finder produces a tone across the entire FM band, change C4 to .01 mf and readjust the slug of L1.

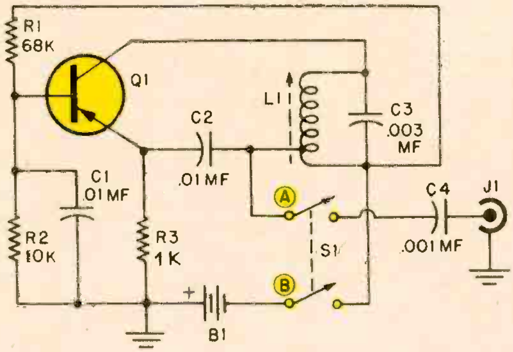
Operation. Hooking the Finder into the multiplex circuits is done with a short piece of shielded cable. The simplest system is soldering the hot lead to the center wire of the tuner's MPX jack (inside the tuner chassis). The shield of the cable goes to chassis ground. Another arrangement utilizes a Y-type connector. Here, the cables from adaptor and Finder merge at the tuner's MPX jack.

First trial with the unit should be run while receiving a station known to be transmitting stereo. Adjust the Finder's tuning knob until you hear a steady, distinctive tone in the speakers. Once the proper setting is found, there's no need to change it. The tone is the same for each stereo station across the band (all have identical 19-kc pilots).

And don't forget to switch off the unit once a stereo station is located. This action removes tone and Finder from the multiplex circuits.

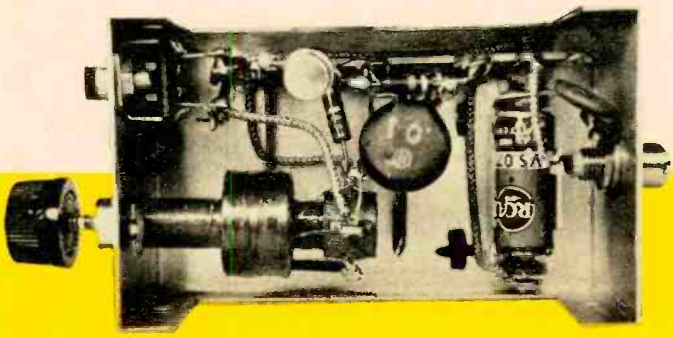
Block diagram shows where Stereo Finder injects signal between tuner and adaptor. Audible tone in the speakers indicates a stereo program.



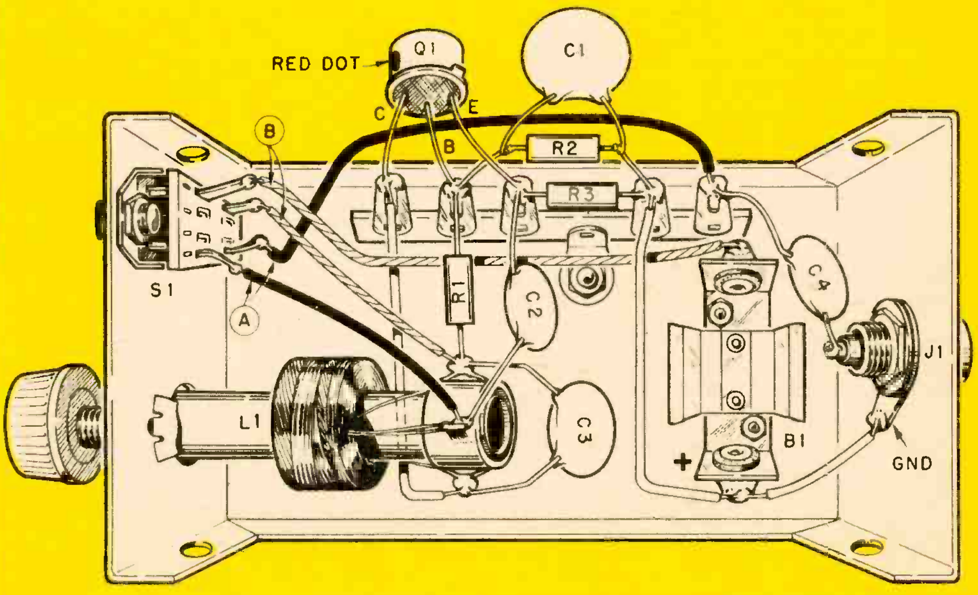


PARTS LIST

Resistors: ½-watt, 20%
R1—68,000 ohms
R2—10,000 ohms
R3—1,000 ohms
Capacitors: 15 V or higher, disc
C1,C2—.01 mf
C3—.003 mf
C4—.001 mf
Q1—PNP transistor (CK722, 2N107, etc.)
L1—Tapped horizontal oscillator coil, 16-42 millihenries (Miller 6211)
S1—DPST slide switch
B1—1.5- to 9-V battery (see text)
J1—Phono jack
Misc.—Aluminum case, 3¼"x2⅛"x ⅝"; knob for ⅛" shaft; 5-lug terminal strip; battery holder; Y adaptor (phono type), if desired



Output is at J1. Tuner's and Finder's outputs should be combined with "Y" connector and fed to MPX adaptor input.



FIRST SINGLE-SIDEBAND CB RIG ON THE AIR!

EI reports on an SSB CB system that has been in use for months.

By Len Buckwalter, KBA4480

IN RECENT MONTHS the big talk in Citizens Band circles, equipment-wise, has been about sideband operation. Many manufacturers are known to be at work on sideband transceivers and at this writing at least one has announced a *double*-sideband rig. Another is marketing a *single*-sideband receiver adaptor, and EI in this issue presents a build-it-yourself adaptor that can be used with any receiver.

All this suggests we're just now getting into sideband CB. That is hardly the case. In truth, single-sideband transceivers have been operating on the Citizens Band almost two years. In day-to-day field operations they have been *tried and proven*, coming out with incredibly good marks. Only a handful of people have known what was happening, but EI now publishes a full report on these first SSB CB transceivers to go into 27-mc service.

The story begins in early 1961 in a suburb of Washington, D. C. A medium-size company called National Electronic Services never was able to establish a good two-way setup with regular CB equipment. Coverage was spotty and range inadequate. Three mobiles roamed a 50-mile-across circle from the edge of Baltimore on the north to Alexandria, Va., on the south. They simply were unable to maintain good contact with base.

The firm's president, a serious young man named George Mason, thought he saw a way out. As W3IZC, he'd been hamming on sideband for years. So why not design an SSB rig for 27 mc? Thus evolved the first prototype, a large and unwieldy job (see photo) that, nevertheless, worked magnificently. Mason quickly gave one of his top men, Roland Martin, the task of building four neatly-packaged, compact units for actual service in the field.

Mason's instant success with SSB CB was no surprise. He had the background from ham radio and he's a sharp chap to boot. NES, his company, had started in the radio-TV repair business but George rounded up a group of talented technicians and began catering to the needs of big federal agencies—a complex audio installation for the State Department; an elaborate timer-recorder for Health, Education & Welfare; some technical work for the FCC. NES suddenly was doing pretty sophisticated electronics. SSB CB was a small problem.

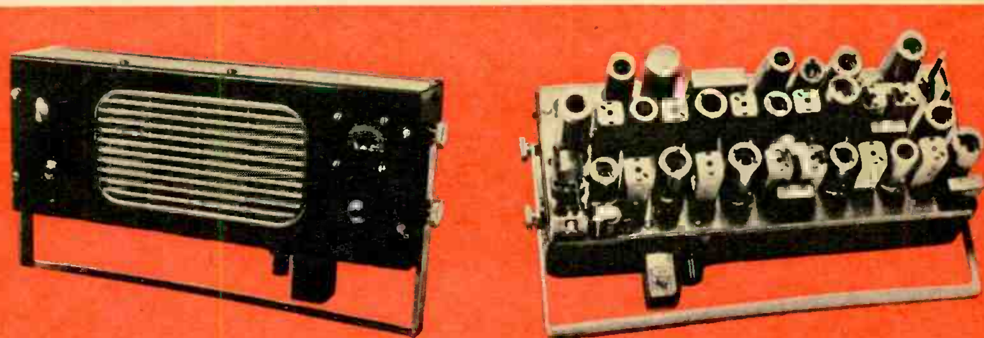
Single-sideband operation at this point looms as CB's biggest technological breakthrough. Via SSB, you can take 5 watts of transmitter power and turn it into a walloping signal packing 20 watts of effective power. It immediately gave George Mason the range and coverage he needed.

From the first, George was wondering what the FCC would think about sideband signals being transmitted right under its nose. So he paid a call at FCC headquarters, learning that SSB would be legal because Part 19 permits AM (amplitude modulation). Sideband assuredly is AM. But George did get a warning not to abuse his privilege. If he started hamming it up there would be swift action, and it could ruin the sideband potential for all CBers.

Since he had no intention of operating outside the rules, the warning didn't bother him. But just to play it safe he began keeping a log of every NES transmission. At the end of three weeks he averaged out the messages handled by all four SSB units and found that total transmission time came to only ten minutes in each 24 hours. A typical message lasted just a few seconds—long enough to transact the business at hand. The log then was sent along to the FCC for study and comment. There was no comment and there never has been a word of complaint.

To find out how the rigs performed, I went along with Roland Martin on a 50-mile trip in a station wagon fitted with a Mason unit under the dash. The antenna was a full-size whip at the rear, and the base was using a Magnum mounted low on a two-story building. A setup like this normally gives you a range of eight or ten miles with flat terrain.

As we rolled to a stop at a light about a mile from base Roland made his first call. Mason's answer from base had the unmistakable tone of a true sideband signal. The voice was slightly hollow but perfectly readable. But the crucial test was stability. Anyone who has tuned SSB on a communications receiver knows that the missing carrier must be supplied by the BFO. If you're more than 50 cps off in BFO frequency, speech becomes garbled or inverted. Could this rig provide a highly accurate BFO signal as the car battery and generator played ping-pong with the volt-



Front panel and chassis of Mason SSB transceiver. Underchassis backs on front panel, with tubes and cans sticking out behind; crystal oven is on side of the chassis. Rig mounts on the bracket.

Mason shows off one of his SSB CB units mounted for mobile operation. Set draws about 42 watts.

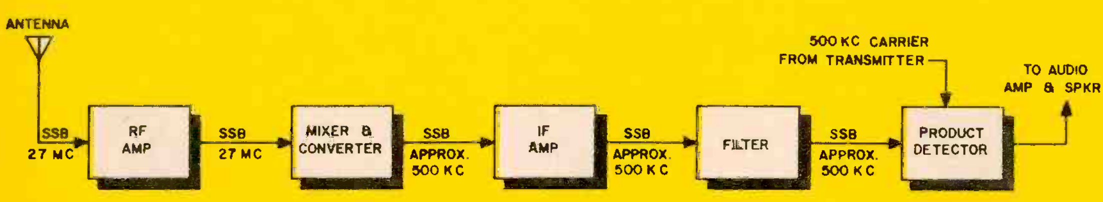
Map shows signal coverage area from Alexandria to Baltimore. Prototype of rig sits on bench.

age supply? It did—by using stiff voltage regulation and the expedient of putting the crystal in a thermostatically controlled oven. The oven is about 2 inches square and holds the crystal at a steady 180 degrees F.

As we headed north toward Baltimore, Roland called for signal reports every two or three miles. At eight miles out noise began to creep behind Mason's voice from base. The combination of distance and hills normally would make for rough going, but signals were still Q5. The sock of the SSB signals really proved out beyond the 15-mile perimeter. From there to 25 miles from base there was no important drop in signal and Mason's voice came through with excellent copy in a remarkable display of what sideband can do.

Range is not the only criterion, however. Speaking in general terms, Mason declared that SSB has proven about four times more effective than conventional CB systems. More importantly, spotty downtown areas now receive reliable coverage.

In a way, George Mason's NES has had a secret channel of communications. So far as is known, no one else in the Washington area had a receiver capable of decoding SSB CB signals. So to any CBer who happened along, the messages were so much hash. As a matter of fact, other licensees were heard now and then wondering on the air about what



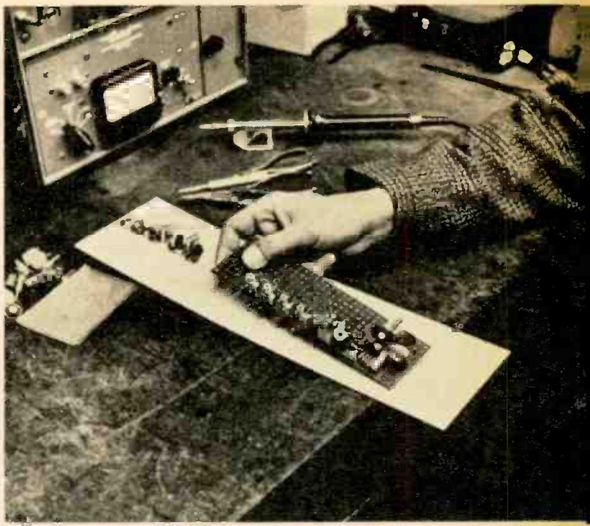
SSB RECEIVER—Block diagram shows three main divergences from usual superhet: the crystal filter, product detector, 500-kc oscillator signal. See text for detailed discussion of the transceiver's operation.

kind of strange stuff they'd been picking up. More than one made some attempt to jam but, in Mason's words: "They just couldn't do it. In a mutual interference situation, sideband can take it. It turned out to be the AM signals from the cut-in stations that got clobbered. We got through."

Mason's transceiver draws about the same number of watts (approximately 42) as a conventional rig. When you speak into the microphone of a normal unit, the RF output signal is divided into two sidebands and a carrier. The sidebands bear the modulation. The carrier merely generates them in the final RF tube. Moreover, the sidebands are mirror images of each other and only one is needed. An SSB rig produces carrier and sidebands in an early, low-power stage and then kills everything except a single sideband. This is fed to the final RF amplifier, which expends *all* its power to boost only this one valuable part of the signal. In the usual rig about two-thirds of the transmitted power is wasted. With SSB, nothing is wasted. And a peak power input to the final of a full 10 watts is legal.

The Mason transceiver looks much like a factory-made product but every one is hand-wired and costs somewhere in the vicinity of $500. Production-line techniques could reduce this figure considerably but George's plans at this point for licensing out the circuit or marketing the unit himself are indefinite.

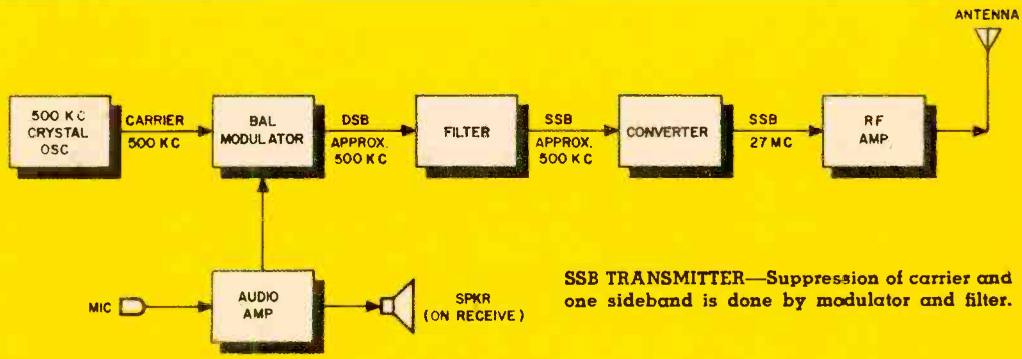
The future looks bright. In months of steady operation NES's rigs have experienced no difficulty beyond normal tube failure. And something even more startling is on the way. On Mason's workbench lies a transistorized version of his SSB transceiver. When completed, it will be a fraction of the size of its big brother, which has 17 tubes and exhibits a dozen transformer cans. The absence of tube filaments will reduce power consumption to a ridiculously low figure. All the breadboard job required at the time of our visit was a husky RF transistor in the final.



Transistorized version of transceiver is under construction; whole circuit will fit on board.

The operation of Mason's transceiver—or any other SSB rig—is both similar to and different from that of a conventional set. SSB *is* AM, but with a difference. In the receiver (see Fig. 1) we

[*Continued on page* 110]



SSB TRANSMITTER—Suppression of carrier and one sideband is done by modulator and filter.

An Easy-to-Build SIDEBAND ADAPTOR for your CB receiver

By Herb Friedman, 2W6045

SINGLE-SIDEBAND operation, a technique that multiplies effective transmitter power, is now a reality on the Citizens Band. But try to tune an SSB signal on your transceiver and all you'll get is a slightly seasick Donald Duck. Though sideband has much to offer CBers, it is not compatible with normal AM signals or equipment. It needs additional processing (see our article, FIRST SINGLE SIDEBAND CB RIG ON THE AIR, in this issue) to convert a carrier-less signal to something which can be detected by any CB receiver. EI's SSB adaptor does this processing.

Without modifying your rig, you can add our adaptor and be able to monitor any SSB signal that comes your way. The adaptor actually is a crystal-controlled oscillator that generates the carrier missing from an incoming SSB signal. Both signals mix in the receiver and sideband modulation is made intelligible. The adaptor may be used with any type receiver, tunable or crystal controlled. Oscillator drift in the receiver, a problem in receiving SSB, is not a factor in this system. Since the carrier is generated outside the receiver, a tuning control on the adaptor permits fine frequency adjustment of the injected carrier. The unit is easy to build and the parts cost only about $6.

Construction. The adaptor is built on the U section of a small Minibox. Lead dress is somewhat critical so follow the pictorial as closely as possible. J1 and J2 are coaxial jacks which must match your existing connectors. Battery B1 can be any miniature 9-volt transistor type, strapped to the Minibox by a length of wire passed through two solder lugs.

L1 must be wound carefully on the coil form. Scrape the insulation off one end of a length of #22 enameled wire and attach it to the coil terminal *adjacent to the mounting nut*. Tightly wind six close-wound turns and bring the wire away from the form about 3 inches. Loop the free end back to the form and continue to wind five more close-wound turns in the same direction as the original six. Scrape off the insulation and fasten the free end to the other coil terminal. Scrape all the insulation off the middle loop, twist it and tin with solder. This will form the centertap connection.

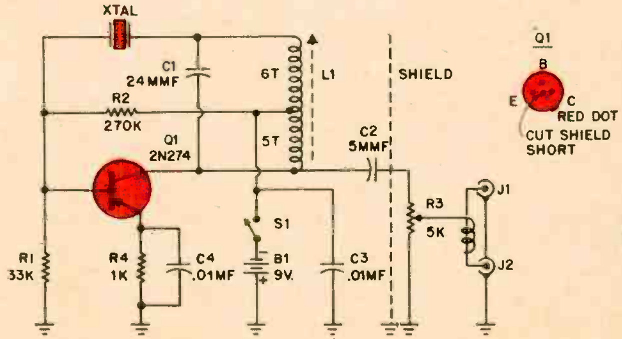
When soldering the transistor leads, avoid damage by using a heat sink, such as an alligator clip, on each lead.

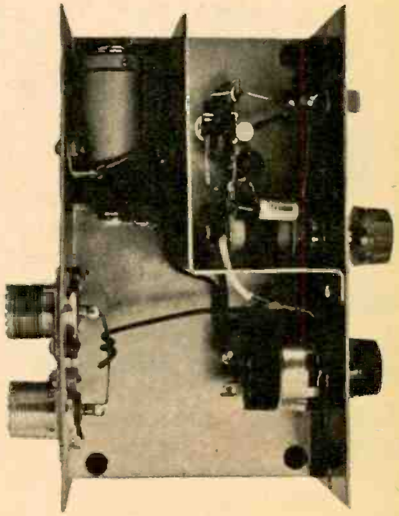
After the circuit is wired, install the shield. Cut it from scrap aluminum or tin to fit snugly around all components, as shown. The shield extends the full height of the U section and to the right end. Using a $\frac{3}{16}$ bit, drill two holes in the shield for B1's negative and C2's leads. The negative battery lead passes through the hole at the bottom of the shield. The insulated lead from C2 passes through the hole approximately one-third down from the top. Make certain C2 is mounted *inside* the shield.

The output lead from injection control R3 is pulled taut and wrapped two or three times around the J1-J2 jumper. Do not remove the insulation from this lead; no solder connection is required at the wrap-around point.

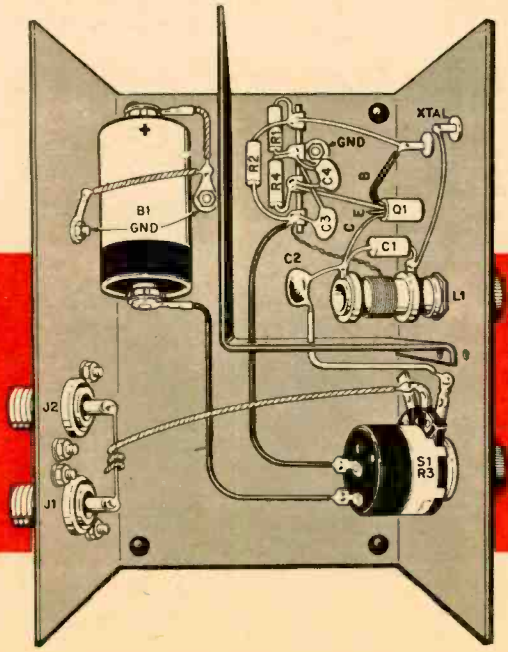
Calibration and Use. An overtone *transmit* crystal is plugged into the crystal socket on the adaptor. There are two possibilities. If your crystals are of the series type, they will bring in the

Circuit is a crystal-controlled transistor oscillator. Coil L1 permits fine frequency adjustments, needed for SSB reception.





L-shape shield, seen in the photo above, keeps the oscillator coil from radiating excessively strong RF carrier signal to the CB receiver.



PARTS LIST

Resistors: ½-watt, 10% unless otherwise indicated
R1—33,000 ohms R2—270,000 ohms
R3—5,000-ohm potentiometer with SPST switch (S1)
Capacitors:
C1—24 mmf molded mica
C2—5 mmf molded mica
C3,C4—.01 mf, 75-V ceramic disc
Q1—2N274 transistor
L1—Coil form, slug tuned, Cambridge Thermionic, CTC—PLS5-2C4L/B. (Allied Radio 61G034)
J1,J2—Coaxial connectors (see text)
B1—9-V transistor type battery
Misc.—Crystal and socket; 4-lug terminal strip; aluminum case, 5¼"x2⅛"x3"

At lower left of wiring guide, notice how insulated wire is wound around J1-J2 jumper.

Transmitting crystal plugs into socket at the right. Both the injection and tuning knobs are carefully adjusted for the clearest audio signal from an SSB transmission.

SSB signal on the *same* channel marked on the crystal. Many rigs, however, use *parallel* crystals and require different treatment. (You can identify crystal type by examining the schematic of your CB transmitter: if the crystal goes from the grid of the oscillator tube to ground, it's a parallel type.) When parallel crystals are used, they must be one channel higher than the one you wish to receive. Thus, an SSB signal on channel 6 requires a channel 7 crystal of the parallel type.

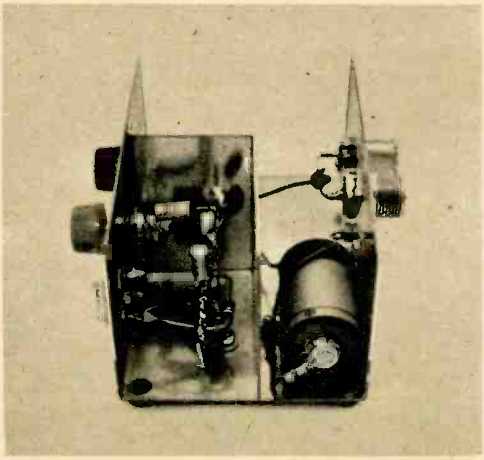
Now connect a 0-10 milliammeter in series with the negative lead of the battery and start rotating L1's slug from its full-in position. Turn counterclockwise until the meter shows a noticeable increase in current. This indicates the crystal is oscillating properly.

The adaptor next is hooked to your receiver. Connect J1 to the antenna input on the CB rig and J2 to the antenna. Tune the receiver to a normal CB signal on the desired channel and turn on the adaptor's power switch. If everything is operating correctly, you should hear a heterodyne (or whistling sound) along with the modulation. When the slug of L1 is rotated slowly the pitch of the heterodyne changes from high to low—then back to high. The precise point to find is the zero beat. It occurs *between* the two high-pitch points. In this tuning position the heterodyne should disappear.

After you get an SSB signal, make a fine adjustment on the adaptor. Begin by tuning the signal for maximum audio. You won't be able to make out words, but it's not difficult to judge strongest sound. With the adaptor power on, adjust both R3 and the coil slug until the speech becomes intelligible. It's a little tricky at first, but the technique is soon learned. Just be sure that the coil slug is never rotated too far from the zero-beat setting found earlier on a normal station. (The heterodyne is not present on an SSB station, regardless of coil setting.)

Until you get the hang of tuning an SSB signal, we suggest you practice this way: Tune in an SSB signal of moderate strength—not too strong and not too weak. Set R3 to approximately mid-position. Slowly adjust L1's slug until the high-pitched chatter becomes recognizable speech. Then adjust R3 for optimum signal.

On weak SSB signals, it's possible for the adaptor to inject excessively strong signals into your receiver. The remedy is to reduce R3 (full counterclockwise). If this doesn't help, remove the adaptor from the transceiver and antenna leads. The antenna is plugged back into the transceiver in normal fashion. Add a short length of wire to J1 or J2 and move the adaptor away from the receiver until signal injection is reduced to lower levels.



End view reveals main oscillator components in shield. Rubber feet (lower left) may be installed.

A LOW-COST

Personal PA

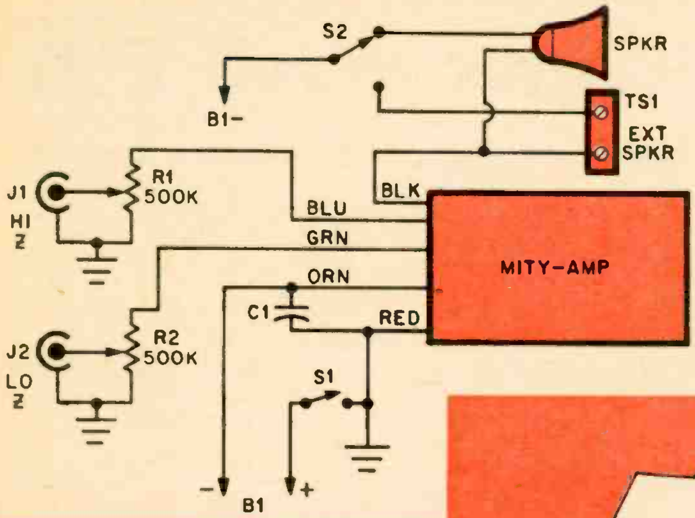
You can use this public-address system anywhere and its transistor module packs a 2-watt punch.

By George A. Moran

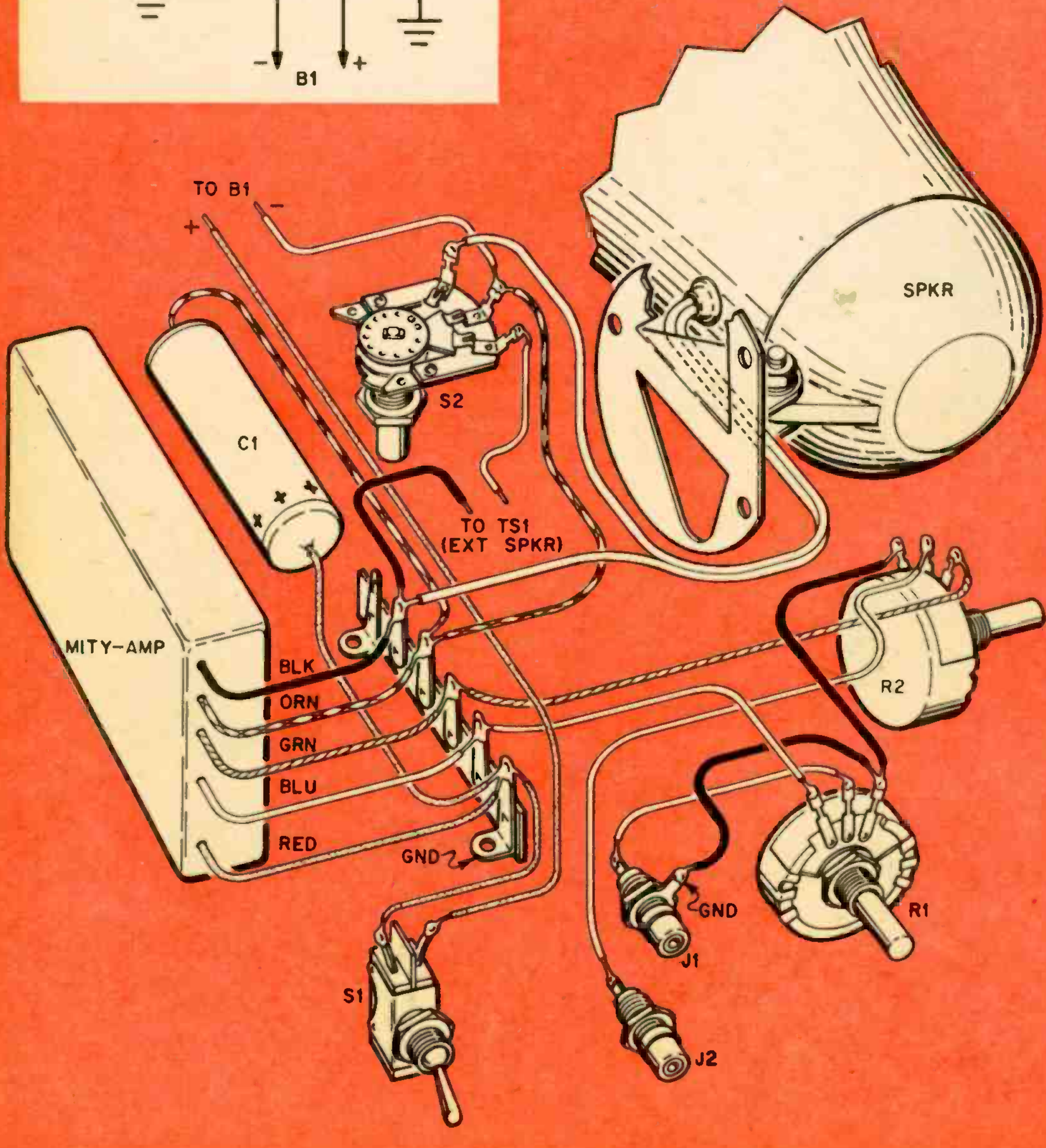
ALTHOUGH the election campaign may be long past, small public-address systems are handy to have around. For a lodge meeting, Boy Scout work, volunteer police duty, serving as a lifeguard at the beach or any occasion where you want to get your voice to an audience, a portable PA system is mighty useful.

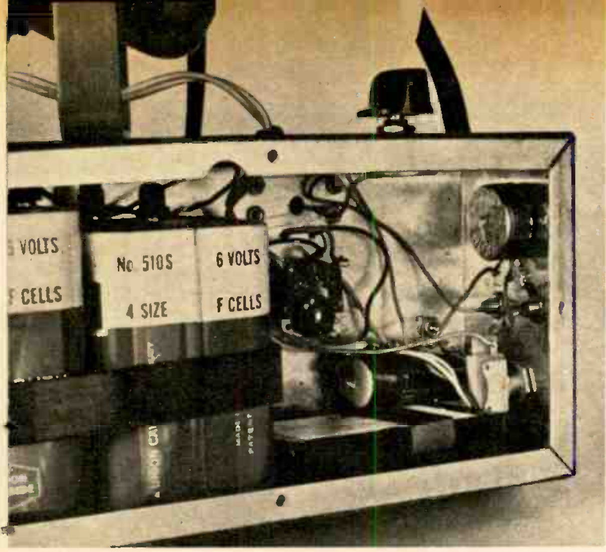
Modern transistor technology makes it possible to construct a powerful, portable, lightweight loudhailer that can function while hanging from a shoulder strap. Using a Mity-Amp transistor module, you can construct the EI loudhailer in an evening and for under $20. It will operate on its own built-in power pack or from a 6- or 12-volt external storage battery. And, of course, you can operate it on your car battery via a cigarette lighter adaptor. Its two watts of power will fill a large area indoors with good volume and it will cover a smaller area outdoors.

Construction. The loudhailer takes no longer than an evening to put together and is not critical so far as parts layout is concerned. Note that there is a two-screw terminal strip (TS1) on the outside of the cabinet to provide connections for an external speaker if desired. Switch S2 connects either the mounted PA trumpet or



Few components appear in schematic, most are inside prefab Mity-Amp. Below, color code is given for wiring in module. Be sure mounting nuts on jacks J1, J2 make good ground contact with the case.





Side panel removed shows dry cells held by metal band. Module is strapped down at lower right.

an external speaker to the amplifier.

Almost any speaker can be used—from a 12-inch cone type to a PA trumpet. Two PA trumpets were tried to see how they would work as part of the loudhailer. The Lafayette PA-295 had slightly better efficiency and high frequency response but was prone to acoustic feedback. Olson trumpet S-453 was not quite as efficient but did not howl in normal use. If you intend to use the loudhailer primarily for musical reproduction, the Lafayette would be the preferred speaker. For voice and general PA use, the Olson is recommended.

Dual inputs permit the use of almost any kind of input device. A phonograph with a crystal or ceramic cartridge may be plugged into the hi-Z input and a dynamic mike into the lo-Z input. Both inputs can be used simultaneously and are controlled independently by two potentiometers.

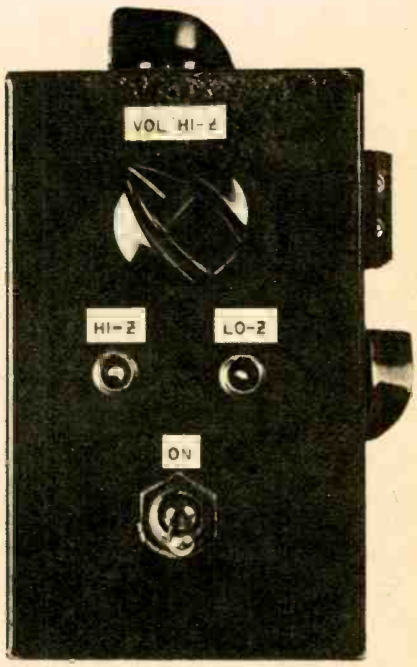
Electrolytic capacitor C1 should have a value of 50 mf or higher at 25 working volts. Its job is to stabilize the unit as the battery ages. If you intend to use the loudhailer with an external storage battery or power supply, C1 may be omitted. The booklet accompanying the Mity-Amp module has plans for an AC power supply.

It is important that B1 does not exceed 12 volts or the Mity-Amp may be damaged. In fact, if you are using a speaker with *less than* 8 ohms impedance it would be best to stay with a 6-volt battery or power supply. It's permissible to use several speakers simultaneously with the loudhailer, so long as they are connected *in series*.

You can use a push-to-talk microphone with the loudhailer by substituting a four-pin socket for J1 or J2 and using the extra two contacts for the push-to-talk function. Wire the PTT leads directly across S1. With S1 in the *off* position you'll have push-to-talk operation at the mike; with S1 switched to *on*, the operation will be normal. The Mity-Amp eats up current. It's best, therefore, to leave the unit switched off when not in use. Since there is instant warm-up, this won't be a problem.

PARTS LIST

R1,R2—500,000-ohm audio taper potentiometers
C1—50 mf or higher electrolytic capacitor, 15 volts
J1,J2—Phono jack, single-hole mounting
B1—6-12 volt battery or DC power supply (see text)
S1—SPST toggle or slide switch
S2—SPDT rotary, toggle or slide switch
TS1—2-screw Jones strip
Mity-Amp — Transistor power amplifier module available from parts houses or distributor: Winco Electronics, 10807 Lyndon Ave., Detroit 38, Mich.
SPKR—PA horn (see text)
Misc.—Cabinet (10"x5"x3" aluminum chassis with cover plate); 6-lug terminal strip; hardware knobs



End view of case shows position of input jacks and controls. Knob on top surface is lo-Z volume.

THE ELECTRONIC PLANT SLEUTH

ANYONE who stays reasonably wide awake in high school biology can tell you that plants may do one of two things with water. They use it in making new cells, increasing their size. Or they give it off via their leaves as vapor.

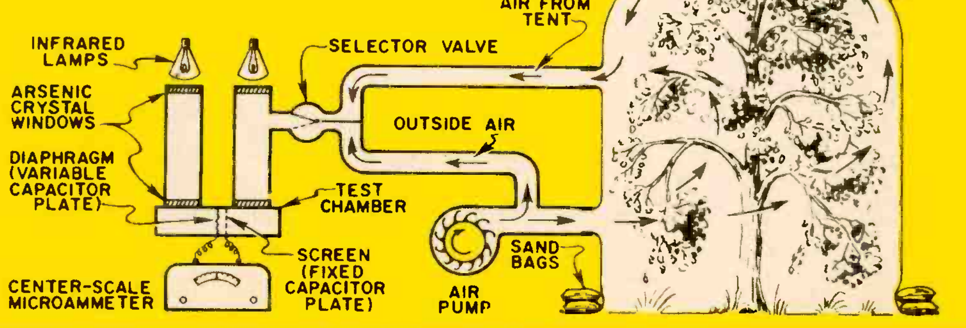
To Dr. John P. Decker, a U.S. Forest Service biophysicist working in a quiet corner of the Arizona State University campus, all this can seem downright criminal. He and everyone else in the Southwest, where the desert is likely to be as close as your doorstep, is worried about water. There never was much of it in those parts, but now increasing consumption and a dropping water table have made conservation more important than ever before.

Dr. Decker doesn't begrudge water to a plant if, in the end, it is consumed by man or beast. It's the drones that he despises, in particular desert shrubs that grow along streams, irrigation canals and reservoirs, gorging on water like parched hippos and then being of no use to anyone or anything.

Even among usable plants and trees, certain varieties consume more water than others. But no one knew the exact thirst of each one. Dr. Decker, to prove his point that useless plants were wasting millions of gallons of water and that you could conserve moisture by cultivating only those with modest thirst, built an electronic apparatus to tell friend from foe.

The Decker assembly (see drawing) is an infrared analyzer which detects water vapor in the air and measures it accurately. The researcher previously had investigated the still-mysterious process of photosynthesis in a more general way. One piece of his equipment (shown in photo beside title) was so

Diagram shows operation of equipment built to determine amount of water used by plants in the arid Southwest. See text for details.



sensitive it could measure the carbon dioxide uptake of one clover leaf in one second. His plant drinkometer performs comparably.

Dr. Decker begins his thirst check by throwing an airtight plastic tent over his test plant, sandbagging it around the bottom. A pump shoots air into the tent and the air picks up the moisture given off by the leaves. A selector valve enables Dr. Decker to feed either of two air streams to a special analyzer: outside air containing normal humidity, or air from the tent with added moisture from the plant.

The ingenious analyzer has two cylinders with crystal windows covering the ends. The left one, containing no moisture, is sealed. Air samples are introduced into the right cylinder. Above each cylinder is an infrared lamp. The IR rays, to which the crystal windows are transparent, shoot through the cylinders and enter a sealed, gas-filled test chamber below. The test chamber is split in half by a gold-foil diaphragm which represents the variable plate of a capacitor. The fixed plate is a screen positioned beside it. Leads from the capacitor plates run to an AC bridge circuit that is hooked to a microammeter.

In operation, when the air in both cylinders is dry the gas in the two test-chamber compartments is warmed equally. The bridge is balanced, no current flows, the meter reads zero.

But with air containing water droplets in the right cylinder, some of the infrared is intercepted, the test chamber on that side cools slightly, the gas contracts and the diaphragm bulges in that direction, changing the capacitance in the bridge circuit and permitting current to flow. The amount of current, indicated by the meter, tells Dr. Decker exactly how much moisture the air contains in comparison to the dry chamber.

By testing outside air and tent air alternately, he is able to give exact figures on the amount of water each test plant adds to the outside air. Under normal conditions, this released water vapor would return as rain. But not in the desert. There, it's gone forever—wasted—because it simply doesn't rain.

—Henry F. Unger

EI AT LARGE

Here Come the Girls

THOUGH we've had the pleasure of knowing a good many women employed at one job or another in this field of electronics, the variety of duties performed by the ladies has always seemed to us pretty restricted. You find girls in the secretarial pool, in the boss's office and on the assembly line, but they're conspicuously absent in the engineering department and at the service bench.

Considering the knowledge of electronics displayed by YL's in the ham radio fraternity and elsewhere, it seems a shame that most gals can't get a divorce from the typewriter or soldering iron.

This corner—a kind of journal recounting the wanderings of the EI staff—is now pleased to report a relatively startling breakthrough for the fair sex. We stumbled upon our bit of news almost by accident. It was at a seminar on Electronic Manpower Resources, convened by the Cleveland Institute of Electronics at the Sheraton-East Hotel in Manhattan.

After several speakers had given us facts about shortages of engineers and technicians, a young man named Ralph Gunter, who is manager of employee service and education for Radiation, Inc., the Florida outfit that is growing like crab grass in the garden, got up and revealed what his firm is doing to alleviate its pressing need for technicians.

"This industry," said Mr. Gunter, who wears a flaming red crew cut, "has never encouraged women in technology. But we at Radiation have done something different. We have begun to use women as technicians. So far, it has worked out well."

[*Continued on page* 108]

AN ALL-ELECTRIC FURNACE

A COMPANY in Westbury, N. Y., is busy looking for homeowners who'd like to buy a new furnace that fits into a box just 14 inches square. As you might expect of a miniaturized furnace, this one has a *micro* in its name. It is called the Micro-Therm, made by the Thermotronics Corp.

With a furnace of that size, you know there's something pretty catchy somewhere. In this case it's in the fuel consumed by the house-heater. It's not gas or oil or coal. It's electricity. The Micro-Therm is a true all-electric furnace, and the first to make a big splash on the market.

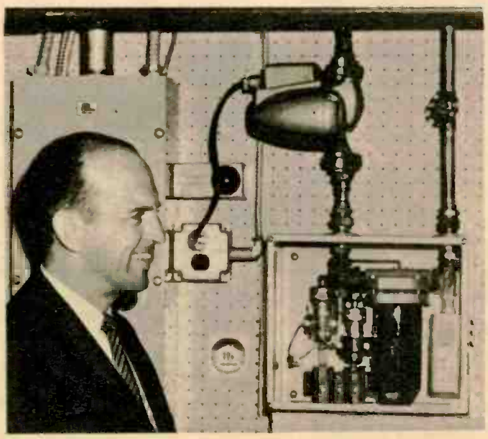
The Micro-Therm's operation is simple and to the point. Cold water flows through the unit, is heated to a high temperature and then is pumped to room convectors or radiators, as in the usual hot-water heating system. A thermostat controls cycles.

The furnace's secret is contained in a small Pyrex dome (see photo at top of page). The heating element inside the dome is a special graphite cloth which provides ten times the wattage density of normal elements. Because of its high BTU output, the element is able to heat water quickly as it flows through the dome. The water pumps, plumbing and controls are standard.

There is a pressure valve on the Micro-Therm but no boiler is required and, since there are no fumes, the flue becomes an anachronism. Price of the unit is about $300.

The leading question, however, concerns operating costs. Can you heat with electricity as cheaply as with gas or oil? The manufacturer says Micro-Therm is *almost* competitive and will become more so as reserves of oil and gas are depleted. The company is fond of pointing out that both these fuels make for inefficient heating in that some heat goes up the flue and more is lost in other ways. With electricity, losses are much lower and efficiency is high.

Micro-Therms have been installed in some 400 homes in the East, and 4,000 units were ordered for a West Coast development. An Alaskan even heated an industrial plant in Anchorage with a Micro-Therm—and said he was pleased with the results.



A complete home furnace fits in the box on the wall; note size as compared to the man in photo.

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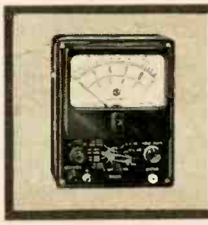

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BASIC CB CIRCUIT THEORY

In our concluding discussion on Citizens Band transceivers we take a look at the circuits found in typical rigs. An understanding of the fundamental theory of operation makes any set easy to analyze.

By Len Buckwalter, KBA4480

PART II

IN PART I we analyzed the functions of each section of a CB receiver, using block diagrams. Now let's get down to specifics and take a look at the schematics inside those blocks. The schematics represent composites of currently popular circuits, not specific rigs offered by manufacturers. In the interest of simplicity, minor components have been eliminated—chiefly bypass capacitors and voltage-dropping resistors. The switching discussed previously is omitted also.

RF and Mixer Stages

The path of a received signal begins at the antenna. From the antenna, it is fed to an RF amplifier (shown in simplified form in Fig. 1) or a broadly tuned input coil (L1 in Fig. 2) which accepts all channels in the 27-mc band. Signals are then boosted in the RF amplifier tube and introduced to RF coupling transformer L2. Both the primary and secondary of L2 are tuned to 27 mc. Up to this point, the receiver displays a moderate amount of selectivity. The tuned elements (even the antenna, which is cut to length, may be considered one) have narrowed the response of the receiver to the CB band. Next is the heterodyne process for pinpointing a given channel.

As shown in Figs. 1 and 2 there are two types of mixers in use. The circuit of Fig. 2 utilizes a separate oscillator tube (seen in Fig. 3) to provide the oscillator signal. Shown are a crystal oscillator, whose frequency is determined by the crystal (A), and a tunable oscillator (B). Note that unlike standard broadcast-band superhets, the oscillator alone is tuned to select the CB operating frequency. As explained earlier, when frequency-mixing occurs only the desired channel creates an IF signal of 1650 kc.

The IF signal is applied to the IF stages (Fig. 4), where each IF transformer is double-tuned. This, plus the comparatively low operating frequency, adds up to a highly selective path with great rejection to undesired signals from the mixer.

The signal is considerably amplified by the time it reaches the detector, which is fed by the IF strip.

Diode detector D1 (either a crystal or part of a tube) recovers

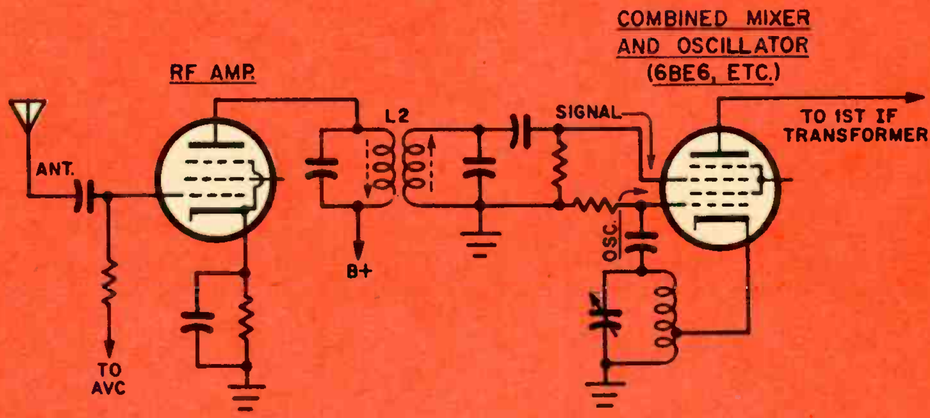


Fig. 1. Typical front-end found in the receiver section of a CB transceiver. Note that RF amplifier input is shown untuned and that oscillator and mixer are combined. Coil L2 is double-tuned.

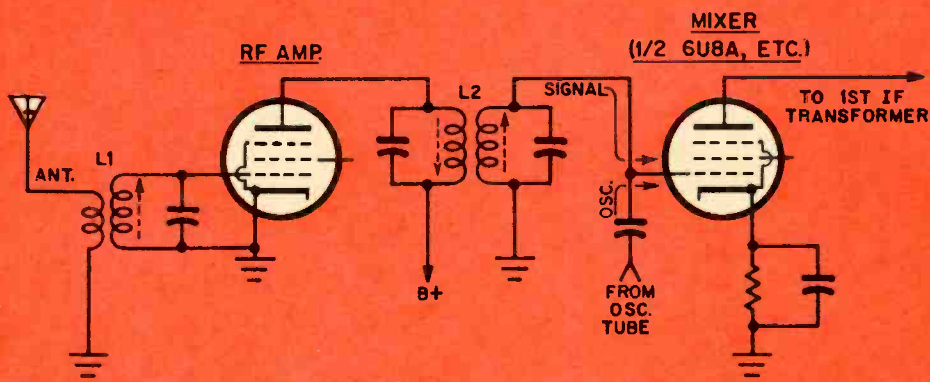


Fig. 2. Another variation on the receiver front-end. Here a broadly tuned coil (L1) tunes the RF amplifier, and the mixer tube is fed from a separate oscillator. L2 is broadly tuned also.

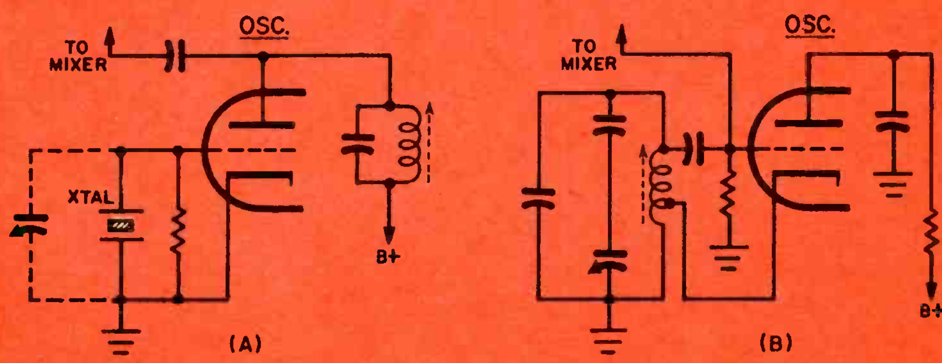


Fig. 3. Two oscillators designed to feed the separate mixer shown in Fig. 2. A is fixed-tuned crystal type. B is tunable oscillator. Most rigs can switch from one to the other via a panel control.

the audio from the RF (now IF) carrier. Note that the original signal enters the receiver at approximately 27 mc. The fact that it has been converted to 1650 kc in no way disturbs the audio modulation. The AF modulation of the IF signal is identical to the AF in the 27-mc carrier. During the detection process not only is audio picked off the IF carrier, but automatic volume control (AVC) is developed. This is a DC negative voltage that varies with the strength of the RF carrier. The AVC voltage is fed from the detector back to the control grids of the RF amplifier, first and second IF tubes and reduces

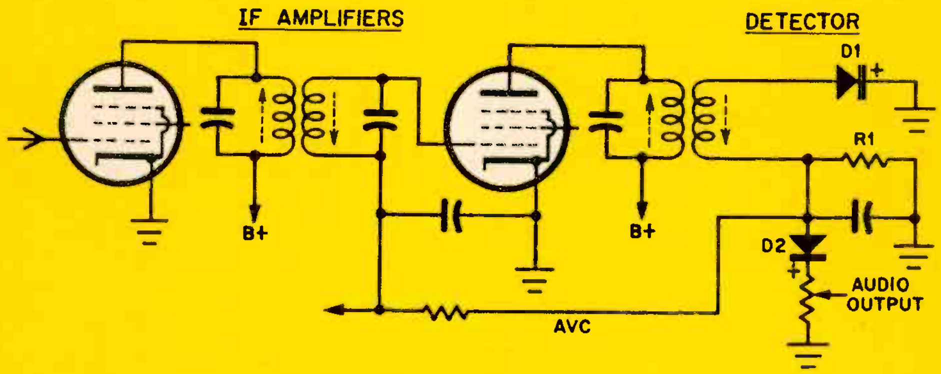


Fig. 4. IF amplifier and detector stage showing AVC and noise limiter circuit. Diodes D1 and D2 may be crystal types or diode elements in a vacuum tube. See text for noise limiter theory.

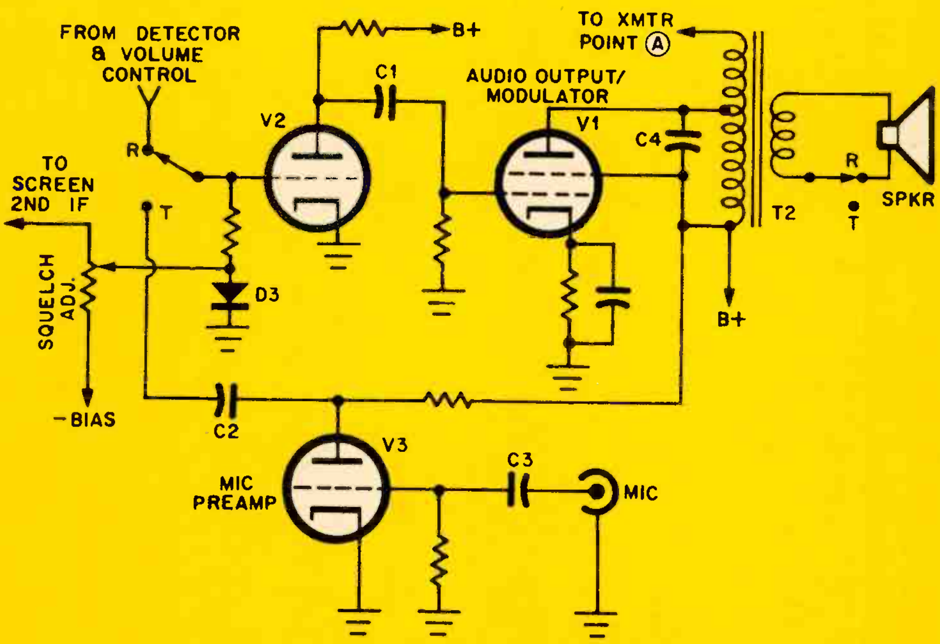


Fig. 5. Complexity of audio output stage in transceiver is due to its dual purpose. Transformer T2 serves both as the audio output in receive position and for modulation in transmit position.

gain on strong signals. This cuts down blasting and overloading.

The signal next encounters noise limiter D2 in Fig. 4. Normal signal levels have little difficulty passing through D2. However, the voltages on D2 are so balanced that any signal above a certain level is clipped and noise is thereby reduced. Output of the noise limiter is fed through the volume control to the audio amplifier.

Figure 5 shows one of the many squelch circuits in common use. Almost all of them operate by turning off the first audio tube in the absence of a received signal. The AVC line or the screen voltage on the last IF amplifier tube (both of which respond to the RF strength of the received signal) is used as a source of the shut-off voltage. The squelch adjust pot in Fig. 5 is connected between a source of positive voltage (the screen grid) and a negative bias supply. In practice, the pot is set so that the negative bias during no-signal conditions is high enough to cut off amplifier tube V2. When a strong signal comes in the screen voltage of the IF tube rises and, therefore, applies more positive voltage to its end of the pot. The voltage at the wiper arm of the pot goes less negative, the tube turns on and a signal is heard. Diode D3 serves only to keep the grid from going positive (which would distort the audio signal) by grounding out any positive voltage that may appear on the wiper arm. Otherwise the grid of V2 sees approximately zero volts bias on strong signals and a high negative bias in the absence of a signal.

The Transmitter

A logical place to start here is at the crystal oscillator, shown in Fig. 6. The crystal circuit generates the RF energy which is fed to the RF amplifier. A 27-mc signal at output coil L1 is coupled via C1 to the RF output amplifier for RF amplification to the 5-watt level.

For the origin of the modulation we'll have to refer back to Fig. 5. Modulation energy begins at the microphone. After the mike preamp, the audio travels through the same audio stages used earlier by the receiver. However, at the final audio amplifier tube the signal does *not* feed the speaker but instead it ultimately reaches the bottom end of the RF output amplifier coil (Fig. 6). The audio signal adds to and subtracts from the B+ voltage at the plate and screen of the RF amplifier tube and thereby modulates the RF energy that is present. The RF at the plate of the RF amplifier (whether modulated or not) is transferred to the pi-type output network.

Thus we have an overall view of the circuits. Variation in actual units is mostly in the number of stages, switching arrangement and choice of IF frequencies. You can analyze any transceiver if you know basic theory.

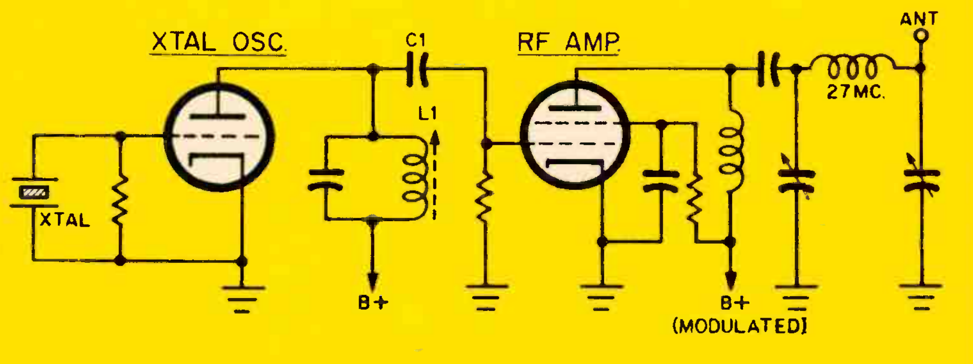
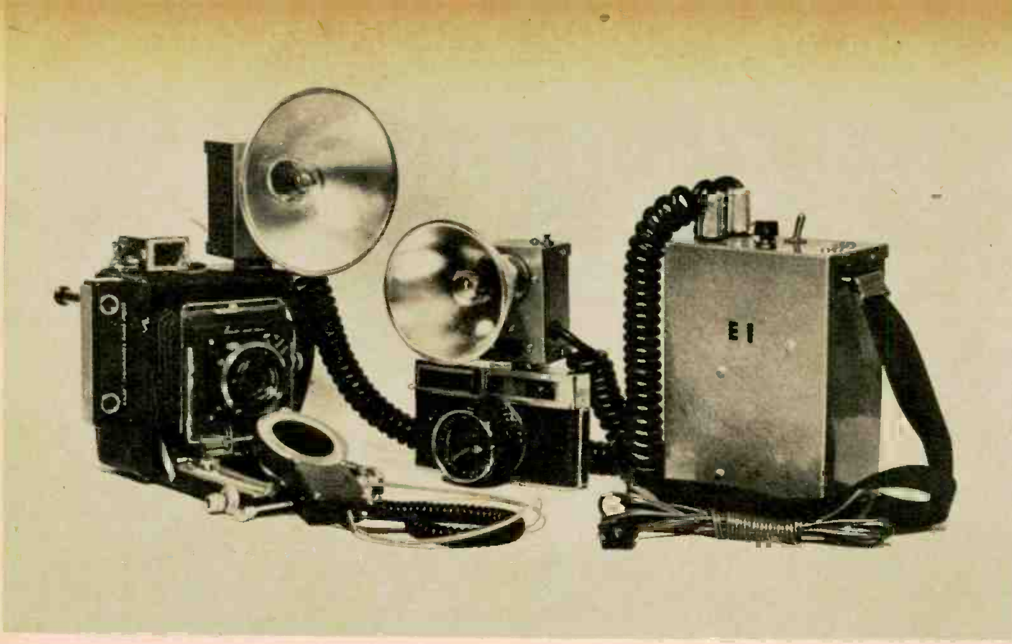


Fig. 6. Note comparative simplicity of transmitter section. The crystal oscillator provides the 27-mc RF signal which is fed to the RF amplifier. Modulation is applied to plate of RF amp.



the EI SUPER-STROBE

. . . makes flashbulbs obsolete, simplifies color film choice, and equips you for high-speed photography.

By Herb Friedman, W2ZLF

IT ALWAYS happens! Just after the party starts you get out the camera for a few shots when you remember it's still loaded with outdoor color film. But that doesn't matter after you find there are no more flashbulbs. Now you realize how much easier life would be with an electronic flash or strobe.

Advertising claims notwithstanding, a strobe usually is more expensive than the flashbulbs you'd use over a period of years . . . but it has other advantages. The shorter flash duration enables you to freeze extremely fast action. The color temperature is equal to daylight, simplifying color film choice, and you won't keep running out of bulbs.

EI's Super-Strobe costs about $45 and has flexibility to satisfy almost any lighting need. Many commercial strobes in the medium-price range have only a single lamphead with a fixed coverage angle. If you want to broaden the lighting area, you're stuck. But with the Super-Strobe the flashtubes and reflectors are plug-in: you can use a bare bulb, narrow-, medium-, or wide-angle reflectors, or even a ringlight for shadowless close-up work. There is a socket for an extension sidelight which can be triggered from the main lamphead.

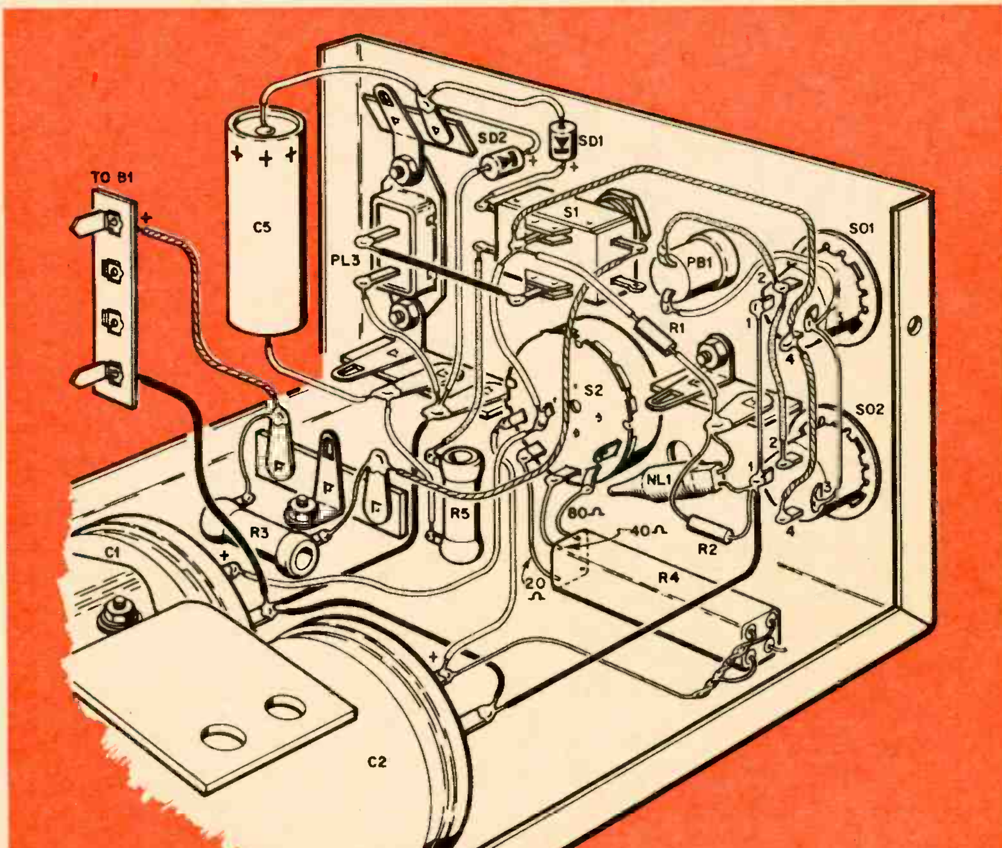
If two flashtubes and reflectors aren't enough, you can add a third or even a fourth. A redi-light (to indicate you can shoot) and an

PARTS LIST

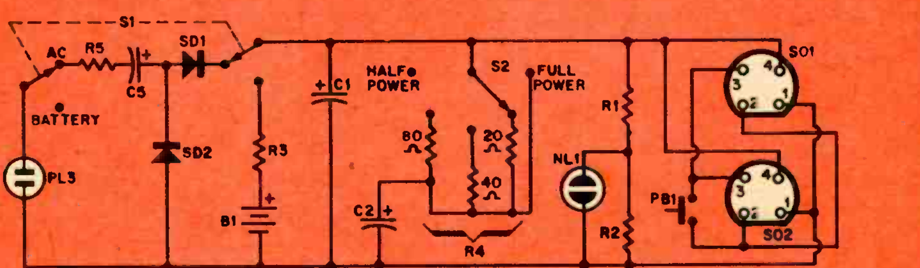
Resistors: ½-watt, 10% unless otherwise indicated
R1,R9—2.2 megohms
R2,R10—1.5 megohms
R3—1,000 ohms, 5 watts
R4—Multi-range resistor, IRC Type MR2 (see text)
R5—500 ohms, 5 watts
R6,R8—1 megohm
R7—4.7 megohms

Capacitors:
C1,C2—1,100 mf @ 300 V (Lafayette F-502, $9.95 ea.)
C3,C4—.25 mf @ 400 V
C5—8 mf @ 250 V

S1—DPDT toggle switch
S2—SP5T rotary switch (Mallory 3215J)
PB1,PB2—Miniature SPST push-button switch (Lafayette MS-449)
SO1,SO2—4-prong socket (Amphenol 78-S4S)
SO3,SO4—4-prong tube socket
SO5—AC socket
PL1,PL2—4-prong plug (Amphenol 91-MPM4L)
PL3—TV AC connector
NL1,NL2—NE1 neon lamp
B1—240-V battery (Lafayette BA-13 or equiv.)
SD1,SD2—750 ma, 400 PIV silicon diode (Lafayette SP-196 or equiv.)
Misc. — Miniboxes (Premier PMC-1008 and PMC-1001); terminal strips; 4-conductor coiled power cord (Alpha Wire 682/2); Ringlight (Lafayette S-501)



Power pack. Battery connector is made by filing sharp points on outer lugs of a terminal strip.



BIG EAR

By John Potter Shields

You, too, can be a Private Ear

. . . with our Electronic Eavesdropper

THOUGH it isn't likely that EI's readers want to take up international (or domestic) spying, our electronic eavesdropper is the type of equipment used in the trenchcoat-and-dagger trade. The Big Ear, as our staff has dubbed it, uses a combination of focused sound pickup and signal amplification which has the effect of transporting a listener to a distant point. Any sound in the area—whether a conversation or a bird singing—then comes to the ears of the listener as if he were right there.

The Big Ear does have some serious and entertaining uses, in addition to the questionable one of permitting you to eavesdrop on your neighbors while they're having a row in the backyard. Audubon groups and others interested in the sounds emanating from birds and other animals and insects will find the Big Ear especially useful. Its output can be fed into a tape recorder, preserving a bird's song or a cricket's chirp for future study.

The Big Ear's directional abilities permit you to locate the exact source of a distant sound, and its sensitivity, in effect, extends the hearing of a lifeguard or searcher, making audible a weak and distant voice. In the category of entertainment, the Big Ear simply is an interesting project for the experimenter and the possibilities it offers for family fun are unlimited. Many applications become obvious, once you've built the device.

The Big Ear is portable, with the entire device, including amplifier and battery, being small enough to carry around in your hands. Basically, it consists of a pickup microphone (actually a speaker) mounted in the center of a reflector. The reflector concentrates the received sound and focuses it on the mike, whose output is applied to a high-gain audio amplifier feeding a pair of headphones. Alternatively, the output may be fed to the input of a tape recorder. The reflector and mike assembly may be mounted on a camera tripod, if desired, so the unit can be swiveled to pinpoint a sound source.

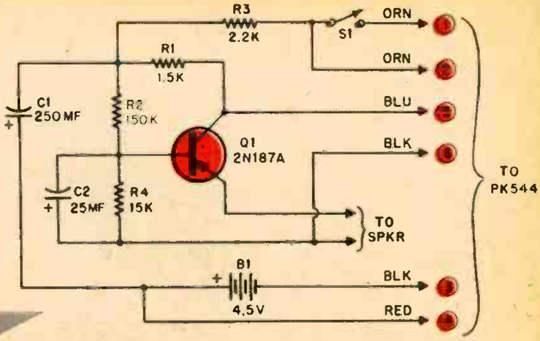
Construction. The Big Ear's amplifier is divided into a preamp and main amplifier. The preamp matches the pickup speaker's low-impedance voice coil to the main amplifier, as well as providing a modest amount of amplification. The preamp is built on a 1½x2-inch piece of perforated phenolic board. A 2N107, 2N109 or any general-purpose small-signal audio PNP transistor may be substituted for the 2N187A (Q1).

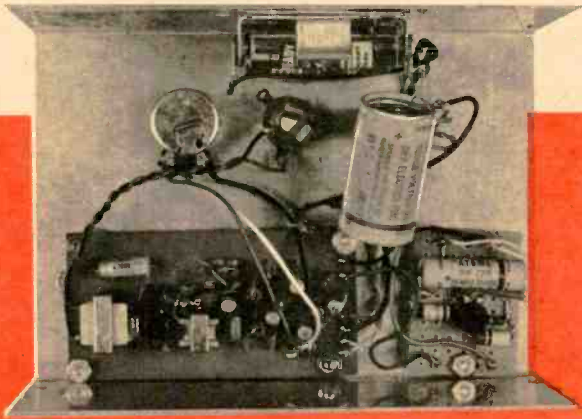
If you do make a substitution, choose a value of R2 which provides maximum signal amplification.

The main amplifier is a preassembled five-transistor unit. While it is intended

Only preamp appears in schematic, main amp is prefab. Color code and numbers show tiepoints.

Parts in wiring guide not shown in original positions. Follow photograph for actual placement.





PARTS LIST

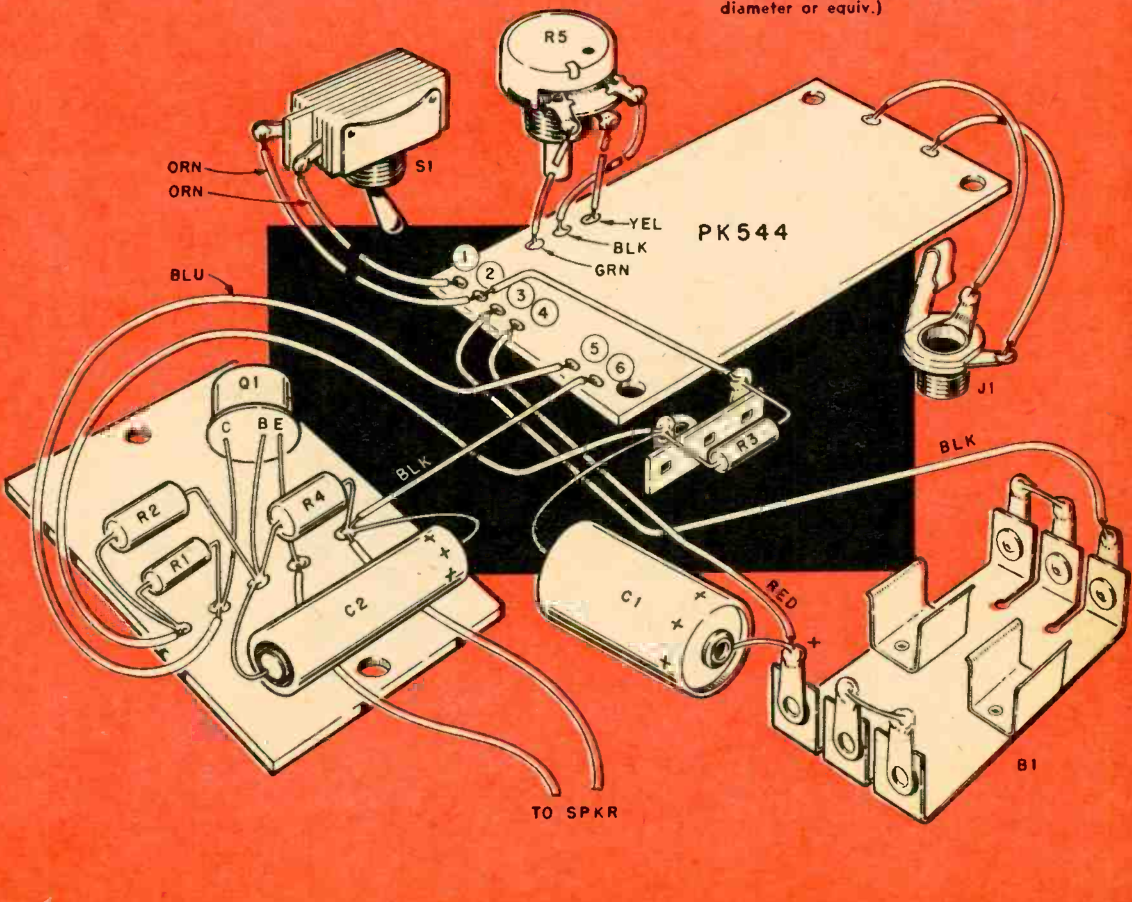
Resistors: ½-watt, 20% unless otherwise indicated

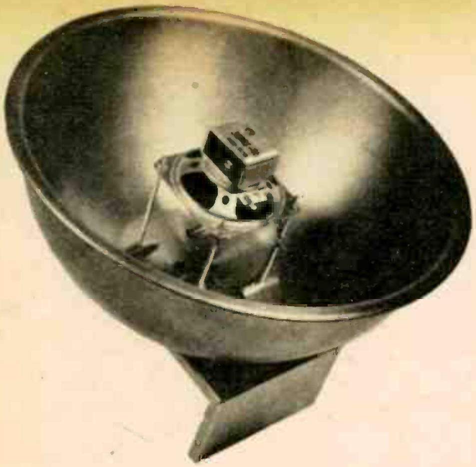
R1—1,500 ohms
R2—150,000 ohms
R3—2,200 ohms
R4—15,000 ohms
R5—10,000-ohm potentiometer

Capacitors: 15-volt, electrolytic

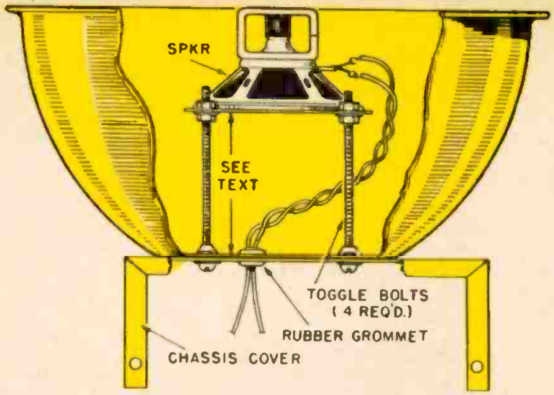
C1—250 mf
C2—25 mf

Q1—2N187A transistor
B1—4.5-V battery (3 size AA cells)
J1—Phone jack
S1—SPST toggle switch
SPKR—45-ohm speaker, 3"
Misc.—Preassembled amplifier (Lafayette PK-544); 2-lug terminal strip; aluminum case 4¾"x 3"x7"; four 6/32 togg e bolts approx. 4" long; perforated pherolic board 1½"x2"; reflector (stainless steel bowl, approx. 12" diameter or equiv.)





Speaker is mounted on 4 toggle bolts. Note that paper cone faces toward the inside of the reflector.



SPEAKER MOUNTING DETAIL

Before speaker is finally tightened in place, adjust its mounting position, as described in text.

to be operated from a miniature 9-volt battery, three penlite cells (4.5 volts) provide a much lower noise level and longer battery life. A low-noise amplifier is important when you are trying to pick up faint sounds.

Both the preamp and main amplifier are mounted on ¼-inch insulated spacers so their underside wiring will not short out to the metal case.

The 45-ohm speaker is a standard unit available at most electronic parts distributors, such as Olson, Lafayette, Allied, etc. However a 3.2- or 8-ohm speaker can be substituted for the 45-ohm unit with a small loss in sensitivity.

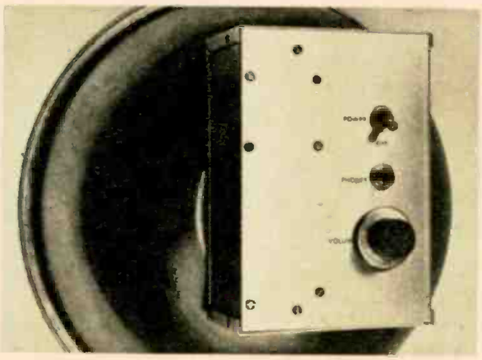
The reflector used by the author is a stainless-steel mixing bowl. Almost any type of large wooden, plastic or metal bowl is satisfactory. The larger the bowl, the greater will be the sensitivity and bass response.

The pickup speaker is mounted in the reflector with four 6/32 toggle bolts, available at hardware stores.

The bowl functions as a parabolic reflector. In our application, distant sounds are focused at a spot in the bowl determined by its curve. For optimum results the speaker-microphone should be adjusted by moving it back and forth until the point of optimum focus is found. This can be done best by aiming the reflector at a continuous sound source (such as a playing radio) and determining at what distance from the bowl's center optimum pickup is attained. If sufficiently long toggle bolts are not available to mount the speaker at the optimum focus point, you can use thin threaded rod instead.

Note that the same bolts mount both Minibox and speaker to the reflector. The best size for the reflector depends on the application of the unit. As the diameter is increased, sensitivity and low-frequency response improve. The 12-inch reflector shown here is fine for picking up the high-frequency tones of bird calls. It also performs well on the human voice whose important tones lie at the higher freqencies.

Good low-frequency response, useful for hearing low-pitch animal sounds, requires a reflector about two or three times larger in diameter.



Rear-panel operating controls: power switch, S1 (top); phone jack, J1 (middle); and control R5.

PEAKING HEADPHONES for CW

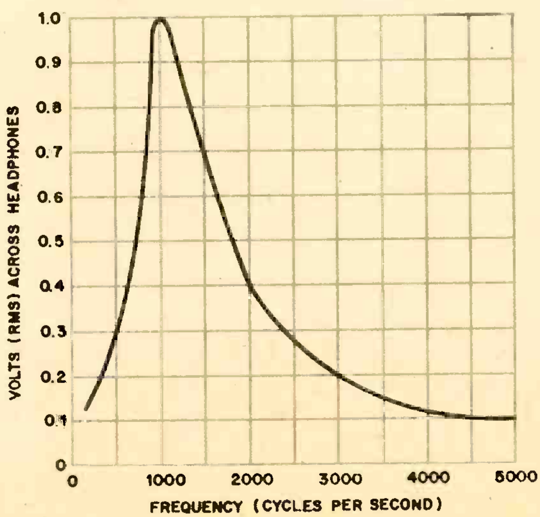
OF THE MANY schemes used to peak the audio output of a receiver for increased CW selectivity, one which usually gets overlooked is the simple expedient of tuning the headphones.

Since magnetic headphones have inductance, it's easy to tune them with a parallel capacitor. The secret is to include a series resistor (R1) to decouple the output of the receiver. The higher the value of R1, the sharper the resonant peak; lower resistance flattens it.

My Trimm 2,000-ohm headphones were tuned to 1,000 cycles with a .008 mf capacitor (a .005 mf and a .003 mf, 5% or 10% mica, connected in parallel). This value was determined experimentally with a capacitor decade box adjusted to give the 1,000-cycle peak response shown in the graph. The lower the capacitance, the higher the frequency of the peak and vice versa.

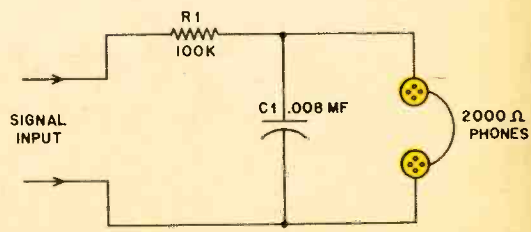
This peaking circuit works best with receivers having the usual capacitor or transformer-coupled headphone output. In receivers where the headphones are plugged directly in series with a tube plate, resistor R1 will reduce the plate voltage considerably. In that case, connect a 2,000-ohm, ½-watt resistor across the headphone jack in the receiver.

—*Rufus Turner, K6AI*



Graph at left indicates the degree of frequency peaking that may be obtained by proper selection of capacitor C1. BFO control should be adjusted to peak the CW signal at the same frequency.

Components R1 and C1 may be installed in phone plug shell. R1 isolates the receiver's low impedance output. C1 becomes part of an L/C peaking circuit; the phone inductance supplies L.



THOSE 45 LPs

By John Milder

High-speed stereo has rave reviews and wide publicity, but will it last?

EARLY LAST FALL an excited young man burst into EI's exhibition room at the New York Hi-Fi Show. "I hear," he blurted out, "that the next big thing in hi-fi will be 45-rpm stereo. Is it true?"

"It might be true," we told him, "and then again it might not be. Come back in a year or so and we can be more definite."

The important fact right now is that the 45-rpm speed, supposedly eliminated in the great hi-fi Speed Trials of more than a decade ago, is back in the race as a vehicle for serious music. The reason lies with two small record companies which have simultaneously come up with the idea of making a large-size 45—a standard 12-inch long-playing record.

The first 45 stereo LP's to be released have caused a stir in hi-fi circles, particularly among buffs with top-quality stereo systems. They have received bundles of publicity and the record critics (including EI's Warren DeMotte) have given them unqualified rave reviews, especially the discs put out by the Connoisseur Society. But whether the 45 LP is here to stay or just a flash in the hi-fi pan isn't yet clear.

The 45-rpm speed has never been dead. But it has remained the vehicle for pop singles by Elvis and Fabian and the other teen-age heroes. It *has* been dead so far as classical music is concerned. Its short playing time was the fatal flaw, since the 33⅓-rpm record could handle the same musical material without annoying interruptions.

Back in 1949, when the 7-inch 45 made its appearance to battle the equally-new 33, the only listeners who considered it a serious rival did so on the basis of sound. Neither competitor offered anything approaching today's sound quality, but the 45 sounded *fairly* good, while the 33 was plain atrocious. It didn't take long, of course, for the 33 to improve.

Now the 45 has come back to offer some advantages over the 33. The 33's natural limit on high-frequency response on its inner grooves (*every* record has such a limit) forces recording companies to use a varying amount of pre-emphasis on the highs, in addition to normal RIAA equalization. The combination sometimes produces a nerve-jangling peak in the highs when the arm nears the spindle. The 45 LP

requires no pre-emphasis because on its inside grooves it has almost twice the undoctored high-frequency potential of the standard LP.

But more important for the 45 is the open and transparent quality of its sound—due largely to the extra room provided for engraving music in its grooves. Put another way, the sound contained in one inch of a 45's groove must be crammed into 33/45ths of an inch on the 33 disc. A 45 plays about 23 minutes per side, fully as long as the average 33.

The better quality of sound you get on a 45 is apparent on a wide range (price-wise) of stereo equipment. The question is whether enough hi-fi record fans will value the increase in quality enough to become buyers.

The two current 45-LP producers are New York firms, the Connoisseur Society and Quarante-Cinq (that's "45" in French) Records. All together, they have released nine albums. The Quarante-Cinq discs are priced at $5.95, the Connoisseurs at $6.95, altogether discounting is likely in most areas. The standard LP lists at $5.98.

Connoisseur Society releases:

Flute Concertos of 18th Century Paris
Boismortier: Three Concertos for Five Solo Flutes, Op. 15, Nos. 1,2,3
Corrette: Concerto Comiques, Op. 8, Nos. 3,4,6
Rampal, Baron, Bennett, L. Schaefer, Robison, flutists — CS-362

Khan: Raga-Chandranandan, Raga-Gauri Manjari
Khan, Misra, Sinha — CS-462

Beethoven: Sonata in F Minor, Op. 57 (appassionata)
Mozart: Sonata in C Minor, K. 457
Moravec, pianist — CS-562

Franck: Prelude, Chorale, Fugue
Chopin: Scherzo No. 1 in B Minor
Ballade No. 3 in A Flat Major
Moravec, pianist — CS-662

Quarante-Cinq releases:

Chabrier: Fete Polonaise, etc.
Adam: Ouverture Si J'etais Roi
Weber: Invitation a la Danse
Leconte, Orch. Pasdeloup
Derveaux, Orch. Concerts Colonne — 45001

Bravo Toro!
Valdez, Banda de Corrida de Cadiz — 45002

Strauss: Till Eulenspiegel, Op. 28
Don Juan, Op. 20
Ackermann, Radio Frankfurt Sym. Orch. — 45003

Stravinsky: The Firebird
De Falla: El Amor Brumo
Goehr, Netherlands Phil. Orch. — 45004

Tchaikovsky: Sleeping Beauty Ballet Suite
Swan Lake Ballet Suite
Goehr, Rome Opera Orch. — 45005

CB CORNER

BY LEN BUCKWALTER K6BA4480

The FCC's Bombshell

ACTION on the FCC proposals for revising Part 19 was postponed early in the year to permit more individuals and organizations to file comments, but long before that it was evident the Commission had dropped a bombshell in the laps of CBers and manufacturers. And while the Commissioners—seven good men and true—sat contemplating the fate of the Citizens Radio Service, shrill cries of anguish rang out, along with some rumblings of support. The docket in question, you no doubt know, contained some stiff new regulations. Most significant was a section setting aside channels 12, 13, 14, 15 and 23 for contacts between stations of different call signs. The rest would be restricted to calls between units of the same station.

Some disagreement showed up in comments by manufacturers about the proposals. The group naturally is sensitive about any new rules which would affect equipment sales. For these men, a clamp-down on hobby-type CB activities might discourage potential buyers.

Market threats notwithstanding, ECI president Peter Robins went on record in agreement with the proposals. He felt the FCC should exercise needed control. Robins pointed out, however, that rules are one thing and enforcement another, suspecting that outlaw CBers would continue to ignore rules in view of the Commission's demonstrated inability to track down every violation.

Gar Greene, president of Browning Labs, expressed a contrary view. He said CB radio has become a "positive force in the country." Rural areas in particular, Greene opined, have been drawn together by a communications link not provided conveniently by other means. He also cited cases of police and fire departments utilizing CB as an adjunct to normal equipment. Thus, argued Greene, the FCC should encourage, rather than restrict, the band.

In support was Sonar's executive sales manager, Jim Liebman. He saw the new rules as a means of dividing business and personal users. In the past, Liebman felt, a conflict existed between the two activities.

As a rule, CB kit manufacturers were singing the blues, feeling that a large fraction of their customers are personal users. Businesses, they felt almost to a man, usually buy ready-made units and have them installed as well.

Individual CBers also were divided for and against. Not a few predicted trouble for the medium. Others saw the rules mainly as undercutting operators of the hobby type.

But no amount of teeth-gnashing can change such proposals. Only logical arguments for or against hold water with the Commission. You might think Washington was hit by a whirlwind as a result of its bombshell. Not so. Ivan H. Loucks, CB's head man at the FCC, said a lot of letters were received, but most were of no value because they said only that the writer was for and against. Mr. Loucks expressed disappointment that more did not contain constructive comments worthy of consideration.

Regardless of the outcome, the law-abiding Citizens Band licensee will be little affected by the Part 19 changes. The frivolous operator, however, is in for trouble.

CB

Jack S. Watts, proprietor of our Prize CB Shack, runs a base station and one mobile unit at 18B3278 in Griffith, Ind. Both units are Heath GW-10's and he uses a GC heavy-duty ground-plane antenna. Other equipment includes a signal generator, tube and capacitor checkers, VTVM, signal tracer and R-100 receiver, along with a Johnson 6 and 2 meter converter. He's studying for an amateur license. Jack is a machinist.

PRIZE SHACKS

YOU CAN WIN $20 with a picture of your ham, CB or SWL shack! Just send the photo, along with a list of your equipment, to EI Prize Shacks, 67 West 44th St., New York 36, N. Y. We prefer 8x10-inch glossy prints. Negatives should be available if you send a snapshot. Color pictures cannot be reproduced. Pack your picture well to prevent damage in the mails, and be sure to put your name and address on the back of each print. Enclose a note describing your activities in SWL, CB or ham radio. Unused pictures are returned.

HAM

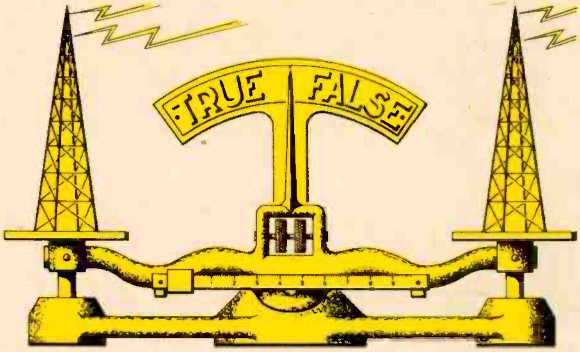
First YL Prize Shack winner is Leslie Johnson, WA4EEZ, of St. Petersburg, Fla. Leslie works CW on 40 and 15 meters, and phone and CW on 6 and 2. She sports no less than four antennas. In the shack are a Heath Twoer, Clegg 99er, VFO, Heath HX-11, Globe Hi-Bander and NC-57, NC-300 receivers. She belongs to six ham groups.

SWL

Ken Greenberg's SWL shack in Chicago is a convenient table loaded with equipment. On it are Heath DF-2, National NC-125, Monitoradio DR-200 and Gonset 3156-B receivers, plus an RME preselector and a Bud crystal calibrator. Ken uses a 50-ft. long-wire and two coax antennas. He teaches, and has been an SWL the last 15 years.

SHORT WAVE FRAUD FINDER

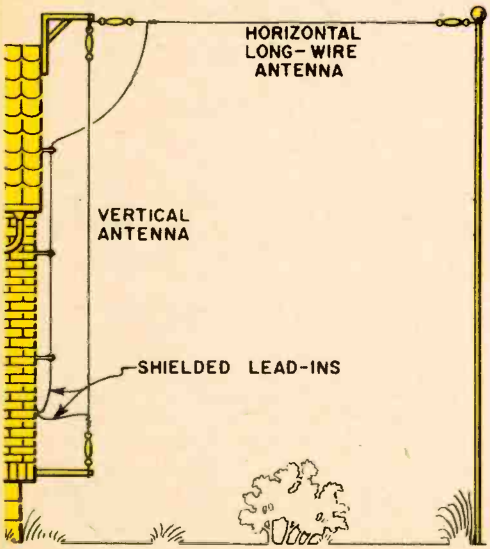
By C. M. Stanbury II



Is that station really where he says he is? Now you can be sure!

DOES Radio Tirana's North American service really come from Albania? Or from a transmitter in buddy-buddy Red China? Is Radio Americas truly—as has been rumored—on Swan Island?

Our Short-Wave Fraud-Finder will give you answers to these and similar puzzles. It's nothing more than one horizontal and one vertical antenna, the first being horizontally polarized, the second vertically polarized. Lead-ins from each must be fully shielded. A receiver with S-meter and a switch permitting you to use the antennas alternately completes the setup. The Fraud-Finder, producing relative S-meter readings, tells you whether two short-wave stations are or are not in the same area.

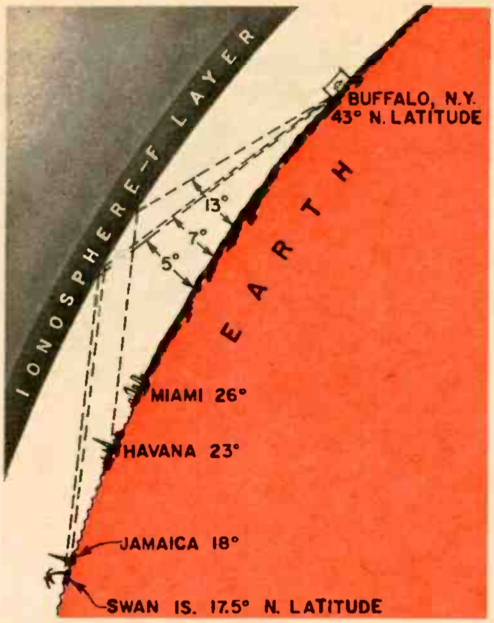


Fraud-Finder has but two components: horizontal and vertical antennas having shielded lead-ins.

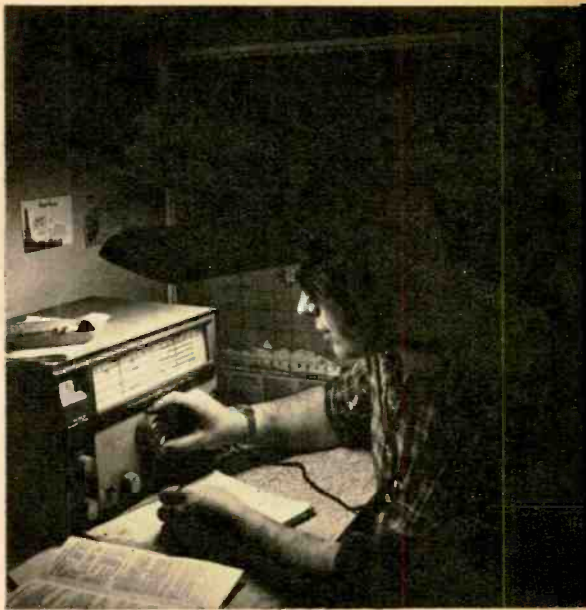
In its journey, any radio skywave is acted upon by the ionosphere and by earth effects. And its apparent strength depends partly on whether your antenna is polarized in the same plane as the signal. A horizontal signal might read S-9 with a horizontal antenna but only S-7 with a vertical, since a horizontal signal into a vertical antenna creates an attenuating condition known as *cross* polarization.

The important point is this: *any* signal from one area, regardless of power, skips off the same ionospheric layer *and* is troubled by the same ground effects *and* meets the same condition of *like* or *cross* polarization when you pick it up on first one antenna and then the other. If R. Peking shows a drop of one S unit when you switch from horizontal to vertical, *every other station in that area will show a similar drop between antennas.* Let's say that in this hypothetical check a station near Albania shows a drop in S-meter readings between antennas of two units. Then all its neighbors will show a two-unit drop. If you find Tirana showing a drop of one unit, you have a right to be suspicious. The relative figures indicate Tirana's signals are coming from *some other area.*

Readings must be taken at approximately the same time (the ionosphere changes fast) and signals must be within 5 per cent of each other. When considered in terms of frequency. Two



Angle of radiation of signals from Cuba, Jamaica, Swan Island differ up to 8 degrees at Buffalo.



Determining whether a station is telling truth can be a fascinating project for dedicated DXer.

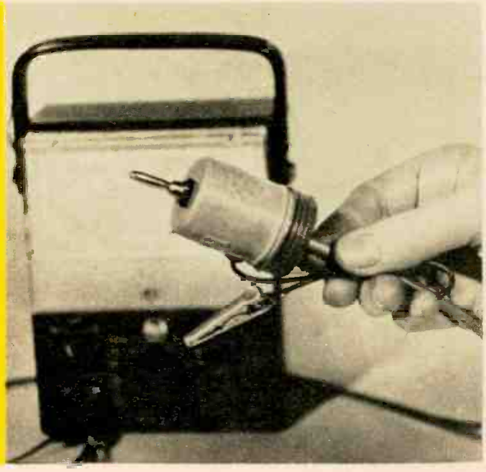
stations should show a difference in S-meter drops of at least one unit (e.g., station A drops 3 units, station B drops 1 unit—difference: 2 units) before readings can be counted significant.

Our chart and cutaway drawing of the earth show a case I got myself involved in. If reception is via the upper layer of the ionosphere, signals from Cuba come into Buffalo (I'm near there) at about 13 degrees. Those from Swan and Jamaica come in at a lower angle with different ground effects. Tests I ran on several evenings (see chart) indicated R. Americas was *not* on Swan Island. Jamaica, near Swan in latitude, showed drops of 1.5 to 2 S units, while RA had half-unit drops, as did R. Havana. The chart suggests RA is much nearer Cuba than it is to Swan, but the Fraud-Finder tells you merely that two stations are or are not in the same area—not where either may be located.

FRAUD-FINDER AT WORK

DATE	TIME (EST)	FREQUENCY (KC)	STATION	S-METER READINGS Horizontal Ant.	Vertical Ant.	DIFFERENCE
1-28-62	1929	6000	R. Americas	8.5	8	.5
	1930	5990	R. Havana	9	8.5	.5
	1931	5920	YNCT, Nicaragua	6	4.5	1.5
1-29-62	2034	6000	R. Americas	9	8.5	.5
	2035	5990	R. Havana	9	8.5	.5
	2036	5920	YNCT, Nicaragua	5.5	4	1.5
1-30-62	1959.5	6000	R. Americas	8.5	8	.5
	2000	5990	R. Havana	9	8.5	.5
	1958	5920	YNCT, Nicaragua	5	3	2
	1958.5	5920	C&W, Jamaica	5.5	4	1.5
2-1-62	2030	5997	R. Americas	7.5	7	.5
	2031	5990	R. Havana	9	8.5	.5
	2029	5920	C&W, Jamaica	6.5	4.5	2

RF BLOCKING PROBE for your VOM



MEASUREMENT of DC in circuits containing RF can be a problem for the CBer or experimenter. For example, a good indication of proper operation of a crystal oscillator is a high negative grid voltage. An attempt to measure this voltage with even a 20,000 ohms/volt VOM usually kills the oscillation. The answer is to provide a means for passing DC to the meter while blocking RF.

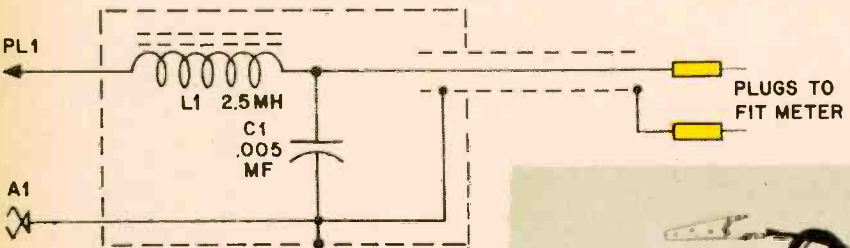
Our RF blocking probe does the job. RF choke L1 in the schematic below presents a high impedance to RF while its DC resistance is too low (about 8 ohms) to cause DC inaccuracy. The probe is built into a 35mm film can, which may be obtained from most photo shops. Probe tip PL1 is a banana plug which takes slip-on insulation-piercing tips, alligator clips or lugs.

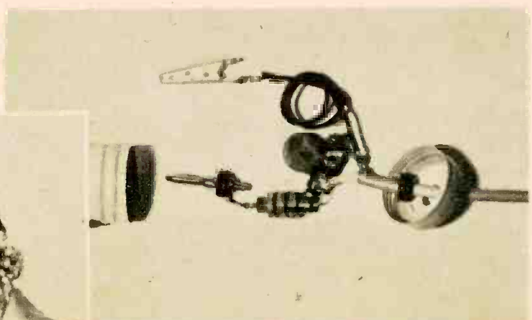
The shielded connecting lead connects to a one-lug terminal strip as shown in the photos. Before closing up the container, make certain L1 does not rest against the container's metal side and that PL1 is well insulated from the film can by shoulder washers.

If you desire to use the probe at frequencies below 3 mc, substitute a 50-mh choke for L1; change C1 to .02 mf.

The probe has no side effects when checking oscillator tubes or transistors. However, there is a slight loading effect when used on RF amplifier grids or plates that drive grids.

—*Herb Friedman*, W2ZLF





WAY-OUT MICROWAVES

By Ken Gilmore

You find those work-horses of radio in some mighty odd places!

OIL MEN in Montana had a problem. They'd struck black gold 3,500 feet down but, thick as tar, it couldn't be pumped to the surface.

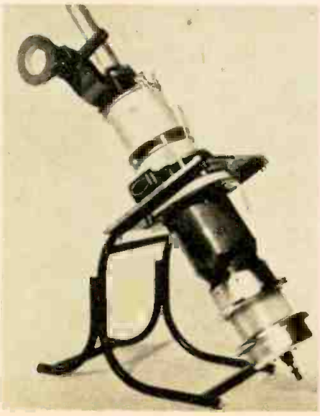
Raytheon engineers had an answer. They put a microwave generator in a capsule, lowered it into the well and turned it on. The rig sent 10,000 watts of microwave energy pulsing into the jellied oil and lifted its temperature 20 degrees. It flowed easily to the surface.

From deep in the earth to high in the ionosphere, you find microwaves in some strange places these days. They're best known as the work-horse waves of radio, of course, for they carry television programs around the country and the world, they carry your telephone conversations from point to point and they transmit data by the billions every minute. In the field of radar, microwaves sweep the sky to guard against an unseen enemy, guide friendly planes to a landing and help ships navigate. But in recent years researchers have discovered scores of ingenious new jobs for these versatile waves, many having nothing to do with communications.

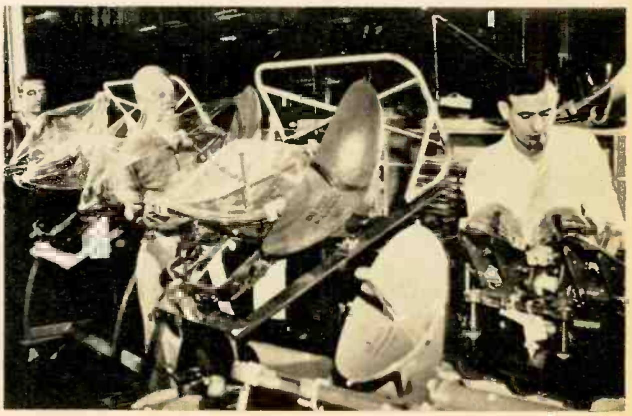
The exact boundaries of the microwave region of the electromagnetic spectrum have never been defined precisely but the term usually covers everything between conventional radio waves and infrared—from about 1,000 to 300,000 mc. *Micro* itself simply means small.

Microwaves don't have much in common with artillery shells but the two got together when munitions experts wanted to know the exact velocity of a projectile. The gadget they used is called a microwave velocity chronograph. You aim a microwave antenna up the side of a gun barrel and, when a shell is fired, some of the waves leaving the transmitter bounce off the projectile and return to the gun. Since the shell is moving, the reflected signal is doppler-shifted. A computer measures apparent difference in frequency between the

Klystron tube is a generator of microwaves; output is upper lt.



Making antennas for B-58 doppler microwave navigation system. The velocity chronograph (see text) rig is extremely accurate.



Bell Labs prober studies interaction of plasma and microwaves; plasma glows in bombarded tube.

outgoing and returning signals and figures the speed of the shell.

Those radar units used by police, by the way, are not really radar. They're velocity chronographs.

When fires swept through Southern California in 1961 the area was covered with smoke so thick that air-borne survey teams couldn't tell where fires were burning, where they weren't.

Scientists at the Space-General Corp. knew that all matter radiates small amounts of energy. Most of it is in the infrared region but some is in the form of weak microwaves. The hotter the object, the more energy it radiates. In the fire area smoke was so dense that infrared was cut off. The Space-General scientists reasoned that the weak microwaves should be getting through. They flew over with a super-sensitive microwave radiometer and were, indeed, able to chart hot spots on a map so firefighters could be directed to critical areas.

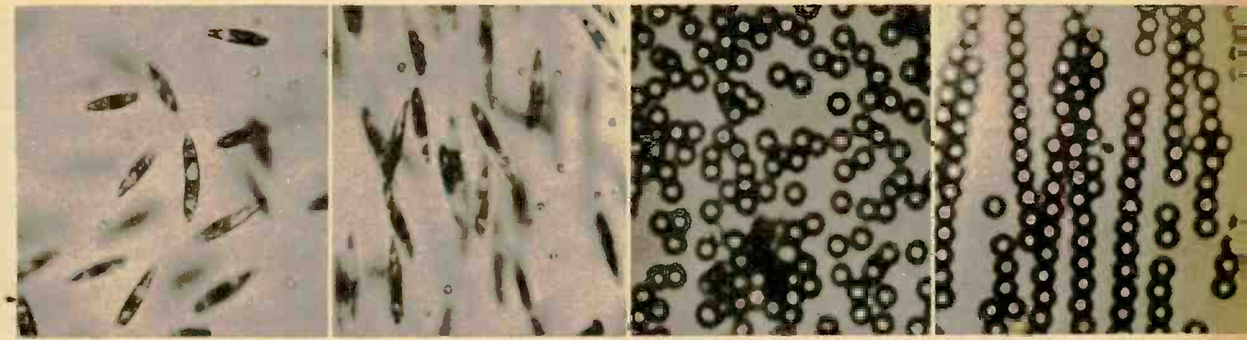
Microwave radiometers can be used to spot unusually cold hazards, too. The U.S. Coast Guard operates an International Ice Patrol, a task force of planes flying back and forth across the North Atlantic during iceberg season. They spot dangerous floes and warn ships of the locations. The big difficulty has been with growlers, small icebergs less than 40 feet across.

Icebergs are lousy radar targets. Since the surface usually is coated with water, it has about the same reflectivity as the sea and the growlers were impossible to spot. Fog precluded visual sightings. Two AC Spark Plug scientists thought, naturally, of microwaves. Since icebergs differ in temperature from the sea, to a microwave radiometer they might stand out like an overcoat at a nudist camp. They built the instrument, mounted it in a Coast Guard plane and took off. It tuned in the growlers as if they were transmitting towers.

Bendix scientists came up with something they call Microvision to help land planes in bad weather. The system consists of several microwave transmitters which shoot beams along an invisible pathway in the sky. These signals, picked up by the plane, go to a computer which plots position and calls for course corrections. The plane, in effect flies down a microwave highway to the airport.

The high frequency and short wavelength (.1 to 10 centimeters) of microwaves give them some unique properties. They act something like light waves, they can be focused and bent like light, and they bounce off small objects. Since dimensions are small, microwave equipment also is small (in the upper microwave regions 25 full-wave antennas would fit inside an inch.

Radaranges in restaurants, such as this, and in a few homes use microwaves to cook food quickly.



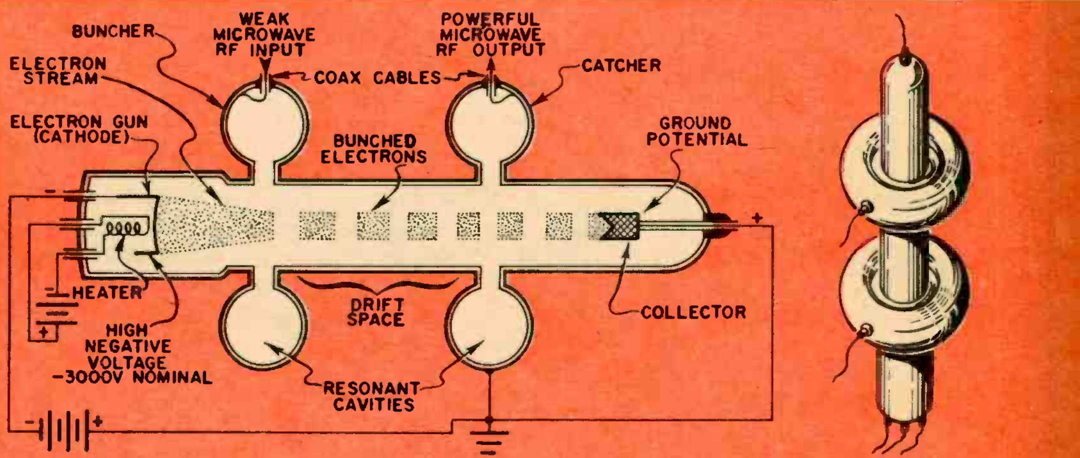
Microwaves have strange effects on microscopic objects, living and inanimate: aquatic creatures at far left swim at random until microwaves hit them, then all face in same direction (second photo). Plastic balls (third photo) measuring .001 millimeter form pearl chains (far right) under influence.

In our defense setup the anti-missile system locates an attacking missile with conventional radar and computes where the missile would be by the time a Nike could get there. Then it directs a microwave beam along the interception path and the anti-missile follows it to rendezvous.

Fishing fleets freeze their catches to preserve them on the long trip home. Back at the processing plant, the fish have to be thawed for packing. The thawing used to be done slowly and inefficiently with water, but now a trip through a microwave cabinet does the job in just 60 seconds.

Cooking with microwaves is, of course, no longer new. Hundreds of restaurants and institutional kitchens use "radar ranges" and even a few homes have them to bake potatoes in 2 minutes, cook lamb chops in 35 seconds and broil sirloin in a minute flat. The only trouble is the $1,000 price tag. But Raytheon engineers now hope for a $500 unit in a year.

Microwaves are used to cook people, too, though not quite so well done. Diathermy has long been used for deep heating of the muscles and other parts of



Gross plan view of microwave-generating klystron tube (at far right) makes it look like a pipe ringed by two tires. Diagram shows how a klystron bunches electrons with RF field (see text).

New techniques push usable frequencies beyond microwaves. Battleground radar unit above is using laser to operate in visible light range.

the body, but the machines always operated at low frequencies. In recent years, however, researchers have found that diathermic transmitters operating at 2,450 mc are often more effective. Some 16,000 of the new higher-frequency machines are in use.

Scientists have wondered for years whether microwaves could be used to treat diseases. They still don't know but Dr. J. H. Heller of the New England Institute for Medical Research has discovered an interesting phenomenon in the field. Microscopic creatures, he found, will align themselves with a microwave field (see photos). At some frequencies they get in line with the field, at other frequencies at right angles to it. Others have discovered further ways that living tissue reacts to microwave energy. But, so far, there are no practical applications.

Chemists have used microwaves to analyze unknown substances. Each substance absorbs energy at a characteristic frequency. By tuning a microwave transmitter, you soon can tell which frequencies are being absorbed and from that what substances are in your sample. Microwaves have been involved in experiments to sterilize dog food, make skinless frankfurters, cure rubber, dry lumber and soften plastic for extrusion, to name a few. The end is by no means in sight.

There is more than one way to generate microwaves but the most-used generator is the klystron tube. Used as an oscillator, the tube puts out a signal of the right frequency, but a weak one. Then an amplifier version of the same tube takes over and boosts the weakling to hundreds or thousands of watts of power.

Klystrons come in various configurations, but the form easiest to visualize is a pipe with two tires wrapped around it (see drawing). The chamber inside each tire opens on the inside of the pipe. At one end of the pipe is a cathode that spews out a stream of electrons, as in a normal vacuum tube. The electrons, accelerated to high speeds, represent a large amount of power. At the first (buncher) cavity, the electrons run into a microwave signal being fed in through a coaxial cable. The radio-frequency field causes the electrons to form in bunches, which drift on down the tube toward the second cavity and a collector, becoming more powerful as they go along. The collector is at ground potential but to the highly-negative electrons it represents a considerable positive charge which attracts them. As they pass the second (catcher) cavity the bunches of electrons induce amplified signals which are removed from the tube via a coupled output transmission line.

Though microwaves usually are thought of as new-fangled they're actually among the oldest radio signals known. When Hertz first proved in 1888 that electrical signals could be sent through space he did it with microwaves. His spark transmitter generated signals up to 1,000 mc. It wasn't until 30 years later that a microwave tube was invented—the magnetron, designed by A. W. Hull and used in thousands of World War II radar sets. The klystron, invented by the Varian brothers of California, came along in the early years of the war and has become the standard in the field.

One of the more exciting possibilities for microwaves in the future has to do with wireless transmission of power. A few years ago there was talk about a

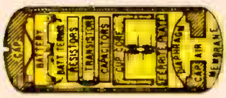
[*Continued on page* 109]

TUMNIKS for the TUMMY

A BIG PROBLEM for medical science is finding out what is going on in a patient's innards while he's alive and ticking. Watching Bufferin commercials is not too helpful, and personal observation is uncomfortable for both doctor and subject.

Latest tool in the field is a little FM transmitter in a plastic capsule. Gulped down by the patient, it beeps all the way through the gastrointestinal tract and, considering its signals, naturally has picked up the name of tumnik.

Best-known tumnik is one turned out by RCA for the Rockefeller Institute.



Its complete transmitter fits into a capsule 1 centimeter in diameter by 3 cm (about 1⅛ inches) in length. Our insert drawing shows it life size.

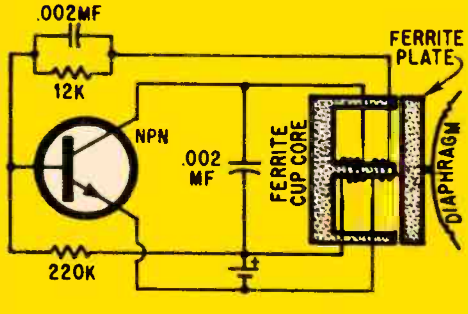
Inside the RCA-RI tumnik is a thimbleful of components (see drawing at top of page) that makes up an FM transmitter which senses pressure in the stomach and intestines and transmits the data to a receiver a few feet from the patient.

The one-transistor circuit, as shown in the schematic, is a simple oscillator. It has a small tickler coil (on the right) and a larger tuned coil wound on a ferrite cup core. The tuned coil represents the L (inductance) and a .002-mf capacitor is the C in a standard L-C circuit. The ferrite plate on the far right moves toward or away from the cup core according to pressure on the diaphragm. The plate's movements increase or decrease the inductance of the tuned coil, which in turn changes the resonance and frequency of the L-C circuit. Natural resonance is 900 kc. The system's frequency response is some 100 cycles per second, according to RCA.

As the muscles of the GI tract do their work, bringing more or less pressure on the diaphragm, the tumnik's signal slowly rises or falls. Using a modified AM broadcast-band radio, researchers pick up the weak FM signal and record it on a graph. By the time the pill has passed all the way through the body it has sent out a complete history of the muscular activity along its route.

The RCA-RI tumnik is powered by a tiny rechargeable battery. A smaller, revised version gets its power from several turns of wire wrapped around the patient's body. Shots of current in the wire induce sufficient power into the oscillator to start it operating. Between pulses, the L-C circuit keeps ringing, sending out damped waves which carry the pressure data. A second modified model indicates temperature in the GI tract.

A tumnik developed at Heidelberg University Children's Hospital is sensitive to chemical reactions on its surface and measures the alkalinity or acidity of the stomach. A child can swallow this tiny tumnik.—*Alex Dorozynski*



Tumnik's simple oscillator produces FM signal as ferrite plate moves in or out.

meet the audio TRANSFORMER

By Don Stoner, W6TNS

AUDIO TRANSFORMERS have the job of handling a wide range of frequencies without attenuation or distortion, while their cousin, the power transformer, operates on only one frequency—that of the power line. For this reason it is more difficult to make a good audio transformer than a good power transformer and the construction techniques used for one are not applicable to the other.

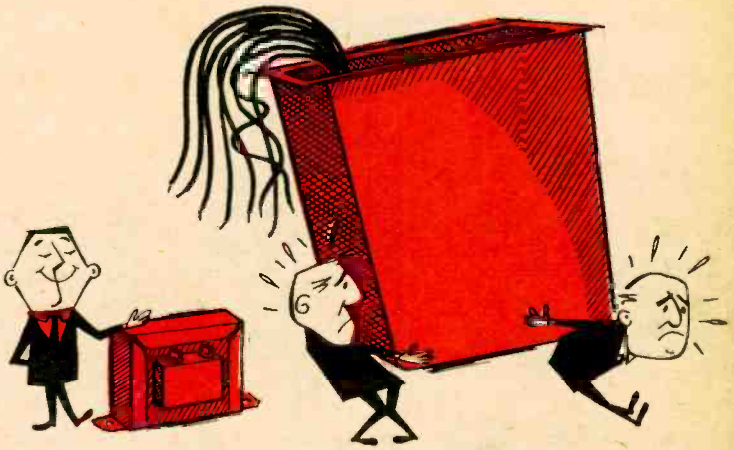
A quality audio transformer must handle extremely low frequencies, even those approaching DC. But we know a transformer can work only on alternating current. Obviously, then, its performance is going to fall off toward the bottom of the spectrum. When audio-frequency signals (20 to 20,000 cps) are applied to a transformer several unusual things happen.

Let's examine core losses first. Have you ever seen a power transformer designed for Canadian 25-cycle power? The core of the transformer is almost twice as large as its 60-cycle counterpart. So it is with audio transformers designed to work at 20 cycles and below. To minimize losses at low frequencies, the core must be large or the low-frequency response is degraded.

As in the power transformer, not all the lines of force sent out by the primary winding cut through the secondary winding. To the circuit in which the transformer is operating this *leakage flux* appears as a reactance (a resistance to alternating current) in series with both the primary and secondary. To make matters worse, the leakage reactance is inductive and, therefore, varies with frequency. As the applied frequency is increased, the reactance increases and the signal transferred from the primary (source) to the secondary (load) decreases. In addition, as the current in the winding increases, so does the leakage reactance.

And if this is not enough in the way of design problems, there is still another major trouble source. We know that capacity always exists between two adjacent conductors. Since a transformer is full of wire, it contains an infinite number of tiny capacitors between the winding layers.

When the input signal's frequency is raised, these built-in capacitors bypass energy from winding to winding. At the high-frequency end of the audio spectrum the transformer appears to have less than its actual number of turns and the frequency response falls off. Even with these obstacles, transformers for high-fidelity use have a flat response (within a db or so) from 20 cps to 20,000 cps. And the proper choice of amplifier circuitry with plenty of negative feedback can extend this range even farther.



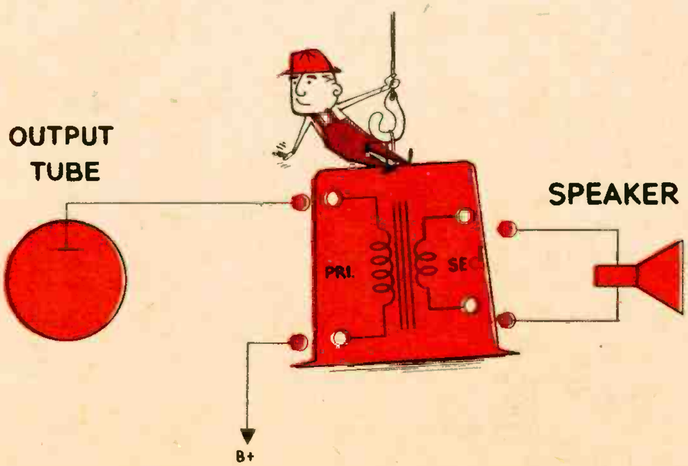
A quick way of judging quality is size, and the bigger the better.

A good audio output transformer has a large core. Inside the transformer you may find the windings are spaced apart and relatively heavy paper is used between layers to reduce capacity. Another trick is to space the primary and secondary to further improve the high-frequency response.

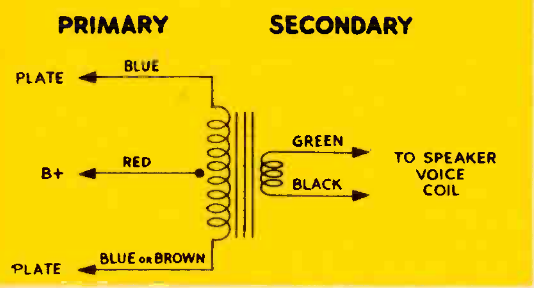
You won't find it stated in any formula, but you can almost always rate the performance of an output transformer by its weight and size. The larger the core and wire size, the better the low-freqeuncy response. Anything done to reduce the transformer's internal capacitance and, therefore, increase its high-frequency response will take up more room inside the transformer.

Impedance. You seldom see a speaker connected directly to a vacuum tube. Tubes, by their nature, require lots of voltage and small amounts of current. A speaker, on the other hand, requires considerable current but low voltage to activate its voice coil. The two are incompatible, for a tube is a high-impedance device (1,000 to 10,000 ohms), while a speaker is a low-impedance device (3.2 to 16 ohms). The purpose of the audio output transformer is to match the impedance of the tube to the speaker.

Primary purpose is to match impedance of output tube to speaker.



Do you know how to calculate impedance? It's just like Ohm's Law. Say you have a simple amplifier with a single 6V6 driving an 8-ohm speaker. Voltage and current measurements show that the plate voltage of the 6V6 is 315 volts and the plate current is 35 ma. The plate impedance (Z) of the tube is determined by dividing the current



Color coding of audio transformer leads has been standardized so save this for reference.

in amperes (I) into the voltage (E):

$$Z=E/I,\ Z=315/.035,\ Z=9{,}000 \text{ ohms}$$

The impedance of a tube (or transistor, for that matter) is calculated with *both* the voltage and current, as you can see from the formula. To prove the point, let's calculate the collector impedance of a transistor amplifier stage. Measurements show it has 9 volts on the collector and that it is drawing 1 ma. By converting ma to amperes, and substituting it in the above formula, you also get 9,000 ohms (9/.001). Even though the voltages and currents involved are widely different, the impedance is the same. From this formula you can see that if the voltage goes up and the current goes down, the impedance increases. If they both change proportionately and in the same direction, the impedance remains the same.

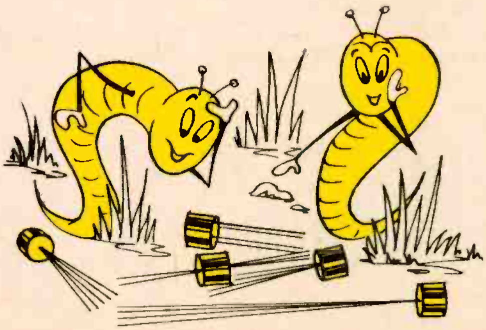
Impedance Matching. Let's see why impedance is so important. Unlike the relationship between turns ratios and voltage discussed in MEET THE POWER TRANSFORMER (November '62 EI), the impedance of a winding changes with the *square* of the ratio of the original number of turns to the new number of turns. For example, a transformer winding has 5,000 turns and a 10,000-ohm impedance. If the number of turns is doubled, the impedance will go up four times to 40,000 ohms. By the same token, if you use only half of a center-tapped 2,000-ohm winding the impedance will be 500 ohms (¼ the original impedance), not 1,000-ohms. This point confuses a lot of people. The required turns ratio in terms of the primary and secondary impedances is determined by this formula:

$$N=\sqrt{Zp/Zs}$$

where N is the turns ratio, Zp is the impedance of the primary and Zs is the impedance of the secondary. To see how this works, let's take a typical example. Assume an amplifier you are building requires a 5,000-ohm transformer load impedance and you plan to use it with an 8-ohm speaker. You will need a transformer which is capable of matching 5,000 ohms to 8 ohms. The formula goes as follows:

$$N=\sqrt{5000/8},\ N=\sqrt{625},\ N=25$$

The amplifier would require a transformer with a turns ratio of approximately 25-to-1 to take care of the proper impedance match. Naturally, the current-handling capacity of the primary (depending on the type of driving tube used) also would be a consideration. For example, such a transformer would have a primary consisting of many turns of fine wire, while the secondary would contain only a few turns of heavier wire. Even though the 9,000-ohm transistor transformer mentioned earlier would have the right impedance ratio, you couldn't use it with a 6V6 tube. Not only is the core too small, but the wire is too fine. The transistor draws only 1 ma, but the tube might draw up to 35 ma. With this overload, the primary would burn out immediately.



Some transformers designed for transistorized equipment aren't much larger than transistors.

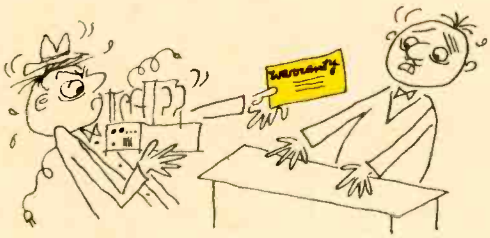
GOOD READING

By John Milder

HIGH FIDELITY SYSTEMS: A USER'S GUIDE. By Roy F. Allison. Acoustic Research, Cambridge, Mass. 70 pages. $1

REPRODUCTION OF SOUND. By Edgar Villchur. Acoustic Research. 93 pages. $2

Neither of these books (first in a proposed AR series) belongs in the usual manufacturer's-literature category for they contain no product propaganda.



All they offer is a wealth of information on high fidelity.

For anyone just getting acquainted with hi-fi, Roy Allison's book is excellent for avoiding confusion. It describes the workings of a hi-fi system, the installation, interconnection and matching of components, and the important considerations in choosing equipment. Illustrations are pertinent (the one we show, from the book, comes up in a discussion on a dealer's warranty responsibilities) and there are photographs that show how to enhance, rather than detract from a room's decor with your components. To my mind, this is the best basic book now available on high fidelity.

Edgar Villchur's book, aimed at the advanced audiophile, contains a detailed explanation of the process of sound reproduction and takes a look at the whole idea of high fidelity. From a chapter on the nature of sound, the author goes on to discuss the components of a modern record-playing system, their design, capabilities and limitations, and the standards by which they should be judged.

THE AGE OF ELECTRONICS. Edited by F. J. Overhage. McGraw-Hill, New York. 218 pages. $7.95

On its tenth anniversary, MIT's Lincoln Laboratory invited leaders in various areas of electronics to lecture on their specialties. As published in this volume, the Lincoln Lectures read like compelling mystery stories. With contributors like William Shockley, a Nobel Prize-winner for his work on transistor theory, and Charles H. Townes, who holds the fundamental patent on the maser, this volume is undeniably authoritative. But, more important, it reflects the excitement of the contributors with what they are doing and communicates a great deal of that excitement to the reader.

CB RADIO MOBILE HANDBOOK. By Jim Kyle. Horizons Publications, Oklahoma City. 113 pages. $2.95

By FCC definition at least, *all* class D CB stations are mobile—a fact that might make this book's title seem redundant. In practice, though, CBers tend to be more sedentary than mobile. This book is for the CBer who, for business or other reasons, is on the move with his rig, and it's meant to help him cope with some of the knotty problems of mobile reception and transmission.

SERVICING ELECTRONIC ORGANS. By Carl R. Pittman and Eugene J. Oliver. Howard Sams & The Bobbs-Merrill Co., New York & Indianapolis. 191 pages. $4.95

Unless what I've been seeing in friends' homes and small-town music stores is a mirage, the electronic organ is on the way to becoming a permanent fad. Someone stands to make a reasonable amount of money from servicing these gadgets, and it might as well be you. This book provides an excellent rundown on current organs and should arm you with enough information to contemplate a lucrative business.

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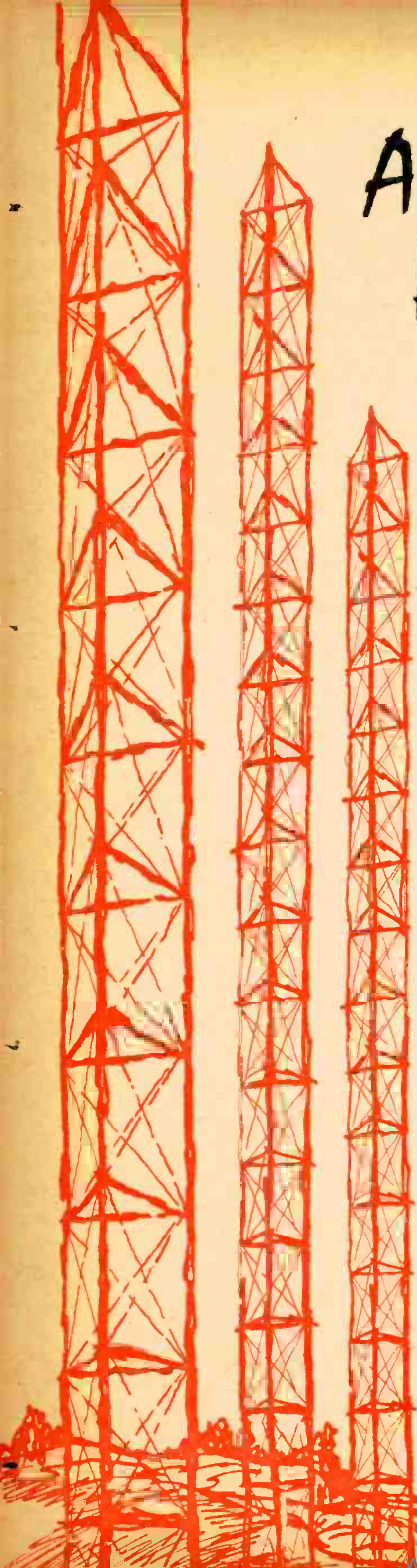


A Radio Propaganda Handbook

The fine art of influencing people and fighting wars with nothing but words.

By John Milder

FOR A BRIEF TIME in the autumn of 1956 Radio Free Hungary commanded attention everywhere and for most of us was the sole source of information on the Hungarian Revolution. Those who didn't listen directly heard RFH broadcasts translated on local news programs.

Toward the end, when Soviet tanks were rumbling in, RFH pricked the conscience of the free world by pleading for help while chronicling defeats. Everyone knew the West could not help the freedom-fighters but the pleas continued and, finally, as the station was going off the air it announced that American troops were on the way. The statement couldn't be true but its pathetic false hope moved Western listeners deeply.

What the listeners never realized was that Radio Free Hungary had been off the air several days before its supposedly final transmission. The moving pleas and that last announcement were products of Soviet propagandists. Broadcasting either from the recaptured station in Budapest or from a clandestine transmitter in the Soviet Union, their intent was to underline the feeling of futility in the West and to flaunt the fact that the United States would not aid the freedom-fighters. So skillful was the masquerade that Western intelligence agencies didn't realize for some time what had happened.

The RFH episode fits the cloak-and-dagger image most of us apply to the word *propaganda*. In one form or another, deception seems to be the main ingredient and to tag any statement as propaganda is to intimate that it's a lie. But is it? To think so is to underestimate the range and aims of propaganda activities around the world,

Ill-fated Hungarian Revolution is remembered graphically for scenes of vicious street fights and, later, Russian tanks. In this photo of October 28, 1956, when the freedom-fighters were succeeding, a Russian cannon is burning at left and another Red vehicle is afire in background. The scene is in Budapest. Less well known is radio propaganda war waged by the Russians, who identified themselves as Radio Free Hungary near the end of the revolt.

particularly on radio. Over the past 30 years radio has become the most important and most extensively used medium for propaganda.

No matter what form it takes, propaganda is an attempt to make some one else think the way you *want* him to. This goes for waging war, selling soapflakes or wooing young ladies. Often there is the further objective of making someone *act* the way you want him to. Obviously, we are all propagandists from birth.

Our focus here is the propaganda traffic between nations—the struggle for the minds of men that we've heard so much about in 17 years of Cold War. On an average day you can tune in hundreds of undisguised propaganda broadcasts on a short-wave receiver. And all of them—ours and theirs—sound alike. Why?

The answer is that the aims of propaganda remain the same. Dispirit and divide your enemies; keep yourself and your allies confident; woo the neutrals by championing both your cause and the inevitability of its victory. In any war, cold or hot, these aims do not change.

The aims may be simple and logical. Achieving them is not. Both sides are willing to waste millions of words in the hope of making a few sink in. The waste is inevitable. Only during crises, when people are especially suggestible, can the propagandist hope for large returns from a few words.

Radio propaganda falls into three broad categories: *white*, *black* and *gray*. By far the largest amount of time and money in both East and West goes for white propaganda. In this category fall the daily standbys like the Voice of America, Radio Moscow, Radio Peking and scores of others. There is no open deception and no big, black lies. The primary aim is to hold an audience. Iron Curtain stations do more news-interpreting and preaching than do our stations, whose tack is to build a reputation for credibility with an eye toward the time when that reputation may be of use. On both sides repetition is important, as is the mere fact of being at the same place on the dial day after day. The objective is just to remind an audience that you're still in business.

On the surface, white broadcasts may seem unimaginative, but one of the biggest propaganda successes of all time was achieved by the British Broadcasting Company in World War II through decidedly white efforts. At the beginning of the war BBC broadcasts to Germany catalogued Allied defeats with agonizing thoroughness. Incredible effort was expended to reach the German people with news of their victories *before* the German Propaganda Ministry could bring the glad tidings. This painfully built reputation for honesty paid off when the tide began to turn. Despite threats from the Gestapo, Germans went on listening to and believing the BBC. The resulting demoralization helped produce the Officers' Revolt

First men to cash in big on radio propaganda face each other in early-1930's shot in Berlin. Speaking is Paul Joseph Goebbels, Minister of Propaganda. In center of front row (arrow) is Adolph Hitler. Most of the infamous Nazi gang is in attendance. To the right of Hitler sit Hermann Goering, Rudolph Hess, Gen. Werner von Blomberg, Wilhelm Frick, Dr. Hjalmar H. G. Schact (an economist). Beyond the microphone are Walther Funk, Heinrich Himmler and Joachim von Ribbentrop. To Hitler's left is Dr. Robert Ley, labor-front leader, and behind him is turncoat Franz von Papen.

against Hitler and shortened the war several months.

But white propaganda pays big only when things are going your way. In a fluid situation, such as the Cold War, the rule is small returns for large efforts.

In *black* propaganda we move into a shadowy realm where deception *is* the keynote. The content of black propaganda broadcasts may be true or false, but the identity assumed by the broadcaster is false. And the objective is that of a confidence man: to make a quick killing and get out of town. The Radio Free Hungary episode is a perfect example. Gross lies usually are left to black operators. But why the frequent use of black stations to tell the truth? Simply because the truth often doesn't seem *credible* when it comes from an identified enemy. Obviously, Radio Moscow could not gloat over the fact that the Hungarians needed our help and weren't getting it. This would just have intensified the outrage felt toward the U.S.S.R. But RFH could and did rub it in.

The large number of brush-fire wars and uprisings in areas like the Middle East have given black stations plenty of opportunities to sow confusion. Maintaining at least a dozen powerful clandestine transmitters, the Soviet Union has been extremely active. During the Suez crisis Soviet broadcasters posed as Arabs, filling the air with far more flagrant anti-Israeli propaganda than the Arabs themselves.

In *any* uprising where communism has a stake, Soviet transmitters go on the air as the voice of the "free" citizens. Since the life span of any counterfeit station is short, it doesn't particularly matter that intelligence agencies can quickly identify the real source of a broadcast.

Gray propaganda is used sparingly. In these broadcasts the identity of the source is simply not given at all. The occasion almost always is a crisis on which the propagandist hopes to capitalize. Usually the objective is quick action from the target audience rather than a verbal victory. Gray opportunities usually come only in wartime, though anti-Castro activity in Latin America has proved an exception. Gray broadcasts have been heard in the Caribbean, and there also have been a few black ones.

Radio propaganda first became an effective tool of war in the 1930's when Adolph Hitler and the Nazi Propaganda Minister, Joseph Goebbels, used it to soften up countries like Czechoslovakia and France prior to invasion. Third Reich propaganda branched off into several hybrid types but most of it would have to be classified as white. The softening-up material was the simplest kind of divide-and-conquer propaganda, but it was undeniably effective. Known points of friction in the target country were exploited day after day until the citizenry broke up into distrustful and antagonistic groups. France was a classic example, and the country still has not recovered from the barrage.

Detested though his memory may be,

California-born Tokyo Rose, a UCLA grad, plied Pacific troops with music and talk. She did 11 years in prison after a treason conviction.

Germany's chief propagandist for far-from-home Allied troops was Mildred Gillars, known as Axis Sally. After World War II she was convicted on treason charge.

Marlene Dietrich and a throaty rendition of Lili Marlene was our secret weapon against Axis troops. Miss Dietrich is shown in uniform in London, late 1944.

Hitler undoubtedly was the first world leader to recognize the true value of radio in leading a nation and conducting a war. Franklin D. Roosevelt's Fireside Chats assuredly were effective but the goals were not on the scale of Hitler's maniacal dreams. Television developed early in Germany largely because Der Fuehrer saw its possibilities and as far back as the middle Thirties appeared *every week* on a regular TV program.

The Nazi radio secret, at home and abroad, wasn't concerned with clandestine stations or stretching the truth, though broadcasts did shade the news and report only chosen facts. Hitler and Goebbels didn't care whether a statement was true or false—only whether it helped the party. Once an idea—true or false—was formulated, it was repeated over and over and over until doubting listeners either began to believe it or simply gave up resisting from sheer mental exhaustion.

For most Americans, real consciousness of radio propaganda (FDR had just been "chatting" with us) did not come until after Pearl Harbor, when our troops were exposed to Tokyo Rose and Axis Sally. These velvet-voiced propagandists had the classic objective of making the soldier feel abandoned and far from home. Though they usually were laughed off by GI's, most men who once huddled in foxholes will tell you there were times when they began to wonder and they *didn't* laugh.

Much has been written about Rose, Sally and Lord Haw-Haw but little is said about operatives on *our* side. Actually, we had an abundance of broadcasters who had lived in Germany and Japan before the war and knew their target audiences thoroughly.

For the German soldier at the front, our most effective propagandist was

Most effective among our propagandists in World War II was Navy Captain Ellis M. Zacharias, who had been on duty in Japan before the war and then was skipper of the USS Salt Lake City at Pearl Harbor in 1941. In 1945 he made many broadcasts to the peace faction in Japan, helped the sudden collapse of the enemy and made bloodless occupation of the country possible.

A Radio Propaganda Handbook

Marlene Dietrich, whose throaty rendition of Lili Marlene was worth a thousand harangues. But for free-wheeling, inventive broadcasting none could top an anything-but-typical army sergeant named Benno Frank.

Frank once had been director of a German theater, a professor of German literature at an American university and, as a child, a resident in the household of a German general. He drew on all of it in preparing broadcasts to German soldiers over much of the war. His radio character was Captain Angers, supposedly a German officer who had come over to our side. Although his direct, personal appeals were consistently effective, his big moment came when his team was sent to the German fortress at Lorient.

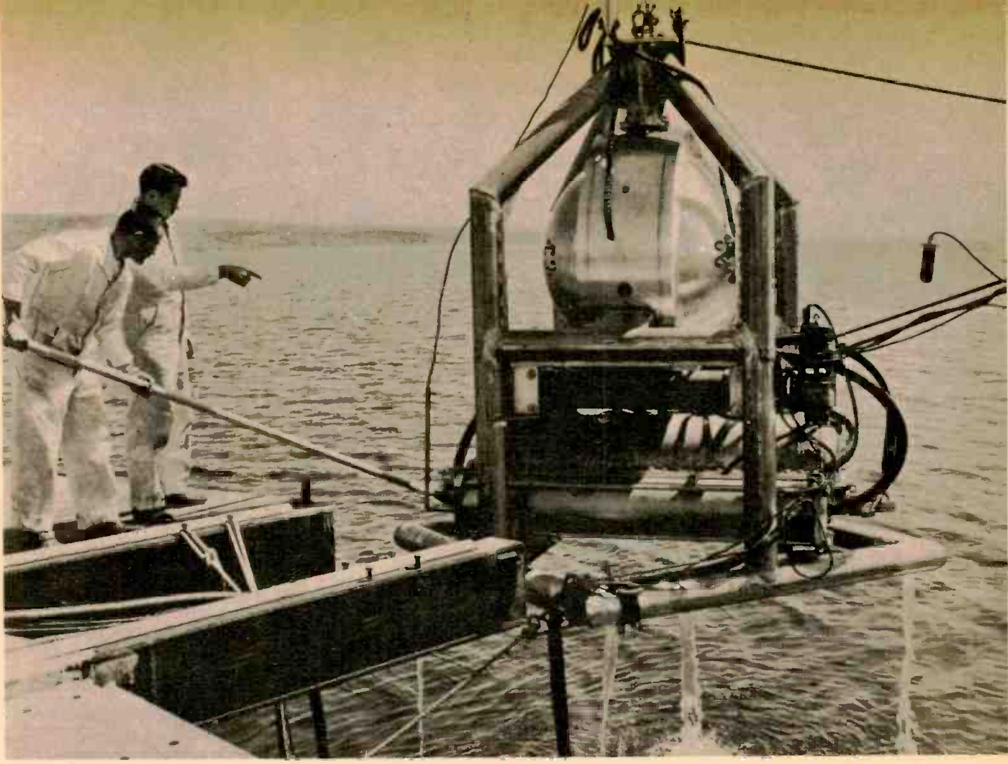
Lorient was a complex of concrete and steel built in Brittany as a refueling station for German submarines. So formidable was it that the Allies bypassed the fortress after breakthrough. Inside were 28,000 Germans, well armed and supplied, living in modern barracks and apartments under 30 feet of concrete. All that Benno Frank and his nine-man team had to do was get them to surrender.

Before Allied forces could threaten a direct attack months later, the Frank operatives had taken some 2,000 prisoners by subjecting the fortress to the only radio siege in the history of warfare. When the first handful of prisoners came out, asking to see Captain Angers, they were milked for information about those still inside. Appeals then were aimed, with deadly humor, at individuals: the former engineer of a crack express train who now drove a tiny locomotive along two miles of track, an officer and his French mistress, a private who was Hitler's greatest fan. Finally, Benno Frank came up with the most inspired of all appeals: "Come on over, and if you don't like it here after a 30-hour free trial you can go back! On my honor! Ask for Captain Angers." The results were phenomenal, and the fact that one soldier was allowed to go back brought a new flood of deserters.

For split-second action in a war of words, top honors must go to an unidentified Russian who took to the air as Ivan the Terrible. Ivan made a fine art of the technique of sliding in. When German propagandists paused for breath, Ivan jumped in with a sarcastic retort. The best-known example came when the Germans started shouting about a new secret weapon that would "shortly bring the war to a close." Ivan cut in with: "They've discovered the white flag!" Nazi broadcasts on the Eastern front were never quite the same after Ivan arrived.

[*Continued on page* 108]

Most United States white propaganda efforts during the Cold War have been carried on by the Voice of America, which spans the world with a network of main, relay stations and programs in dozens of different languages. In this photo of January 22, 1948, a VOA team makes one of country's first big propaganda pushes, broadcasting to Russian people the contents of several secret treaties between Russia, Germany. Transmission later was translated to 23 other tongues.



Electronics under the sea

By George Kai-Nung

New instruments are giving us an exciting view of Inner Space.

ONE of the world's oldest sciences, oceanography, suddenly looks as young as tomorrow, thanks to the infusion of a large dose of electronic equipment. That the study of inner space is important cannot be doubted, for oceans occupy 71 per cent of the earth's surface and contain limitless quantities of food, fiber and minerals. Yet we know less about what lies under the sea than about outer space or the moon.

New instruments now are giving us millions of hitherto unknown facts about materials of the sea floor, and about marine plants and animals.

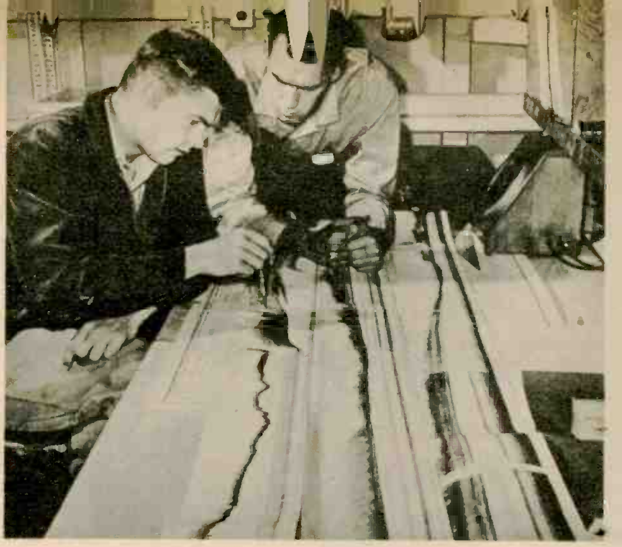
One interesting new undersea electronic gadget is a materials analyzer that does its job right on the ocean floor, which is strewn here and there with fist-size nodules of manganese, cobalt and other rich metals. The nodules represent a lucrative natural resource if we could be sure where they are. The analyzer, built by Well Surveys, Inc., Dallas, can give us this information. Sitting on the bottom, it subjects surrounding materials to fast neutron bombardment. The materials react by producing radioisotopes whose radiations, between bombardments, are detected by a scintillation counter. The data, indicating what material has been bombarded, are sent to the surface via cable.

Getting such information topside is a problem in deep water. Newest development is underwater telemetry, which uses sound waves to carry information.

Sound travels through water better than through air and can be modulated like a radio wave. Sent out by a powerful transducer, it can be picked up and demodulated at a distance of several miles by sensitive new hydrophones.

Using sound under the sea is an old art, of course. Sonar has been picking up direct sound waves and echoes for years, detecting submarines and ships, mapping the ocean bottom and spying on marine life. The new sound transmission systems, however, carry full voice intelligence. They're used by the Navy for sub-to-sub and sub-to-ship messages, and a plan for using sonar-radio buoys would couple underseas craft with stations thousand of miles away. A message would flow from submarine to buoy via sound. There it would be converted to a radio signal by the unmanned buoy and relayed to a ship or shore station.

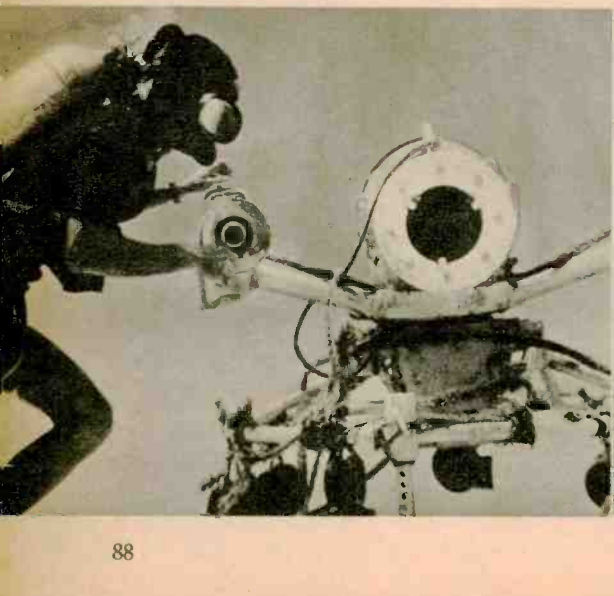
A dramatic use of undersea sound is the Navy's experiments with noise in anti-submarine warfare. According to one theory, massive sound patterns could be set up permanently under the surface by big transducers. When an enemy submarine interfered with the sound pattern it could be detected immediately and the information transmitted to ship or shore by a buoy. Our lead photograph shows such a giant underwater noisemaker produced by General Dynamics.

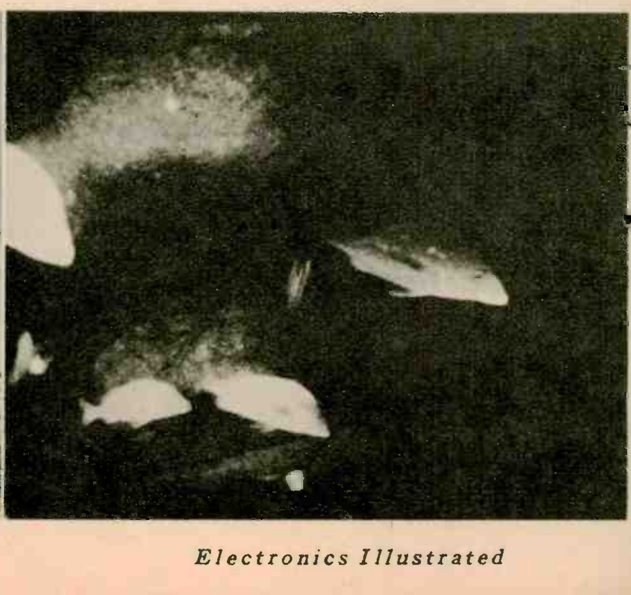


College students with a lake-bed profile made with ultrasound equipment at a Canadian lake.

The ocean is full of strange creatures and noises. Underwater TV cameras, hooked by cable to topside monitors, are the standard tool of visual research. One camera off the California coast turned up some sort of sea serpent that still has not been identified. More prosaic critters are watched by a camera

The University of Miami maintains hydrophones and TV camera (left) 65 feet underwater at Bimini to study marine life, record and analyze marine sounds. Fish (right) appeared on topside TV screen.

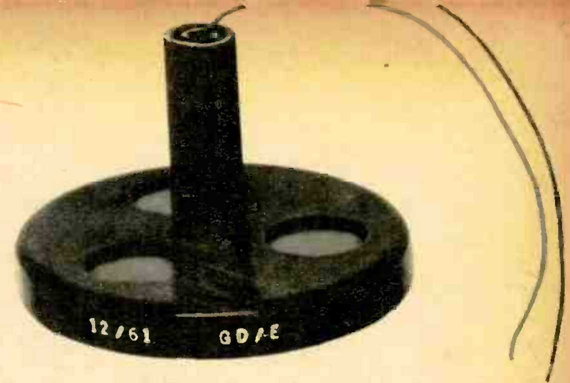




maintained 65 feet down at Bimini Island by the University of Miami's Institute of Marine Science. The U. of M. project also includes hydrophones at many depths. These pick up all the noises in the area, which are recorded for analysis and study. The sea offers many unidentified sounds that confuse Navy sonarmen. The Bimini team is taking away some of the mystery by identifying unexplained cheeps, chirps and grunts.

The immense reserves of petroleum lying under the sea are, for the most part, untapped. The main troubles are in finding it and getting it out. Much hope is held for new electronic equipment for both jobs, now being designed.

Probably the most intensive use of electronic gear has been in mapping and charting. Ship after ship has put to sea to sound the depths, most using sonar. The Woods Hole Oceanographic Institute built a piece of equipment that picks up the sonar pings bouncing off the sea floor and records them on electrosensitive paper in broad tonal gradations. The result is a detailed marine topographic map. In one ambitious charting project, 3 million square miles of the Northern Pacific was surveyed by two ships which traveled a series of north-south lines spaced ten miles apart. The craft stayed exactly on course by using Loran-C radio navigation.

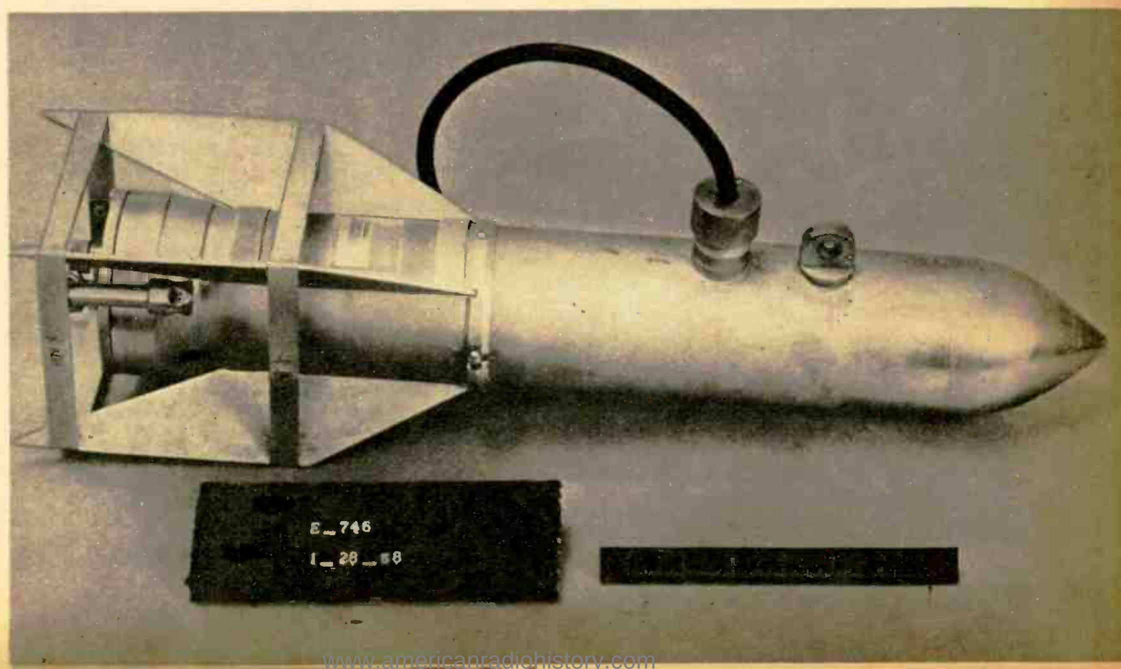


Low-frequency, disc-type hydrophone by General Dynamics. Unit is only 4 inches in diameter.

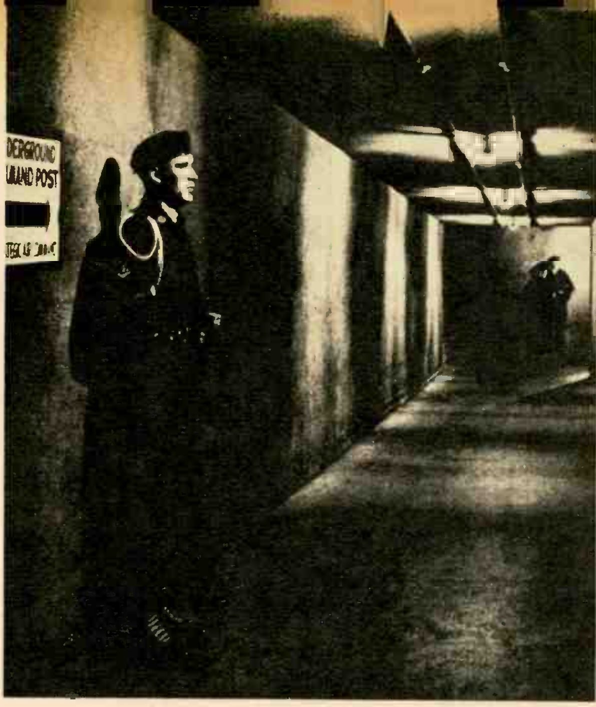
Just as important as charting the ocean floor is the study of the water itself, tides and currents. By its temperature and movement, the ocean greatly influences our weather. Many special deep-diving instruments have been produced. A typical one is a bathythermometer designed by the Scripps Institution of Oceanography. This bomb-shaped device sends up data on the temperature of the water it is traveling through and, at the same time, gives data on its depth.

Soon we may know as much about inner space as about outer space.

Bathythermometer at the Scripps Institution of Oceanography looks like a bomb but is designed to measure ocean current temperatures, which affect our weather; the device also indicates its depth.



HOTTEST HOLE this side of HELL



By Robert Hertzberg, W2DJJ

If it ever comes, the command to fire our nuclear missiles will be transmitted from a labyrinthine cave deep in Nebraska's earth.

IF YOU are used to being around Army posts and Air Force bases, Offutt AFB outside Omaha looks pretty much like any other field. The Headquarters building is a prosaic-enough three-story structure of buff brick. But when you start walking down ramps toward the basement you realize you're going to find more than the furnace room and some supply closets.

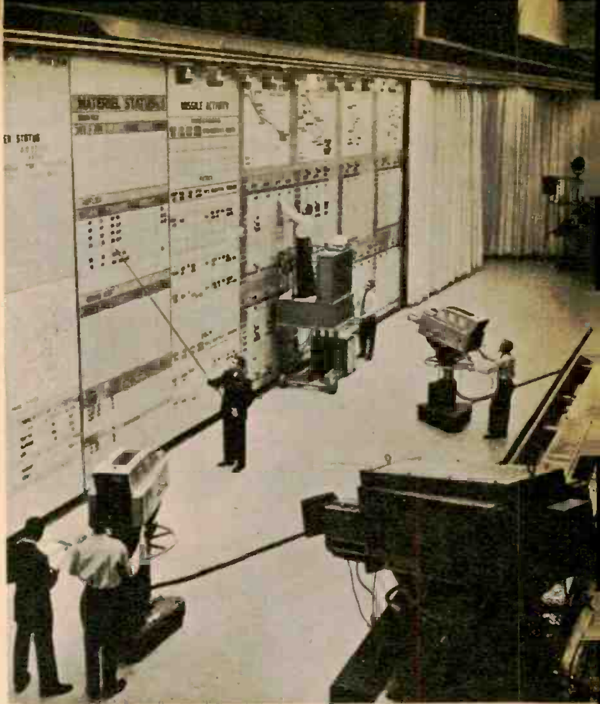
Offutt is the headquarters of the Strategic Air Command—the Air Force branch in charge of carrying out a missile-and-plane nuclear attack, if it ever comes to pass. Deep in the Nebraska earth under the Offutt Headquarters building is a labyrinthine man-made cave holding SAC's Command Post. From the War Room in that cave would come the order to launch the attack. It would be the second strike of World War III. The first would have been made by the enemy.

No one makes a secret of the cave's location and members of the press encounter a minimum of red tape in obtaining clearance to visit the vital communications hole. On a recent visit, I was met in the Headquarters building by the base's public relations officer, picked up an ID badge (giving my Army Reserve card as security) and went on a tour. The PRO and I started walking down ramps through a concrete passage that made a big spiral. We walked and we walked and we walked. At every turn was an air policeman with a .38 at his side, and between AP's our progress was watched by closed-circuit TV cameras. Finally, at the end of the last ramp we came to a plain-looking door that brought us into an extraordinary chamber—SAC's War Room.

The War Room is the most vital of all the vital spots in the many-pocketed cave. Along one two-story-high wall is a status board that, at a glance, indicates the activities and state of readiness of every SAC base. From a glassed-in balcony the SAC commander-in-chief (currently Gen. Thomas S. Power) and his staff view the data on display and make their decisions in war or peace.

Underneath the balcony are several small communications cubicles, segre-

Single-sideband communications room in the SAC cave controls world-wide SSB net. Pins on the polar map on back wall indicate stations in net.



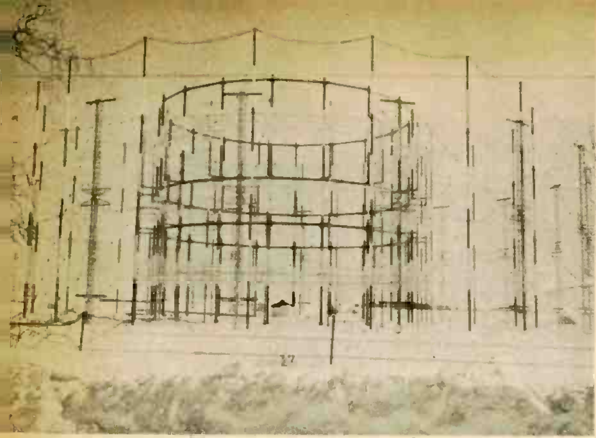
In the big War Room a TV camera focuses on the briefing officer (left) while an airman posts data. The huge status board shows all SAC's activities.

gated largely because of the noise factor. In one are banks of computers, another has communications consoles and a third is the telephone room. In the last is found SAC's famous Red Telephone. By picking up its handset, the CIC is put in instantaneous touch with every SAC base in the world. But he would pick it up for only one purpose—to issue an order to attack, using an elaborate code that is changed daily and always kept under lock. Less publicized, but even more important, is a gold telephone. Over it would come the order from the President telling the CIC to pick up the red one.

The War Room is lit up like a TV studio, and understandably so, for a closed-circuit color television system picks up images of the status board and sends them along to every important room in SAC's Nebraska hell-hole.

Separate compartments outside the 140-by-30-foot War Room house other Command Post activties. There are administration offices, sleeping quarters for men on standby duty, dining facilities, an emergency power room and

In late '62 President Kennedy and Vice-President Johnson toured cave, saw command phone console.



SAC's fantastic Nebraska antenna farm is major factor in making communications system reliable.

other special cave pockets. One room is jammed with Teletype machines which carry orders and routine messages to and from the other SAC bases scattered around the globe.

Yet another underground compartment is occupied by single-sideband radio equipment. SAC has an extensive SSB net that encircles the earth like a spider web, and this is the control room for the whole setup. SAC has come to rely heavily on its SSB net for emergency communications, partly as a result of pressure from and demonstrations by Lt. Gen. Francis H. (Butch) Griswold, a long-time ham with the current call of K3RBA. Butch once was vice-commander of SAC, now commands The National War College. (See HIGH-FLYING HAM, Nov. '61 EI.)

Having a special interest in SSB myself, I spent a few minutes in the net control room. But you don't hear much. There are few contacts, and those are largely checks to make sure the equipment is still operating. One of the regular transmissions, and an intriguing one, is to a big KC-135 jet plane that cruises around over the Mid-West 24 hours a day. The ship's cargo is an elaborate multi-channel radio station and seven Air Force men. It is SAC's Flying Command Post, which would take control of the whole force if the cave caught one down the chimney. This may indicate to you that the guys who dug the hole could have been working in vain if their artificial Carlsbad is still vulnerable to attack. Well, the hell-hole *is* vulnerable, but so is everything else unless you want to dig down where the lava starts. A hydrogen bomb right on the button would put the cave out of business in a flash—literally. But it will withstand near-misses, and that's why it was dug. It's *relatively* safe from attack.

While I was in the underground SSB room the men did run one check on the complete system. From one end of the earth to the other, code-named stations reported into and out of the net in rapid succession. The voices, carrying that slight metallic tone characteristic of sideband, were grim and business-like and the transmissions were limited to the absolute minimum of words. Obviously, in that room and all the other pockets of the cave, the men on duty were alert and ready for the call on the gold telephone—the one they hope will never come.

Messages to and from posts all over the world pour through crowded underground Teletype Room.

Famous Red Telephone would carry commander's order to all bases to launch a nuclear attack.

THE HAM SHACK

BY ROBERT HERTZBERG W2DJJ

THE END . . . My serialized account about a friend who bought a complete sideband setup but had no ticket, then flunked but finally passed his exam comes to a halt with this chapter and a picture of the "wireless" room he fixed up in his new house, bought mainly to hold his station. As the photo makes evident, he's a stickler for neatness. His name, by the way is, S. M. Weingast, now WA2WXT, Box 57, Atlantic Beach, N. Y. He's the long-time head of the firm that makes the Precision-Paco line of instruments and kits. Okay, Sol, you're on your own.

The Little Ham . . . After carrying on an extended conversation with what I thought was a local YL about various aspects of SSB technique, I was staggered to learn that the reason WA2YJD's voice is high-pitched is a matter of years instead of sex. YJD turned out to be a chap less than 11 years old who has held a General since 3 months past 10, was a novice at 9 years and 7 months. And he's on sideband!

Another Voice . . . Mention in the January Shack of a TV announcer's voice emanating from WA6MSE in California turned up another famous one. Bill Spence, K1OTT, asks, "How about K4LIB?" This voice you're sure to recognize on the air because it belongs to Arthur Godfrey. K4LIB trained as a Coast Guard sparks, got into broadcasting as an engineer and then wound up as an entertainer almost by accident. But you probably already know all that. The Redhead still wiggles a mean bug.

Private List . . . Do you have pet peeves? I do, and I've been thinking of starting my own list of characters who won't be missed. Leading candidate is the guy who ignores the fact that a CQ is aimed in a specific direction or at a city, state or country and answers it just for the sake of a cheap QSO, although he's way off somewhere else, or across the street. In second position goes the thoughtless stoop who interrupts a phone patch between an overseas serviceman and his family by yelling, "Break, break," and then giving a signal report nobody wanted in the first place. Next to him goes the CW operator who acknowledges a transmission with a string of R's and then asks for a 90 per cent repeat.

Barefoot . . . There's been a lot of joking about the meaning of "running a transmitter barefoot." The oldest yuk-yuk definition, of course, is that you are sending with your toes, and that's why your signal sounds the way it does. But I suspect a good many beginners in this game really are confused by the expression. Its true meaning is that the transmitter is of relatively low power, up to about 150 watts, and that it is not driving a power amplifier putting out anywhere from 500 watts to a full kilowatt, the legal limit.

Curiously, many stations exhibit no difference in signal strength between barefoot and amplifier operation. This is particularly true in DX situations. All of which merely points up an old but often overlooked fact of radio life: short-wave communications depend more on atmospheric and especially ionospheric conditions than on sheer power. There are times when a full gallon on sideband won't get you into the next state. And times when 5 watts puts you right into Europe.

The Strange Case of Radio WUMS

By C. M. Stanbury II

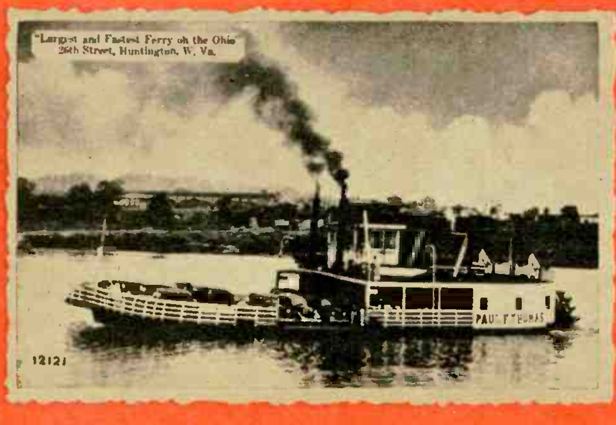
We're Unknown Mysterious Station, he said. He wasn't kidding!

WATT FOR WATT, Radio WUMS holds some kind of record for sprouting gray hair at the FCC and its predecessor, the Federal Radio Commission. In its 23-year history, WUMS never had much power, but neither did it have a license. And the spot where it chose to operate was by no means obscure—right in the broadcast band.

WUMS first hit the air on Nov. 16, 1925. The call letters came—not from the FRS but from the fertile brain of its owner. He chose them for a reason, to stand for We're Unknown Mysterious Station. As it turned out, WUMS was not as unknown as it was mysterious. Scores of people heard the station on the air but for six years few knew its location. WUMS is a rarity in FCC annals because it was a true outlaw that went on and on and on. Its license couldn't be revoked because it had none. Its operator couldn't be tossed in the jug because no one of official standing knew who he was.

Builder, operator and protector of WUMS was one David F. Thomas. Now in his 50's, Thomas grew up and lived, boy and man, around the little (population now 831) river town of Proctorville, Ohio. The hamlet lies at the southern tip of the state, across the Ohio from Huntington, W. Va. Just why WUMS came into being is a little obscured by time but Thomas's own explanation probably is close: "I sure liked to broadcast."

Thomas was 16 when his voice started to fill the ether around Proctorville. Just talking must have become a bit of a bore, however, and then WUMS went mobile. Thomas carried the transmitter to neighboring towns and began broadcasting from churches, schools and theaters. These one-night broadcasts featured local talent and probably were heard by a few dozen people. Thomas was running only half a watt of power at that time and he might not have been breaking the law, since only



Outlaw station once operated on the ferry Paul F. Thomas, which plied the Ohio River. Home port of the ferry was Huntington, W. Va. Picture is from old-time post card.

interstate transmissions were regulated and it's questionable whether WUMS could span the Ohio River.

Thomas and his father operated several ferries out of Huntington, so the boy boosted the power of WUMS and was able to get a special FRC permit to operate as an emergency service, mainly at flood-time.

"During floods," says Thomas, "we ran up and down the river and farmers brought food and milk and mail to the landings. They had broadcast radios and could tune in the station to get details about the next trip." The station then was semi-legal, although on the wrong frequency.

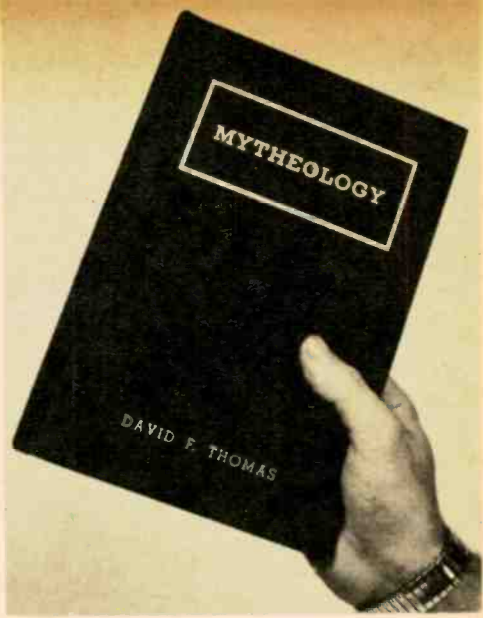
Thomas was a high school student when he hatched up WUMS. Later he studied theology but flunked out of school and still later listed himself as an "engineer." As the WUMS business makes obvious, Dave Thomas likes to do big things and attract attention. He's always considered himself quite a thinker and theologian. Fifteen years ago he wrote and paid for the publication of a book called Mytheology (pronounced my theology). The tome is notable for its misspelled words, its obscure currents of thought and its wild Thomas-made words. Among other things, it deals with religion, the real truth, brainwaves and "metaphysico-theologicocosmonicology." A quote:

"Every man who is acquainted with the exact discoveries of the physiological psychology, understands that they leave the question of immortality where they found it—*unanswered still.*"

The paragraph may be lifted out of context but the lines above and below it only confuse the picture further.

Thomas has always taken a special pride in WUMS, his own little outlaw monster. As late as 1959 he was able to obtain Ohio license plates carrying the station's call letters (see photo). He claims he was issued the only car li-

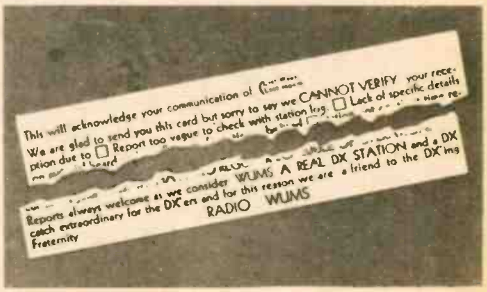
[*Continued on page* 103]



Book authored by the WUMS operator is strange mixture of religion, opinions, obscure chatter.

David F. Thomas—theologian, author, thinker, engineer . . . and a pain in the neck to the FCC.

An un-QSL card from WUMS. Thanks, it said, but it could not verify for one of several reasons.



KIT EI REPORT

2 Walkie-Talkies

THE 100-milliwatt walkie-talkies fall into two categories: those designed to operate on both the Citizens Band and the 27-mc License-Free Band, and those for License-Free operation only. The two bands overlap but are not the same. Any 100-mw rig can get on the License-Free Band if it has a *Part 15* Certificate of Compliance. But to operate in the CB service, it also must have FCC form 452-C, certifying that it adheres to the .005 per cent tolerance of *Part 19,* and the operator must have a CB license. There is a further division in that the more expensive walkie-talkies usually have a full circuit of about nine transistors, while low-cost units, intended primarily for License-Free operation may have as few as three transistors. EI here reports on one walkie-talkie kit of each type.

EICO 740

The dual-band EICO Model 740 has two features not found in most walkie-talkies: a reflexed final IF amplifier/audio stage and a rechargeable nickel-cadmium battery. The reflexed stage, besides providing extra gain, produces a background hiss which warns you that the unit is on, even when the volume is turned down. The leak-proof n-c cell can be rejuvenated by plugging in a small charger that comes with the 740. It holds a charge decently long, even if not used, and will accept more than 100 charges.

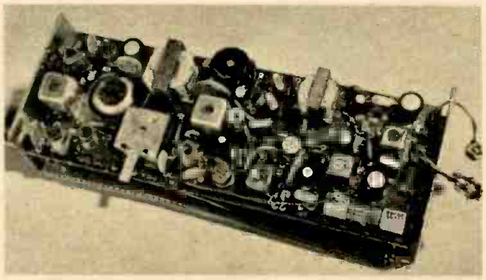
We built the kit ($54.95) in about five hours. The battery comes uncharged, so it's a good idea to assemble the charger first (30 minutes) and start the charging cycle. A full charge takes about 16 hours, but you can get an hour of operation after four or five hours of charging.

The construction manual is well organized and a pictorial for each page makes it unnecessary to keep turning back and forth. Take special care when mounting the battery so its metal-strap leads are not bent too often.

The IF, RF and oscillator coils are prealigned and require only a touch-up. Alignment instructions are detailed and easy to follow. Only test instrument required is a VOM. If you have a field-strength meter, so much the better. The final RF amplifier can be adjusted to give you an input power as high as 220 mw, which is fine for CB, where anything up to 5 watts is legal. But for license-free operation, final input must be held to 100 mw.

We checked a pair of 740's in an area of tall buildings and got a range of several blocks. Open-country range is up to three miles. Modulation and audio quality were good and there was no overmodulation, distortion, noise or RF splatter. The crystal-controlled superhet receiver has excellent sensitivity.

The crystals supplied with the 740 are subminiature and not readily available at parts distributors. Therefore, if you plan to operate on a channel other than 16, for which crystals are supplied, order extras from the dealer when you buy the kit. A word of caution: be



Inside view of the EICO. Nickel-cadmium battery fits underneath the printed-circuit board.

sure to install the crystals in the correct sockets or you'll be transmitting and receiving out of Citizens Band limits.

Spacephone S2100

The Spacephone Model S2100 obviously is intended for license-free operation by youngsters who have become interested in electronics. With a circuit of only three transistors, the S2100 is

a tightly packaged (2½ inches wide by 5 inches high) transmitter, audio amplifier, modulator and superregenerative receiver. The small size does not mean it is a toy, however, nor does the low price. The unit came on the market at $21.95 but is now being reduced in price to $9.95 to make it competitive with other walkie-talkies of similar design.

We built this truly pocket-size transceiver in about two hours. Unlike other kits that have large construction manuals and many pictorial diagrams, the Spacephone's manual consists of an eight-page booklet and two large foldout pictorial sheets. Forty-four steps and it's done.

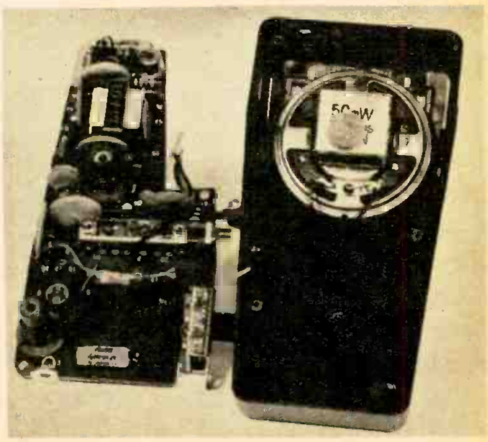
But the compactness of the printed-circuit board causes problems in mounting and soldering components. It is unfortunate that construction does require so much skill and care because this consideration makes the kit inadvisable for those it is designed and priced for—the young beginners. The S2100 cannot be recommended for anyone who has not had previous experience building kits and, in particular, kits with printed circuit boards.

No space has been wasted between components on the top of the printed-circuit board. When soldering components, be careful of excessive solder which could cause shorts between strips of the etched foil. Watch the heat too when installing the transistors. Their leads are joined directly to the board.

Since the receiver is a superregen, alignment is not a problem. The regeneration level is set by adjusting a small pot for loudest hiss. The antenna coil is pretuned. Power is furnished by a 9-volt transistor-radio battery.

We measured 83-mw input power. Modulation quality is good, there was no RF splatter and we could not detect distortion. Audio quality was good. We had no difficulty in distinguishing who was talking when we made our tests. The three-inch speaker doubles as a microphone. However, the "half mile" range claimed is stretching a point. Intelligible conversation could be carried on up to a few hundred feet but it is doubtful that even a straight shot over water would give you a half-mile range.

Since the receiver is a superregen, tuning is somewhat broad and you may hear stations on adjacent channels.

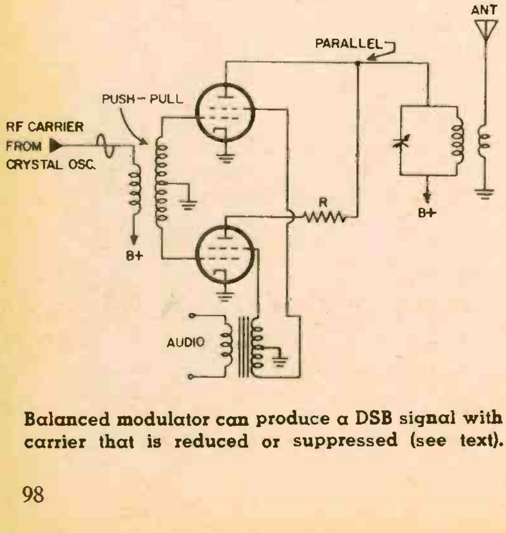


Some parts cover eyelets yet to be soldered on the Spacephone's compact printed-circuit board.

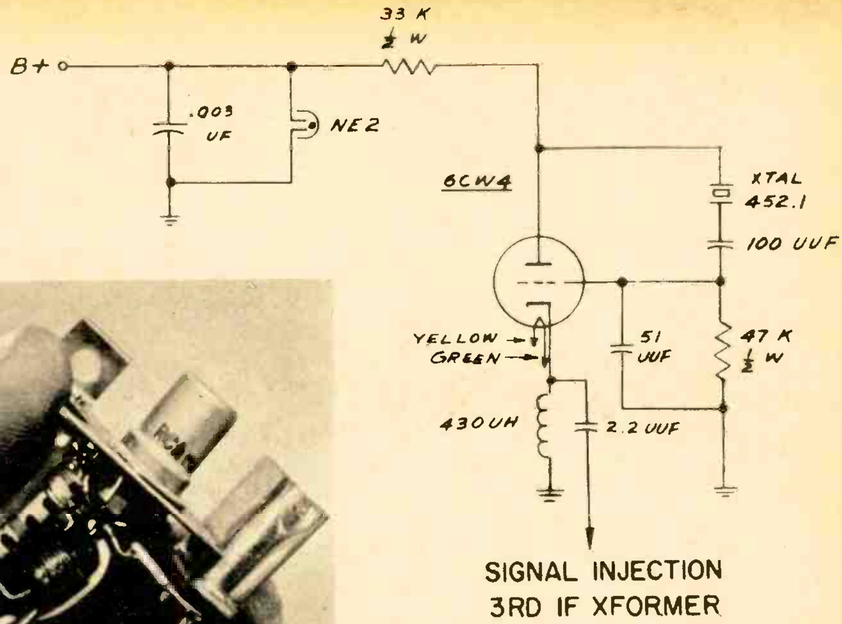
SIDEBAND CB NOTES

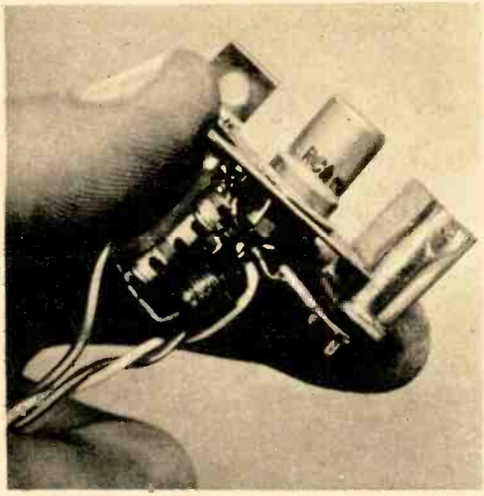
ELSEWHERE in this issue is an article on a privately-built single-sideband transceiver which was first to get into operation on the Citizens Band. But many manufacturers are busy designing SSB CB sets for the market (Heath, Cadre, Sonar, Webster and Olson are among them). And a few pieces of sideband gear already have been introduced. First complete transceiver to bow is a *double*-sideband job by Regency Electronics (see photo above). We usually think of sideband, double or single, as having a suppressed carrier. But the Regency product, priced at $250, puts out a *reduced*-carrier signal. Rather than being completely suppressed, the carrier in this case goes along with the sidebands, but in a much-weakened form. The idea, evidently, is to make the rig more compatible with existing AM equipment. The vestigial carrier would permit the local oscillator in a normal receiver to lock in on the signal.

The Regency DSB transceiver has 23-channel crystal control, a four-way meter (S reading, power, final plate voltage and current), final plate tuning and frequency-adjusting delta tuning. The company hasn't revealed its DSB circuit but our schematic shows how a reduced-carrier signal could be achieved. A low-level RF carrier is introduced to the grids of a balanced modulator (which replaces the RF amplifier of a conventional rig). The carrier is applied in push-pull. Since output is in parallel, the carrier bucks itself out through cancellation. Audio is applied to the screens in push-pull, causing the tubes to unbalance *in step* with voice frequencies. Thus, at the output, only the modulated RF—the two sidebands—will be present. Note resistor R in the plate lead of one tube. It unbalances the stage just enough to let a vestige of carrier through. Increasing its value would unbalance the modulator until a normal AM signal appeared at the output. Eliminating it would produce truly balanced modulation and a



Balanced modulator can produce a DSB signal with carrier that is reduced or suppressed (see text).





General Radiotelephone's SSB adaptor (left) uses one tiny Nuvistor tube. The circuit (above) is oscillator that injects carrier in the detector.

suppressed carrier. Regency claims the system quadruples effective power.

General Radiotelephone has taken an add-on approach to sideband, the philosophy apparently being not to obsolete conventional equipment but to update it with adaptors. First out is a *single*-sideband adaptor for the receiver section (see photo). The unit, designed specifically for General's MC line of transceivers, is being marketed as an experimental circuit. The company has said it is not intended for commercial applications. The adaptor uses one tiny Nuvistor tube and can be mounted right on the chassis. It is priced at $19.95, plus installation charges.

The adaptor provides the missing carrier for an SSB signal, just as a BFO does in a ham receiver. An incoming sideband signal mixes with the adaptor signal to produce audio. The schematic (above) reveals a crystal-controlled oscillator whose output (taken from the 6CW4 tube's cathode) is fed in at the output of the last IF stage; it and the sideband heterodyne in the detector.

The adaptor's frequency is 452.1 kc, matching the nominal IF frequency of the MC line. The frequency is unusual in that most IF frequencies in comparable CB equipment are 455 kc. In operation, the adaptor frequency remains the same. The transceiver's manual tuning knob is used to change the incoming IF signal to the right frequency with respect to the adaptor frequency. Manual tuning *must* be used because receive crystals wouldn't be accurate enough.

Assume a sideband representing 400-cycle audio is fed to the mixer stage, causing it to produce an IF frequency of 452.5 kc (452.1 plus .4 kc). The 452.1 kc signal injected by the adaptor will beat with the 452.5-kc IF signal and the result will be 400-cycle audio (452.5 minus 452.1 kc). Spacing between the adaptor frequency and the IF must be exact. This adjustment is made with the manual tuning knob, as mentioned earlier.

Refinements not shown in the schematic include an RF gain control to reduce receiver sensitivity on strong SSB signals. Sideband energy could overmodulate the adaptor signal and cause

[*Continued on page* 106]

THE LISTENER

SWL-DX NOTES

BY C. M. STANBURY II

THE CUBAN AFFAIR . . . Most surprising event of 1962 for broadcast-band DXers happened the night they found some favorite targets broadcasting in Spanish. This was during the Cuban crisis, when the government took over nine BCB outlets, eight of them in the U.S., to get its message to the Cuban people.

The Voice of America programs carried by the stations, ranging as far from Castro's island as WCKY, Cincinnati, and KAAY, Little Rock, were on every night from 1900 to 0600 EST. It lasted some three weeks. Then two VOA transmitters took over, also operating on the broadcast band. There was a bit of irony when it came to WMIE, Miami. The station, one of the most important because of its nearness to Cuba, carries some regular programs that are violently opposed to federal policies. One is Space Station, which mixes flying saucer flaps with plugs for the John Birch Society. A daily WMIE presentation is Billy James Hargis's Christian Crusade, which is not even in sight of the New Frontier. The irony in this case is a healthy one showing a certain amount of editorial freedom and broadness of viewpoint at WMIE.

The Mystery . . . Only station outside the U.S. to carry the Spanish-language programs was mystery-shrouded Radio Americas (see QSL card). The mystery has to do with RA's location. Where is it? Elsewhere in this issue, a piece on a short-wave fraud finder indicates RA is not on Swan Island, as was thought at one time (and seemingly as indicated by the station's QSL card). A good many DXers would rather cling to that theory than drop a rare country from their logs, but consider some more evidence: while using 1160 kc, RA came in strong at Miami, cutting right through Cuban jammers (noise type) plus CMDX at Bayamo, CMBQ at Havana and an unidentified Cadena Musical Nacional relay, all operating within a couple of kc of 1160. The Cubans were 200 to 300 miles away, Swan Island 600 miles. RA was *not* operating from there. But neither was it in the Miami area because it didn't completely dominate the channel in southern Florida. So where is R. Americas? Speculation has it aboard ship, on Cay Sal (Bahamas), Navassa Island and so on. We frankly don't know, but we see no reason why its location should be kept secret at this late date.

For those who haven't yet made this catch, the BCB frequency has now moved up 5 kc to 1165 and RA also uses 11800 during the day, 6000 at night.

Notes . . . If you go in for the fraud finder in this issue and don't find R. Tirana at 9475 kc, try (in order) 11945, 15040, 15095 . . . Unless plans go awry, two new Latin American countries soon will be represented on SWBC bands, both via stations owned by Trans World Radio, a religious organization. Construction is getting started on two 250-KW transmitters on the island of Curacao in the Netherlands Antilles. At the same time TWR has an application before the FCC for a Puerto Rican outlet . . . Good QSLer YNOL, Managua, Nicaragua, has moved up 3 kc to 828.

[*Continued on page* 108]

HI-FI RECORD GUIDE

by Warren DeMotte

TWO American college groups, the Eastman Philharmonia and the University of Michigan Band, toured Europe with success and now are seeing their triumphant performances released on records. Led by Howard Hanson, the orchestra of Eastman School of Music students plays short concert pieces on Musical Diplomats U.S.A. The orches-

tra's technical proficiency and interpretive expressiveness explain vividly the enthusiasm of foreign audiences, while the recording's broad range makes it easy to understand why its zestful Stars and Stripes Forever excited the Russians into demanding encores.

Unlike the Eastman students, the Michigan band members do not study music professionally. But they nevertheless play with skill and vitality, and they generate a sonorous tone. Conducted by William D. Revelli, they have recorded a group of miniature masterpieces by march king John Philip Sousa on a disc aptly called Hail, Sousa!

One of the most fascinating records in the catalog of Folk Music is The Unfortunate Rake, named after an old Irish song. It shows the evolution through the ages, with changes in words and melody, of that ditty through 20 incarnations, including a relatively recent one as The Streets of Laredo. Since each song is performed by a different singer, the record also offers a vast amount of variety and a cross-section of folk-singing styles.

About ten years ago, Antal Dorati and the Minneapolis Symphony Orchestra recorded a scintillating performance of the complete score of Tchaikovsky's The Nutcracker Ballet. Now, with the London Symphony Orchestra, Dorati does it again, this time with a bit more interpretive warmth and modern sound that is particularly brilliant in stereo.

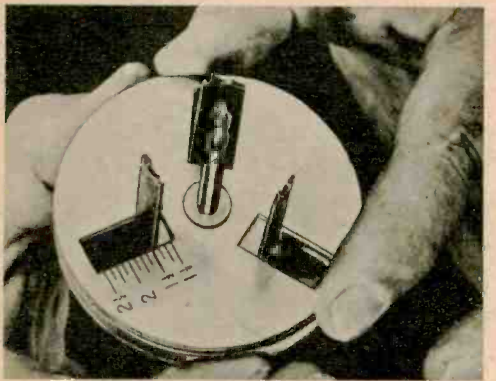
The harpsichord is often recorded bigger than life but in Music for the Harpsichord and Virginal, its ingratiating tone is conveyed with more pleasing, unostentatious naturalness. The featured piece is Dietrich Buxtehude's La Capricciosa, a tremendous composition in the form of a Theme and Thirty-one Variations. Recorded for the first time, this unfamiliar masterpiece is played with unerring style and sensitivity by Stewart Robb, who also performs a group of charming works on the virginal, the harpsichord of Elizabethan and Jacobean England.

The sonic balance of piano and orchestra has rarely been captured with the finesse achieved in the recording of two Mozart Concertos by Artur Rubinstein and an orchestra conducted by Alfred Wallenstein. The performances are lyrical and virile and the sparkling interplay of the instruments is delineated with astonishing clarity, yet with blending that is integrated without a hint of cloudiness.

Arnold Schoenberg's Pierrot Lunaire created a furore at its 1912 premiere with its modernistic treatment of voice and chamber ensemble. It still is a tough nut to crack but its eeriness and intensity are impressive. This new per-

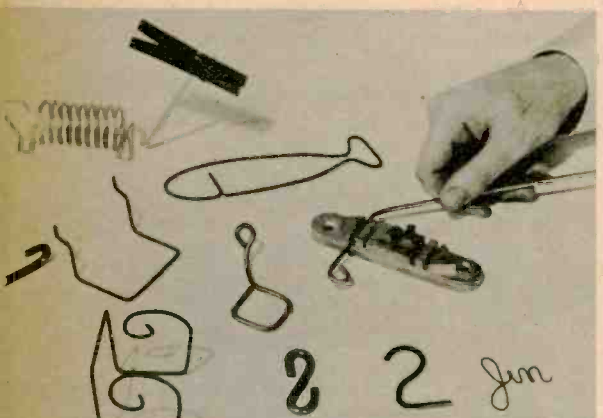
[*Continued on page* 110]

New non-electronic products for the electronic workshop.

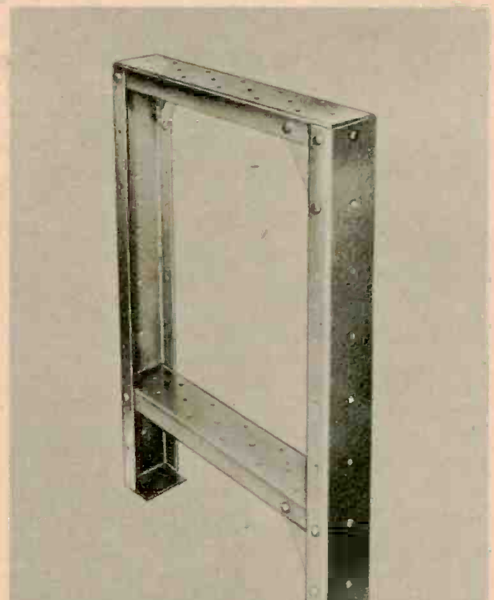


Three-blade hole-cutter is good for hardboard, wood, aluminum and especially plastic because it does not gum up. Settings from 1⅛ to 2½". Name: Z-Saw. Zoron, Inc., 612 W. Monroe, Chicago.

Moisture damage and corrosion in all kinds of electrical gear are prevented by CRC aerosol spray (left). Product is available in several formulas from CRC, 116 Chestnut, Philadelphia. Stops Rust WD-40 (right in photo) is just what the name implies, a rust preventative. Rocket Chemical, 4674 Alvarado Canyon Rd., San Diego.



Handi-Bender uses slots and pins to form basic wire bends for tool-holders, mike brackets, test instrument handles—or extremely neat wiring. $1. Jon-Cee Products, 1203 Ford Rd., Cleveland.



Pridecraft's sturdy metal workbench legs sell for $8.50 a pair, come with workbench plans that the electronic hobbyist can alter to suit. Pollard Brothers, 5504 Northwest Highway, Chicago 30.

The Strange Case of Radio WUMS

Continued from page 95

censes in history to carry the call of an unlicensed station. He might be right.

In 1931, after its location became known to DX circles, WUMS began getting reception reports. The idea of being heard in distant parts seemed to cause Thomas to blow a safety valve. As he says today, speaking of himself in the third person: "We began to get DX crazy."

The WUMS jack-of-all-trades dreamed up a QSL card and began verifying. Naturally, *this* QSL bureau was different. Each report was scrutinized like a fingerprint at a murder scene. If everything was not exactly up to snuff the DXer got what amounted to an un-QSL card, which said the report could not be verified. All verifications were notarized and mailed with a now-valuable commemorative stamp. WUMS's requirements were so stiff that only three dozen QSL's were issued. Thomas claims to have received one report from New Zealand.

WUMS now used 2004 kc for ferry work and 1560 for broadcasting and ran as much as 10 watts. Thomas broadcast bimonthly DX tests, made up of music and voice interspersed with Morse code. Raucous laughter must have rung up and down the broad Ohio when people along the banks bumped into these strange programs on their new-fangled wireless sets. To qualify for a QSL, DXers had to copy the code letters exactly and mail their reports within 24 hours.

In November 1931 WUMS had two brushes with the feds. Although he was already on the air, Thomas applied for a broadcast station permit but was turned down. At the same time, a Chicago DXer got miffed when he received one of the quaint un-QSL cards and promptly finked to the FRC. Thomas got a stern warning.

"The Commission was determined that I become an amateur, and I had to stay on the broadcast band," says Thomas.

A long series of applications, refusals, threats and court actions followed. And WUMS kept broadcasting. In 1939 several hams worked WUMS because its 2004-kc channel was near the 160-meter band. The Department of Justice rose up in wrath and filed suit in Cincinnati, the indictment charging Thomas with operating an amateur station without a license. Somebody goofed. WUMS was running without a license, all right, but not as a ham trasmitter. No, sir. It was an unlicensed *broadcast* station. Amidst considerable snickering over the booboo, the indictment was quashed.

Since Thomas's last application for a broadcast license (actually for a construction permit) had been dismissed *with prejudice*, he had just run out of tails to twist. But he soon realized the G-men hadn't forgotten him. The FCC began to build a huge monitoring station within sight of the WUMS antenna. In the proprietor's view, they were out to nail his hide to the wall. The location was a coincidence, of course, but not in the mind of Dave Thomas.

Despite the monitoring facility, WUMS kept tripping along like a moonshiner in the Treasury Department and stayed out of trouble several years. Then in 1948 the roof finally fell in. Thomas got into a hassle with some fellow members of the National Radio Club, a group of DXers who later threw him out for cheating. The NRC gang were so mad they tipped off the FCC about the next WUMS DX test and the government boys were on frequency and waiting. Thomas was arrested, hauled into court on charges of operating a radio station without a license and then convicted in the Federal District Court at Portsmouth, Ohio. He faced a maximum penalty of a $5,000 fine and five years in stir.

Thomas appealed and once again saved his neck. This time he pulled out the old FRC flood permit. According to him, the action went like this: "The FCC engineer in charge of the Lexington District said he did not know I had this permit. I said, 'Perhaps you were not important enough for the FCC to tell you about it.'" There was an

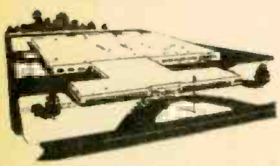
[*Continued on page* 106]

What kind of (active)

This great, new transistorized organ offers full-toned, high fidelity standards of sound—a chance for creative expression.

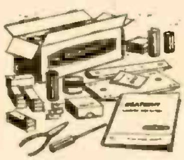
The Heathkit version of the Thomas Transistor Organ has these real organ features: Two 37-note keyboards, 10 true organ voices, 13-note bass pedals, variable vibrato, variable bass pedal volume, keyboard balance control, 20-watt peak power amplifier and speaker, deluxe walnut cabinet with matching bench.

Kit GD-232, no money down, $22 mo. $329.95
Bench GD-232-1, ... $ 24.95



Who is Heathkit?

Heathkit is the pioneer and world's largest manufacturer devoted exclusively to the design and manufacture of do-it-yourself electronic kits. All our efforts are aimed at creating more kits, better kits, easier-to-build kits.



What are Heathkits?

Heathkits are electronic equipment in unassembled form. All parts are packaged in convenient groups and a complete, easy-to-read, well-illustrated instruction manual tells you how to put them together. Heath offers over 250 kits from simple portable radios to big analog computers.

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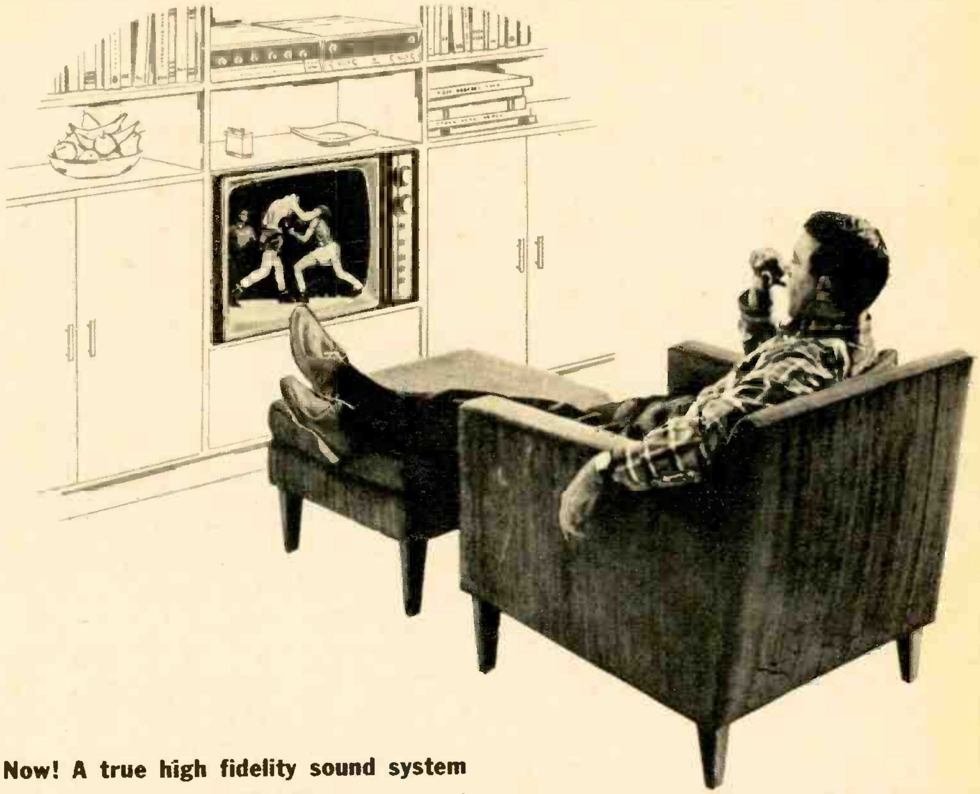
(passive) (or both)



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This superb new Heathkit Hi-Fi TV set incorporates advance engineering to bring you the finest in picture quality plus truly high fidelity sound (the first TV receiver that earns the right to drive a hi-fi system)! Prebuilt assemblies make it easy to complete in 2 or 3 evenings. Optional UHF.

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With Wall Mount, **$189.95**; With Console Cabinet, **$249.95**.

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NAME ____________________

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CITY ____________ ZONE ______ STATE ____________ uproar in court and Thomas barely escaped a contempt citation. But he did escape, as he had from every other pitfall along WUMS's 23-year history of outlawry.

Dave Thomas at last decided he'd had enough. WUMS left the air forever. But now its operator is transmitting again . . . as a Citizens Band licensee. He does have a license this time and, chances are, he's as legal as anybody else on the band.

The EI Super-Strobe

Continued from page 61

flectors are available from Kemlite Laboratories, Inc., 1819 W. Grand Ave., Chicago 22, Ill. You can purchase either the tube and a reflector (which can be removed) or a flashtube with the reflector cemented in place. If your camera has a 45° field of view, the reflector should be 45°. If you use a 60° reflector with a 45° camera, half the light will spill outside the camera's field of view.

To allow for reflex cameras and misalignment of the flash, a 60° reflector is recommended for general use. The following reflectors are available: R2, 50°; R3, 45°; R5, 60°. A type CX7 flashtube costs $13; with reflector it's $16.

To use the ringlight it is necessary to remove its plug and connect the red lead to pin 4 and the black lead to pin 1 of an Amphenol 91-MPM4L plug.

The flash guide number for an R5 reflector when operating on *battery* and *half power*, using Kodachrome II, is 28 to 40. When on *AC power*, the voltage will be slightly higher and the guide number is 35 to 45. On *full power*, set the lens one stop down (f-5.6 instead of f-4.5). Since the capacity of C1 and C2 can vary widely, the guide numbers are only approximations and you should experiment to determine the exact number. The Kodachrome guide number for the ringlight when operating on *battery* and *half power* is 10.

The chart below gives you the guide number for *other films*. As an example of how it is used, go down the film-index column to 25, the rating for Kodachrome II. Three columns to the right you find 40, the guide number previously determined. The number in this column opposite the ASA number of your film is the new guide number.

A.S.A. Film Index	RELATIVE GUIDE NUMBERS						
200	56	80	110	160	220	320	450
100	40	56	80	110	160	220	320
80	35	50	70	100	140	190	280
50	28	40	56	80	110	160	220
32	23	32	45	63	90	120	180
25	20	28	40	56	80	110	160
10	13	18	25	35	50	70	100

When a sidelight is used the power divides equally between the two flashtubes. If the lampheads are arranged so only the main lamp contributes to the basic lighting, the exposure must be increased a full stop to compensate for the power lost in the sidelight.

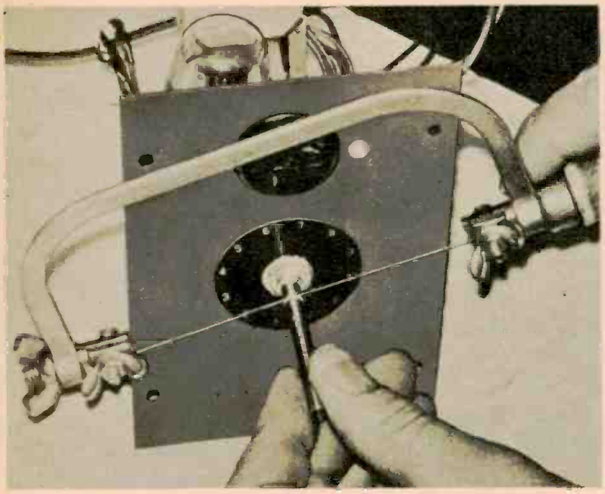
Sideband CB Notes

Continued from page 99

distortion. (The same control adjusts squelch when the receiver is switched to conventional AM.) Finally, a neon bulb is added to the receiver's B-plus circuit to provide voltage regulation and reduce drift.

The General adaptor *could* be used with receivers having a 455-kc IF but results would be questionable.

General's second adaptor is a *double*-sideband transmitter unit which is of unusual design. The adaptor, like a linear amplifier, is a separate unit. Its input is the full 3-plus watts of modulated RF power from the transmitter's final. The circuit amounts to a normal balanced modulator (see our first schematic). The RF carrier is applied in push-pull and bucks itself out in the adaptor (resistor R in our schematic is not present so the carrier is suppressed completely). Audio for application to the screens (causing the tubes to unbalance and put out a two-sideband-only signal) is obtained by the simple expedient of connecting a diode detector between the unit's RF input and its audio input (at the bottom of the schematic).



Cutting Control Shafts

A good solution to the problem of cutting shafts neatly is in the use of a jeweler's saw. Its fine-tooth blade makes the job a cinch, especially when the particular control is already installed.

Deburring Tool

Builders who hacksaw chassis will find this tool useful. Grind ½" from the tip of a can opener and file a ½" deep notch. Remove burrs by running the tool over the rough edges left by the saw.

Meter Protection

Always remove the jumper from the terminals of a new meter before use and replace jumper if meter is to be shipped. Shorting terminals damps the movement and reduces chances of damage due to vibration en route.

EI at Large

Continued from page 49

Later, Mr. Gunter told us that Radiation's ladies are electronic technicians in the true sense. They are trained in the same way as the men and perform the same duties.

The company has about half a dozen feminine technicians now, said Radiation's talent recruiter (or engineer-stealer, as recruiters are known in the trade), and it is hiring and training more. The old worry about losing a highly trained woman employee when she marries or becomes pregnant has proved at Radiation to be a canard. Among other benefits, the firm offers maternity leaves of absence. It has found that most women who are interested enough to become skilled technicians do not leave permanently when the wedding bells ring or a baby arrives. Instead, they stay in the community and, when the situation is right again, come back and resume their careers.

Where Are the Guys?

SOME more down-to-earth statistics were rolled out by Mr. Kenneth L. Ede, VP of the Cleveland Institute.

The industry seems to agree you need about three technicians for every engineer in industrial electronics. But Mr. Ede, citing a study by the Engineers Joint Council, told us that the ratio now is less than one technician to each *two* engineers. And, though engineering colleges aren't turning out a sufficient number of graduates to fill the need, the engineer-technician ratio is becoming worse instead of better. It is easy to see that opportunities for technicians in our field have never been brighter or more numerous. If you contemplate that sort of career you can be sure of a huge choice of jobs when you're ready.

There are many ways of becoming a technician—attending technical college, on-the-job training, night school, community college and (to put in a plug which the sponsors of the seminar, for reasons of their own, never got around to mentioning) home study.—*R.G.B.*

The Listener

Continued from page 100

The Hams . . . Many amateurs look on SWL's as second-class hobbyists and SWBC stations as a waste of frequencies. This is due partly to poor reports by novice DXers but even more to the fact that hams think of SWLing as it was ten or 15 years ago. There *were* many skillful DXers then, but the average listener cared more for entertainment.

But we should make it clear that conditions have changed and SWL and DXing are not mere stepping stones to amateur radio. They are distinct fields in themselves—every bit as broad and with as much potential as hamming. When hams make contact internationally, there are four major topics of conversation: quality of reception, equipment, DX and the weather. While this may promote international friendship, it seldom does much for international *understanding*. Such topics as politics, living conditions and customs remain exclusive SWL property.

Happy listening!

A Radio Propaganda Handbook

Continued from page 86

The single most important propagandist on our side remains unsung to this day, probably because the extent of his success was impossible to measure. Navy Capt. Ellis Zacharias, who had been stationed in Japan as a language officer during the 1920's and 1930's and knew every important officer in the Japanese Navy, was assigned in the spring of 1945 to make a series of broadcasts to Japan. His objective was to strengthen the peace faction in Japan, made up mostly of naval officers who opposed the fanatical Generals Koiso and Tojo. Zacharias had a huge handicap in the Allied dictum of unconditional surrender, which most Japanese interpreted as total annihilation.

Zacharias's broadcasts, like those of Benno Frank, were direct and personal, but they were anything but humorous. His delicate job was to bolster the "face" of the peace faction, to appeal to their strong sense of honor, to convince the Japanese—including the Emperor, who was given copies of Zacharias's broadcasts—that the Tojo clique was bringing the country into disgrace. And finally he had to make the point that unconditional surrender would mean neither dishonor nor annihilation.

Credit for Japan's sudden cave-in almost always goes to the atomic bomb. But after the war several high Japanese insisted that the broadcasts of Captain Zacharias were a more important factor. Japanese newsmen were virtually unanimous in saying that Zacharias made the bloodless occupation possible.

From Hitler to the Cold War there is abundant evidence of the importance of radio as a propaganda medium. And as long as there is any reason for one man—or nation—to influence another, the voice of the propagandist will be heard on the airwaves.

Way-Out Microwaves

Continued from page 76

microwave-powered helicopter which could hover endlessly. Giant transmitters would beam enough power skyward to keep the craft suspended at 65,000 feet, where it would serve as a communications relay or early-warning radar sentry. The trouble at the time lay in the fact that there wasn't a good way to turn the microwave power back into electricity at the receiving end. Efficiency was extremely low. But last summer Purdue scientists announced they had achieved 60 per cent efficiency in converting transmitted microwave power into useful electrical energy. Currently available equipment, then, could make the helicopter a reality, and it also could transmit enough power to satellites to run their equipment and even to furnish propulsion for them.

The visions get wilder. Cesium clouds in the sky to cause microwaves to skip like normal radio waves (they pass right through the ionosphere). And fireballs in the heavens, capable of burning an enemy missile to a crisp, all created by the meeting of two powerful microwave beams.

Hi-Fi Record Guide

Continued from page 101

formance by Alice Howland and a group of instrumentalists under Herbert Zipper's direction is effective, tonally and emotionally.

Gustav Holst's The Hymn of Jesus is a splendid example of English composition for chorus and orchestra. It is exalted and moving, qualities made immediately apparent by Sir Adrian Boult's warm and communicative interpretation, which is recorded with great depth of sound. The disc is filled out with the same composer's colorful ballet music from The Perfect Fool and his moody orchestral tone poem, Egdon Heath.

Witchcraft in old New England has furnished themes for every form of art and recently inspired Robert Ward's The Crucible, an opera based on Arthur Miller's grim play about that unhappy period. It is a gripping, dramatic work, with music that intensifies the action and strengthens its impact. Ward writes skillfully for voices and orchestra. His roots lie in romanticism and the opera is tuneful and colorful but not superficial. Emerson Buckley conducts with conviction and spirit and the recording is well engineered. This probably is the most distinguished album in the CRI catalog of American music.

The Indian blood that presumably courses through the veins of Keely Smith is the source of the Cherokeely Swings title on her latest disc. She rips through a dozen fine songs with the fervor of a brave on the warpath and Billy May's orchestra lends hearty support.

Ray Charles again converts musical corn in Volume Two of Modern Sounds in Country and Western Music. The genius is in his usual exuberant form and the beat really goes rockin' along.

I have a soft spot in my heart for the Firehouse Five Plus Two. Their uninhibited enjoyment of the music they play has a contagious effect. At Disneyland, they are as unpretentiously impertinent as ever, playing a string of old time Dixieland favorites with easy-going gusto and a surprising amount of musicianship.

Leopold Stokowski has found material more than two centuries old for a modern sound spectacular. Handel's Royal Fireworks Musick was a hit at its first performance in 1749, although the fireworks display that followed the music burned down the concert hall. The music is magnificent and Stokowski has assembled a grand orchestra to record it—an ensemble of 125 players with 24 oboes and 12 bassoons in the ranks. The exciting, lovely tone that he draws from his players is magical. Fortunately, its beauty is fully captured by the rich, spacious recording.

Records discussed in this column, with monaural discs listed first and stereo versions following:

Musical Diplomats U.S.A.
Hanson, Eastman Philharmonia — Mercury MG-50299; SR-90299
Hail, Sousa! *Revelli, University of Michigan Band* — Vanguard VRS-9115; VSD-2125
The Unfortunate Rake *20 Soloists* — Folkways FS-3805 (monaural only)
Tchaikovsky: The Nutcracker
Dorati, London Sym. Orch. — Mercury OL-2-113; SR-2-9013
Music for the Harpsichord and Virginal
Stewart Robb — Folkways FM-3320 (monaural only)
Mozart: Piano Concerto Nos. 21 and 23
Rubinstein, Wallenstein — RCA Victor LM-2634; LSC-2634
Schoenberg: Pierrot Lunaire
Howland, Zipper, Ensemble — Concert-Disc 1232; CS-232
Holst: The Hymn of Jesus
Boult, B.B.C. Sym. and Chorus — London CM-9324; CS-6324
Ward: The Crucible
Buckley, New York City Opera — Composers Recordings CRI-168; CRI-168-SD
Cherokeely Swings *Keely Smith* — Dot DLP-3460; DLP-25460
Modern Sounds in Country and Western Music, Vol. 2
Ray Charles — ABC-Paramount ABC-435; ABCS-435
Firehouse Five Plus Two at Disneyland — Good Time Jazz M-12049; S-10049
Handel: Royal Fireworks Musick; Water Musick
Stokowski, Orchestra — RCA Victor LM-2612; LSC-2612

Single-Sideband CB

Continued from page 41

find three key differences. A sideband signal comes down from the antenna and is boosted by the RF amplifier. Then, through regular heterodyne action, the mixer-converter reduces its 27-mc frequency to about 500 kc and feeds it to the IF for further amplification. At that point we hit something new—a crystal lattice filter that acts like a sharply tuned circuit. So narrow is its tuning slot that only the slim sideband signal gets through. Any remnants of the suppressed carrier and the other sideband, which the transmitter may have passed, are filtered out. The filter also limits the receiver's response to noise.

In the next block of the receiver diagram we find the product detector which, as in a normal rig, has the job of converting the RF signal into the audio pattern of the voice. In conventional AM, the carrier provides the mixing frequency, but SSB has no carrier. In this case, a substitute carrier is provided by the 500-kc crystal oscillator in the transmitter section (see Fig. 2). As an example, let's say the operator at the transmitter hums a 400-cycle tone into the mike, giving you a sideband frequency of 500.4 kc. When this is mixed with the 500-kc oscillator signal, you get a difference signal at 400 cps, representing the recovered audio. Product detectors are more suited to SSB than the common diode type because of their ability to keep the proper voltage relationship between the mixing frequencies.

In the final receiver stage the audio is applied to the audio amplifier and then to the speaker for reproduction.

In the transmitter (Fig. 2) we find the 500-kc crystal oscillator, mentioned earlier, as the first stage. It takes the place of the 27-mc crystal in regular CB rigs. It generates an RF carrier which is applied to the balanced modulator. An audio signal from the audio amplifier beats with the RF carrier in this stage, producing two difference signals or sidebands. In the case of the 400-cycle hum discussed above, the sidebands would be at 500.4 and 499.6 kc (the carrier's frequency plus and minus the audio frequency). In normal modulation the output would be the carrier and the two sidebands. But in a balanced modulator, after mixing, the carrier in effect beats with itself and cancels itself out. With the carrier thus suppressed, the output is the two sidebands—or a double-sideband (DSB) signal. We have no further use for the carrier and, since one sideband is a mirror-image of the other, we can get rid of one of them, too.

This is done by the crystal lattice filter—the same one used in the receiver. The filter permits only one narrow side-

[*Continued on page* 113]

OVER AND OUT

BY *Harbaugh*

"'Fix it by Tuesday,' she said. And you thought she was kidding!"

"It's all right, lady. He used to work in a carnival."

"Johnson's just never got used to being shocked."

"Okay, boy, you'll replace Watson. Go in there and do your best."

band, usually the upper one, to pass. Now, for the first time, we have an SSB signal. It is low in level and frequency, but there is a reason. Filtering action is best done at low frequencies, where selectivity can be great; 500 kc is such a frequency.

The SSB signal now is presented to the converter, where it is mixed with new signals to heterodyne its frequency to the desired 27 mc of the Citizens Band. Finally, the RF amplifier boosts the signal to full output level and applies it to the antenna for transmission. The RF output tube is operated as a *linear* amplifier. This type is required to preserve the shape of the sideband signal during amplification.

Good Reading

Continued from page 81

FUNDAMENTALS OF MAGNETIC AMPLIFIERS. By Barron Kemp. Howard Sams & The Bobbs-Merrill Co., New York & Indianapolis. 127 pages. $2.95

The importance of magnetic amplifiers continues to grow, but many electronic buffs, including those who keep up with every new development in the semiconductor field, haven't got around to doing their homework on them. Although this book is meant for technicians, its explanation of mag-amps is straight-forward enough for anyone with reasonable electronic know-how.

And make note of . . .

ABC'S OF RADIOTELEPHONE. By Leo G. Sands. Sams. 96 pages. $1.95

MASTER CARTRIDGE SUBSTITUTION HANDBOOK. By Jack Strong. Rider. 86 pages. $2

HOW TO PREPARE EFFECTIVE ENGINEERING PROPOSALS. By Emerson Clarke. TW Publishers, River Forest, Ill. 212 pages. $6.95

TROUBLESHOOTING WITH THE VOM AND VTVM. By Robert G. Middleton. Sams. 160 pages. $2.50

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___3Q4	.63	___6CG7	.61	___8CS7	.74	___12SF7	.69
___3S4	.75	___6CG8	.80	___8EB8	.94	___12SK7GT	.95
___3V4	.63	___6CL8	.79	___8FQ7	.56	___12SL7	.80
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___4DT6	.55	___6CQ8	.92	___12A4	.60	___12U7	.62
___4GM6	.60	___6CR6	.60	___12AB5	.60	___12V6	.63
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___5CG8	.81	___6DE6	.61	___12AL5	.47	___19AU4	.87
___5CL8	.76	___6DG6	.62	___12AL8	.95	___19BG6	1.39
___5CQ8	.84	___6DJ8	1.21	___12AQ5	.60	___19EA8	.79
___5EA8	.80	___6DK6	.59	___12AT6	.50	___19T8	.85
___5EU8	.80	___6DN6	1.55	___12AT7	.76	___21EX6	1.49
___5J6	.72	___6DQ6	1.10	___12AU6	.51	___25AX4	.70
___5T8	.86	___6DT5	.81	___12AU7	.61	___25C5	.53
___5U4	.60	___6DT6	.53	___12AV6	.41	___25CA5	.59
___5U8	.84	___6DT8	.94	___12AV7	.82	___25CD6	1.52
___5V6	.56	___6EA8	.79	___12AX4	.67	___25CU6	1.11
___5X8	.82	___6EB5	.73	___12AX7	.63	___25DN6	1.42
___5Y3	.46	___6EB8	.84	___12AY7	1.44	___25EH5	.55
___6AB4	.46	___6EM5	.77	___12AZ7	.86	___25L6	.57
___6AC7	.96	___6EM7	.82	___12B4	.68	___25W4	.68
___6AF4	1.01	___6EU8	.79	___12BD6	.50	___32ET5	.55
___6AQ5	.70	___6EV5	.75	___12BE6	.53	___35C5	.51
___6AH4	.81	___6EW6	.57	___12BF6	.60	___35L6	.60
___6AH6	1.10	___6EY6	.75	___12BH7	.77	___35W4	.42
___6AK5	.95	___6FG7	.69	___12BK5	1.00	___35Z5	.60
___6AL5	.47	___6FV8	.79	___12BL6	.56	___36AM3	.36
___6AM8	.78	___6GH8	.80	___12BQ6	1.16	___50B5	.69
___6AQ5	.53	___6GK5	.61	___12BR7	.74	___50C5	.53
___6AS5	.60	___6GK6	.79	___12BV7	.76	___50EH5	.55
___6AT6	.49	___6GN8	.94	___12BY7	.77	___50L6	.61
___6AT8	.86	___6H6	.58	___12BZ7	.86	___70L7	.97
___6AU4	.85	___6J5GT	.51	___12CN5	.56	___117Z3	.85
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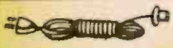

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